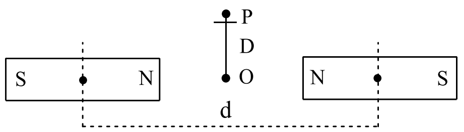
Single Correct Answer Type

1. Four charged particles are projected perpendicularly into the magnetic field with equal. Which will have minimum frequency?
a) Proton b) Electron c) Li^+ d) He^+
2. A circular coil carrying a certain current produces a magnetic field B_0 at its centre. The coil is now rewound so as to have 3 turns and the same current is passed through it. The new magnetic field at the centre is
a) $\frac{B_0}{9}$ b) $9B_0$ c) $\frac{B_0}{3}$ d) $3B_0$
3. A proton of energy 200 MeV enters the magnetic field of 5 T. If direction of field is from south to north and motion is upward, the force acting on it will be
a) Zero b) $1.6 \times 10^{-10} N$ c) $3.2 \times 10^{-8} N$ d) $1.6 \times 10^{-6} N$
4. Magnetic fields at two points on the axis of a circular coil at a distance of 0.05 m and 0.2m from the centre are in the ratio 8:1. The radius of the coil is
a) 1.0 m b) 0.1 m c) 0.15 m d) 0.2 m
5. A circular coil of 20 turns and radius 10 cm is placed in uniform magnetic field of 0.10 T normal to the plane of the coil. If the current in coil is 5 A, then the torque acting on the coil will be
a) 31.4 Nm
b) 3.14 Nm
c) 0.314 Nm
d) zero
6. A vertical circular coil of radius 0.1 m and having 10 turns carries a steady current. When the plane of the coil is normal to the magnetic meridian, a neutral point is observed at the centre of the coil. If $B_H = 0.314 \times 10^{-4}$ the current in the coil is
a) 0.5 A b) 0.25 A c) 2 A d) 1 A
7. A current i flows in a circular coil of radius r. If the coil is placed in a uniform magnetic field B with its plane parallel to the field, magnitude of the torque that acts on the coil is
a) Zero b) $2\pi riB$ c) $\pi r^2 iB$ d) $2\pi r^2 iB$
8. Two identical bar magnets are fixed with their centres at a distance d apart. A stationary charge Q is placed at P in between the gap of the two magnets at a distance D from the centre O as shown in the figure



The force on the charge Q is
a) Zero b) Directed along OP
c) Directed along PO d) Directed perpendicular to the plane of paper
9. The proton is energy 1 MeV describes a circular path in plane at right angles to a uniform magnetic field of 6.28×10^{-4} T. The mass of the proton is 1.7×10^{-27} kg. The cyclotron frequency of the proton is very nearly equal to
a) 10^7 Hz b) 10^5Hz c) 10^6 Hz d) 10^4 Hz
10. A particle of mass m and charge q is placed at a rest in a uniform electric field E and then released. The kinetic energy attained by the particle after moving a distance y is
a) $q\,Ey^2$ b) $q\,E^2y$ c) $q\,Ey$ d) q^2Ey
11. Two particles of equal charges after being accelerated through the same potential difference enter a uniform transverse magnetic field and describe circular path of radii R_1 and R_2 respectively. Then the ratio of their masses (M_1/M_2) is

a) $\frac{R_1}{R_2}$ b) $\left(\frac{R_1}{R_2}\right)^2$ c) $\frac{R_2}{R_1}$ d) $\left(\frac{R_2}{R_1}\right)^2$

12. A 2 μC charge moving around a circle with a frequency of $6.25 \times 10^{12} Hz$ produces a magnetic field 6.28 tesla at the centre of the circle. The radius of the circle is
a) 2.25 m b) 0.25 m c) 13.0 m d) 1.25 m

13. Two particles X and Y having equal charges, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describes circular path of radius R_1 and R_2 respectively. The ratio of mass of X to that of Y is
a) $(R_1/R_2)^{1/2}$ b) R_2/R_1 c) $(R_1/R_2)^2$ d) R_1/R_2

14. The deflection in a moving coil galvanometer is
a) Directly proportional to the torsional constant
b) Directly proportional to the number of turns in the coil
c) Inversely proportional to the area of the coil
d) Inversely proportional to the current flowing

15. A microammeter has a resistance of 100 Ω and full scale range of 50μ A. It can be used as a voltmeter of as a higher range ammeter provided a resistance is added to it. Pick the correct range and resistance combinations
a) 50 V range with 10 k Ω resistance in series
b) 10 V range with 200 k Ω resistance in series
c) 10 mA range with 1 Ω resistance in parallel
d) 10 mA range with 0.1 Ω resistance in parallel

16. A straight section PQ of a circuit lies along the X-axis from $x = \frac{-a}{2}$ to $x = \frac{a}{2}$ and carries a steady current i. The magnetic field due to the section PQ at a distance $x = +a$ will be
a) Proportional to a b) Proportional to $1/a$ c) Proportional to a^2 d) Zero

17. A vertical wire carrying a current in the upward direction is placed in horizontal magnetic field directed towards north. The wire will experience a force directed towards
a) North b) South c) East d) West

18. A direct current I flows along the length of an infinitely long straight thin walled pipe, then the magnetic field is
a) Uniform throughout the pipe but not zero
b) Zero only along the axis of the pipe
c) Zero at any point inside the pipe
d) Maximum at the centre and minimum at the edge

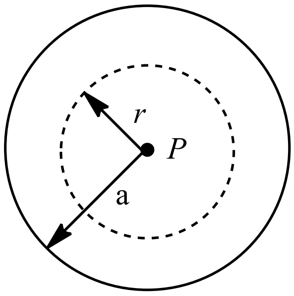
19. A current of 1 $ampere$ is passed through a straight wire of length 2.0 $metres$. The magnetic field at a point in air at a distance of 3 $metres$ from either end of wire and lying on the axis of wire will be
a) $\frac{\mu_0}{2\pi}$ b) $\frac{\mu_0}{4\pi}$ c) $\frac{\mu_0}{8\pi}$ d) Zero

20. When a positively charged particle enters a uniform magnetic field with uniform velocity, its trajectory can be
(1) a straight line
(2) a circle
(3) a helix
a) (1) only
b) (1) or (2)
c) (1) or (3)
d) Any one of (1), (2) and (3)

21. An electron is travelling along the x-direction. It encounters a magnetic field in the y-direction. Its subsequent motion will be
a) Straight line along the x-direction
b) A circle in the xz-plane
c) A circle in the yz-plane
d) A circle in the xy-plane

22. A thin disc having radius r and charge q distributed uniformly over the disc is rotated n rotations per second about its axis. The magnetic field at the centre of the disc is
a) $\frac{\mu_0 qn}{2r}$ b) $\frac{\mu_0 qn}{r}$ c) $\frac{\mu_0 qn}{4r}$ d) $\frac{3\mu_0 qn}{4r}$

23. The figure shows the cross-section of a long cylindrical conductor of radius a carrying a uniformly distributed current i. The magnetic field due to current at P is



a) $\mu_0 ir/(2\pi a^2)$ b) $\mu_0 ir^2/(2\pi a)$ c) $\mu_0 ia/(2\pi r^2)$ d) $\mu_0 ia^2/(\pi r^2)$

24. Force acting on a magnetic pole of 7.5×10^{-2} A-m is 1.5 N. Magnetic field at the point is
a) 20 Wbm^{-2} b) 50 Wbm^{-2} c) 112.5 T d) 2.0 T

25. The direction of magnetic lines of forces close to a straight conductor carrying current will be
a) Along the length of the conductor b) Radially outward
c) Circular in a plane perpendicular to the conductor d) Helical

26. If a proton, deuteron and α-particle on being accelerated by the same potential difference enters perpendicular to the magnetic field, then the ratio of their kinetic energies is
a) 1 : 2 : 2 b) 2 : 2 : 1 c) 1 : 2 : 1 d) 1 : 1 : 2

27. The strength of the magnetic field at a point r near a long straight current carrying wire is B. The field at a distance $\frac{r}{2}$ will be
a) $\frac{B}{2}$ b) $\frac{B}{4}$ c) $2B$ d) $4B$

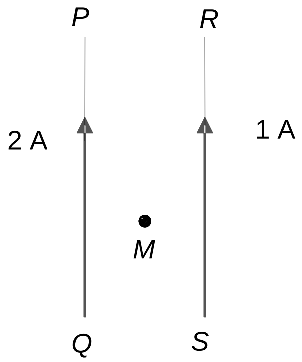
28. A charge particle of mass m and charge q enters a region of uniform magnetic field **B** perpendicular of its velocity **v**. The particle initially at rest was accelerated by a potential difference V (volts) before it entered the region of magnetic field. What is the diameter of the circular path followed by the charged particle in the region of magnetic field?
a) $\frac{2}{B}\sqrt{\frac{mV}{q}}$ b) $\frac{2}{B}\sqrt{\frac{2mV}{q}}$ c) $B\sqrt{\frac{2mV}{q}}$ d) $\frac{B}{q}\sqrt{\frac{2mV}{B}}$

29. Positively charged particles are projected into a magnetic field. If the direction of the magnetic field is along the direction of motion of the charge particles, the particles get
a) Accelerated b) Decelerated
c) Deflected d) No changed in velocity

30. Toroid is
a) Ring shaped closed solenoid b) Rectangular shaped solenoid
c) Ring shaped open solenoid d) Square shaped solenoid

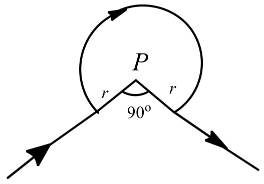
31. A long solenoid has 800 turns per metre length of solenoid. A current of 1.6 A flows through it. The magnetic induction at the end of the solenoid on its axis is
a) 16×10^{-4} T b) 8×10^{-4} T c) 32×10^{-4} T d) 4×10^{-4} T

32. PQ and RS are long parallel conductors separated by certain distance. M is the mid-point between them (see the figure). The net magnetic field at M is B. Now, the current 2 A is switched off. The field at M now becomes



a) $2B$ b) B c) $\frac{B}{2}$ d) $3B$

33. A wire shown in figure carries a current of 40 A. If $r = 3.14$ cm, the magnetic field at point P will be



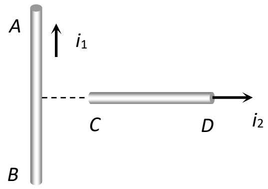
a) 1.6×10^{-3} T b) 3.2×10^{-2} T c) 4.8×10^{-3} T d) 6.0×10^{-4} T

34. Two long parallel wires P and Q are both perpendicular to the plane of the paper with distance 5 m between them. If P and Q carry current of 2.5 amp and 5 amp respectively in the same direction, then the magnetic field at a point half way between the wires is

a) $\frac{\sqrt{3}\mu_0}{2\pi}$ b) $\frac{\mu_0}{\pi}$ c) $\frac{3\mu_0}{2\pi}$ d) $\frac{\mu_0}{2\pi}$

35. The magnetic force on a charged particle moving in the field does not work, because
   a) Kinetic energy of the charged particle does not change
   b) The charge of the particle remains same
   c) The magnetic force is parallel to velocity of the particle
   d) The magnetic force is parallel to magnetic field

36. An infinitely long straight conductor AB is fixed and a current is passed through it. Another movable straight wire CD of finite length and carrying current is held perpendicular to it and released. Neglect weight of the wire



   a) The rod CD will move upwards parallel to itself
   b) The rod CD will move downward parallel to itself
   c) The rod CD will move upward and turn clockwise at the same time
   d) The rod CD will move upward and turn anti-clockwise at the same time

37. A wire of length 2 m carrying a current of 1 A is bent to form a circle, the magnetic moment of the coil is

a) 2π Am^2 b) $\frac{1}{\pi}$ Am^2 c) π Am^2 d) $\frac{2}{\pi}$ Am^2

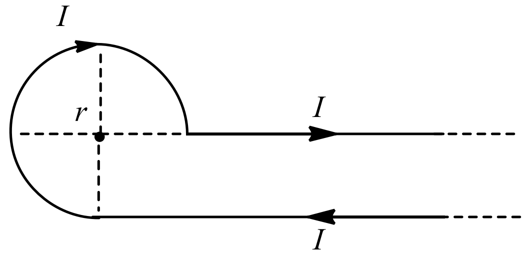
38. A current flows in a conductor from east to west. The direction of the magnetic field at a point above the conductor is

a) Towards east b) Towards west c) Towards north d) Towards south

39. A particle having a mass of 10^{-2} kg carries a charge of $5 \times 10^{-8} C$. The particle is given an initial horizontal velocity of 10^5 ms^{-1} in the presence of electric field $\vec{E}$ and magnetic field $\vec{B}$. To keep the particle moving in a horizontal direction, it is necessary that
   (1) $\vec{B}$ should be perpendicular to the direction of velocity and $\vec{E}$ should be along the direction of velocity
   (2) Both $\vec{B}$ and $\vec{E}$ should be along the direction of velocity
   (3) Both $\vec{B}$ and $\vec{E}$ are mutually perpendicular and perpendicular to the direction of velocity
   (4) $\vec{B}$ should be along the direction of velocity and $\vec{E}$ should be perpendicular to the direction of velocity
   Which of the following pairs of statements is possible

a) (1) and (3) b) (3) and (4) c) (2) and (3) d) (2) and (4)

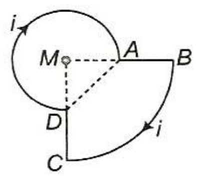
40. Current I is flowing in conductor shaped as shown in the figure. The radius of the curved part is r and the length of straight portion is very large. The value of the magnetic field at the centre O will be



a) $\frac{\mu_0 I}{4\pi r}\left(\frac{3\pi}{2}+1\right)$ b) $\frac{\mu_0 I}{4\pi r}\left(\frac{3\pi}{2}-1\right)$ c) $\frac{\mu_0 I}{4\pi r}\left(\frac{\pi}{2}+1\right)$ d) $\frac{\mu_0 I}{4\pi r}\left(\frac{\pi}{2}-1\right)$

41. A horizontal overhead powerline is at a height of 4 m from the ground and carries a current of 100 A from east to west. The magnetic field directly below it on the ground is
$(\mu_0 = 4\pi \times 10^{-7}\ \text{TmA}^{-1})$
a) 2.5×10^{-7} T, southward
b) 5.0×10^{-6} T, northward
c) 5.0×10^{-6} T, southward
d) 2.5×10^{-7} T, northward

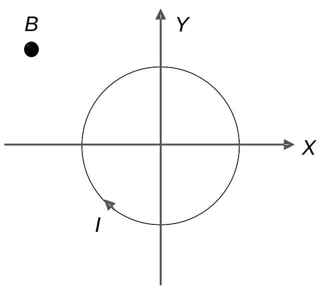
42. A current i is flowing through the loop. The direction of the current and the shape of the loop are as shown in the figure.
The magnetic field at the centre of the loop is $\frac{\mu_0 i}{R}$ times.
$(MA = R, MB = 2R, \angle DMA = 90°$



a) $\frac{5}{16}$, but out of the plane of the paper
b) $\frac{5}{16}$, but into the plane of the paper
c) $\frac{7}{16}$, but out of the plane of the paper
d) $\frac{7}{16}$, but into the plane of the paper

43. A chare q coulomb moves in a circle at n revolutions per second and the radius of the circle is $r$metre. Then the magnetic field at the centre of the circle is
a) $\frac{2\pi q}{nr} \times 10^{-7}\ \text{NA}^{-1}\ \text{m}^{-1}$
b) $\frac{2\pi q}{r} \times 10^{-7}\ \text{NA}^{-1}\ \text{m}^{-1}$
c) $\frac{2\pi nq}{r} \times 10^{-7}\ \text{NA}^{-1}\ \text{m}^{-1}$
d) $\frac{2\pi q}{r} \times 10^{-6}\ \text{NA}^{-1}\ \text{m}^{-1}$

44. A conducting loop carrying a current I is placed in a uniform magnetic field pointing into the plane of the paper as shown. The loop will have a tendency to



a) Contract
b) Expand
c) Move towards +ve x − axis
d) Move towards −ve x − axis

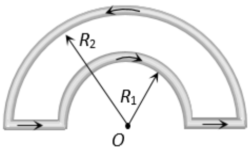
45. If a current is passed in a spring, it
a) Gets compressed b) Gets expanded c) Oscillates d) Remains unchanged

46. If a particle of charge 10^{-12} C moving along the x-direction with a velocity of 10^5 m/s experience a force of 10^{-10} N in y-direction due to magnetic field, then the minimum value of magnetic field is
a) 6.25×10^3 T in z − direciton
b) 10^{-15} T in z − direction

c) 6.25×10^{-3} T in $z-$ direction
d) 10^{-3} T in $z-$ direciton

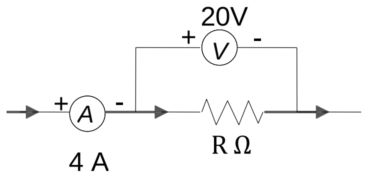
47. A electron moving with kinetic energy 6×10^{-16} J enters a field of magnetic induction 6×10^{-3} Wbm^{-2} at right angle to its motion. The radius of its path is
a) 3.42 cm
b) 4.23 cm
c) 6.17 cm
d) 7.7 cm

48. The magnetic induction at the centre O in the figure shown is



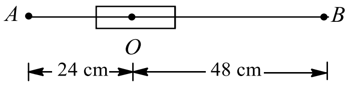
a) $\frac{\mu_0 i}{4}\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$
b) $\frac{\mu_0 i}{4}\left(\frac{1}{R_1}+\frac{1}{R_2}\right)$
c) $\frac{\mu_0 i}{4}(R_1-R_2)$
d) $\frac{\mu_0 i}{4}(R_1+R_2)$

49. A candidate connects a moving coil ammeter A and a moving coil voltmeter V and a resistance R as shown in figure



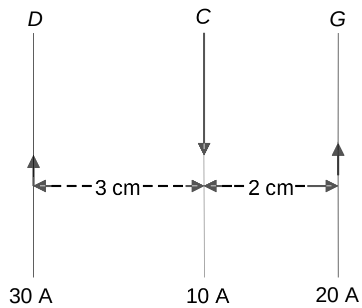
If the voltmeter reads 20 V and the ammeter reads 4 A, then R is
a) Equal to 5 Ω
b) Greater than 5 Ω
c) Less than 5 Ω
d) Greater or less than 5 Ω depending upon its material

50. A bar magnet of length 3 cm has a point A and B along axis at a distance of 24 cm and 48 cm on the opposite ends. Ratio of magnetic fields at these points will be



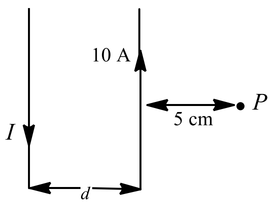
a) 8
b) 3
c) 4
d) $1/2\sqrt{2}$

51. Three long, straight parallel wires, carrying current, are arranged as shown in figure. The force experienced by a 25 cm length of wire C is



a) 10^{-3} N
b) 2.5×10^{-3} N
c) Zero
d) 1.5×10^{-3}

52. Two long parallel conductors carry currents in opposite directions as shown. One conductor carries a current of 10 A and the distance between the wires is $d = 10$ cm. Current I is adjusted, so that the magnetic field at P is zero. P is at a distance of 5 cm to the right of the 10 A current. Value of I is

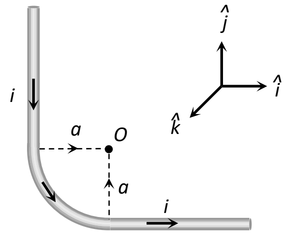


a) 40 A
b) 30 A
c) 20 A
d) 10 A

53. Two thin long parallel wires separated by a distance b are carrying currents of i amp each, the magnitude of the force per unit length exerted by one wire over the other is

a) $\frac{\mu_0 i^2}{b^2}$ b) $\frac{\mu_0 i^2}{2\pi b}$ c) $\frac{\mu_0 i}{2\pi b}$ d) $\frac{\mu_0 i}{2\pi b^2}$

54. The unit vectors $\hat{\imath}, \hat{\jmath}$ and $\hat{k}$ are as shown below. What will be the magnetic field at O in the following figure

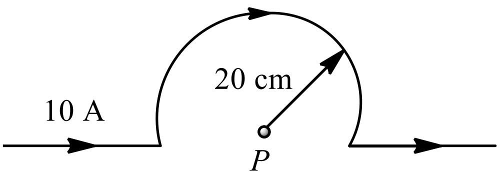


a) $\frac{\mu_0}{4\pi}\frac{i}{a}\left(2-\frac{\pi}{2}\right)\hat{\jmath}$ b) $\frac{\mu_0}{4\pi}\frac{i}{a}\left(2+\frac{\pi}{2}\right)\hat{\jmath}$ c) $\frac{\mu_0}{4\pi}\frac{i}{a}\left(2+\frac{\pi}{2}\right)\hat{\imath}$ d) $\frac{\mu_0}{4\pi}\frac{i}{a}\left(2+\frac{\pi}{2}\right)\hat{k}$

55. Field inside a solenoid is

a) Directly proportional to its length b) Directly proportional to current
c) Inversely proportional to total number of turns d) Inversely proportional to current

56. A current of 10 A is passing through a long wire which has semicircular loop of the radius 20 cm as shown in the figure. Magnetic field produced at the centre of the loop is



a) 10 πμ tesla b) 5 πμ tesla c) 4 πμ tesla d) 2 πμ tesla

57. The cyclotron frequency of an electron grating in a magnetic field of 1 T is approximately

a) 28 MHz b) 280 MHz c) 2.8 GHz d) 28 GHz

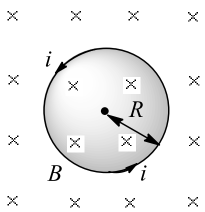
58. What is the shape of magnet used in moving coil galvanometer to make the magnetic fields radial

a) Concave b) Horse shoe magnet c) Convex d) None of these

59. An electron enters a region where magnetic field $(\vec{B})$ and electric field $(\vec{E})$ are mutually perpendicular to one another then

a) It will always move in the direction of $\vec{B}$ b) It will always move in the direction of $\vec{E}$
c) It always possesses circular motion d) It can go undeflected also

60. A current (i) carrying circular wire of radius R is placed in a magnetic field B perpendicular to its plane. The tension T along the circumference of wire is



a) BiR b) $2\pi BiR$ c) πBiR d) $2BiR$

61. A long solenoid is formed by winding 20 $turns/cm$. The current necessary to produce a magnetic field of 20 $millitesla$ inside the solenoid will be approximately

$\left(\frac{\mu_0}{4\pi} = 10^{-7}\ tesla - metre/ampere\right)$

a) 8.0 A b) 4.0 A c) 2.0 A d) 1.0 A

62. When the current flowing in a circular coil is doubled and the number of turns of the coil in it is halved, the magnetic field at its centre will become

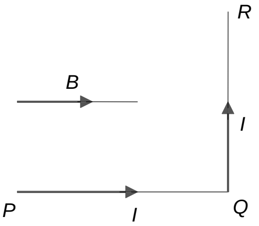
a) Four times b) Same c) Half d) Double

63. A long hollow copper tube carries a current I. Then which of the following will be true?

a) The magnetic field B will be zero at all points inside the tube
b) The magnetic field B will be zero only at points on the axis of the tube
c) The magnetic field B will be maximum at points on the axis of the tube

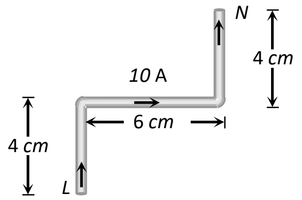
d) The magnetic field will be zero at any point outside the tube

64. A wire PQR is bent as shown in figure and is placed in a region of uniform magnetic field B. The length of $PQ = QR = l$. A current I ampere flows through the wire as shown. The magnitude of the force on PQ and QR will be



a) $BIl, 0$ b) $2BIl, 0$ c) $0, BIl$ d) $0, 0$

65. A current carrying wire LN is bent in the form shown below. If wire carries a current of 10 A and it is placed in a magnetic field of $5T$ which acts perpendicular to the paper outward then it will experience a force



a) Zero b) 5 N c) 30 N d) 20 N

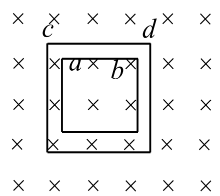
66. A closely wound flat circular coil of 25 turns of wire has diameter of 10 cm and carries a current of 4 $ampere$. Determine the flux density at the centre of a coil

a) $1.679 \times 10^{-5} tesla$ b) $2.028 \times 10^{-4} tesla$ c) $1.257 \times 10^{-3} tesla$ d) $1.512 \times 10^{-6} tesla$

67. A current of i ampere flows along an infinitely long straight thin walled tube, then the magnetic induction at any point inside the tube is

a) Infinite b) zero c) $\frac{\mu_0 2i}{4\pi r}$ T d) $\frac{\mu_0 i_0}{2r}$ T

68. The figure shows certain wire segments joined together to form a coplanar loop. The loop is placed in a perpendicular magnetic field in the direction going into the plane of the figure. The magnitude of the field increases with time. I_1 and I_2 are the currents in segment **ab** and **cd**. Then,



a) $I_1 > I_2$ b) $I_1 < I_2$

c) I_1 is in the direction **ba** and I_2 is in the direction **cd** d) I_1 is in the direction **ab** and I_2 is in the direction **dc**

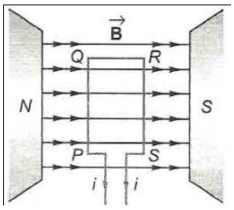
69. An electron is revolving round a proton, producing a magnetic field of 16 $weber/m^2$ in a circular orbit of radius 1Å. It's angular velocity will be

a) $10^{17} rad/sec$ b) $1/2\pi \times 10^{12} rad/sec$ c) $2\pi \times 10^{12} rad/sec$ d) $4\pi \times 10^{12} rad/sec$

70. If the direction of the initial velocity of the charged particle is neither along nor perpendicular to that of the magnetic field, then the orbit will be

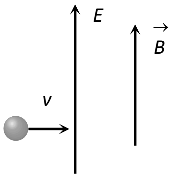
a) A straight line b) An ellipses c) A circle d) A helix

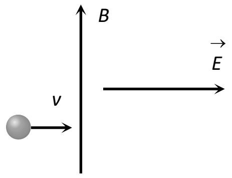
71. A coil $PQRS$ carrying a current i ampere is placed in a powerful horse shoe magnet NS of uniform magnetic field $\vec{B}$ figure. If A is the area of the coil and θ is the inclination of the plane of the coil with the magnetic field in equilibrium, then the deflecting couple will be

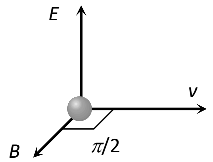


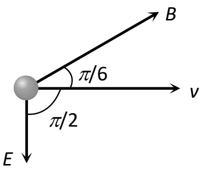
a) $BiA \cot \theta$ b) $BiA \cos \theta$ c) $BiA \operatorname{cosec} \theta$ d) $BiA \sin \theta$

72. A uniform magnetic field B and a uniform electric field E, act in a common region. An electron is entering this region of space. The correct arrangement for it to escape undeviated is

a) 

b) 

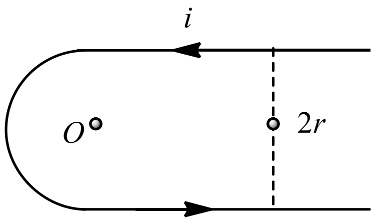
c) 

d) 

73. A long straight wire carrying a current of 30 A is placed in an external uniform magnetic field of induction 4×10^{-4} T. The magnetic field is acting parallel to the direction of current. The magnitude of the resultant magnetic induction in tesla at a point 2.0 cm away from the wire is ($\mu_0 = 4\pi \times 10^{-7}$ H/m)

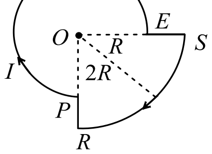
a) 10^{-4} b) 3×10^{-4} c) 5×10^{-4} d) 6×10^{-4}

74. In the figure shown, the magnetic field induction at the point O will be



a) $\frac{\mu_0 i}{2\pi r}$ b) $\left(\frac{\mu_0}{4\pi}\right)\left(\frac{i}{r}\right)(\pi + 2)$ c) $\left(\frac{\mu_0}{4\pi}\right)\left(\frac{i}{r}\right)(\pi + 1)$ d) $\frac{\mu_0}{4\pi}\frac{i}{r}(\pi - 2)$

75. A current I flowing through the loop as shown in figure. The magnetic field at centre O is



a) $\frac{7\mu_0 I}{16R} \otimes$ b) $\frac{7\mu_0 I}{16R} \odot$ c) $\frac{7\mu_0 I}{16R} \odot$ d) $\frac{5\mu_0 I}{16R} \odot$

76. Two long wires are hanging freely. They are joined first in parallel and then in series and then are connected with a battery. In both cases, which type of force acts between the two wires

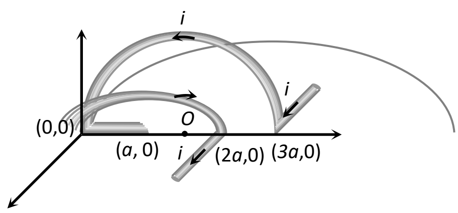
a) Attraction force when in parallel and repulsion force when in series

b) Repulsion force when in parallel and attraction force when in series

c) Repulsion force in both cases

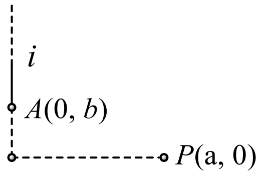
d) Attraction force in both cases

77. In the given figure and magnetic field at O will be



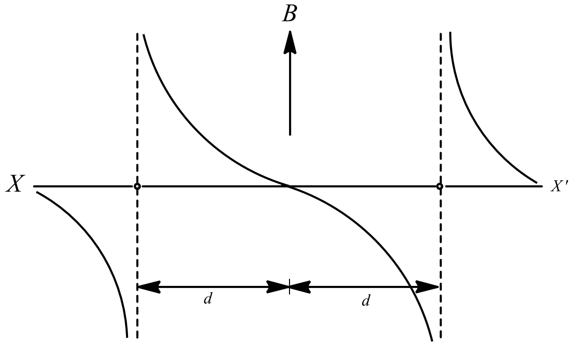
a) $\frac{2\mu_0 i}{3\pi a}\sqrt{4 - \pi^2}$ b) $\frac{\mu_0 i}{3\pi a}\sqrt{4 + \pi^2}$ c) $\frac{2\mu_0 i}{3\pi a^2}\sqrt{4 + \pi^2}$ d) $\frac{\mu_0 i}{3\pi a}\sqrt{4 - \pi^2}$

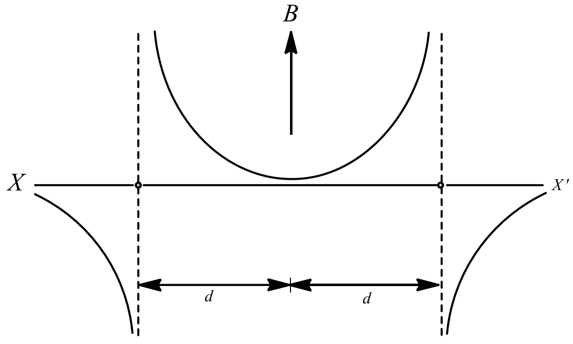
78. An infinitely long wire carrying current i is along Y-axis such that its one end is at point $(0, b)$ while the wire extends upto ∞. The magnitude of magnetic field strength at point P $(a, 0)$ is

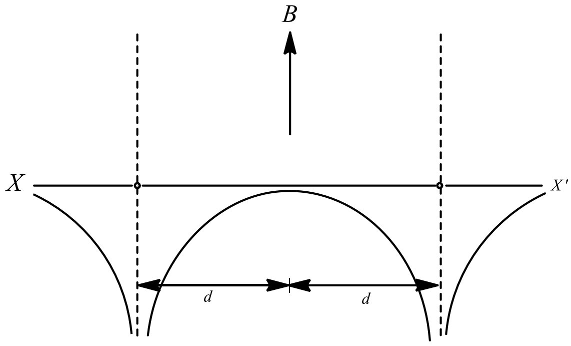


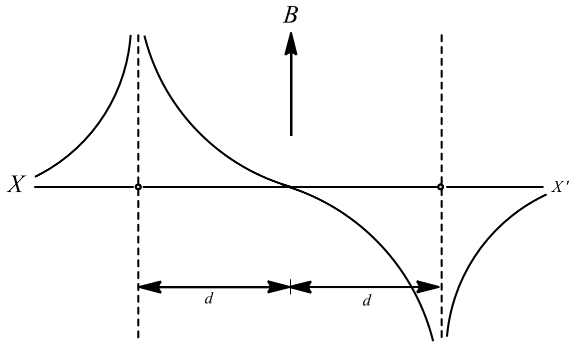
a) $\frac{\mu_0 i}{4\pi a}\left(1+\frac{b}{\sqrt{a^2+b^2}}\right)$ b) $\frac{\mu_0 i}{4\pi a}\left(1-\frac{b}{\sqrt{a^2+b^2}}\right)$ c) $\frac{\mu_0 i}{4\pi a}\left(1-\frac{a}{\sqrt{a^2+b^2}}\right)$ d) $\frac{\mu_0 i}{4\pi a}\left(\frac{b}{\sqrt{a^2+b^2}}\right)$

79. Two long parallel wires are at a distance $2d$ apart. They carry steady equal current flowing out of the plane of the paper as shown. The variation of the magnetic field along the line $XX'$is given by

a) 

b) 

c) 

d) 

80. A conduction rod of 1 m length and 1 kg mass is suspended by two vertical wires through its ends. An external magnetic field of 2 T is applied normal to the rod. Now the current to be passed through the rod so as to make the tension in the wires zero is
[Take g $= 10$ ms^{-2}]
a) 0.5 A b) 15 A c) 5 A d) 1.5 A

81. A current carrying coil is subjected to a uniform magnetic field. The coil will orient so that its plane becomes
a) Inclined at 45° to the magnetic field
b) Inclined at any arbitrary angle to the magnetic field
c) Parallel to the magnetic field
d) Perpendicular to the magnetic field

82. A straight conductor carrying current I. If the magnetic field at a distance r is 0.4 T, then magnetic field at a distance $2r$ will be
a) 0.4 T b) 0.1 T c) 0.8 T d) 0.2 T

83. A straight wire of mass 200 g and length 1.5 m carries a current of 2 A. It is suspended in mid-air by a uniform horizontal magnetic field B. The magnitude of B (in tesla) is
a) 2 b) 1.5 c) 0.55 d) 0.65

84. A proton a mass m and charge $+e$ is moving in a circular orbit in a magnetic field with energy 1 MeV. What should be the energy of α −particle (mass $= 4m$ and charge $= +2e$), so that it can revolve in the path of same radius
a) 1 MeV b) 4 MeV c) 2 MeV d) 0.5 MeV

85. The magnetic field at the centre of a circular current carrying conductor of radius r is B_c. The magnetic field on its axis at a distance r from the centre is B_a. The value of $B_c : B_a$ will be
a) $1 : \sqrt{2}$ b) $1 : 2\sqrt{2}$ c) $2\sqrt{2} : 1$ d) $\sqrt{2} : 1$

86. An electron has a circular path of radius 0.01 m in a perpendicular magnetic induction 10^{-3} T. The speed

of the electron is nearly

a) 1.76×10^4 ms^{-1} b) 1.76×10^6 ms^{-1} c) 3.52×10^6 ms^{-1} d) 7.04×10^6 ms^{-1}

87. A beam of electrons passes undeflected through mutually perpendicular electric and magnetic fields. If the electric field is switched off and the same magnetic field is maintained the electrons move

a) In an elliptical orbit b) In a circular orbit
c) Along a parabolic path d) Along a straight line

88. A straight wire of mass 200 g and length 1.5 m carries a current of 2 A. It is suspended in mid-air by a uniform horizontal magnetic field B. The magnitude of B (in tesla) is

a) 2 b) 1.5 c) 0.55 d) 0.65

89. The current is flowing in south direction along a power line. The direction of magnetic field above the power line (neglecting earth' field) is

a) South b) East c) North d) West

90. A long wire A carries a current of 10 amp. Another long wire B, which is parallel to A and separated by $0.1m$ from A, carries a current of 5 amp, in the opposite direction to that in A. What is the magnitude and nature of the force experience per unit length of B
$(\mu_0 = 4\pi \times 10^{-7} weber/amp - m)$

a) Repulsive force of $10^{-4} N/m$ b) Attractive force of $10^{-4} N/m$
c) Repulsive force of $2\pi \times 10^{-5} N/m$ d) Attractive force of $2\pi \times 10^{-5} N/m$

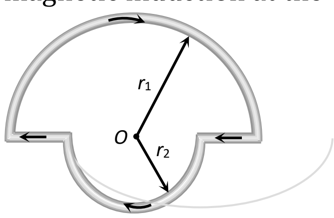
91. A proton, a deutron and a α- particle enter a magnetic field perpendicular to field with same velocity. What is the ratio of the radii of circular paths?

a) 1 : 2 : 2 b) 2 : 1 : 1 c) 1 : 1 : 2 d) 1 : 2 : 1

92. An arc of a circle of radius R subtends an angle $\pi/2$ at the centre. It carries a current i. The magnetic field at the centre will be

a) $\frac{\mu_0 i}{2R}$ b) $\frac{\mu_0 i}{8R}$ c) $\frac{\mu_0 i}{4R}$ d) $\frac{2\mu_0 i}{5R}$

93. In the figure shown there are two semicircles of radii r_1 and r_2 in which a current i is flowing. The magnetic induction at the centre O will be



a) $\frac{\mu_0 i}{r}(r_1 + r_2)$ b) $\frac{\mu_0 i}{4}(r_1 - r_2)$ c) $\frac{\mu_0 i}{4}\left(\frac{r_1 + r_2}{r_1 r_2}\right)$ d) $\frac{\mu_0 i}{4}\left(\frac{r_2 - r_1}{r_1 r_2}\right)$

94. A doubly ionized helium ion and a H_2 ion are accelerated through the same potential. The ratio of the speed of helium and H_2 ion is

a) 2 : 1 b) 1 : 2 c) $1 : \sqrt{2}$ d) $\sqrt{2} : 1$

95. The magnetic moment of a current (i) carrying circular coil of radius (r) and number of turns (n) varies as

a) $1/r^2$ b) $1/r$ c) r d) r^2

96. A charged particle enters in a magnetic field whose direction is parallel to velocity of the particle, then the speed of this particle

a) In straight line b) In coiled path c) In circular path d) In ellipse path

97. An electron is revolving around a proton in a circular path of diameter 0.1 nm. It produces a magnetic field 14 T at a proton. Then the angular speed of the electron is

a) 8.8×10^6 rad s^{-1} b) 4.4×10^{16} rad s^{-1} c) 2.2×10^{16} rad s^{-1} d) 1.1×10^{16} rad s^{-1}

98. A proton, a deuteron and an $\alpha -$ particle with the same kinetic energy enter a region of uniform magnetic field moving at right angles to B. What is the ratio of the radii of their circular paths?

a) $1 : \sqrt{2} : \sqrt{2}$ b) $1 : \sqrt{2} : 1$ c) $\sqrt{2} : 1 : 1$ d) $\sqrt{2} : \sqrt{2} : 1$

99. At a specific instant emission of radioactive compound is deflected in a magnetic field. The compound can emit

(i) Electrons (ii) Circle
(iii) He^{2+} (iv) Neutrons
The emission at the instant can be
a) i, ii, iii b) i, ii, iii, iv c) iv d) ii, iii

100. A charge moves in a circle perpendicular to a magnetic field. The time period of revolution is independent of
a) Magnetic field b) Charge
c) Mass of the particle d) Velocity of the particle

101. An electron ($e = 1.6 \times 10^{-19}$C) moves in a circular orbit of radius 1.42 cm with a speed of 10^5 ms^{-1} in presence of magnetic field of 4×10^{-2}T. If the mass of electron is 9.1×10^{-31} kg the energy gained by the electron in going one round the circular orbit is
a) zero b) 4.54×10^{-28} J c) 9.08×10^{-28} J d) 28.55×10^{-28} J

102. An electron (mass $= 9.0 \times 10^{-31}$) kg and charge (1.6×10^{-19} C) is moving in a circular orbit in a magnetic field of 1.0×10^{-4} Wbm^{-2}. Its period of revolution is
a) 2.1×10^{-6} s b) 1.05×10^{-6} s c) 7×10^{-7} s d) 3.5×10^{-7} s

103. A particle of mass m, charge Q and kinetic energy T enters a transverse uniform magnetic field of induction $\vec{B}$. After 3 seconds the kinetic energy of the particle will be
a) T b) $4\,T$ c) $3\,T$ d) $2\,T$

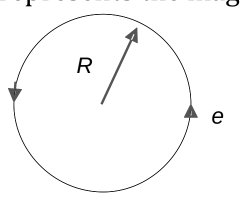
104. The magnetic moment of a circular coil carrying current is
a) Directly proportional to the length of the wire in the coil
b) Inversely proportional to the length of the wire in the coil
c) Directly proportional to the square of the length of the wire in the coil
d) Inversely proportional to the square of the length f the wire in the coil

105. A long wire carries a steady current. It is bent into a circle of one turn and the magnetic field at the centre of the coil is B. It is then bent into a circular loop of n turns. The magnetic field at the centre of the coil will be
a) nB b) n^2B c) $2nB$ d) $2n^2B$

106. Which of the following statements is true
a) The presence of a large magnetic flux through a coil maintains a current in the coil if the circuit is continuous
b) A coil of a metal wire kept stationary in a non-uniform magnetic field has an e.m.f. induced in it
c) A charged particle enters a region of uniform magnetic field at an angle of 85° to the magnetic line of force; the path of the particle is a circle
d) There is no change in the energy of a charged particle moving in a magnetic field although a magnetic force is acting on it

107. An electron is moving on a circular path of radius r with speed v in a transverse magnetic field B. e/m for it will be
a) $\frac{v}{Br}$ b) $\frac{B}{rv}$ c) Bvr d) $\frac{vr}{B}$

108. An electron is moving in an orbit of radius R with a time period T as shown in the figure. The magnetic moment produced may be given by $|e|$ represents the magnitude of the electron charge.



$|\text{A}| = \pi R^2$

a) $\mathbf{M} = \frac{2\pi|e|\mathbf{A}}{T}$ b) $\mathbf{M} = -\frac{2\pi|e|\mathbf{A}}{T}$ c) $\mathbf{M} = \frac{|e|\mathbf{A}}{T}$ d) $\mathbf{M} = -\frac{|e|\mathbf{A}}{T}$

109. The radius of circular path of an electron when subjected to a perpendicular magnetic field is

a) $\frac{mv}{Be}$ b) $\frac{me}{Be}$ c) $\frac{mE}{Be}$ d) $\frac{Be}{mv}$

110. A steady current I goes through a wire loop PQR having shape of a right angle triangle with $PQ = 3x, PR = 4\,x$ and $QR = 5x$. If the magnitude of the magnetic field at P due to this loop is $k\left(\frac{\mu_0 I}{48\pi\,x}\right)$, find the value of k

a) 8 b) 3 c) 7 d) None of these

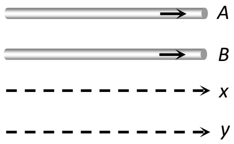
111. A beam of well collimated cathode rays travelling with a speed of $5 \times 10^6\ ms^{-1}$ enter a region of mutually perpendicular electric and magnetic fields and emerge undeviated from this region. If $|B| = 0.02\ T$, the magnitude of the electric field is

a) $10^5\ Vm^{-1}$ b) $2.5 \times 10^8\ Vm^{-1}$ c) $1.25 \times 10^{-10}\ Vm^{-1}$ d) $2 \times 10^3\ Vm^{-1}$

112. In ballistic galvanometer, the frame on which the coil is wound is non-metallic to

a) Avoid the production of induced e.m.f.
b) Avoid the production of eddy currents
c) Increase the production of eddy currents
d) Increase the production of induced e.m.f.

113. A and B are two conductors carrying a current i in the same direction. x and y are two electron beams moving in the same direction



a) There will be repulsion between A and B attraction between x and y
b) There will be attraction between A and B repulsion between x and y
c) There will be repulsion between A and B and also x and y
d) There will be attraction between A and B and also x and y

114. A power line lies along the east-west direction and carries a current of 10 *ampere*. The force per metre due to the earth's magnetic field of $10^{-4} tesla$ is

a) $10^{-5}N$ b) $10^{-4}N$ c) $10^{-3}N$ d) $10^{-2}N$

115. If m is magnetic moment and B is the magnetic field, then the torque is given by

a) $\vec{m} \cdot \vec{B}$ b) $\frac{|\vec{m}|}{|\vec{B}|}$ c) $\vec{m} \times \vec{B}$ d) $|\vec{m}| \cdot |\vec{B}|$

116. A square current carrying loop is suspended in a uniform magnetic field acting in the plane of the loop. If the force on one arm of the loop is $\vec{F}$, the net force on the remaining three arms of the loop is

a) $\vec{F}$ b) $3\vec{F}$ c) $-\vec{F}$ d) $-3\vec{F}$

117. If two streams of protons move parallel to each other in the same direction, then they

a) Do not exert any force on each other
b) Repel each other
c) Attract each other
d) Get rotated to be perpendicular to each other

118. A charged particle moving in a uniform magnetic field penetrates layer of lead and there by loss one-half of its kinetic energy. How does the radius of curvature of its path change?

a) The radius reduces to $r\sqrt{2}$
b) The radius reduces to $\frac{r}{\sqrt{2}}$
c) The radius remains the same
d) The radius becomes $r/2$

119. The deflection in moving coil galvanometer is reduced to half, when it is shunted with a 40 Ω coil. The resistance of the galvanometer is

a) 60 Ω b) 10 Ω c) 40 Ω d) 20 Ω

120. Two wires A and B are of lengths 40 cm and 30 cm. A is bent into a circle of radius r and B into an arc of radius r. A current i_1 is passed through A and i_2 through B. To have the same magnetic inductions at the centre, the ratio of $i_1 : i_2$ is

a) 3 : 4 b) 3 : 5 c) 2 : 3 d) 4 : 3

121. An electron ($q = 1.6 \times 10^{-19}$ C) is moving at right angle to the uniform magnetic field

3.534×10^{-5} T. The time taken by the electron to complete a circular orbit is

a) 2μs b) 4μs c) 3μs d) 1μs

122. Two long conductors, separated by a distance d carry currents I_1 and I_2 in the same direction. They exert a force F on each other. Now the current in one of them is increased to two times and its direction is reversed. The distance is also increased to 3 d. The new value of the force between them is

a) $-2\ F$ b) $F/3$ c) $-2F/3$ d) $-F/3$

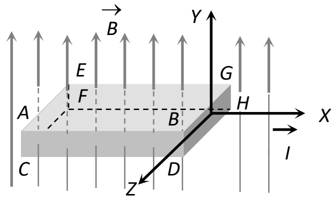
123. A pulsar is a neutron star having magnetic field is 10^{12} G at its surface. The maximum magnetic force experienced by an electron moving with velocity 0.9 $c$is

a) 43.2 N b) $4.32\ \times 10^{-3}$ N c) $4.32\ \times 10^{3}$ N d) zero

124. A particle is moving in a uniform magnetic field, then

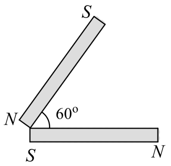
a) Its momentum changes but total energy remains the same
b) Both momentum and total energy remain the same
c) Both will change
d) Total energy changes but momentum remains the same

125. A metallic block carrying current I is subjected to a uniform magnetic induction $\vec{B}$ as shown in the figure. The moving charges experience a force F given by ...... which results in the lowering of the potential of the face ..... Assume the speed of the carriers to be v



a) $eVB\hat{k}, ABCD$ b) $eVB\hat{k}, EFGH$ c) $-eVB\hat{k}, ABCD$ d) $-eVB\hat{k}, EFGH$

126. Two magnets of equal magnetic moments M each are placed as shown in figure. The resultant magnetic moment is



a) M b) $\sqrt{3}M$ c) $\sqrt{2}M$ d) $M/2$

127. Two very long, straight, parallel wires carry steady current $i\ and - i$ resepectively. The distance between the wires is d. At a certain instant of time, a point charge q is at a point equidistant from the two wires, in the plane of the wires. Its instantaneous magnitude of the force due to the magnetic field acting on the charge at this instant is

a) $\frac{\mu_0 iqv}{2\pi d}$ b) $\frac{\mu_0 iqv}{\pi d}$ c) $\frac{2\mu_0\ iqv}{\pi d}$ d) zero

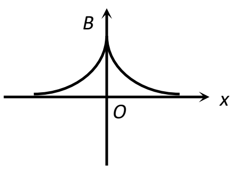
128. When a magnetic field is applied in a direction perpendicular to the direction of cathode rays, then their

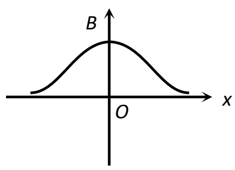
a) Energy decreases b) Energy increases
c) Momentum increases d) Momentum and energy remain unchanged

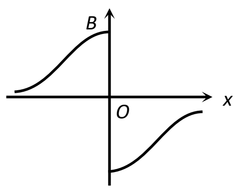
129. A charged particle is projected in a plane perpendicular to a uniform magnetic field. The area bounded by the path described by the particle is proportional to

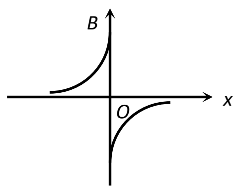
a) The velocity b) The momentum c) The kinetic energy d) None of these

130. A circular coil is in y-z plane with centre at origin. The coil is carrying a constant current. Assuming direction of magnetic field at $x = -25\ cm$ to be positive direction of magnetic field, which of the following graphs shows variation of magnetic field along x-axis

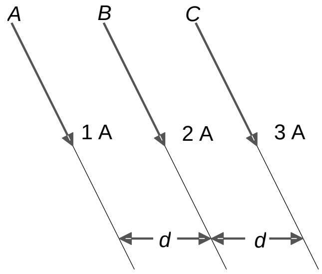
a) 

b) 

c) 

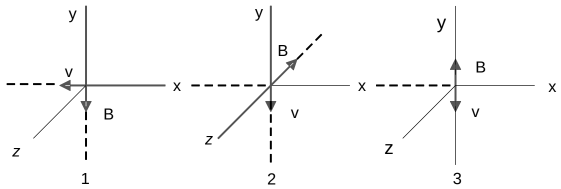
d) 

131. Three long straight wires A, B and C are carrying currents as shown in figure. Then the resultant force on B is directed



a) perpendicular to the plane of paper and outward
b) perpendicular to the plane of paper and inward
c) towards A
d) towards B

132. The figure shows three situations when an electron with velocity $\boldsymbol{v}$ travels through a uniform magnetic field $\boldsymbol{B}$. In each case, what is the direction of magnetic force on the electron?



a) $+$ ve $z-$ axis, $-$ve $x-$ axis, $+$ve $y-$ axis
b) $-$ ve $z-$ axis, $-$ve $x-$ axis and zero
c) $+$ ve $z-$ axis, $+$ve $y-$ axis and zero
d) $-$ ve $z-$ axis, $+$ve $y-$ axis and zero

133. There are 50 turns of a wire in every cm length of a long solenoid. If 4 $ampere$ current is flowing in the solenoid, the approximate value of magnetic field along its axis at an internal point and at one end will be respectively
a) $12.6 \times 10^{-3} weber/m^2, 6.3 \times 10^{-3} weber/m^2$
b) $12.6 \times 10^{-3} weber/m^2, 25.1 \times 10^{-3} weber/m^2$
c) $25.1 \times 10^{-3} weber/m^2, 6.3 \times 10^{-3} weber/m^2$
d) $25.1 \times 10^{-5} weber/m^2, 6.3 \times 10^{-5} weber/m^2$

134. The electrons in the beam of television tube move horizontally form south to north. The vertical component of the earth's magnetic field points down. The electron is deflected towards
a) West b) No deflection c) East d) North to south

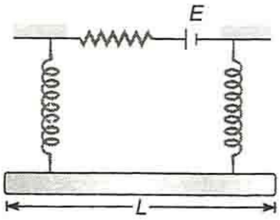
135. A current i A flows along an infinitely long straight thin walled tube, then the magnetic induction at any point inside the tube is
a) Infinite b) Zero c) $\frac{\mu_0}{4\pi} \cdot \frac{2i}{r}$ T d) $\frac{2i}{r}$ T

136. Two galvanometer A and B require $3mA$ and $5mA$ respectively to produce the same deflection of 10 divisions. Then
a) A is more sensitive than B
b) B is more sensitive than A
c) A and B are equally sensitive
d) Sensitiveness of B is 5/3 times that of A

137. Two infinitely long parallel wires carry equal current in same direction. The magnetic field at a mid point in between the two wires is
a) Twice the magnetic field produced due to each of the wires
b) Half of the magnetic field produced due to each of the wires
c) Square of the magnetic field produced due to each of the wires
d) Zero

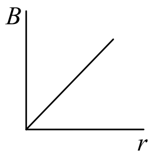
138. A straight rod of mass m and length L is suspended from the identical springs as shown in figure. The spring is stretched a distance x_0 due to the weight of the wire. The circuit has total resistance R. When the

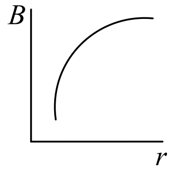
magnetic field perpendicular to the plane of paper is switched on, springs are observed to extend further by the same distance. The magnetic field strength is

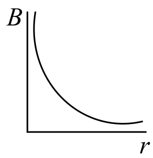


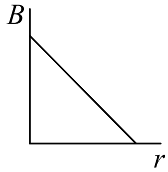
a) $\frac{2mgR}{LE}$ b) $\frac{mgR}{LE}$ c) $\frac{mgR}{2LE}$ d) $\frac{mgR}{E}$

139. Which of the following graph represents the variation of magnetic flux density B with distance r for a straight long wire carrying an electric current?

a) 

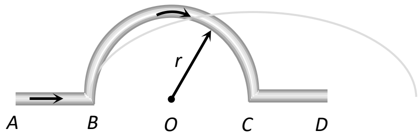
b) 

c) 

d) 

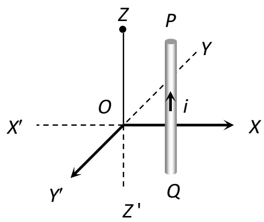
140. Magnetic field intensity at the centre of coil of 50 turns, radius 0.5 m and carrying a current of 2 A is
a) $0.5 \times 10^{-5} T$ b) $1.25 \times 10^{-4} T$ c) $3 \times 10^{-5} T$ d) $4 \times 10^{-5} T$

141. In the figure shown the magnetic induction at the centre of the arc due to the current in portion AB will be



a) $\frac{\mu_0 i}{r}$ b) $\frac{\mu_0 i}{2r}$ c) $\frac{\mu_0 i}{4r}$ d) Zero

142. A vertical wire kept in Z-X plane carries a current from Q to P (see figure). The magnetic field due to current will have the direction at the origin O along

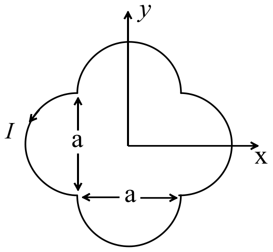


a) OX b) OX' c) OY d) OY'

143. If the direction of the initial velocity of the charged particle is perpendicular to the magnetic field, then the orbit will be
Or
The path executed by a charged particle whose motion is perpendicular to magnetic field is
a) A straight line b) An ellipse c) A circle d) A helix

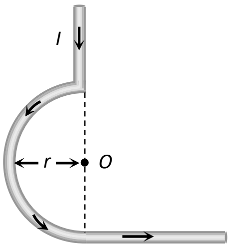
144. Magnetic field due to a ring having n turns at a distance x on its axis is proportional to (if r = radius of ring)
a) $\frac{r}{(x^2 + r^2)}$ b) $\frac{r^2}{(x^2 + r^2)^{3/2}}$ c) $\frac{nr^2}{(x^2 + r^2)^{3/2}}$ d) $\frac{n^2 r^2}{(x^2 + r^2)^{3/2}}$

145. A loop carrying current I lies in the x-y plane as shown in the figure. The unit vector $\hat{k}$ is coming out of the plane of the paper. The magnetic moment of the current loop is



a) $a^2 I\hat{k}$ b) $\left(\frac{\pi}{2}+1\right)a^2 I\hat{k}$ c) $-\left(\frac{\pi}{2}+1\right)a^2 I\hat{k}$ d) $(2\pi+1)a^2 U\hat{k}$

146. In the figure, what is the magnetic field at the point O



a) $\frac{\mu_0 I}{4\pi r}$ b) $\frac{\mu_0 I}{4\pi r}+\frac{\mu_0 I}{2\pi r}$ c) $\frac{\mu_0 I}{4r}+\frac{\mu_0 I}{4\pi r}$ d) $\frac{\mu_0 I}{4r}+\frac{\mu_0 I}{4\pi r}$

147. A conductor in the form of a right angle ABC with $AB = 3\ cm$ amd $BC = 4\ cm$ carries a current of 10 A. There is a uniform magnetic field of 5 T perpendicular to the plane of the conductor. The force on the conductor will be

a) 1.5 N b) 2.0 N c) 2.5 N d) 3.5 N

148. Two similar coils are kept mutually perpendicular such that their centres coincide. At the centre, find the ratio of the magnetic field due to one coil and the resultant magnetic field by both coils, if the same current is flown

a) $1:\sqrt{2}$ b) 1 : 2 c) 2 : 1 d) $\sqrt{3}:1$

149. A circular coil carrying a current has a radius R. The ratio of magnetic induction at the centre of the coil and at a distance equal to $\sqrt{3}\ R$ from the centre of the coil on the axis is

a) 1 : 1 b) 1 : 2 c) 2 : 1 d) 8 : 1

150. A particle of charge -16×10^{-18} *coulomb* moving with velocity 10 ms^{-1} along the x-axis enters a region where a magnetic field of induction B is along the y-axis, and an electric field of magnitude $10^4 V/m$ is along the negative z-axis. If the charged particle continues moving along the x-axis, the magnitude of B is

a) $10^{-3} Wb/m^2$ b) $10^3 Wb/m^2$ c) $10^5 Wb/m^2$ d) $10^{16} Wb/m^2$

151. An electron is projected along the axis of a circular conductor carrying some current. Electron will experience force

a) Along the axis b) Perpendicular to the axis
c) At an angle of 4° with axis d) No force experienced

152. Imaging that an electron revolves round a circle of radius 5.3×10^{-11} m with a linear velocity of 7.5×10^4 ms^{-1} in a hydrogen atom. The magnetic field produced at the centre of the circle due to the electron is

a) 43 Wbm^{-2} b) 43×10^2 Wbm^{-2} c) 0.43 Wbm^{-2} d) 43×10^{-4} Wbm^{-2}

153. A moving coil galvanometer gives full scale deflection, when a current of 0.005 A is passed through its coil. It is converted into a voltmeter reading upto 5V by using an external resistance of 975 Ω. What is the resistance of the galvanometer coil?

a) 30 Ω b) 25 Ω c) 50 Ω d) 40 Ω

154. A circular loop of radius 0.0175m carries a current of 2.0 amp. The magnetic field at the centre of the loop is
($\mu_0 = 4\pi \times 10^{-7} weber/amp - m$)

a) $1.57 \times 10^{-5}\ weber/m^2$ b) $8.0 \times 10^{-5}\ weber/m^2$
c) $2.5 \times 10^{-5}\ weber/m^2$ d) $3.14 \times 10^{-5}\ weber/m^2$

155. An electron enters a region where electrostatic field is $20N/C$ and magnetic field is $5T$. If electron passes undeflected through the region, the velocity of electron will be

a) $0.25ms^{-1}$ b) $2ms^{-1}$ c) $4ms^{-1}$ d) $8ms^{-1}$

156. A length of wire carries a steady current. It is bent first to form a circular coil of one turn. The same length is now bent more sharply to give a double loop of smaller radius. The magnetic field at the centre caused by the same current is
a) Double of its first value b) Quarter of its first value
c) Four times of its first value d) Same as the first value

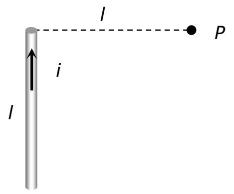
157. A charged particle of mass m and charge q describes circular motion of radius r in a uniform magnetic field of strength B. The frequency of revolution is
a) $\frac{Bq}{2\pi m}$ b) $\frac{Bq}{2\pi rm}$ c) $\frac{2\pi m}{Bq}$ d) $\frac{Bm}{2\pi q}$

158. A charged particle enters a magnetic field H with its initial velocity making an angle of 45° with H. The path of the particle will be
a) A straight line b) A circle c) An ellipse d) A helix

159. The magnetic field near a current carrying conductor is given by
a) Coulomb's law b) Lenz's law c) Biot-Savart's law d) Kirchhoff's law

160. A circular loop has a radius of 5 cm and it is carrying a current of 0.1 amp. Its magnetic moment is
a) $1.32 \times 10^{-4} amp\text{-}m^2$ b) $2.62 \times 10^{-4} amp\text{-}m^2$ c) $5.25 \times 10^{-4} amp\text{-}m^2$ d) $7.85 \times 10^{-4} amp\text{-}m^2$

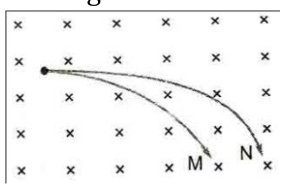
161. Figure shows a straight wire of length l carrying current i. The magnitude of a magnetic field produced by the current at point P is



a) $\frac{\sqrt{2}\mu_0 i}{\pi l}$ b) $\frac{\mu_0 i}{4\pi l}$ c) $\frac{\sqrt{2}\mu_0 i}{8\pi l}$ d) $\frac{\mu_0 i}{2\sqrt{2}\pi l}$

162. A wire of length L is bent in the form of a circular coil and current i is passed through it. If this coil is placed in a magnetic field then the torque acting on the coil will be maximum when the number of turns is
a) As large as possible b) Any number c) 2 d) 1

163. Two charged particles M and N enter a space of uniform magnetic field, with velocities perpendicular to the magnetic field. The paths are as shown in figure. The possible reason (s) is/are?

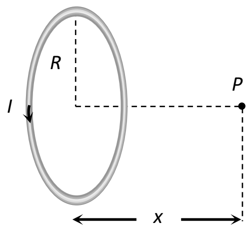


a) The charge of M is greater than that of N b) The momentum of M is greater than that of N
c) Specific charge of M is greater than that of N d) The speed of M is greater than that of N

164. Current i_0 is passed through a solenoid of length l having number of turns N when it is connected to a DC source. A charged particle with charge q is projected along the axis of the solenoid with a speed v_0. The velocity of the particle in the solenoid
a) Increases b) Decreases c) Remain same d) Becomes zero

165. A small coil of N turns has an effective area A and carries a current I. It is suspended in a horizontal magnetic field $\vec{B}$ such that its plane is perpendicular to $\vec{B}$. The work done in rotating it by 180° about the vertical axis is
a) $NAIB$ b) $2NAIB$ c) $2\pi NAIB$ d) $4\pi NAIB$

166. A coil having N turns carry a current I as shown in the figure. The magnetic field intensity at point P is

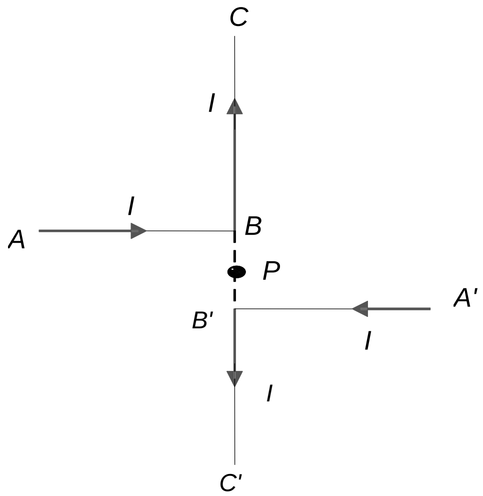


a) $\dfrac{\mu_0\, NIR^2}{2(R^2+x^2)^{3/2}}$ b) $\dfrac{\mu_0 NI}{2R}$ c) $\dfrac{\mu_0 NIR^2}{(R+x)^2}$ d) Zero

167. A charged particle (charge q) is moving in a circle of radius R with uniform speed v. The associated magnetic moment μ is given by

a) $\dfrac{qvR}{2}$ b) qvR^2 c) $\dfrac{qvR^2}{2}$ d) qvR

168. Current through ABC and $A'B'C'$ is I. What is the magnetic field at P? $BP = PB' = r$ (Here $C'B'PBC$ are collinear)



a) $B = \dfrac{1}{4\pi}\dfrac{2I}{r}$ b) $B = \dfrac{\mu_0}{4\pi}\left(\dfrac{2I}{r}\right)$ c) $B = \dfrac{\mu_0}{4\pi}\left(\dfrac{I}{r}\right)$ d) Zero

169. Two circular coils mounted parallel to each other on the same axis carry steady currents. If an observer between the coils reports that one coil is carrying a clockwise current i_1, while the other is carrying a counter clockwise current i_2, between the two coils, then there is

a) A steady repulsive force b) Zero force
c) A repulsive force d) A steady attractive force

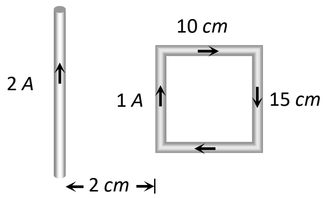
170. The magnetic field due to a current carrying circular loop of radius 3 cm at a point on the axis at a distance of 4 cm from the centre is 54 μT. What will be its value at the centre of the loop?

a) 250 μ T b) 150 μ T c) 125 μ T d) 75 μ T

171. One $Tesla$ is equal to

a) $10^7 gauss$ b) $10^{-4} gauss$ c) $10^4 gauss$ d) $10^{-8} gauss$

172. What is the net force on the square coil



a) $25 \times 10^{-7} N$ moving towards wire b) $25 \times 10^{-7} N$ moving away from wire
c) $35 \times 10^{-7} N$ moving towards wire d) $35 \times 10^{-7} N$ moving away from wire

173. If two parallel wires carry current in opposite directions

a) The wires attract each other b) The wires repel each other
c) The wires experience neither attraction nor d) The forces of attraction or repulsion do not

repulsion depend on current direction

174. The magnetic induction at a point P which is at a distance 4 cm from a long current carrying wire is $10^{-8} tesla$. The field of induction at a distance 12 cm from the same current would be

a) $3.33 \times 10^{-9} tesla$ b) $1.11 \times 10^{-4} tesla$ c) $3 \times 10^{-3} tesla$ d) $9 \times 10^{-2} tesla$

175. A steady electric current is flowing through a cylindrical conductor

a) The magnetic field in the vicinity of the conductor is zero

b) The electric field in the vicinity of the conductor is non-zero

c) The magnetic field at the axis of the conductor is zero

d) The electric field at the axis of the conductor is zero

176. The forces existing between two parallel current carrying conductors is F. If the current in each conductor is doubled, then the value of force will be

a) $2F$ b) $4\,F$ c) $5\,F$ d) $F/2$

177. A charge $+\,Q$ is moving upwards vertically. It enters a magnetic field directed to north. The force on the charge will be towards

a) North b) South c) East d) West

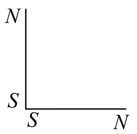
178. The magnetic force acting on a charge particle of charge $-2\mu c$ in a magnetic field of $2T$ actin in y direction, when the particle velocity is $(2i + 3j) \times 10^6 ms^{-1}$ is

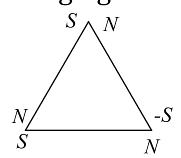
a) 8 N in $-z$ direction b) 8 N in z direction c) 8 N in y direction d) 8 N in z direction

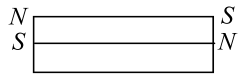
179. An electric current is passed through a circuit containing two wires of the same material, connected in parallel. If the lengths and radii of the wires are in the ratio of 4/3 and 2/3, then the ratio of the currents passing through the wire will be

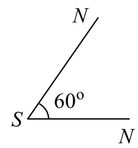
a) 3 b) 1/3 c) 8/9 d) 2

180. In which orientation the resultant magnetic moment of two magnets, will be zero, if magnetic moment of each magnets is M in the following figures?

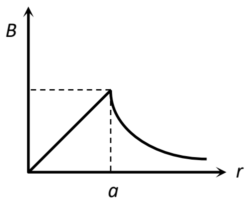
a) 

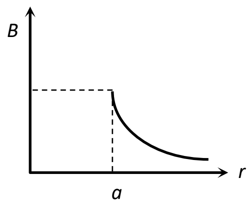
b) 

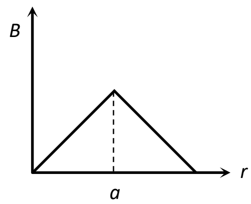
c) 

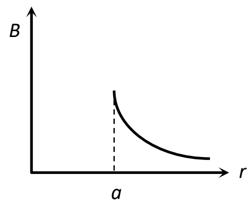
d) 

181. The magnetic field due to a straight conductor of uniform cross section of radius a and carrying a steady current is represented by

a) 

b) 

c) 

d) 

182. An electron and a proton enter region of uniform magnetic field in a direction at right angles to the field with the same kinetic energy. They describe circular paths of radius r_e and r_p respectively. Then

a) $r_e = r_P$

b) $r_e < r_P$

c) $r_e > r_P$

d) r_e may be less than or greater than r_P depending on the direction of the magnetic field

183. An α-particle with a specific charge of 2.5×10^7 C kg^{-1} moves with a speed of 2×10^5 ms^{-1} in a perpendicular magnetic field of 0.05 T. Then the radius of the circular path described by it is

a) 8 cm b) 4 cm c) 16 cm d) 2 cm

184. Graph of force per unit length between two long parallel currents carrying conductor and the distance between them is

a) Straight line b) Parabola

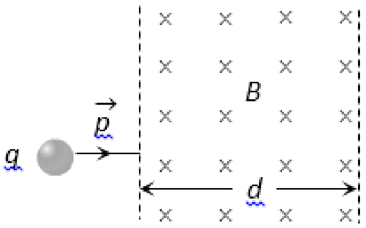
c) Ellipse d) Rectangular hyperbola

185. An arbitrary shaped closed coil is made of a wire of length L and a current I ampere is flowing in it. If the plane of the coil is perpendicular to magnetic field $\vec{B}$, the force on the coil is

a) Zero b) IBL c) $2IBL$ d) $\frac{1}{2}IBL$

186. A beam of protons is moving parallel to a beam of electrons. Both the beams will tend to
a) Repel each other b) Come closer c) Move more apart d) Either (b) or (c)

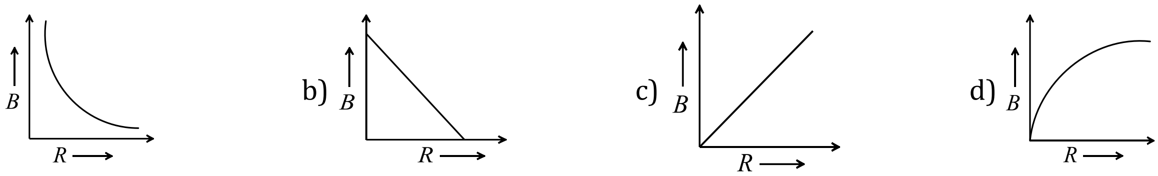
187. A particle with charge q, moving with a momentum p, enters a uniform magnetic field normally. The magnetic field has magnitude B and is confined to a region of width d, where $d < \frac{p}{Bq}$. If the particle is deflected by an angle θ in crossing the field, then



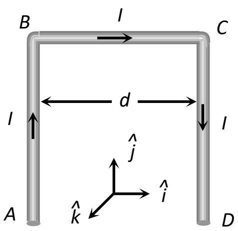
a) $\sin\theta = \frac{Bqd}{p}$ b) $\sin\theta = \frac{p}{Bqd}$ c) $\sin\theta = \frac{Bp}{qd}$ d) $\sin\theta = \frac{pd}{Bq}$

188. Magnetic induction at the centre of a circular loop of area π m^2 is 0.1 T. The magnetic moment of the loop is (μ_0 = permeability of air)
a) $\frac{0.1\pi}{\mu_0}$ b) $\frac{0.2\pi}{\mu_0}$ c) $\frac{0.3\pi}{\mu_0}$ d) $\frac{0.4\pi}{\mu_0}$

189. A charge Q is uniformly distributed over the surface of non-conducting disc of radius R. The disc rotates about an axis perpendicular to its plane and passing through its centre with an angular velocity ω. As a result of this rotation a magnetic field of induction B is obtained at the centre of the disc. If we keep both the amount of charge placed on the disc and its angular velocity to be constant and very the radius of the disc then the variation of the magnetic induction at the centre of the disc will be represented by the figure



190. AB and CD are long straight conductors, distance d apart, carrying a current I. The magnetic field at the midpoint of BC is



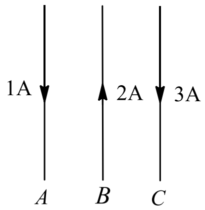
a) $\frac{-\mu_0 I}{2\pi d}\hat{k}$ b) $\frac{-\mu_0 I}{\pi d}\hat{k}$ c) $\frac{-\mu_0 I}{4\pi d}\hat{k}$ d) $\frac{-\mu_0 I}{8\pi d}\hat{k}$

191. The expression for magnetic induction inside a solenoid of length L carrying a current I and having N number of turns is
a) $\frac{\mu_0}{4\pi}\frac{N}{LI}$ b) $\mu_0 NI$ c) $\frac{\mu_0}{4\pi} NLI$ d) $\mu_0 \frac{N}{L} I$

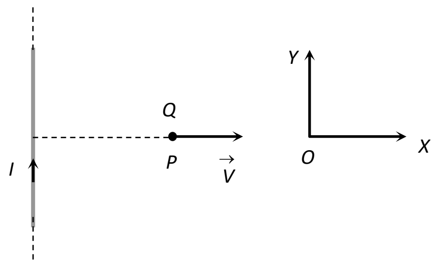
192. If same current I passing through two parallel wires separated by a distance b, then force per unit length will be
a) $\frac{\mu_0}{4\pi}\frac{2I^2}{b}$ b) $\frac{\mu_0 I}{4\pi b^2}$ c) $\frac{\mu_0 I^2}{4\pi b^2}$ d) $\frac{\mu_0 I^2}{4\pi b}$

193. The earth's magnetic induction at certain point is $7 \times 10^{-5}\ Wb/m^2$. This is to be annulled by the magnetic induction at the centre of a circular conducting loop of radius 5 cm. The required current in the loop is
a) 0.56 A b) 5.6 A c) 0.28 A d) 2.8 A

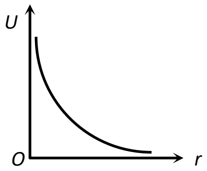
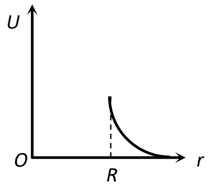
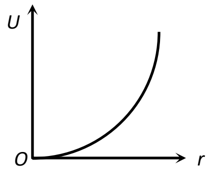
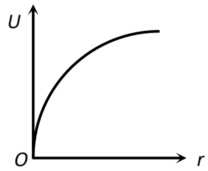
194. A galvanometer of resistance 100 Ω gives a full scale deflection for a current of 10^{-5} A. To convert it into a ammeter capable of measuring upto 1A, we should connect a resistance of
a) 1 Ω in parallel b) 10^{-3} Ω in parallel c) 10^5 Ω in series d) 100 Ω in series
195. The radius of the path of an electron moving at a speed of 3×10^7 m/s perpendicular to a magnetic field 5×10^{-4} T is nearly
a) 15 cm b) 45 cm c) 27 cm d) 34 cm
196. Biot-Savart's law may be represented in vector form as
a) $\mathbf{dB} = \frac{\mu_0}{4\pi} i \frac{\mathbf{dl} \times \mathbf{r}}{r^3}$ b) $\mathbf{dB} = \frac{\mu_0}{4\pi} i\, \mathbf{dl} \times \mathbf{r}$ c) $\mathbf{dB} = \frac{\mu_0}{4\pi} i \frac{\mathbf{dl} \times \mathbf{r}}{r^2}$ d) $\mathbf{dB} = \frac{\mu_0}{4\pi} i \frac{\mathbf{dl} \times \mathbf{r}}{r}$
197. If a long hollow copper pipe carries a direct current, the magnetic field associated with the current will be
a) Only inside the pipe b) Only outside the pie
c) Neither inside nor outside the pipe d) Both inside and outside the pipe
198. The number of lines of force passing through a unit area placed perpendicularly to the magnetic lines of force is termed as
a) Magnetic induction b) Magnetic flux density
c) Intensity of magnetic field d) All of the above
199. A particle moving in a magnetic field increases its velocity then its radius of the circle
a) Decreases b) Increases c) Remains the same d) Becomes half
200. An alternating electric field, of frequency v, is applied across the dees (radius $= R$) of a cyclotron that is being used to accelerated protons (mass $= m$). The operating magnetic field (B) used in the cyclotron and the kinetic energy (K) of the proton beam, produced by it, are given by
a) $B = \frac{mv}{e}$ and $K = 2m\pi^2v^2R^2$ b) $B = \frac{2\pi mv}{e}$ and $K = m^2\pi vR^2$
c) $B = \frac{2\pi mv}{e}$ and $K = 2m\pi^2v^2R^2$ d) $B = \frac{mv}{e}$ and $K = m^2\pi vR^2$
201. Three infinite straight wires A, B and C carry currents as shown. The net force on the wire B is directed



a) Toward A b) Toward C
c) Normal to plane of paper d) zero
202. A beam of electrons and protons move parallel to each other in the same direction, then they
a) Attract each other b) Repel each other
c) No relation d) Neither attract nor repel
203. A current carrying loop is placed in a uniform magnetic field. The torque acting on it does not depend upon
a) Shape of the loop b) Area of the loop c) Value of the current d) Magnetic field
204. A very long straight wire carries a current I. At the instant when a charge $+Q$ at point P has velocity $\vec{V}$, as shown, the force on the charge is



a) Opposite OX b) Along OX c) Opposite OY d) Along OY
205. A current is flowing through a thin cylindrical shell of radius R. If energy density in the medium, due to magnetic field, at a distance r from axis of the shell is equal to U then which of the following graphs is correct

a) 
b) 
c) 
d) 

206. Two concentric coplanar circular loops of radii r_1 and r_2 carry currents of respectively i_1 and i_2 in opposite directions (one clockwise and the other anticlockwise.) The magnetic induction at the centre of the loops is half that due to i_1 alone at the centre. If $r_2 = 2r_1$. The value of i_2/i_1 is
a) 2 b) 1/2 c) 1/4 d) 1
207. Due to the flow of current in a circular loop of radius R, the magnetic induction produced at the centre of the loop is B. The magnetic moment of the loop is
(μ_0 = permeability constant)
a) $BR^3/2\pi\mu_0$ b) $2\pi BR^3/\mu_0$ c) $BR^2/2\pi\mu_0$ d) $2\pi BR^2/\mu_0$
208. A charged particle is moving in a magnetic field of strength B perpendicular to the direction of the field. If q and m denote the charge and mass of the particle respectively, then the frequency of rotation of the particle is
a) $f = \frac{qB}{2\pi m}$ b) $f = \frac{qB}{2\pi m^2}$ c) $f = \frac{2\pi^2 m}{qB}$ d) $f = \frac{2\pi m}{qB}$
209. A proton and a deuteron with the same initial kinetic energy enter a magnetic field in a direction perpendicular to the direction of the field. The ration of the radii of the circular trajectories described by them is
a) 1 : 4 b) $1 : \sqrt{2}$ c) 1 : 1 d) 1 : 2
210. The dimension of the magnetic field intensity B is
a) $MLT^{-2}A^{-1}$ b) $MT^{-2}A^{-1}$ c) ML^2TA^{-2} d) $M^2LT^{-2}A^{-1}$
211. A wire in the form of a circular loop of one turn carrying a current produces a magnetic field B at the centre. If the same wire is looped into a coil of two turns and carries the same current, the new value of magnetic induction at the centre is
a) $3B$ b) $5B$ c) $4B$ d) $2B$
212. A horizontal rod of mass 10 gm and length 10 cm is placed on a smooth plane inclined at an angle of 60° with the horizontal, with the length of the rod parallel to the edge of the inclined plane. A uniform magnetic field of induction B is applied vertically downwards. If the current through the rod is 1.73 $ampere$, then the value of B for which the rod remains stationary on the inclined plane is
a) 1.73 $tesla$ b) $\frac{1}{1.73}$ $tesla$ c) 1 $tesla$ d) None of the above
213. A small coil of N turns has area A and a current I flows through it. The magnetic dipole moment of this coil will be
a) NI/A b) NI^2A c) N^2AI d) NIA
214. Two infinite length wires carry currents $8A$ and $6A$ respectively and are placed along X and Y-axis. Magnetic field at a point $P(0,0,d)m$ will be
a) $\frac{7\mu_0}{\pi l}$ b) $\frac{10\mu_0}{\pi l}$ c) $\frac{14\mu_0}{\pi l}$ d) $\frac{5\mu_0}{\pi l}$
215. A triangular loop of side l carries a current I. It is placed in a magnetic field B such that the plane of the loop is in the direction of B. The torque on the loop is
a) Zero b) IBl c) $\frac{\sqrt{3}}{2}Il^2B^2$ d) $\frac{\sqrt{3}}{4}IBl^2$
216. Consider the following statements regarding a charged particle in a magnetic field
(i) starting with zero velocity, it accelerates in a direction perpendicular to the magnetic field
(ii) While deflecting in the magnetic field, its energy gradually increases
(iii) Only the component of magnetic field perpendicular to the direction of motion of the charged particle is effective if deflecting it
(iv) Direction of deflecting force on the moving charged particle is perpendicular to its velocity. Of these

statement

a) (ii) and (iii) are correct
b) (iii) and (iv) are correct
c) (ii) . (iii) and (iv) are correct
d) (i). (ii) and (iii) are correct

217. Positively charged particles are projected into a magnetic field. If the direction of the magnetic field is along the direction of motion of the charge particles, the particles get

a) Accelerated
b) Decelerated
c) Deflected
d) No change in velocity

218. Two parallel long wires A and B carry currents i_1 and i_2 $(< i_1)$. When i_1 and i_2 are in the same direction, the magnetic field at a point mid way between the wires is 10 μ T. If i_2 is reversed, the field becomes 30 μ T. The ratio i_1/i_2 is

a) 1
b) 2
c) 3
d) 4

219. An electron having charge 1.6×10^{-19} C and mass 9×10^{-31} kg is moving with speed 4×10^{6} ms^{-1} in a magnetic field of 2×10^{-1} T in a circular orbit. The force acting on electron and the radius of the circular orbit will be

a) 18.8×10^{-13} N, 1.1×10^{-4} m
b) 12.8×10^{-14} N, 1.1×10^{-3} m
c) 12.8×10^{-13} N, 1.1×10^{-3} m
d) 1.28×10^{-13} N, 1.1×10^{-4} m

220. Two parallel beam of electrons moving in the same direction produce a mutual force

a) Of attraction in plane of paper
b) Of repulsion in plane of paper
c) Upwards perpendicular to plane of paper
d) Downward perpendicular to plane of paper

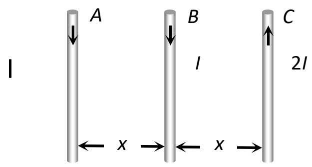
221. A wire of length l metre carrying a current i ampere is bent in the form of a coil having two turns. Its magnitude of magnetic moment will be

a) $il/4\pi$
b) $i^2l^2/4\pi$
c) $i^2l/8\pi$
d) $il^2/8\pi$

222. A long, straight, solid metal wire of radius 2 mm carries a current uniformly distributed over its circular cross-section. The magnetic field induction at a distance 2 mm from its axis is B. Then the magnetic field induction at distance 1 mm from axis will be

a) B
b) $B/2$
c) $2B$
d) B

223. A, B and C are parallel conductors of equal length carrying currents I, I and $2I$ respectively. Distance between A and B is x. Distance between B and C is also x. F_1 is the force exerted by B on A and F_2 is the force exerted by C on A. Choose the correct answer



a) $F_1 = 2F_2$
b) $F_2 = 2F_1$
c) $F_1 = F_2$
d) $F_1 = -F_2$

224. The magnetic field at the centre of a circular coil of radius r carrying current I is B_1. The field at the centre of another coil of radius $2r$ carrying same current I is B_2. The ratio $\frac{B_1}{B_2}$ is

a) 1/2
b) 1
c) 2
d) 4

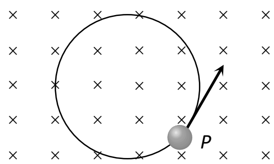
225. A uniform electric field and a uniform magnetic field exist in a region in the same direction. An electron is projected with a velocity pointed in the same direction. Then the electron will

a) Be deflected to the left without increase in speed
b) Be deflected to the right without increase in speed
c) Not be deflected but its speed will decrease
d) Not be deflected but its speed will increase

226. Two particles A and B having equal charges $+6C$, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii $2cm$ and $3cm$ respectively. The ratio of mass of A to that of B is

a) $\frac{4}{9}$
b) $\frac{9}{5}$
c) $\frac{1}{2}$
d) $\frac{1}{3}$

227. A particle having a charge of 10.0 μC and mass $1 \mu g$ moves in a circle of radius 10 cm under the influence of a magnetic field of induction $0.1T$. When the particle is at a point P, a uniform electric field is switched on so that the particle starts moving along the tangent with a uniform velocity. The electric field is



a) 0.1 V/m b) 1.0 V/m c) 10.0 V/m d) 100 V/m

228. An electron moving with a uniform velocity along the positive x-direction enters a magnetic field directed along the positive y-direction. The force on the electron is directed along

a) Positive y-direction b) Negative y-direction c) Positive z-direction d) Negative z-direction

229. A current carrying circular loop is freely suspended by a long thread. The plane of the loop will point in the direction

a) Wherever left free b) North-south
c) East-west d) At 45° with the east-west direction

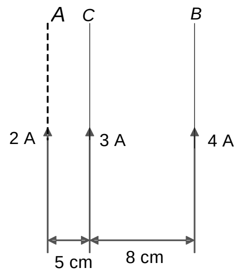
230. The magnetic dipole moment of a current loop is independent of

a) Magnetic field in which it is lying b) Number of turns
c) Area of the loop d) Current in the loop

231. A charge of 2.0 μC moves with a speed of 3.0×10^6 ms^{-1} along $+ve$ X-axis. A magnetic field of strength $\vec{B} = -0.2\ \hat{k}\ tesla$ exists in space. What is the magnetic force ($\vec{F}_m$) on the charge

a) $F_m = 1.2\ N$ along $+ve\ x -$ direction b) $F_m = 1.2\ N$ along $-ve\ x -$ direction
c) $F_m = 1.2\ N$ along $+ve\ y -$ direction d) $F_m = 1.2\ N$ along $-ve\ y -$ direction

232. A and B are two infinitely long straight parallel conductors. C is another straight conductor of length 1 m kept parallel to A and B as shown in the figure. Then the force experienced by C is.



a) Towards A equal to 0.6×10^{-5} N b) Towards B equal to 5.4×10^{-5} N
c) Towards A equal to 5.4×10^{-5} N d) Towards B equal to 0.6×10^{-5} N

233. Two concentric coils of 10 turns each are placed in the same plane. Their radii are 20 cm and 40 cm and carry 0.2 A and 0.3 A current respectively in opposite directions. The magnetic induction (in tesla) at the centre is

a) $\frac{3}{4}\mu_0$ b) $\frac{5}{4}\mu_0$ c) $\frac{7}{4}\mu_0$ d) $\frac{9}{4}\mu_0$

234. Which of the following while in motion cannot be deflected by magnetic field?

a) Protons b) Cathode rays c) Alpha particles d) Neutrons

235. The distance at which the magnetic field on axis as compared to the magnetic field at the center of the coil carrying current I and radius R is $\frac{1}{8}$, would be

a) R b) $\sqrt{2}R$ c) $2R$ d) $\sqrt{3}R$

236. To make the field radial in a moving coil galvanometer

a) The number of turns in the coil is increased
b) Magnet is taken in the form of horse-shoe
c) Poles are cylindrically cut
d) Coil is wounded on aluminium frame

237. A current of 5 *ampere* is flowing in a wire of length 1.5 *metres*. A force of 7.5 N acts on it when it is placed in a uniform magnetic field of 2 *tesla*. The angle between the magnetic field and the direction of the current is

a) 30° b) 45° c) 60° d) 90°

238. In case of Hall effect for a strip having charge Q and area of cross-section A, the Lorentz force is
a) Directly proportional to Q
b) Inversely proportional to Q
c) Inversely proportional to A
d) Directly proportional to A

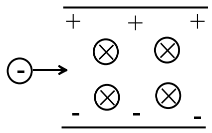
239. A proton, a deutron and an α − particle having the same kinetic energy are moving in circular trajectories in a constant magnetic field. If r_p, r_d and r_α denote respectively the radii of the trajectories of these particles, then
a) $r_\alpha = r_d > r_p$
b) $r_\alpha = r_d = r_p$
c) $r_\alpha < r_d < r_p$
d) $r_\alpha = r_p < r_d$

240. The current in the windings on a toroid is $2.0A$. There are 400 turns and the mean circumferential length is $40cm$. If the inside magnetic field is $1.0T$, the relative permeability is near to
a) 100
b) 200
c) 300
d) 400

241. Potential energy of a bar magnet of magnetic moment M placed in a magnetic field of induction B such that it makes an angle θ with the direction of B is
a) $MB \sin\theta$
b) $-MB \cos\theta$
c) $MB(1 - \cos\theta)$
d) $MB(1 + \cos\theta)$

242. An electron and proton having same kinetic energy enter into magnetic field perpendicular to it. Then
a) The path of electron is less curved
b) The path of proton is less curved
c) Both have equal curved paths
d) Both have straight line paths

243. An electron enters the space between the plates of a charged capacitor as shown. The charge density on the plate is σ. Electric intensity in the space between the plates is E. A uniform magnetic field B also exists in that space perpendicular to the direction of E. The electron moves perpendicular to both $\vec{E}$ and $\vec{B}$ without any change in direction. The time taken by the electron to travel a distance l in that space is



a) $\frac{\sigma l}{\varepsilon_0 B}$
b) $\frac{\sigma B}{\varepsilon_0 l}$
c) $\frac{\varepsilon_0 l B}{\sigma}$
d) $\frac{\varepsilon_0 l}{\sigma B}$

244. Two parallel wires carrying currents in the same direction attract each other because of
a) Potential difference between them
b) Mutual inductance between them
c) Electric force between them
d) Magnetic force between them

245. A uniform magnetic field B is acting from south to north and is of magnitude $1.5\ wb/m^2$. If a proton having mass $= 1.7 \times 10^{-27} kg$ and charge $= 1.6 \times 10^{-19} C$ moves in this field vertically downward with energy $5\ MeV$, then the force acting on it will be
a) $7.4 \times 10^{12}\ N$
b) $7.4 \times 10^{-12}\ N$
c) $7.4 \times 10^{19}\ N$
d) $7.4 \times 10^{-19}\ N$

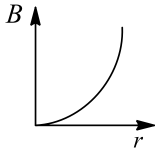
246. If in a circular coil A of radius R, current i is flowing and in another coil B of radius $2R$ a current $2i$ is flowing, then the ratio of the magnetic fields, B_A and B_B produced by them will be
a) 1
b) 2
c) $\frac{1}{2}$
d) 4

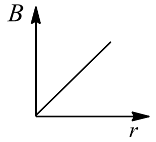
247. A circular loop carrying a current is replaced by an equivalent magnetic dipole. A point on the axis of the loop is
a) An end-on position
b) A broad side-on position
c) Both (a) and (b)
d) Neither (a) nor (b)

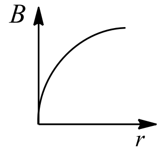
248. An electric current passes through a long straight copper wire. At a distance 5 cm from the straight wire, the magnetic field is B. The magnetic field at 20 cm from the straight wire would be
a) $\frac{B}{6}$
b) $\frac{B}{4}$
c) $\frac{B}{3}$
d) $\frac{B}{2}$

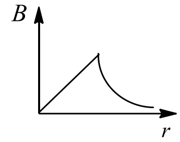
249. The velocity of two α-particles $A\ and\ B$ in a uniform magnetic field is in the ratio of 1 : 3. They move in different circular orbits in the magnetic field. The ratio of radius of curvatures of their paths is
a) 1 : 2
b) 1 : 3
c) 3 : 1
d) 2 : 1

250. The magnetic flux density B at a distance r from a long straight rod carrying a steady current varies with r as shown in figure.

a) 

b) 

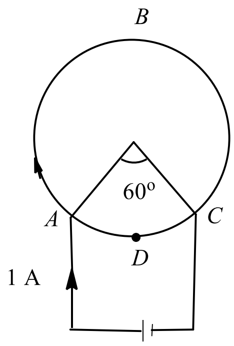
c) 

d) 

251. A uniform magnetic field $\vec{B} = B_0\hat{j}$ exists in space. A particle of mass m and charge q is projected towards x-axis with speed v from a point $(a, 0, 0)$. The maximum value of v for which the particle does not hit the y-z plane is

a) $\frac{B\,q\,a}{m}$ b) $\frac{B\,q\,a}{2\,m}$ c) $\frac{B\,q}{a\,m}$ d) $\frac{B\,q}{2\,a\,m}$

252. A cell is connected between the points A and C of a circular conductor $ABCD$ with O as centre and angle $AOC = 60°$. If B_1 and B_2 are the magnitudes of the magnetic fields at O due to the currents in ABC and ADC respectively, then ratio $\frac{B_1}{B_2}$ is



a) 1 b) 2 c) 5 d) 6

253. A long solenoid carrying a current produces a magnetic field B along its axis. If the current is doubled and the number of turns per cm is halved, the new value of the magnetic field is

a) B b) $2\,B$ c) $4\,B$ d) $B/2$

254. A long solenoid of length L has a mean diameter D. It has n layers of winding of N turns each. If it carries a current I, the magnetic field at its centre will be

a) Proportional to D
b) Inversely proportional to D
c) Independent of D
d) Proportional to L

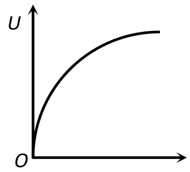
255. Two concentric coils each of radius equal to 2πcm are placed at right angles to each other. 3 A and 4 A are the currents flowing in each coil respectively. The magnetic induction in Wbm^{-2} at the centre of the coils will be ($\mu_0 = 4\pi \times 10^{-7}$ WbAm^{-1})

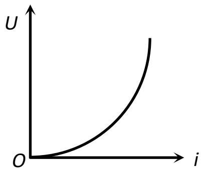
a) 12×10^{-5} b) 10^{-5} c) 5×10^{-5} d) 7×10^{-5}

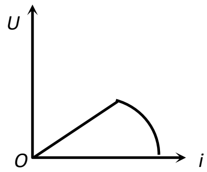
256. In hydrogen atom, the electron is making 6.6×10^{15} rev s^{-1} around the nucleus of radius of 53 Å. The magnetic field produced at the centre of the orbit is nearly

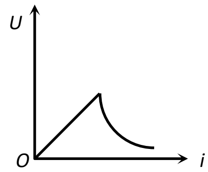
a) 0.14 Wbm^{-2} b) 1.4 Wbm^{-2} c) 14 Wbm^{-2} d) 140 Wbm^{-2}

257. If current flowing through shell of previous objective is equal to i, then energy density at a point distance $2R$ from axis of the shell varies according to the graph

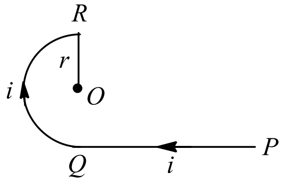
a) 

b) 

c) 

d) 

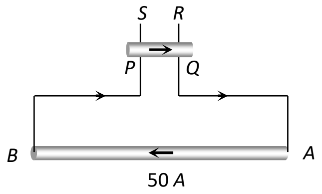
258. The magnetic field induction at the centre O, in the arrangement shown in figure is



a) $\frac{\mu_0\,i}{4\pi\,r}(4+\pi)$ b) $\frac{\mu_0\,i}{4\pi\,r}(3+\pi)$ c) $\frac{\mu_0\,i}{4\pi\,r}(2+\pi)$ d) $\frac{\mu_0\,i}{4\pi\,r}(1+\pi)$

259. When deuterium and helium are subjected to an accelerating field simultaneously then
a) Both acquire same energy
b) Deuterium accelerates faster
c) Helium accelerates faster
d) Neither of them is accelerated

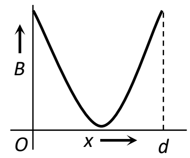
260. A long wire AB is placed on a table. Another wire PQ of mass 1.0 g and length 50 cm is set to slide on two rails PS and QR. A current of $50A$ is passed through the wires. At what distance above AB, will the wire PQ be in equilibrium

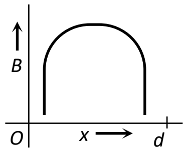


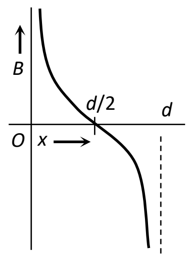
a) 25 mm
b) 50 mm
c) 75 mm
d) 100 mm

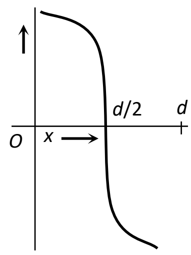
261. A straight wire carrying current i is turned into a circular loop. If the magnitude of magnetic moment associated with it in MKS unit is M, the length of wire will be
a) $\frac{4\pi}{M}$
b) $\sqrt{\frac{4\pi M}{i}}$
c) $\sqrt{\frac{r\pi i}{M}}$
d) $\frac{M\pi}{4i}$

262. Two parallel beams of protons and electrons, carrying equal currents are fixed at a separation d. The protons and electrons move in opposite directions. P is a point on a line joining the beams, at a distance x from any one beam. The magnetic field at P is B. If B is plotted against x, which of the following best represents the resulting curve

a)


b)


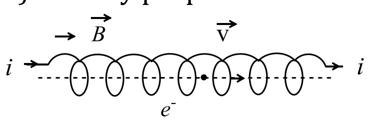
c)


d)


263. A straight conductor of length l carrying a current I, is bent in the form of a semicircle. The magnetic field (in tesla) at the centre of the semicircle is
a) $\frac{\pi^2 I}{l} \times 10^{-7}$
b) $\frac{\pi I}{l} \times 10^{-7}$
c) $\frac{\pi I}{l^2} \times 10^{-7}$
d) $\frac{\pi I^2}{l} \times 10^{-7}$

264. A charge $+q$ is moving upwards vertically. It enters a magnetic field directed to the north. The force on the charged will be towards
a) North
b) South
c) West
d) East

265. The strength of the magnetic field around a long straight wire, carrying current, is
a) Same everywhere around the wire at any distance
b) Inversely proportional to the distance from the wire
c) Inversely proportional to the square of the distance from the wire
d) Directly proportional to the square of the distance from the wire

266.


Work done on an electron moving in a solenoid along its axis is equal to
a) Zero
b) $-evB$
c) i/B
d) None of the above

267. A magnetic field can be produced by
a) A moving charge
b) A changing electric field
c) None of these
d) Both of these

268. A tangent galvanometer is connected directly to an ideal battery. If the number of turns in the coil is doubled, the deflection will
a) Increase
b) Decrease

c) Remain unchanged
d) Either increase or decrease

269. A charged particle is moving in a uniform magnetic field in a circular path. Radius of circular path is R. When energy of particle is doubled, then new radius will be
a) $R\sqrt{2}$
b) $R\sqrt{3}$
c) $2R$
d) $3R$

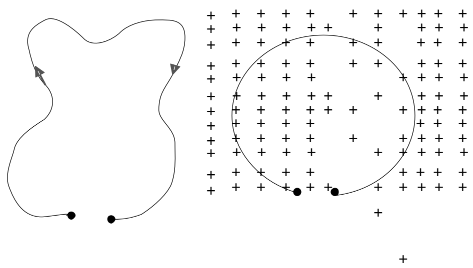
270. An electron enters a magnetic field whose direction is perpendicular to the velocity of the electron. Then
a) The speed of the electron will increase
b) The speed of the electron will decrease
c) The speed of the electron will remain the same
d) The velocity of the electron will remain the same

271. A current I flow in an infinitely long wire cross-section in the form of a semi-circular ring of radius R. The magnitude of the magnetic induction along its axis is
a) $\frac{\mu_0 I}{2\pi^2 R}$
b) $\frac{\mu_0 I}{2\pi R}$
c) $\frac{\mu_0 I}{4\pi R}$
d) $\frac{\mu_0 I}{\pi^2 R}$

272. In a hydrogen atom, an electron moves in a circular orbit of radius $5.2 \times 10^{-11} m$ and produces a magnetic induction of $12.56\ T$ at its nucleus. The current produced by the motion of the electron will be (Given $\mu_0 = 4\pi \times 10^{-7} Wb/A-m$)
a) 6.53×10^{-3} *ampere*
b) 13.25×10^{-10} *ampere*
c) 9.6×10^{6} *ampere*
d) 1.04×10^{-3} *ampere*

273. An electron, a proton, a deuteron and an alpha particle, each having the same speed are in a region of constant magnetic field perpendicular to the direction of the velocities of the particles. The radius of the circular orbits of these particles are respectively R_e, R_p, R_d and R_α. If follows that
a) $R_e = R_p$
b) $R_p = R_d$
c) $R_d = R_\alpha$
d) $R_p = R_\alpha$

274. A thin flexible wire of length L is connected to two adjacent fixed points and carries a current I in the clockwise direction, as shown in the figure. When the system is put in a uniform magnetic field of strength B going into the plane of the paper, the wire takes the shape of a circle. The tension in the wire is



a) IBL
b) $\frac{IBL}{\pi}$
c) $\frac{IBL}{2\pi}$
d) $\frac{IBL}{4\pi}$

275. A circular disc of radius $0.2\ m$ is placed in a uniform magnetic field of induction $\frac{1}{\pi}(Wb/m^2)$ in such a way that its axis makes an angle of 60° with vector $\vec{B}$. The magnetic flux linked with the disc is
a) $0.08\ Wb$
b) $0.01\ Wb$
c) $0.02\ Wb$
d) $0.06\ Wb$

276. A circular current carrying coil has a radius R. The distance from the centre of the coil on the axis of the coil, where the magnetic induction is $\frac{1}{8}$th of its value at the centre of the coil is
a) $\sqrt{3}R$
b) $R/\sqrt{3}$
c) $\left(\frac{2}{\sqrt{3}}\right)R$
d) $\frac{R}{2\sqrt{3}}$

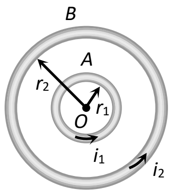
277. A current carrying conductor produces
a) Only electric field
b) Only magnetic field
c) Both electric and magnetic fields
d) Neither electric nor magnetic field

278. The ratio of magnetism potentials due to magnetic dipole in the end on position to that in broad side on position for the same distance from it is
a) Zero
b) ∞
c) 1
d) 2

279. A current carrying rectangular coil is placed in a uniform magnetic field. In which orientation, the coil will not tend to rotate

a) The magnetic field is parallel to the plane of the coil
b) The magnetic field is perpendicular to the plane of the coil
c) The magnetic field is at 45° with the plane of the coil
d) Always in any orientation

280. A and B are two concentric circular conductors of centre O and carrying currents i_1 and i_2 as shown in the adjacent figure. If ratio of their radii is 1 : 2 and ratio of the flux densities at O due to A and B is 1 : 3, then the value of i_1/i_2 is



a) 1/6 b) 1/4 c) 1/3 d) 1/2

281. A horizontal straight wire 10 m long extending from east to west falling with a speed of 5.0 m/s, at right angles to the horizontal component of the earth's magnetic field of strength $0.30 \times 10^{-4} Wb/m^2$. The instantaneous value of the induced potential gradient in the wire, from west to east is

a) $+1.5 \times 10^{-3} V/m$ b) $-1.5 \times 10^{-3} V/m$ c) $+1.5 \times 10^{-4} V/m$ d) $-1.5 \times 10^{-4} V/m$

282. A charged particle with charge q enters a region of constant, unform and mutually orthogonal fields $\vec{E}$ and $\vec{B}$ with a velocity $\vec{v}$ perpendicular to both $\vec{E}$ and $\vec{B}$, and comes out without any change in magnitude or direction of $\vec{v}$. Then

a) $\vec{v} = \vec{E} \times \vec{B}/B^2$ b) $\vec{v} = \vec{E} \times \vec{B}/B^2$ c) $\vec{v} = \vec{E} \times \vec{B}/E^2$ d) $\vec{v} = \vec{B} \times \vec{E}/E^2$

283. A circular coil of wire consisting of 100 turns, each of radius 8.0 cm carries a current of 0.40 A. What is the magnitude of the magnetic field B at the centre of the coil?

a) $\pi \times 10^{-3}$ T b) $2\pi \times 10^{-4}$ T c) $\pi \times 10^{-4}$ T d) Zero

284. A strong magnetic field is applied on a stationary electron, then

a) The electron moves in the direction of the field
b) The electron moves in an opposite direction
c) The electron remains stationary
d) The electron starts spinning

285. A long solenoid has a radius a and number of turns per unit length n. If it carries a current i, then the magnetic field on its axis is directly proportional to

a) ani b) ni c) $\frac{ni}{a}$ d) $n^2 i$

286. Magnetic field at the centre of a circular coil of radius Rdue to i flowing through it is B. The magnetic field at a point along the axis at distance R from the centre is

a) $\frac{B}{2}$ b) $\frac{B}{4}$ c) $\frac{B}{\sqrt{8}}$ d) $\sqrt{8B}$

287. A wire of length l is bent into a circular loop of radius R and carries a current I. The magnetic field at the centre of the loop is B. The same wire is now bent into a double loop of equal radii. If both loop carry the same current I and it is in the same direction, the magnetic field at the centre of the double loop will be

a) Zero b) 2 B c) 4 B d) 8 B

288. A circular coil A of radius r carries current i. Another circular coil B of radius $2r$ carries current of i. The magnetic fields at the centres of the circular coils are in the ratio of

a) 3 : 1 b) 4 : 1 c) 1 : 1 d) 2 : 1

289. A small cylindrical soft iron piece is kept in a galvanometer so that

a) A radial uniform magnetic field is produced b) A uniform magnetic field is produced
c) There is a steady deflection of the coil d) All of these

290. A charged particle moving in a magnetic field experiences a resultant force

a) In the direction of field
b) In the direction opposite to the field

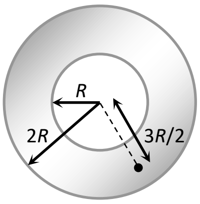
c) In the direction perpendicular to both the field and its velocity
d) None of the above

291. For the magnetic field to be maximum due to a small element of current carrying conductor at a point, the angle between the element and the line joining the element to the given point must be
a) 0° b) 90° c) 180° d) 45°

292. The magnetic field at the centre of current carrying coil is
a) $\frac{\mu_0 ni}{2r}$ b) $\frac{\mu_0}{2\pi}\frac{ni}{r}$ c) $\frac{\mu_0 ni}{4r}$ d) $\mu_0 ni$

293. A charged particle of mass m and charge q travels in a circular path of radius r that is perpendicular to a magnetic field B. The time taken by the particle to complete one revolution is
a) $\frac{2\pi B}{m}$ b) $\frac{2\pi\, m}{q\, B}$ c) $\frac{2\pi\, mq}{B}$ d) $\frac{2\pi\, q^2 B}{m}$

294. Figure shows the cross-sectional view of the hollow cylindrical conductor with inner radius 'R' and outer radius '$2R$'. Cylinder is carrying uniformly distributed current along it's axis. The magnetic induction at point 'P' at a distance $\frac{3R}{2}$ from the axis of the cylinder will be



a) Zero b) $\frac{5\mu_0 i}{72\pi\, R}$ c) $\frac{7\mu_0 i}{18\pi\, R}$ d) $\frac{5\mu_0 i}{36\pi\, R}$

295. A battery is connected between two points A and B on the circumference of a uniform conducting ring of radius r and resistance R. One of the acrs AB of the ring subtends an angle θ at the centre. Magnetic field due to current at the centre of ring is
a) Zero, only if $\theta = 180°$ b) Zero for all values of θ c) Proportional to $2(180° - \theta)$ d) Inversely proportional to r

296. The magnetic induction at the centre of a current carrying circular of radius r, is
a) Directly proportional to r
b) Inversely proportional to r
c) Directly proportional to r^2
d) Inversely proportional to r^2

297. The field due to a long straight wire carrying a current I is proportional to
a) I b) I^3 c) $\sqrt{I}$ d) $1/I$

298. Two very long straight parallel wires carry current i and 2 i in opposite directions. The distance between the wires is r. At a certain instant of time a point charge q is at a point equidistant from the two wires in the plane of the wires. Its instantaneous velocity $\vec{V}$ is perpendicular to this plane. The magnitude of the force due to the magnetic field acting on the charge at this instant is
a) zero b) $\frac{3\mu_0}{2\pi}\frac{i\,q\,v}{r}$ c) $\frac{\mu_0}{\pi}\frac{i\,q\,v}{r}$ d) $\frac{\mu_0}{2\pi}\frac{i\,q\,v}{r}$

299. A proton (mass $= 1.67 \times 10^{-27} kg$ and charge $= 1.6 \times 10^{-19} C$) enters perpendicular to a magnetic field of intensity 2 $weber/m^2$ with a velocity $3.4 \times 10^7 m/sec$. The acceleration of the proton should be
a) $6.5 \times 10^{15}\ m/\text{sec}^2$ b) $6.5 \times 10^{13}\ m/\text{sec}^2$ c) $6.5 \times 10^{11}\ m/\text{sec}^2$ d) $6.5 \times 10^{9}\ m/\text{sec}^2$

300. A coil in the shape of an equilateral triangle of side l is suspended between the pole pieces of a permanent magnet such that $\vec{B}$ is in plane of the coil. If due to a current i in the triangle a torque τ acts on it, the side l of the triangle is
a) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{Bi}\right)^{\frac{1}{2}}$ b) $\frac{2}{3}\left(\frac{\tau}{Bi}\right)$ c) $2\left(\frac{\tau}{\sqrt{3}Bi}\right)^{\frac{1}{2}}$ d) $\frac{1}{\sqrt{3}}\frac{\tau}{Bi}$

301. The force on a charged particle moving with a velocity v in a magnetic field B is not
a) Perpendicular to both v and B
b) Maximum if v is perpendicular to B
c) Maximum, if v is parallel to B
d) Zero if v is parallel to B

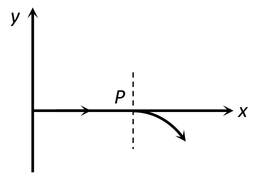
302. A current carrying wire in the neighborhood produces

a) No field
b) Electric field only
c) Magnetic field only
d) Electric and magnetic field

303. A long copper tube of inner radius R carries a current i. The magnetic field B inside the tube is
a) $\frac{\mu_0 i}{2\pi R}$
b) $\frac{\mu_0 i}{4\pi R}$
c) $\frac{\mu_0 i}{2R}$
d) Zero

304. The direction of induced magnetic field **dB** due to current element i **dL,** at a point of distance r from it, when a current i passes through a long conductor is in the direction
a) Of position vector **r** of the point
b) Of current element **dL**
c) Perpendicular to both **dL** and **r**
d) Perpendicular to **dL** only

305. For a positively charged particle moving in a x-y plane initially along the x-axis, there is a sudden change in its path due to the presence of electric and/or magnetic fields beyond P. The curved path is shown in the x-y plane and is found to be non-circular. Which one of the following combination is possible



a) $\vec{E} + 0; \vec{B} = b\hat{\imath} + c\hat{k}$
b) $\vec{E} + a\hat{\imath}; \vec{B} = c\hat{k} + a\hat{\imath}$
c) $\vec{E} + 0; \vec{B} = c\hat{\jmath} + b\hat{k}$
d) $\vec{E} + a\hat{\imath}; \vec{B} = c\hat{k} + b\hat{\jmath}$

306. When a charged particle enters a uniform magnetic field, its kinetic energy
a) Remains constant
b) Increases
c) Decreases
d) Becomes zero

307. If a particle of charge 10^{-12} C moving along the x-direction with a velocity of 10^5 ms^{-1} experience a force of 10^{-10} N in y-direction due to magnetic field, then the minimum value of magnetic field is
a) 6.25×10^3 T in z-direction
b) 10^{-15} T in z-direction
c) 6.25×10^{-3} T in z-direction
d) 10^{-3} T in z-direction

308. Lorentz force can be calculated by using the formula
a) $\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$
b) $\vec{F} = q(\vec{E} - \vec{v} \times \vec{B})$
c) $\vec{F} = q(\vec{E} + \vec{v} \cdot \vec{B})$
d) $\vec{F} = q(\vec{E} \times \vec{B} + \vec{v})$

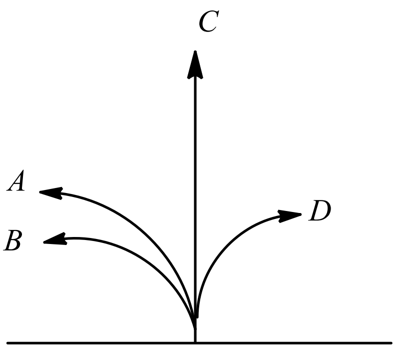
309. At the centre of a circular coil of radius 5 cm carrying current, magnetic field due to earth is 0.5×10^{-5} Wbm^{-2}. What should be the current flowing through the coil so that it annuals the earth's magnetic field?
a) 40 A
b) 4 A
c) 0.4 A
d) 0.2 A

310. A thin circular disk of radius R is uniformly charged with density $\sigma > 0$ per unit area. The disk rotates about its axis with a uniform angular speed ω. The magnetic moment of the disk is
a) $2\pi R^4 \sigma\omega$
b) $\pi R^4 \sigma\omega$
c) $\frac{\pi R^4}{2}\sigma\omega$
d) $\frac{\pi R^4}{4}\sigma\omega$

311. A positively charged particle moving due east enters a region of uniform magnetic field directed vertically upwards. The particle will
a) Get deflected vertically upwards
b) Move in a circular orbit with its speed increased
c) Move in a circular orbit with its speed unchanged
d) Continue to move due east

312. A wire of length I is bent into a circular coil of one turn of radius R_1. Another wire of the same material and same area of cross-section and same lengths is bent into a circular coil of two turns of radius R_2. When the same current flows, through the two coils, the ratio of magnetic induction at the centres of the two coils is
a) 1 : 2
b) 1 : 1
c) 1 : 4
d) 3 : 1

313. A neutron, a proton, an electron and an $\alpha -$ particle enter a region of uniform magnetic field with the same velocities. The magnetic field is perpendicular and directed into the plane of the paper. The tracks of the particles are labeled in the figure. The electron follows the track

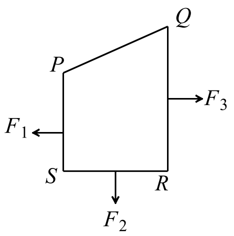


a) D b) C c) B d) A

314. A current i is passing through a straight conductor of infinite length. The magnetic field at a point situated at a distance R from the conductor is

a) $\frac{\mu_0}{2\pi} i$ b) $\frac{\mu_0}{2\pi} \frac{i}{R^2}$ c) $\frac{\mu_0}{2\pi} \frac{i}{R^3}$ d) $\frac{\mu_0}{2\pi} \frac{i}{R}$

315. A closed loop $PQRS$ carrying a current is placed in a uniform magnetic field. If the magnetic forces on segment PS, SR and RQ are F_1, F_2 and F_3 respectively and are in the plane of the paper and along the directions shown, the force on the segment QP is



a) $\sqrt{(F_3 - F_1)^2 - F_2^2}$ b) $F_3 + F_1 - F_2$ c) $F_3 - F_1 + F_2$ d) $\sqrt{(F_3 - F_1)^2 + F_2^2}$

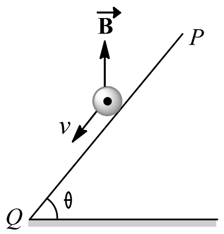
316. Two concentric circular lops of radii R and $2R$ carry currents of $2I$ and I respectively in opposite sense (i.e., clockwise in one coil and counter-clockwise in the other coil). The resultant magnetic field at their common centre is

a) $\mu_0 \frac{I}{4R}$ b) $\mu_0 \frac{5I}{4R}$ c) $\mu_0 \frac{3I}{4R}$ d) $\mu_0 \frac{I}{2R}$

317. A beam of ions with velocity $2 \times 10^5 m/s$ enters normally into a uniform magnetic field of $4 \times 10^{-2} tesla$. If the specific charge of the ion is $5 \times 10^7 C/kg$, then the radius of the circular path described will be

a) $0.10\ m$ b) $0.16\ m$ c) $0.20\ m$ d) $0.25\ m$

318. A conducting rod of length l and mass m is moving down a smooth inclined plane of inclination θ with constant speed v. A vertically upward magnetic field $\vec{B}$ exists in space there. The magnitude of magnetic field $\vec{B}$ is

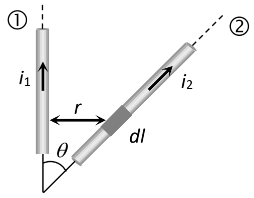


a) $\frac{mg}{il} \sin \theta$ b) $\frac{mg}{il} \cos \theta$ c) $\frac{mg}{il} \tan \theta$ d) $\frac{mg}{il \sin \theta}$

319. The ratio of the magnitude field at the centre of a current carrying coil of the radius a and at a distance 'a' from centre of the coil and perpendicular to the axis of coil is

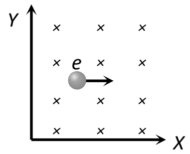
a) $\frac{1}{\sqrt{2}}$ b) $\sqrt{2}$ c) $\frac{1}{2\sqrt{2}}$ d) $2\sqrt{2}$

320. Wires 1 and 2 carrying currents i_1 and i_2 respectively are inclined at an angle θ to each other. What is the force on a small element dl of wire 2 at a distance of r from wire 1 (as shown in figure) due to the magnetic field of wire 1



a) $\frac{\mu_0}{2\pi r} i_1 i_2\, dl \tan\theta$ b) $\frac{\mu_0}{2\pi r} i_1 i_2\, dl \sin\theta$ c) $\frac{\mu_0}{2\pi r} i_1 i_2\, dl \cos\theta$ d) $\frac{\mu_0}{4\pi r} i_1 i_2\, dl \sin\theta$

321. In the given figure, the electron enters into the magnetic field. It deflects in …. direction

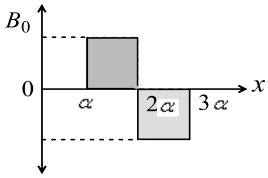


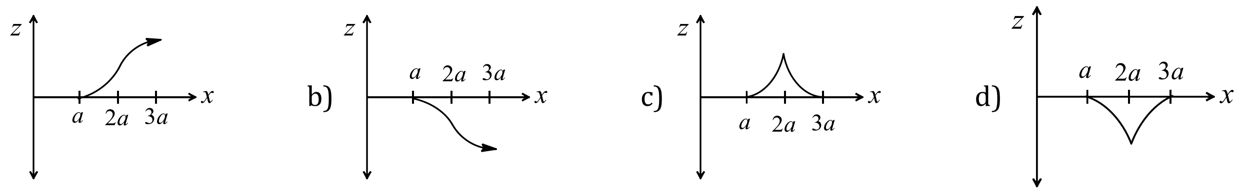
a) $+ve\ X$ direction b) $-ve\ X$ direction c) $+ve\ Y$ direction d) $-ve\ Y$ direction

322. The force between two parallel current carrying wires is independent of

a) Their distance of separation b) The length of the wires
c) The magnitude of currents d) The radii of the wires

323. A magnetic field $\vec{B} = B_0\hat{j}$ exists in the region $a < x < 2a$ and $\vec{B} = -B_0\hat{j}$, in the region $2a < x < 3a$, where B_0 is a positive constant. A positive point charge moving with a velocity $\vec{V} = V_0\hat{\imath}$, where V_0 is a positive constant, enters the magnetic field at $x = a$. The trajectory of the charge in this region can be like





a) b) c) d)

324. A current carrying small loop behaves like a small magnet. If A be its area and M its magnetic moment, the current in the loop will be

a) M/A b) A/M c) MA d) A^2M

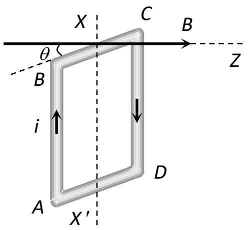
325. A charge is fired through a magnetic field. The force acting on the charge is maximum when the angle between the direction of motion of charge and the magnetic field is

a) Zero b) $\frac{\pi}{4}$ c) π d) $\frac{\pi}{2}$

326. The magnitude of the magnetic field required to accelerate protons (mass $= 1.67 \times 10^{-27} kg$) in a cyclotron that is operated at an oscillator frequency 12 MHz is approximately

a) 0.8 T b) 1.6 T c) 2.0 T d) 3.2 T

327. The square loop $ABCD$, carrying a current i, is placed in uniform magnetic field B, as shown. The loop can rotate about the axis XX'. The plane of the loop makes an angle θ ($\theta < 90°$) with the direction of B. Through what angle will the loop rotate by itself before the torque on it becomes zero



a) θ b) $90° - \theta$ c) $90° + \theta$ d) $180° - \theta$

328. A loosely wound helix made of stiff wire is mounted vertically with the lower end just touching a dish of mercury. When a current from a battery is started in the coil through the mercury

a) The wire oscillates
b) The wire continues making contact
c) The wire breaks contact just as current is passed
d) The mercury will expand by heating due to passage of current

329. A uniform electric field and a uniform magnetic field are produced, pointing in the same direction. If an electron is projected with its velocity pointing in the same direction
a) The electron will turn to its right
b) The electron will turn to its left
c) The electron velocity will increase in magnitude
d) The electron velocity will decrease in magnitude

330. Two long parallel wires carry currents i_1 and i_2 such that $i_1 > i_2$. When the currents are in the same direction, the magnetic field at a point midway between the wires is 6×10^{-6} T. If the direction of i_2 is reversed, the field becomes 3×10^{-5} T. The ratio $\frac{i_1}{i_2}$ is
a) $\frac{1}{2}$
b) 2
c) $\frac{2}{3}$
d) $\frac{3}{2}$

331. Through two parallel wires A and B, 10A and 2A of currents are passed respectively in opposite directions. If the wire A is infinitely long and the length of the wire B is 2m, then force on the conductor B, which is situated at 10 cm distance from A, will be
a) 8×10^{-7} N
b) 8×10^{-5} N
c) 4×10^{-7} N
d) 4×10^{-5} N

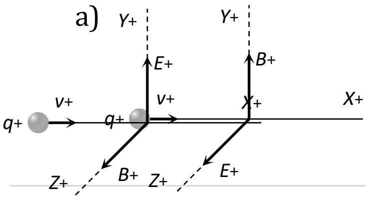
332. Magnetic dipole moment of a rectangular loop is
a) Inversely proportional to current in loop
b) Inversely proportional to area of loop
c) Parallel to plane of loop and proportional to area of loop
d) Perpendicular to plane of loop and proportional to area of loop

333. When a certain length of wire is turned into one circular loop, the magnetic induction at the centre of coil due to some current flowing is B_0. If the same wire is turned into three loops to make a circular coil, the magnetic induction at the center of this coil for the same current will be
a) B_0
b) $9\ B_0$
c) $3\ B_0$
d) $27\ B_0$

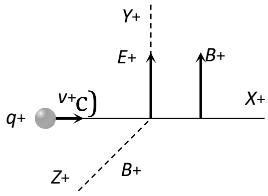
334. An electron and a proton with equal momentum enter perpendicularly into a uniform magnetic field, then
a) The path of proton shall be more curved than that of electron
b) The path of proton shall be less curved than that of electron
c) Both are equally curved
d) Path of both will be straight line

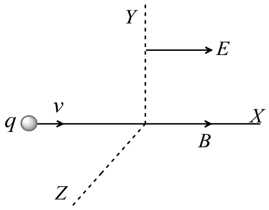
335. A magnetic needle lying parallel to a magnetic field required W units of work to turn it through 60°. The torque required to maintain the needle in this position will be
a) $\sqrt{3}\,W$
b) W
c) $\sqrt{3}\frac{W}{2}$
d) $2\,W$

336. An electron (charge q coulomb) enters a magnetic field of $H\ weber/m^2$ with a velocity of vm/s in the same direction as that of the field. The force on the electron is
a) Hqv newtons in the direction of the magnetic field
b) Hqv dynes in the direction of the magnetic field
c) Hqv newtons at right angles to the direction of the magnetic field
d) Zero

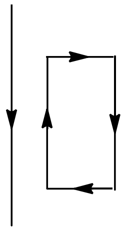
337. A particle of charge q and mass m is moving along the x-axis with a velocity v and enters a region of electric field E and magnetic field B as shown in figure below. For which figure the net force on the charge may be zero
a)


b)

c) 

d) 

338. A rectangular loop carrying current is placed near a long straight fixed wire carrying strong current such that long sides are parallel to wire. If the current in the nearer long side of loop is parallel to current in the wire. Then the loop



a) Experiences no force
b) Experiences a force towards wire
c) Experiences a force away from wire
d) Experiences a torque but no force

339. A long straight wire of radius a carries a steady current i. The current is uniformly distributed across its cross-section. The ratio of the magnetic field at $\frac{a}{2}$ and $2a$ is

a) $\frac{1}{4}$
b) 4
c) 1
d) $\frac{1}{2}$

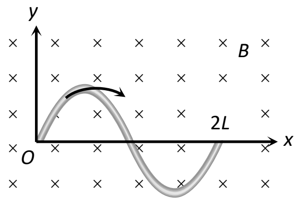
340. A current i flows along the length of an infinitely long, straight, thin-walled pipe. Then

a) The magnetic field at all points inside the pipe is the same, but not zero
b) The magnetic field at any point inside the pipe is zero
c) The magnetic field is zero only on the axis of the pipe
d) The magnetic field is different at different points inside the pipe

341. If an electron is going in the direction of magnetic field $\vec{B}$ with the velocity of $\vec{v}$ then the force on electron is

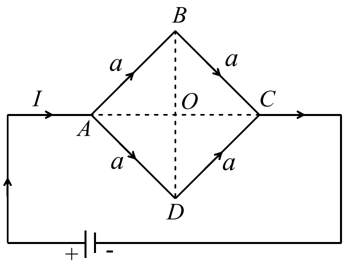
a) Zero
b) $e(\vec{v} \cdot \vec{B})$
c) $e(\vec{v} \times \vec{B})$
d) None of these

342. A wire carrying a current i is placed in a uniform magnetic field in the form of the curve $y = a \sin\left(\frac{\pi x}{L}\right), 0 \leq x \leq 2L$. The force acting on the wire is



a) $\frac{iBL}{\pi}$
b) $iBL\pi$
c) $2iBL$
d) Zero

343. Magnetic field induction at the centre O of a square loop of side 'a' carrying current I as shown in figure is



a) $\frac{\mu_0 I}{\sqrt{2}\pi a}$
b) $2\sqrt{2}\frac{\mu_0 I}{\pi a}$
c) $\frac{2\mu_0 I}{\pi a}$
d)

344. Two parallel wires in free space are 10 cm apart and each carries a current of 10 A in the same direction. The force one wire exerts on the other per metre of length is

a) $2 \times 10^{-4} N$, attractive
b) $2 \times 10^{-4} N$, repulsive

c) $2 \times 10^{-7} N$, attractive
d) $2 \times 10^{-7} N$, repulsive

345. The unit of electric current "*ampere*" is the current which when flowing through each of two parallel wires spaced 1 m apart in vacuum and of infinite length will give rise to a force between them equal to
a) $1\ N/m$
b) $2 \times 10^{-7} N/m$
c) $1 \times 10^{-2} N/m$
d) $4\pi \times 10^{-7} N/m$

346. A coil of n number of turns is wound tightly in the form of a spiral with inner and outer radii a and b respectively. When a current of strength I is passed through the coil, the magnetic field at its centre is
a) $\frac{\mu_0 nI}{(b-a)} \log_e \frac{a}{b}$
b) $\frac{\mu_0 nI}{2(b-a)}$
c) $\frac{2\mu_0 nI}{b}$
d) $\frac{\mu_0 nI}{2(b-a)} \log_e \frac{b}{a}$

347. A wire oriented in the east-west direction carries a current eastward. Direction of the magnetic field at a point to the south of the wire is
a) Vertically down
b) Vertically up
c) North-east
d) South-east

348. Two parallel conductors A and B of equal lengths carry currents I and 10 I, respectively, in the same direction. Then
a) A and B will repel each other with same force
b) A and B will attract each other with same force
c) A will attract B, but B will repel A
d) A and B will attract each other with different forces

349. A charge moving with velocity v in X-direction is subjected to a field of magnetic induction in the negative X-direction. As a result, the charge will
a) Remain unaffected
b) Start moving in a circular path in Y-Z plane
c) Retard along X-axis
d) Move along a helical path around X-axis

350. An electron beam travels with a velocity of $1.6 \times 10^7\ \text{ms}^{-1}$ perpendicularly to magnetic field of intensity 0.1 T. The radius of the path of the electron beam $(m_e = 9 \times 10^{-31}\ \text{kg})$
a) 9×10^{-5} m
b) 9×10^{-2} m
c) 9×10^{-4} m
d) 9×10^{-3} m

351. A particle of mass M and charge Q moving with velocity $\vec{v}$ describes a circular path of radius R when subjected to a uniform transverse magnetic field of induction B. The work done by the field when the particle completes one full circle is
a) $BQv2\pi R$
b) $\left(\frac{Mv^2}{R}\right) 2\pi R$
c) Zero
d) $BQ2\pi R$

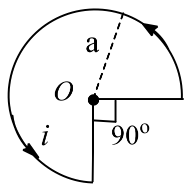
352. The magnetic induction at a distance r from the axis of an infinitely straight conductor which carries current $i$is
a) $\frac{\mu_0 i}{2\pi r}$
b) $\frac{\mu_0 i}{2r}$
c) ∞
d) Zero

353. A moving coil galvanometer has N number of turns in a coil of effective area A, it carries a current I. The magnetic field B is radial. The torque acting on the coil is
a) NA^2B^2I
b) $NABI^2$
c) N^2ABI
d) $NABI$

354. Gauss is unit of which quantity
a) H
b) B
c) ϕ
d) I

355. A proton (mass m and charge $+e$) and an α-particle (mass $4m$ and charge $+2e$) are projected with the same kinetic energy at right angles to the uniform magnetic field. Which one of the following statements will be true
a) The α-particle will be bent in a circular path with a small radius that for the proton
b) The radius of the path of the α-particle will be greater than that of the proton
c) The α-particle and the proton will be bent in a circular path with the same radius
d) The α-particle and the proton will go through the field in a straight line

356. For the arrangement as shown in the figure, the magnetic induction at the centre is

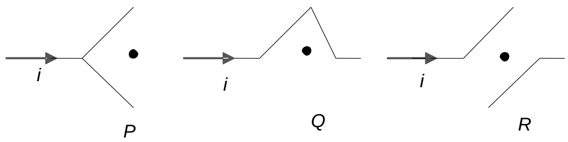


a) $\frac{3\mu_0 i\pi}{4a}$ b) $\frac{\mu_0 i}{4\pi a}(1+\pi)$ c) $\frac{\mu_0 i}{4\pi a}$ d) $\frac{3\mu_0 i}{8al}$

357. A long solenoid has 200 turns/cm and carries a current i. The magnetic field at its centre is 6.28×10^{-2} Wb/m^2. Another long solenoid has 100 turns/cm and it carries a current $i/3$. The value of the magnetic field at its centre is

a) 1.05×10^{-2} Wbm^{-2} b) 1.05×10^{-5} Wbm^{-2} c) 1.05×10^{-3} Wbm^{-2} d) 1.05×10^{-4} Wbm^{-2}

358. Two thick wires and two thin wires, all of same material and same length, form a square in three different ways P, Q and R as shown in the figure. With correct connections shown, the magnetic field due to the current flow, at the centre of the loop will be zero in case of



a) Q and R b) P only c) P and Q d) P and R

359. A proton, a deuteron and an alpha particle with the same kinetic energy enter a region of uniform magnetic field B at right angles to the field. The ratio of the radii of their circular paths is

a) $1:1:1$ b) $1:\sqrt{2}:\sqrt{2}$ c) $\sqrt{2}:1:1$ d) $\sqrt{2}:\sqrt{2}:1$

360. A proton and an alpha particle are separately projected in a region where a uniform magnetic field exists. Their initial velocities are perpendicular to direction of magnetic field. If both the particles move around magnetic field in circles of equal radii, the ratio of momentum of proton to alpha particle $\left(\frac{P_p}{P_\alpha}\right)$ is

a) 1 b) 1/2 c) 2 d) 1/4

361. Two magnets have the same length and the same pole strength. But one of the magnets has a small hole at its center. Then

a) Both the equal magnetic moment
b) One with hole has smaller magnetic moment
c) One with hole has large magnetic moment
d) One with hole has loses magnetism through the hole

362. The magnetic field at the centre of a current carrying circular loop is B. If the radius of the loop is doubled, keeping the current same, the magnetic field at the centre of the loop would be

a) $\frac{B}{4}$ b) $\frac{B}{2}$ c) $2B$ d) $4B$

363. Ampere's circuital law is equivalent to

a) Biot-Savart law b) Coulomb's law c) Faraday's law d) Kirchhoff's law

364. Two parallel wires of length 9 m each are separated by a distance 0.15 m. If they carry equal currents in the same direction and exert a total force of $30 \times 10^{-7} N$ on each other, then the value of current must be

a) 2.5 amp b) 3.5 amp c) 1.5 amp d) 0.5 amp

365. A coil of 100 turns and area 2×10^{-2} m^2, pivoted about a vertical diameter in a uniform magnetic field carries a current of 5 A. When the coil is held with its plane in North-South direction, it experiences a torque of 0.3 Nm. When the plane is in East-West direction the torque is 0.4 Nm. The value of magnetic induction is (Neglect earth's magnetic field)

a) 0.2 T b) 0.3 T c) 0.4 T d) 0.5 T

366. An electron (mass $= 9.1 \times 10^{-31} kg$, charge $= 1.6 \times 10^{-18} C$) experience no deflection if subjected to an electric field of $3.2 \times 10^5 V/m$, and a magnetic field of $2.0 \times 10^{-3} Wb/m^2$. Both the fields are normal to the path of electron and to each other. If the electric field is removed, then the electron will revolve in an orbit of radius

a) 45 m b) 4.5 m c) 0.45 m d) 0.045

367. A wire along x-axis carries a current 3.5 A. Find the force in newton on a 1 cm section of the wire exerted by a magnetic field $\vec{B} = (0.74\,\hat{j} + 0.36\,\hat{k})$ T.

a) $(1.26\,\hat{k} - 2.59\,\hat{j})10^{-2}$ N
b) $(-1.26\,\hat{k} + 2.59\,\hat{j}) \times 10^{-2}$ N
c) $(-2.59\,\hat{k} + 1.26\,\hat{j}) \times 10^{-2}$ N
d) $(2.59\,\hat{k} - 1.26\,\hat{j}) \times 10^{-2}$ N

368. In hydrogen atom, the electron is making $6.6 \times 10^{15} rev/sec$ around the nucleus in an orbit of radius 0.528 Å. The magnetic moment $(A - m^2)$ will be

a) 1×10^{-15} b) 1×10^{-10} c) 1×10^{-23} d) 1×10^{-27}

369. Energy in a current carrying coil is stored in the form of

a) Electrical energy b) Magnetic field c) Heat d) None of these

370. A homogenous electric field $\vec{E}$ and a uniform magnetic field $\vec{B}$ are pointing in the same direction. A proton is projected with its velocity parallel to $\vec{E}$. It will

a) Go on moving in the same direction with increasing velocity
b) Go on moving in the same direction with constant velocity
c) Turn to its right
d) Turn to its left

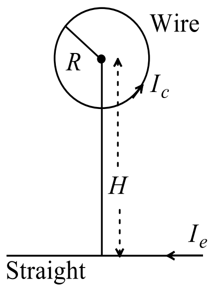
371. A stream of electrons is projected horizontally to the right. A straight conductor carrying a current is supported parallel to electron stream and above it. If the current in the conductor is from left to right, then what will be the effect on electron stream?

a) The electron stream will be speeded up towards the right b) The electron stream will be retarded
c) The electron stream will be pulled upward d) The electron stream will be pulled downward

372. A straight wire of diameter 0.5 mm carrying a current of 1 A is repaced by another wire of 1 mm diameter carrying the same current. The strength of magnetic field far away is

a) Twice the earlier value b) Half of the earlier value
c) Quarter of its earlier value d) Unchanged

373. Circular loop of a wire and long straight wire carry currents I_c and I_e, respectively as shown in figure. Assuming that these are placed in the same plane. The magnetic fields will be zero at the centre of the loop when the separation H is

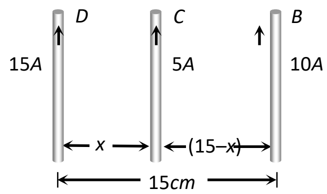


a) $\frac{I_e R}{I_c \pi}$ b) $\frac{I_c R}{I_e \pi}$ c) $\frac{\pi I_c}{I_e R}$ d) $\frac{I_e \pi}{I_c R}$

374. An electron, moving in a uniform magnetic field of induction of intensity $\vec{B}$, has its radius directly proportional to

a) Its charge b) Magnetic field c) Speed d) None of these

375. Three long, straight and parallel wires carrying currents are arranged as shown in the figure. The wire C which carries a current of 5.0 amp is so placed that it experiences no force. The distance of wire C from wire D is then



a) 9 cm b) 7 cm c) 5 cm d) 3 cm

376. If a current is passed in a spring, it

a) Gets compressed b) Get expanded
c) Oscillates d) Remains unchanged

377. A coil carrying a heavy current and having large number of turns is mounted in a N-S vertical plane and a

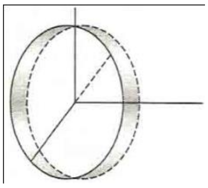
current flows in clockwise direction. A small magnetic needle at its centre will have its north pole in

a) East-north direction b) West -north direction c) East-south direction d) West-south direction

378. An electron moving in a circular orbit of radius r makes n rotations per second. The magnetic field produced at the centre has a magnitude of

a) $\frac{\mu_0 ne}{2r}$ b) $\frac{\mu_0 n^2 e}{2r}$ c) $\frac{\mu_0 ne}{2\pi r}$ d) Zero

379. Two insulated rings, one of slightly smaller diameter than the other are suspended along the common diameter as shown. Initially the planes of the rings are mutually perpendicular. When a steady current is set up in each of them,



a) The two rings rotate into a common plane
b) The inner ring oscillates about its initial position
c) The inner rings stays stationary while the outer one moves into plane of the inner ring
d) The outer ring stays stationary while the inner one moves into plane of the outer ring

380. Two short bar magnets with magnetic moments 400 ab-amp cm^2 and 800 ab-amp cm^2 are placed with their axis in the same straight line with similar poles facing each other and with their centers at 20 cm from each other. Then the force of repulsion is

a) 12 dyne b) 6 dyne c) 800 dyne d) 150 dyne

381. A large magnet is broken into two pieces so that their lengths are in the 2:1. The pole strengths of the two pieces will have ratio

a) 2 : 1 b) 1 : 2 c) 4 : 1 d) 1 : 1

382. An electron with mass m, velocity v and charge e describes half a revolution in a circle of radius r in a magnetic field B, will acquire energy equal to

a) $1/2mv^2$ b) $1/4mv^2$ c) $\pi rBev$ d) zero

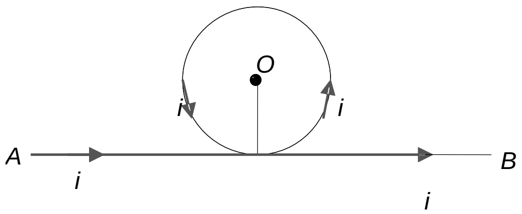
383. A length l of wire carries a steady current i. It is bent first to form a circular plane coil of one turn. The same length is now bent more sharply to give three loops of smaller radius. The magnetic field at the centre caused by the same current is

a) One-third of its first value
b) Unaltered
c) Three times of its initial value
d) Nine times of its initial value

384. A proton of energy 8 eV is moving in a circular path in a uniform magnetic field. The energy of an alpha particle moving in the same magnetic field and along the same path will be

a) 4 eV b) 2 eV c) 8 eV d) 6 eV

385. A part of a long wire carrying a current i is bent into a circle of radius r as shown in figure. The net magnetic field at the centre O of the circular loop is



a) $\frac{\mu_0 i}{4r}$ b) $\frac{\mu_0 i}{2r}$ c) $\frac{\mu_0 i}{2\pi r}(\pi + 1)$ d) $\frac{\mu_0 i}{2\pi r}(\pi - 1)$

386. The magnetic induction due to an infinitely long straight wire carrying a current i at a distance r from wire is given by

a) $|\boldsymbol{B}| = \left(\frac{\mu_0}{4\pi}\right)\frac{2i}{r}$ b) $|\boldsymbol{B}| = \left(\frac{\mu_0}{4\pi}\right)\frac{r}{2i}$ c) $|\boldsymbol{B}| = \left(\frac{4\pi}{\mu_0}\right)\frac{2i}{r}$ d) $|\boldsymbol{B}| = \left(\frac{4\pi}{\mu_0}\right)\frac{r}{2i}$

387. The magnetic field induction at a point 4 cm from a long current carrying wire is 10^{-3} T. The magnetic field induction at a distance of 1.0 cm from the same current wire will be

a) 2×10^{-4} T b) 3×10^{-4} T c) 4×10^{-3} T d) 1.11×10^{-4} T

388. A current carrying loop is free to turn in a uniform magnetic field. The loop will them come into equilibrium when its plane is inclined at

a) 0° to the direction of the field b) 45° to the direction of the field
c) 90° to the direction of the field d) 135° to the direction of the field

389. The radius of curvature of the path of the charged particle in a uniform magnetic field is directly proportional to

a) The charge on the particle b) The momentum of the particle
c) The energy of the particle d) The intensity of the field

390. A solenoid of 1.5 m length and 4.0 cm diameter has 10 turns per cm. A current of 5 A is flowing through it. The magnetic field induction at axis inside the solenoid is

a) $2\pi \times 10^{-4}$ T b) $2\pi \times 10^{-5}$ T c) $20\,\pi\, G$ d) $2\,\pi\, G$

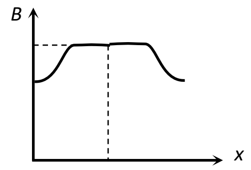
391. Which of the following particles will describe the smallest circle when projected with the same velocity perpendicular to the magnetic field?

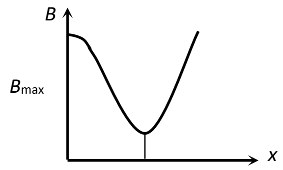
a) Electron b) Proton c) $\alpha -$ particle d) Deuteron

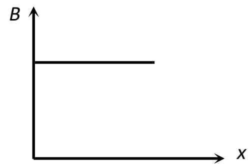
392. At a distance of 10 cm from a long straight wire carrying current, the magnetic field is 0.04 T. At the distance of 40 cm, the magnetic field will be

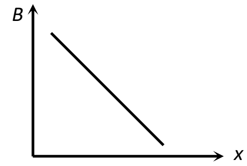
a) 0.01 T b) 0.02 T c) 0.08 T d) 0.16 T

393. The correct curve between the magnetic induction (B) along the axis of a long solenoid due to current flow i in it and distance x from one end is

a) 

b) 

c) 

d) 

394. A uniform magnetic field acts at right angles to the direction of motion of electrons. As a result, the electron moves in a circular path of radius 2 cm. If the speed of the electrons is doubled, then the radius of the circular path will be

a) 2.0 cm b) 0.5 cm c) 4.0 cm d) 1.0 cm

395. A particle of mass 0.6 g and having charge of 25 nC is moving horizontally with a uniform velocity $1.2 \times 10^4\ ms^{-1}$ in a uniform magnetic field, then the value of the magnetic induction is ($g = 10\ ms^{-2}$)

a) Zero b) 10 T c) 20 T d) 200 T

396. A current of i ampere flows in a circular area of wire which subtends an angle of $(3\pi/2)$ radian at its centre, whose radius is R. The magnetic induction B at the centre is

a) $\mu_0\, i/R$ b) $\mu_0\, i/2R$ c) $2\mu_0\, i/R$ d) $3\mu_0\, i/8R$

397. A long hollow copper tube carries a current I. Then which of the following will be true?

a) The magnetic field B will be zero at all points inside the tube
b) The magnetic field B will be zero only at points on the axis of the tube
c) The magnetic field B will be maximum at points on the axis of the tube
d) The magnetic field will be zero at any point outside the tube

398. Two long parallel wires carry equal current i flowing in the same direction area at a distance $2d$ apart. The magnetic field B at a point lying on the perpendicular line joining the wires and a distance x from the midpoint is

a) $EQ\ \dfrac{\mu_0 id}{\pi(d^2+x^2)}$ b) $\dfrac{\mu_0 ix}{\pi(d^2-x^2)}$ c) $\dfrac{\mu_0 ix}{(d^2+x^2)}$ d) $\dfrac{\mu_0 id}{(d^2-x^2)}$

399. A particle of charge q and mass m starts moving from the origin under the action of an electric field $\vec{E} = E_0\hat{i}$ and $\vec{B} = B_0\hat{i}$ with a velocity $\vec{V} = v_0\hat{j}$. The speed of the particle will becomes $\frac{\sqrt{5}}{2}v_0$ after a time

a) $\dfrac{mv_0}{qE}$ b) $\dfrac{m\,v_0}{2q\,E}$ c) $\dfrac{\sqrt{3}\,m\,v_0}{2q\,E}$ d) $\dfrac{\sqrt{5}\,m\,v_0}{2q\,E}$

400. A fixed horizontal wire carries a current of 200 A. Another wire having a mass per unit length $10^{-2}\,kg/m$

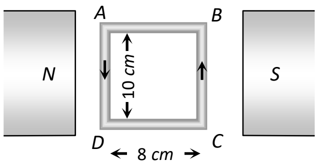
is placed below the first wire at a distance of 2 cm and parallel to it. How much current must be passed through the second wire if it floats in air without any support? What should be the direction of current in it

a) 25 A (direction of current is same to first wire)
b) 25 A (direction of current is opposite to first wire)
c) 49 A (direction of current is same to first wire)
d) 49 A (direction of current is opposite to first wire)

401. The ratio of magnetic field and magnetic moment at the centre of a current carrying circular loop is x. When both the current and radius is doubled then the ratio will be

a) $\frac{x}{8}$ b) $\frac{x}{4}$ c) $\frac{x}{2}$ d) $2x$

402. A 100 turns coil shown in figure carries a current of 2 amp in a magnetic field $B = 0.2\ Wb/m^2$. The torque acting on the coil is



a) 0.32 Nm tending to rotated the side AD out of the page
b) 0.32 Nm tending to rotated the side AD into the page
c) 0.0032 Nm tending to rotated the side AD out of the page
d) 0.0032 Nm tending to rotated the side AD into the page

403. A charged particle is moving in a circular orbit of radius 6 cm with a uniform speed of $3 \times 10^6 m/s$ under the action of a uniform magnetic field $2 \times 10^{-4} wb/m^2$ at right angles to the plane of the orbit. The charge to mass ratio of the particle is

a) $5 \times 10^9 C/kg$ b) $2.5 \times 10^{11} C/kg$ c) $5 \times 10^{11} C/kg$ d) $5 \times 10^{12} C/kg$

404. A straight wire carrying a current 10 A is bent into a semicircular arc of radius 5 cm. The magnitude of magnetic field at the centre is

a) $1.5 \times 10^{-5} T$ b) $3.14 \times 10^{-5} T$ c) $6.28 \times 10^{-5} T$ d) $19.6 \times 10^{-5} T$

405. A thin circular wire carrying a current I has a magnetic moment M. The shape of the wire is changed to a square and it carries the same current. It will have a magnetic moment

a) M b) $\frac{4}{\pi^2} M$ c) $\frac{4}{\pi} M$ d) $\frac{\pi}{4} M$

406. A moving coil galvanometer has N number of turns in a coil of effective area A, it carries a current I. The magnetic field B is radial. The torque acting on the coil is

a) A moving coil galvanometer has N number of turns in a coil of effective area A, it carries a current I. The magnetic field B is radial. The torque acting on the coil is
b) A moving coil galvanometer has N number of turns in a coil of effective area A, it carries a current I. The magnetic field B is radial. The torque acting on the coil is
c) A moving coil galvanometer has N number of turns in a coil of effective area A, it carries a current I. The magnetic field B is radial. The torque acting on the coil is
d) A moving coil galvanometer has N number of turns in a coil of effective area A, it carries a current I. The magnetic field B is radial. The torque acting on the coil is

407. A voltmeter with a resistance $50 \times 10^3 \Omega$ is used to measure voltage in a circuit. To increase its range to 3 times, the additional resistance to be put in series is

a) $9 \times 10^6\ \Omega$ b) $10^5\ \Omega$ c) $1.5 \times 10^5\ \Omega$ d) $9 \times 10^5\ \Omega$

408. The magnetic field at the point of intersection of diagonals of a square loop of side L carrying a current I is

a) $\frac{\mu_0 I}{\pi L}$ b) $\frac{2\mu_0 I}{\pi L}$ c) $\frac{\sqrt{2}\mu_0 I}{\pi L}$ d) $\frac{2\sqrt{2}\mu_0 I}{\pi L}$

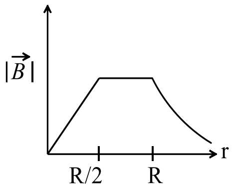
409. A particle of mass m and charge q moves with a constant velocity v along the positive x direction. It enters a region containing a uniform magnetic field B directed along the negative z direction, extending from $x = a$ to $x = b$. The minimum value of v required so that the particle can just enter the region $x > b$ is

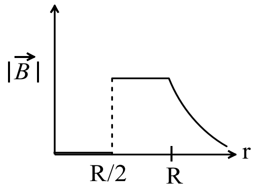
a) $qb\ B/m$ b) $q(b-a)B/m$ c) $qa\ B/m$ d) $q(b+a)B/2m$

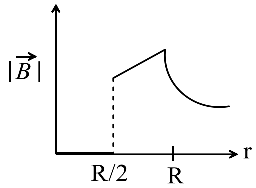
410. An electron is accelerated by a potential difference of 12000 *volts*. It then enters a uniform magnetic field of $10^{-3}T$ applied perpendicular to the path of electron. Find the radius of path. Given mass of electron = $9 \times 10^{-31} kg$ and charge on electron = $1.6 \times 10^{-19} C$

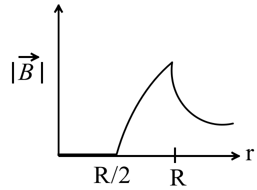
a) 36.7 *m* b) 36.7 *cm* c) 3.67 *m* d) 3.67 *cm*

411. An infinitely long hollow conducting cylinder with inner radius $R/2$ and outer radius R carries a uniform current density along its length. The magnitude of the magnetic field $|\vec{B}|$ as a function of the radial distance r from the axis is best represented by

a) 

b) 

c) 

d) 

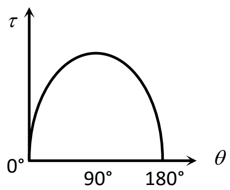
412. 3A of current is flowing in a linear conductor having a length of 40 cm. The conductor is placed in a magnetic field of strength 500 gauss and makes an angle of 30° with direction of the field. It experiences a force of magnitude

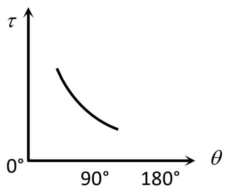
a) 3×10^{4} N b) 3×10^{2} N c) 3×10^{-2} N d) 3×10^{-4} N

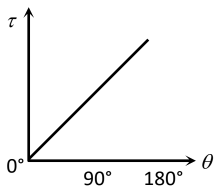
413. Consider two straight parallel conductors A and B separated by a distance x and carrying individual currents i_A and i_B respectively. If the two conductors attract each other, it indicates that

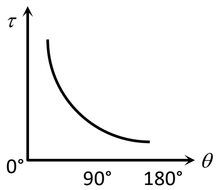
a) The two currents are parallel in direction
b) The two currents are anti-parallel in direction
c) The magnetic lines induction are parallel
d) The magnetic lines of induction are parallel to length of conductors

414. The $(\tau - \theta)$ graph for a coil is

a) 

b) 

c) 

d) 

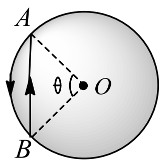
415. A neutral point is obtained at the centre of a vertical circular coil carrying current. The angle between the plane of the coil and the magnetic meridian is

a) 0 b) 45° c) 60° d) 90°

416. A current of 2 *amp*, flows in a long, straight wire of radius 2 *mm*. The intensity of magnetic field on the axis of the wire is

a) $\left(\frac{\mu_0}{\pi}\right) \times 10^3 tesla$ b) $\left(\frac{\mu_0}{2\pi}\right) \times 10^3 tesla$ c) $\left(\frac{2\mu_0}{\pi}\right) \times 10^3 tesla$ d) Zero

417. Net magnetic field at the centre of the circle O due to a current through a loop as shown in figure ($\theta < 180°$)



a) zero
b) Perpendicular to paper inwards
c) Perpendicular to paper outwards
d) Perpendicular to paper inwards if $\theta \le 90°$ and perpendicular to paper outwards if $90° \le \theta < 180°$

418. Two circular coils are made of two identical wires of same length. If the number of turns of two coils are 4 and 2, then the ratio of magnetic induction at centres will be zero

a) 4 : 1 b) 2 : 1 c) 1 : 2 d) 1 : 1

419. A proton with energy of 2 MeV enters a uniform magnetic field of 2.5 T normally. The magnetic force on the proton is

(Take mass of proton to be 1.6×10^{-27} kg)

a) 3×10^{-12} N b) 8×10^{-10} N c) 8×10^{-12} N d) 2×10^{-10} N

420. An electron and a proton are projected at right angles to a uniform magnetic field with the same kinetic energy. Then

a) The electron trajectory will be less curved than proton trajectory
b) The electron trajectory will be more curved than proton trajectory
c) Both the trajectories will be equally curved
d) Both particles continue to move along a straight line

421. A winding wire which is used to frame a solenoid can bear a maximum 10 A current. If length of solenoid is 80 cm and it's cross sectional radius is 3 cm then required length of winding wire is ($B = 0.2\ T$)

a) $1.2 \times 10^2\ m$ b) $4.8 \times 10^2\ m$ c) $2.4 \times 10^3\ m$ d) $6 \times 10^3\ m$

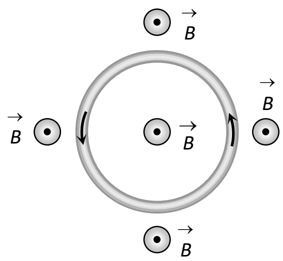
422. A metallic loop is placed in a magnetic field. If a current is passed through it, then

a) The ring will feel a force of attraction
b) The ring will feel a force of repulsion
c) It will move to and from about its centre of gravity
d) None of these

423. A current carrying straight wire is kept along the axis of a circular loop carrying a current. The straight wire

a) Will exert an inward force on the circular loop
b) Will exert an outward force on the circular loop
c) Will exert a force on the circular loop parallel to itself
d) Will not exert any force on the circular loop

424. An elastic circular wire of length l carries a current I. It is placed in a uniform magnetic field $\vec{B}$ (out of paper) such that its plane is perpendicular to the direction of $\vec{B}$. The wire will experience



a) No force b) A stretching force c) A compressive force d) A torque

425. An electron revolves in a circle of radius 0.4 Å with a speed of $10^5 ms^{-1}$. The magnitude of the magnetic field, produced at the center of the circular path due to the motion of the electron, in $weber\ metre^{-2}$ is

a) 0.01 b) 10.0 c) 1.0 d) 0.005

426. Magnetic effect of current was discovered by

a) Faraday b) Oersted c) Ampere d) Bohr

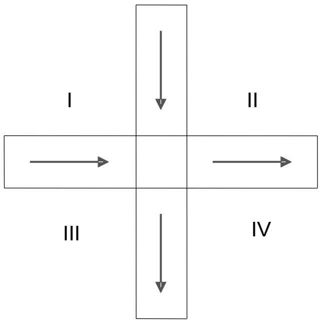
427. The areas of cross-section of three magnets of same length area A, 2 A and 6A respectively. The ratio of their magnetic moments will be

a) 6 : 2 : 1 b) 1 : 2 : 6 c) 2 : 6 : 1 d) 1 : 1 : 1

428. An electron having mass (9.1×10^{-31} kg) and charge (1.6×10^{-19} C) moves in a circular path of radius 0.5 m with a velocity 10^6 ms^{-1} in a magnetic field. Strength of magnetic field is

a) 1.13×10^{-5} T b) 5.6×10^{-6} T c) 2.8×10^{-6} T d) None of these

429. Two thin metallic strips, carrying current in the direction shown, cross each other perpendicularly without touching but being close to each other, as shown in the figure. The regions which contain some points of zero magnetic induction are

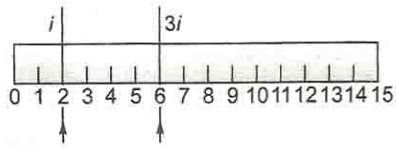


a) I and II b) I and III c) I and IV d) II and III

430. A straight wire of length (π^2) $metre$ is carrying a current of $2A$ and the magnetic field due to it is measured at a point distance 1 cm from it. If the wire is to be bent into a circle and is to carry the same current as before, the ratio of the magnetic field at its centre to that obtained in the first case would be

a) 50 : 1 b) 1 : 50 c) 100 : 1 d) 1 : 100

431. Two parallel long straight conductors are placed at right angle to the meter scale at the 2 cm and 6 cm marks as shown in the figure. If they carry currents i and 3 i respectively in the same direction, then they will produce zero magnetic field at



a) Zero mark b) 9 cm mark c) 3 cm mark d) 7 cm mark

432. A circular coil of radius R carries an electric current. The magnetic field due to the coil at a point on the axis of the coil located at a distance r from the centre of the coil, such that $r >> R$, varies as

a) $\frac{1}{r}$ b) $\frac{1}{r^{3/2}}$ c) $\frac{1}{r^2}$ d) $\frac{1}{r^3}$

433. An electron and a proton have equal kinetic energies. They enter in a magnetic field perpendicular to B, then

a) Both will follow a circular path with same radius
b) Both will follow a helical path
c) Both will follow a parabolic path
d) All the statements are false

434. An electron of mass m and charge q is travalling with a speed v along a circular path of radius r at right angles to a uniform of magnetic field B. If speed of the electron is doubled and the magnetic field is halved, then resulting path would have a radius of

a) $\frac{r}{4}$ b) $\frac{r}{2}$ c) $2r$ d) $4r$

435. A coil carrying electric current is placed in uniform magnetic field, then

a) Torque is formed b) E.M.f. is induced
c) Both (a) and (b) are correct d) None of these

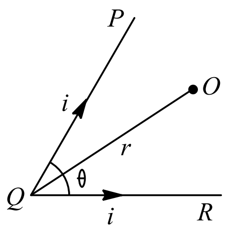
436. In a mass spectrometer used to measuring the masses of ions, the ions are initially accelerated by an electric potential V and then made to describe semicircular paths of radius R using a magnetic field B. If V and B are kept constant, the ratio $\left(\frac{\text{charge on the ion}}{\text{mass of the ion}}\right)$ will be proportional

a) $1/R$ b) $1/R^2$ c) R^2 d) R

437. The direction of magnetic lines of force produced by passing a direct current in a conductor is given by

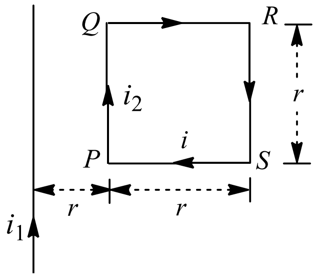
a) Lenz's law b) Fleming' left hand rule
c) Right hand palm rule d) Maxwell's law

438. Two wires PQ and QR, carry equal currents i as shown in figure. One end of both the wires extends to infinity $\angle PQR = \theta$. The magnitude of the magnetic field at O on the bisector angle of these two wires at a distance r from point Q is



a) $\frac{\mu_0}{4\pi}\frac{i}{r}\sin\left(\frac{\theta}{2}\right)$ b) $\frac{\mu_0}{4\pi}\frac{i}{r}\cot\left(\frac{\theta}{2}\right)$ c) $\frac{\mu_0}{4\pi}\frac{i}{r}\tan\left(\frac{\theta}{2}\right)$ d) $\frac{\mu_0}{4\pi}\frac{i}{r}\frac{(1+\cos\theta/2)}{(\sin\theta/2)}$

439. A current carrying square loop is placed near an infinitely long current carrying wire as shown in figure The torque acting on the loop is



a) $\frac{\mu_0}{2\pi}i_1i_2r$ b) $\frac{\mu_0}{2\pi}i_1i_2\log_e 2$ c) $\frac{\mu_0}{2\pi}\frac{i_1i_2r}{2}$ d) zero

440. A circular coil of 5 turns and of 10 cm mean diameter is connected to a voltage source. If the resistance of the coil is 10 Ω, the voltage of the source so is to nullify the horizontal component of earth's magnetic field of 30 A turn m^{-1} at centre of the coil should be

a) 6 V, plane of the coil normal to magnetic meridian
b) 2 V, plane of the coil normal to magnetic meridian
c) 6 V, plane of the coil along the magnetic meridian
d) 2 V, plane of the coil along the magnetic meridian

441. A circular loop and a square loop are formed from the same wire and the same current is passed through them. Find the ratio of their dipole moments.

a) 4π b) $\frac{4}{\pi}$ c) $\frac{2}{\pi}$ d) 2π

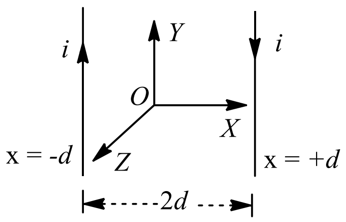
442. An electron ($q = 1.6 \times 10^{-19}$ C) is moving at right angle to the uniform magnetic field 3.534×10^{-5} T. The time taken by the electron to complete a circular orbit is

a) 2μs b) 4μs c) 3μs d) 1μs

443. A man carrying suitable instruments for measuring electric and magnetic field passes by a stationary electron with velocity V. Then these instruments will note

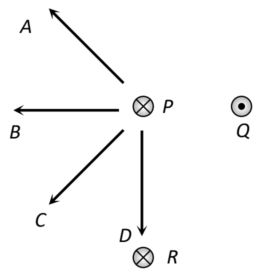
a) Electric field b) Magnetic field c) Both a and b d) None of these

444. In the given diagram two long parallel wires carry equal currents in opposite direction. Point O is situated midway between the wires and the XY- plane contains the two wires and the positive Z-axis comes normally out of the plane of paper. The magnetic field B at O is non-zero along



a) X, Y and Z-axes b) X-axis c) Y-axis d) Z-axis

445. The figure shows three long straight wires P, Q and R carrying currents normal to the plane of the paper. All three currents have the same magnitude. Which arrow best shows the direction of the resultant force on the wire P



a) A b) B c) C d) D

446. A horizontal metal wire is carrying an electric current from the north to the south. Using a uniform magnetic field, it is to be prevented from falling under gravity. The direction of this magnetic field should be towards the

a) North b) South c) East d) West

447. A bar magnet is cut into two equal halves by a plane parallel to the magnetic axis. Of the following physical quantities, the one which remains unchanged is

a) Pole strengths b) Magnetic moment
c) Intensity of magnetization d) Moment of inertia

448. When a charged particle moving with velocity $\vec{V}$ is subjected to a magnetic field of induction $\vec{B}$, the force on it is non-zero. This implies that

a) Angles between $\vec{V}$ and $\vec{B}$ can have any value other than zero and 180°
b) Angel between $\vec{V}$ and $\vec{B}$ is either zero or 180°
c) Angle between $\vec{V}$ and $\vec{B}$ is necessarily 90°
d) Angle between $\vec{V}$ and $\vec{B}$ can have any value other than 90°

449. If the strength of the magnetic field produced $10cm$ away from a infinitely long straight conductor is $10^{-5} weber/m^2$, the value of the current flowing in the conductor will be

a) 5 $ampere$ b) 10 $ampere$ c) 500 $ampere$ d) 1000 $ampere$

450. Two charged particles are projected into a region in which a magnetic field is perpendicular to their velocities. After they enter the magnetic field, you can conclude that

a) The charges are deflected in opposite directions
b) The charges continue to move in a straight line
c) The charges move in circular paths
d) The charges move in circular paths but in opposite directions

451. Two long parallel copper wires carry currents of $5A$ each in opposite directions. If the wires are separated by a distance of $0.5m$, then the force between the two wires is

a) $10^{-5}N$, attractive b) $10^{-5}N$, repulsive
c) $2 \times 10^{-5}N$, attractive d) $2 \times 10^{-5}N$, repulsive

452. A proton, a deutron and an α-particle with the same KE enter a region of uniform magnetic field, moving at right angle to B. What is the ratio of the radius of their circular paths ?

a) $1 : \sqrt{2} : 1$ b) $1 : \sqrt{2} : \sqrt{2}$ c) $\sqrt{2} : 1 : 1$ d) $\sqrt{2} : \sqrt{2} : 1$

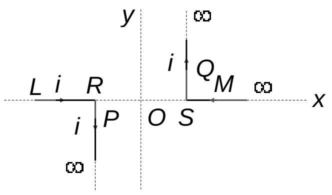
453. The magnetic field on the axis of a long solenoid having n turns per unit length and carrying a current i is

a) $\mu_0 ni$ b) $\mu_0 n^2 i$ c) $\mu_0 ni^2$ d) None of these

454. The coil of a moving coil galvanometer is wound over a metal frame in order to

a) Reduce hysteresis b) Provide electromagnetic damping
c) Increase the moment of inertia d) Increase the sensitivity

455. A pair of stationary and infinite long bent wires are placed in the $x - y$ plane. The wires carrying currents of 10 A each as a shown in figure. The segments L and M are parallel to x-axis. The segments P and Q are parallel to y-axis, such that $OS = OR = 0.02$ m. The magnetic field induction at the origin O is



a) 10^{-3} T b) 4×10^{-3} T c) 2×10^{-4} T d) 10^{-4} T

456. In a cyclotron, the angular frequency of a charged particle is independent of
a) Mass b) Speed c) Charge d) Magnetic field

457. Due to 10 ampere of current flowing in a circular coil of 10 cm radius, the magnetic field produced at its centre is $3.14 \times 10^{-3} weber/m^2$. The number of turns in the coil will be
a) 5000 b) 100 c) 50 d) 25

458. A rectangular loop carrying a current i is placed in a uniform magnetic field B. The area enclosed by the loop is A. If there are n turns in the loop, the torque acting on the loop is given by
a) $ni\, \vec{A} \times \vec{B}$ b) $ni\, \vec{A} \cdot \vec{B} \cdot$ c) $\frac{1}{n}(i\vec{A} \times \vec{B})$ d) $\frac{1}{n}(i\vec{A} \cdot \vec{B})$

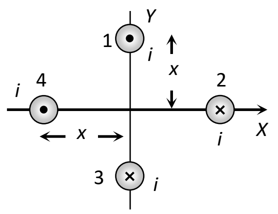
459. An α particle and a proton travel with same velocity in a magnetic field perpendicular to the direction of their velocities. Find the ratio of the radii of their circular path
a) 4 : 1 b) 1 : 4 c) 2 : 1 d) 1 : 2

460. The deflection in a galvanometer falls from 50 division to 20 when a 12 Ω shunt is applied. The galvanometer resistance is
a) 18 Ω b) 36 Ω c) 24 Ω d) 30 Ω

461. A closely wound solenoid of 2000 turns and area of cross-section $1.5 \times 10^{-4} m^2$ carries a current of 2.0 A. It is suspended through its centre and perpendicular to its length, allowing it to turn in a horizontal plane in a uniform magnetic field 5×10^{-2} tesla making an angle of 30° with the axis of the solenoid. The torque on the solenoid will be
a) $3 \times 10^{-3} N.m$ b) $1.5 \times 10^{-3} N.m$ c) $1.5 \times 10^{-2} N.m$ d) $3 \times 10^{-2} N.m$

462. A particle carrying a charge equal to 100 times the charge on an electron is rotating per second in a circular path of radius 0.8 $metre$. The value of the magnetic field produced at the centre will be ($\mu_0 =$ permeability for vacuum)
a) $\frac{10^{-7}}{\mu_0}$ b) $10^{-17}\mu_0$ c) $10^{-6}\mu_0$ d) $10^{-7}\mu_0$

463. What will be the resultant magnetic field at origin due to four infinite length wires if each wire produces magnetic field 'B' at origin



a) 4 B b) $\sqrt{2}\, B$ c) $2\sqrt{2}\, B$ d) Zero

464. A proton (or charged particle) moving with velocity v is acted upon by electric field E and magnetic field B. The proton will move undeflected if
a) E is perpendicular to B
b) E is parallel to v and perpendicular to B
c) E, B and v are mutually perpendicular and $v = \frac{E}{B}$
d) E and B both are parallel to v

465. Two similar coils of radius R are lying concentrically with their planes at right angles to each other. The currents flowing in them are I and $2I$, respectively. The resultant magnetic field induction at the centre will be
a) $\frac{\sqrt{5}\mu_0 I}{2R}$ b) $\frac{3\mu_0 I}{2R}$ c) $\frac{\mu_0 I}{2R}$ d) $\frac{\mu_0 I}{R}$

466. $1A$ current flows through an infinitely long straight wire. The magnetic field produced at a point 1 *metre* away from it is

a) $2\times10^{-3} tesla$ b) $\frac{2}{10} tesla$ c) $2\times10^{-7} tesla$ d) $2\pi\times10^{-6} tesla$

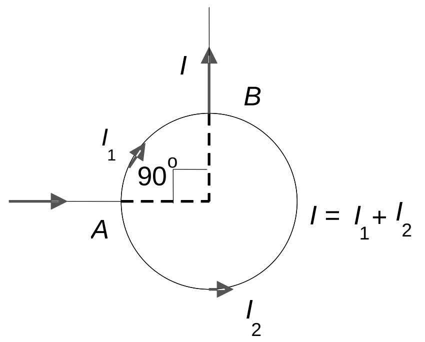
467. A long straight wire along the z-axis carries a current I in the negative z direction. The magnetic vector field $\vec{B}$ at a point having coordinates (x, y) in the $z=0$ plane is

a) $\frac{\mu_0 I(y\hat{i}-x\hat{j})}{2\pi(x^2+y^2)}$ b) $\frac{\mu_0 I(x\hat{i}+y\hat{j})}{2\pi(x^2+y^2)}$ c) $\frac{\mu_0 I(x\hat{i}-y\hat{j})}{2\pi(x^2+y^2)}$ d) $\frac{\mu_0 I(x\hat{i}-y\hat{j})}{2\pi(x^2+y^2)}$

468. The magnetic field existing in a region is given by $\vec{B}=B_0\left[1+\frac{x}{l}\right]\hat{k}$. A square loop of edge l and carrying current i is placed with its edges parallel to $x-y$ axis. The magnitude of the net magnetic force experienced by the loop is

a) $2B_0il$ b) B_0i_0l c) B_0il d) Bil

469. A current I enters a circular coil of radius R, branches into two parts and then recombines as shown in the circuit diagram



The resultant magnetic field at the centre of the coil is

a) Zero b) $\frac{\mu_0 I}{2R}$ c) $\frac{3}{4}\left(\frac{\mu_0 I}{2R}\right)$ d) $\frac{1}{4}\left(\frac{\mu_0 I}{2R}\right)$

470. Which is a vector quantity

a) Density b) Magnetic flux
c) Intensity of magnetic field d) Magnetic potential

471. The magnetic field at the centre of coil of n turns, bent in the form of a square of side $2l$, carrying i, is

a) $\frac{\sqrt{2}\mu_0 ni}{\pi l}$ b) $\frac{\sqrt{2}\mu_0 ni}{2\pi l}$ c) $\frac{\sqrt{2}\mu_0 ni}{4\pi l}$ d) $\frac{2\mu_0 ni}{\pi l}$

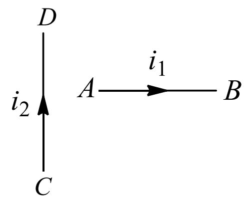
472. The radius of a circular loop is r and a current i is flowing in it. The equivalent magnetic moment will be

a) ir b) $2\pi ir$ c) $i\pi r^2$ d) $\frac{1}{r^2}$

473. In the above question, the magnetic induction at O due to the whole length of the conductor is

a) $\frac{\mu_0 i}{r}$ b) $\frac{\mu_0 i}{2r}$ c) $\frac{\mu_0 i}{4r}$ d) Zero

474. A current i_1 carrying wire AB is placed near an another long wire CD carrying current i_2 as shown in figure. If free to move, wire AB will have



a) Rotational motion only b) Translational motion only
c) Rotational as well as translational motion d) Neither rotational nor translational motion

475. A deutron of kinetic energy 50 keV is describing a circular orbit of radius 0.5 m in a plane perpendicular to magnetic field $\vec{B}$. The kinetic energy of the proton that describes a circular orbit of radius 0.5 m in the same plane with the same $\vec{B}$ is

a) 200 keV b) 100 keV c) 50 keV d) 25 keV

476. Two wires of same length are shaped into a square and a circle. If they carry same current, ratio of the magnetic moment is

a) $2 : \pi$ b) $\pi : 2$ c) $\pi : 4$ d) $4 : \pi$

477. An electron enters into a region of uniform magnetic field of strength 10 webers/m^2 with a speed of $3 \times 10^7 m/s$ which of the following is not possible

a) The electron may or may not experience an acceleration

b) The electron may experience an acceleration but can continue to move with same speed

c) The electron may experience an acceleration and continue to move with same velocity

d) The kinetic energy of the electron remains unchanged

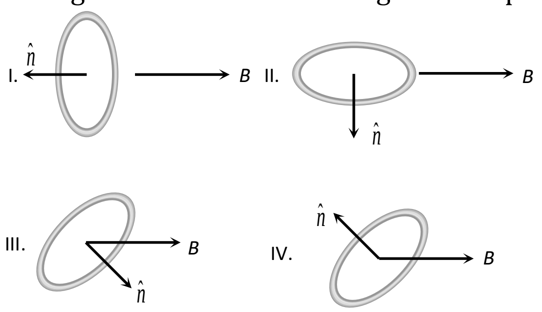
478. Rate of change of torque τ with deflection θ is maximum for a magnet suspended freely in a uniform magnetic field of induction B, when

a) $\theta = 0°$ b) $\theta = 45°$ c) $\theta = 60°$ d) $\theta = 90°$

479. Two straight parallel wires, both carrying 10 *ampere* in the same direction attract each other with a force of $1 \times 10^{-3} N$. If both currents are doubled, the force of attraction will be

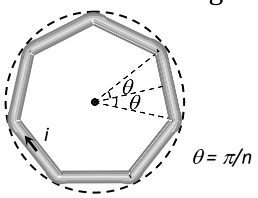
a) $1 \times 10^{-3} N$ b) $2 \times 10^{-3} N$ c) $4 \times 10^{-3} N$ d) $0.25 \times 10^{-3} N$

480. A current carrying loop is placed in a uniform magnetic field in four different orientations, I, II, III & IV. Arrange them in the decreasing order of potential energy



a) I>III>II>IV b) I>II>III>IV c) I>IV>II>III d) III>IV>I>II

481. In the following figure a wire bent in the form of a regular polygon of n sides is inscribed in a circle of radius a. Net magnetic field at centre will be



a) $\frac{\mu_0 i}{2\pi a} \tan\frac{\pi}{n}$ b) $\frac{\mu_0 n i}{2\pi a} \tan\frac{\pi}{n}$ c) $\frac{2}{\pi}\frac{ni}{a}\mu_0 \tan\frac{\pi}{n}$ d) $\frac{ni}{2a}\mu_0 \tan\frac{\pi}{n}$

482. The relation between voltage sensitivity (σ_v) and current sensitivity (σ_i) of a moving coil galvanometer is (Resistance of galvanometer = G)

a) $\frac{\sigma_i}{G} = \sigma_v$ b) $\frac{\sigma_v}{G} = \sigma_i$ c) $\frac{G}{\sigma_v} = \sigma_i$ d) $\frac{G}{\sigma_i} = \sigma_v$

483. The magnetic field $d\vec{B}$ due to a small current element $d\vec{l}$ at a distance $\vec{r}$ and element carrying current i is

Or

Vector form of Bio-savart's law is

a) $d\vec{B} = \frac{\mu_0}{4\pi} i \left(\frac{d\vec{l} \times \vec{r}}{r}\right)$ b) $d\vec{B} = \frac{\mu_0}{4\pi} i^2 \left(\frac{d\vec{l} \times \vec{r}}{r}\right)$

c) $d\vec{B} = \frac{\mu_0}{4\pi} i^2 \left(\frac{d\vec{l} \times \vec{r}}{r^2}\right)$ d) $d\vec{B} = \frac{\mu_0}{4\pi} i \left(\frac{d\vec{l} \times \vec{r}}{r^3}\right)$

484. A current loop consists of two identical semicircular parts each of radius R, one lying in the $x - y$ plane and the other in $x - z$ plane. If the current in the loop is i. The resultant magnetic field due to the two semicircular part at their common centre is

a) $\frac{\mu_0 i}{2\sqrt{2}R}$ b) $\frac{\mu_0 i}{2R}$ c) $\frac{\mu_0 i}{4R}$ d) $\frac{\mu_0 i}{\sqrt{2}R}$

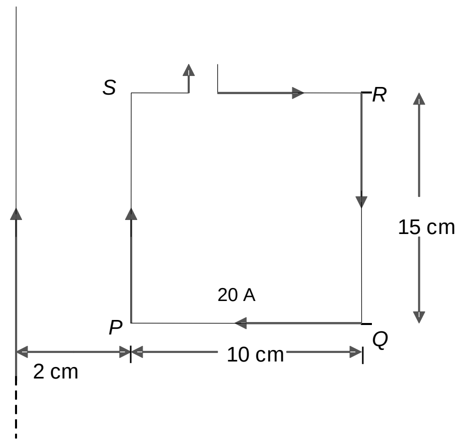
485. A charge q is moving in a magnetic field then the magnetic force does not depend upon

a) Charge b) Mass c) Velocity d) Magnetic field

486. An electron of charge e moves with a constant speed v along a circle of radius r. Its magnetic moment will be

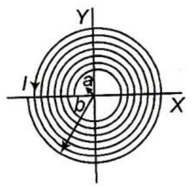
a) evr b) $evr/2$ c) $\pi r^2 ev$ d) $2\pi rev$

487. The resultant force on the current loop $PQRS$ due to a long current carrying conductor will be



a) 10^{-4} N b) 3.6×10^{-4} N c) 1.8×10^{-4} N d) 5×10^{-4} N

488. A long insulated copper wire is closely wound as a spiral of Nturns. The spiral has inner radius a and outer radius b. The spiral lies in the $X-Y$ plane and a steady current I flows through the wire. The Z-component of the magnetic field at the centre of the spiral is



a) $\frac{\mu_0 NI}{2(b-a)}\ln\left(\frac{b}{a}\right)$ b) $\frac{\mu_0 NI}{2(b-a)}\ln\left(\frac{b+a}{b-a}\right)$ c) $\frac{\mu_0 NI}{2b}\ln\left(\frac{b}{a}\right)$ d) $\frac{\mu_0 NI}{2b}\ln\left(\frac{b+a}{b-a}\right)$

489. A wire of length l is bent in the from of a circular coil of some turns. A current i flows through the coil. The coil is placed in a uniform magnetic field B. The maximum torque on the coil can be

a) $\frac{iBl^2}{2\pi}$ b) $\frac{iBl^2}{4\pi}$ c) $\frac{iBl^2}{\pi}$ d) $\frac{2iBl^2}{\pi}$

490. A positive charge is moving towards an observer. The direction of magnetic induction is

a) Clockwise b) Anticlockwise c) Right d) Left

491. A uniform magnetic field $B = 1.2\ mT$ is directed vertically upward throughout the volume of a laboratory chamber. A proton ($m_p = 1.67 \times 10^{-27}\ kg$) enters the laboratory horizontally from south to north. Calculate the magnitude of centripetal acceleration of the proton if its speed is $3 \times 10^7 m/s$

a) $3.45 \times 10^{12} m/s^2$ b) $1.67 \times 10^{12} m/s^2$ c) $5.25 \times 10^{12} m/s^2$ d) $2.75 \times 10^{12} m/s^2$

492. A cable carrying a direct current is burried in a wall which stands in a north-south plane. A horizontal compass needle on the west side of the wall is found to point towards south instead of north. The coil is laid

a) Vertically upwards and the current is also flowing upwards
b) Vertically upwards and the current is flowing down downwards
c) Horizontal with current from south to north
d) Horizontal with current from north to south

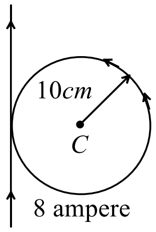
493. An electron is shot in steady electric and magnetic fields such that its velocity v, electric field E and magnetic field B are mutually perpendicular. The magnitude of B are mutually perpendicular. The magnitude of E is 1 Vcm^{-1} and that of B is 2 T. Now if it so happens that the Lorentz (magnetic) force cancels the electrostatic force on the electron, then the velocity of the electron is

a) $50\ ms^{-1}$ b) $2\ cms^{-1}$ c) $0.5\ cms^{-1}$ d) $200\ cms^{-1}$

494. A wire carrying current I and other carrying $2I$ in the same direction produces a magnetic field B at the mid point. What will be the field when $2I$ wire is switched off

a) $B/2$ b) $2B$ c) B d) $4B$

495. A long, straight wire is turned into a loop of radius 10 cm (see figure). If a current of 8 amperes is passed through the lop, then the value of the magnetic field and its direction as the centre C of the loop shall be close to



a) 5.0×10^{-5} Newton/(amp-meter), upward

b) 3.4×10^{-5} Newton/(amp-meter), upward

c) 1.6×10^{-5} Newton/(amp-meter), downward

d) 1.6×10^{-5} Newton/(amp-meter), upward

496. The oscillating frequency of a cyclotron is 10 MHz. If the radius of its Dees is 0.5 m, then kinetic energy of a proton, which is accelerated by the cyclotron is

a) 10.2 MeV b) 2.55 MeV c) 20.4 MeV d) 5.1 MeV

497. A steady current i flows in a small square loop of wire of side l in a horizontal plane. The loop is now folded about its middle such that half of it lies in a vertical plane. Let $\widehat{M}_1$ and $\widehat{M}_2$ respectively denote the magnetic moments due to current loop before and after folding. Then

a) $\widehat{M}_2 = 0$ b) $\widehat{M}_1$ and $\widehat{M}_2$ are in the same direction

c) $M_1/M_2 = \sqrt{2}$ d) $M_1/M_2 = 1/\sqrt{2}$

498. Current i is carried in a wire of length L. If the wire is turned into a circular coil, the maximum magnitude of torque in a given magnetic field B will be

a) $\frac{LiB^2}{2}$ b) $\frac{Li^2B}{2}$ c) $\frac{L^2iB}{4\pi}$ d) $\frac{Li^2B}{4\pi}$

499. If cathode rays are projected at right angles to a magnetic field, their, trajectory is

a) Ellipse b) Circle c) Parabola d) None of these

500. A moving charge will gain energy due to the application of

a) Electric field b) Magnetic field c) Both of these d) None of these

501. A small circular flexible loop of wire of radius r carries a current I. It is placed in a uniform magnetic field B. The tension in the loop will be doubled if

a) I is doubled b) B is halved

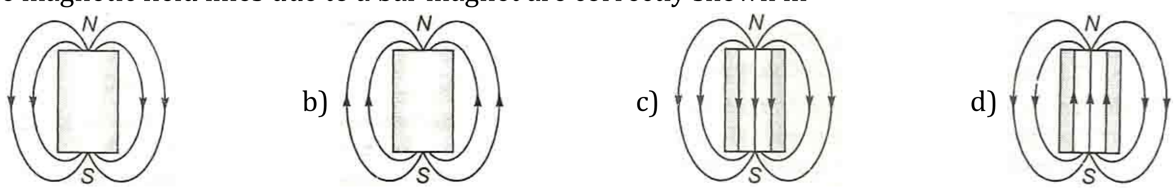
c) r is doubled d) Both B and I are doubled

502. A proton moving with a velocity $2.5 \times 10^7\ m/s$, enters a magnetic field of intensity $2.5T$ making an angle 30° with the magnetic field. The force on the proton is

a) $3 \times 10^{-12} N$ b) $5 \times 10^{-12} N$ c) $6 \times 10^{-12} N$ d) $9 \times 10^{-12} N$

503. The magnetic field lines due to a bar magnet are correctly shown in

a) b) c) d)



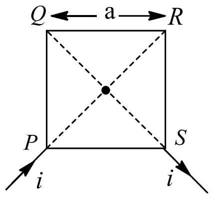
504. A particle mass m and charge q enters a magnetic field B perpendicularly with a velocity v. The radius of the circular path described by it will be

a) Bq/mv b) mq/Bv c) mB/qv d) mv/Bq

505. Magnetic field at the centre of a circular loop of area A is B. The magnetic moment of the loop will be

a) $\frac{BA^2}{\mu_0\pi}$ b) $\frac{BA^{3/2}}{\mu_0\pi}$ c) $\frac{BA^{3/2}}{\mu_0\pi^{1/2}}$ d) $\frac{2\,BA^{3/2}}{\mu_0\pi^{1/2}}$

506. In a square loop $PQRS$ made with a wire of cross-section current i enters from point P and leaves from point S. The magnitude of magnetic field induction at the centre O of the square is

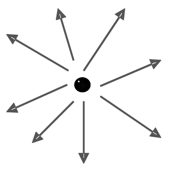
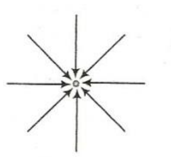
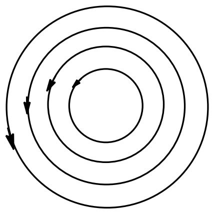
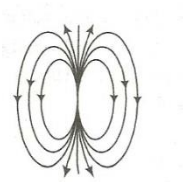


a) $\frac{\mu_0}{4\pi}\frac{2\sqrt{2}i}{a}$ b) $\frac{\mu_0}{4\pi}\frac{4\sqrt{2}i}{a}$ c) $\frac{\mu_0}{4}\frac{2\sqrt{2}i}{a}$ d) zero

507. An electron rotates about a proton, the induced magnetic field is $14T$ at the centre, find out the angular velocity of electron if radius of rotation is 0.5 nm

a) $4.4 \times 10^{17} rad/sec$ b) $4.4 \times 10^{12} rad/sec$ c) $3.14 \times 10^{-15} rad/sec$ d) $4.2 \times 10^{10} rad/sec$

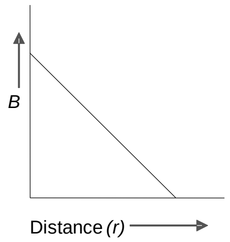
508. Which of the field pattern given in the figure is valid for electric field as well as for magnetic field?

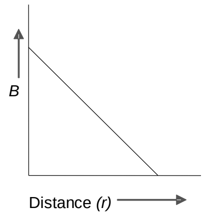
a) 
b) 
c) 
d) 

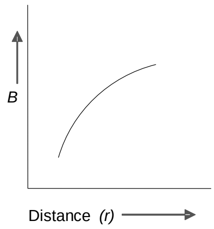
509. A charged particle moves with velocity v in a uniform magnetic field $\vec{B}$. The magnetic force experienced by the particle is

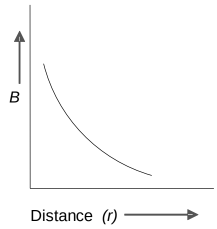
a) Always zero b) Never zero
c) Zero, if $\vec{B}$ and $\vec{v}$ are perpendicular d) Zero, if $\vec{B}$ and $\vec{v}$ are parallel

510. Which of the following graphs represent variation of magnetic field B with distance r for a straight long wire carrying current?

a) 

b) 

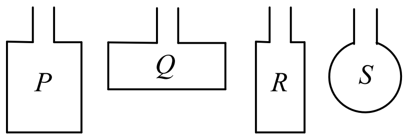
c) 

d) 

511. Two free parallel wires carrying currents in the opposite directions

a) attract each other b) repel each other
c) do not effect each other d) get rotated to be perpendicular to each other

512. Four wires each of length 2.0 m are bent into four P, Q, R and S and then suspended into a uniform magnetic field. Same current in passed in each loop



a) Couple on loop P will be maximum b) Couple on loop Q will be maximum
c) Couple on loop R will be maximum d) Couple on loop S be maximum

513. In order to increase the sensitivity of a moving coil galvanometer, one should decrease

a) The strength of its magnet b) The torsional constant of its suspension
c) The number of turns in its coil d) The area of its coil

514. Proton and α −particle are projected perpendicularly in a magnetic field, if both move in a circular path with same speed. Then ratio of their radii is

a) 1 : 2 b) 2 : 1 c) 1 : 4 d) 1 : 1

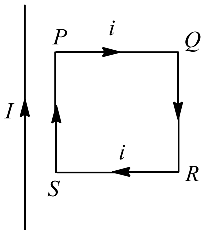
515. A ring of radius R, made of an insulating material carries a charge Q uniformly distributed on it. If the ring rotates about the axis passing through its centre and normal to plane of the ring with constant angular speed ω, then the magnitude of the magnetic moment of the ring is

a) $Q\omega R^2$ b) $1/2\ Q\omega R^2$ c) $Q\omega^2 R$ d) $1/2\ Q\omega^2 R$

516. An electron moves in a circular orbit with a uniform speed v. It produces a magnetic field B at the centre of the circle. The radius of the circle is proportional to

a) $\frac{B}{v}$ b) $\frac{v}{B}$ c) $\sqrt{\frac{v}{B}}$ d) $\sqrt{\frac{B}{v}}$

517. A rectangular loop carrying a current i is situated near a long straight wire such that the wire is parallel to the one of the sides of the loop and is in the plane of the loop. If a steady current I is established in wire as shown in figure, the loop will



a) Rotate about an axis parallel to the wire b) Move away from the wire to towards right
c) Move towards the wire d) Remain stationary

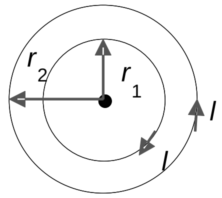
518. In Nebraska the horizontal component of earth's field is 0.2 G. If a vertical wire carries a current of 30 A upward there. What is the magnitude and direction of the force on 1 m of wire?
(1 G = 10^{-4} T)

a) 6 E to W b) $6\ \times 10^{-3}$ E to W c) $6\ \times 10^{-3}$ E to W d) $6\ \times 10^{-4}$ E to W

519. A circular coil having N turns is made from a wire of length L meter. If a current I ampere is passed through it and is placed in a magnetic field of B *tesla*, the maximum torque on it is

a) Directly proportional to N b) Inversely proportional to N
c) Inversely proportional to N^2 d) Independent of N

520. Two circular concentric loops of radii $r_1 = 20$ cm and $r_2 = 30$ cm are placed in the $X - Y$ plane as shown in the figure. A current $I = 7$ A is flowing through them. The magnetic moment of this loop system is



a) $+ 0.4\ \hat{\mathbf{k}}$ (Am^2) b) $-1.5\ \hat{\mathbf{k}}$ (Am^2) c) $+1.1\ \hat{\mathbf{k}}$ (Am^2) d) $+ 1.3\ \hat{\mathbf{j}}$ (Am^2)

521. A cyclotron is used to accelerate protons, deuterons $\alpha -$ particle etc. If the energy attained, after acceleration, by the protons is E, the energy attained by $\alpha -$ particles shall be

a) $4\ E$ b) $2E$ c) E d) $E/4$

522. An element $d\vec{\mathrm{I}} = dx\hat{\imath}$ (where $dx = 1$ cm) is placed at the origin and carries a large current $i = 10$ A. What is the magnetic field on the y-axis at a distance f 0.5 m?

a) $2 \times 10^{-8}\hat{k}$ T b) $4 \times 10^{-8}\hat{k}$ T c) $-2 \times 10^{-8}\hat{k}$ T d) $-4 \times 10^{-8}\hat{k}$ T

523. A particle with 10^{-11} *coulomb* of charge and 10^{-7} *kg* mass is moving with a velocity of $10^8 m/s$ along the y-axis. A uniform static magnetic field $B = 0.5$ *tesla* is acting along the x-direction. The force on the particle is

a) $5 \times 10^{-11} N$ along $\hat{\imath}$ b) $5 \times 10^3 N$ along $\hat{k}$ c) $5 \times 10^{-11} N$ along $-\hat{\jmath}$ d) $5 \times 10^{-4} N$ along $-\hat{k}$

524. A proton and an electron both moving with the same velocity v enter into a region of magnetic field directed perpendicular to the velocity of the particles. They will now move in circular orbits such that

a) Their time periods will be same b) The time period for proton will be higher
c) The time period for electron will be higher d) The orbital radii will be the same

525. If the current is doubled, the deflection is also doubled in

a) A tangent galvanometer
b) A moving coil galvanometer
c) Both (a) and (b)
d) None of these

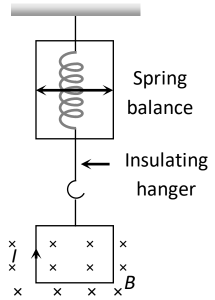
526. A proton of mass 1.67×10^{-27} kg and charge 1.6×10^{-19} C is projected with a speed of 2×10^{6} ms^{-1} at an angle of 60° to the *X*-axis. If a uniform magnetic field of 0.104 T is applied along *Y*-axis, the path of proton is

a) A circle of radius =0.2 m and time period $= 2\pi \times 10^{-7}$ s
b) A circle of radius = 0.1 m and time period $= 2\pi \times 10^{-7}$ s
c) A helix of radius 0.1 m and time period $= 2\pi \times 10^{-7}$ s
d) A helix of radius 0.2 m and time period $= 2\pi \times 10^{-7}$ s

527. Which of the following gives the value of magnetic field according to Biot-Savart' law

a) $\frac{i\Delta l \sin\theta}{r^2}$
b) $\frac{\mu_0}{4\pi}\frac{i\Delta l \sin\theta}{r}$
c) $\frac{\mu_0}{4\pi}\frac{i\Delta l \sin\theta}{r^2}$
d) $\frac{\mu_0}{4\pi} i\Delta l \sin\theta$

528. A square loop of side 'a' hangs from an insulating hanger of spring balance. The magnetic field of strength B occurs only at the lower edge. It carries a current I. Find the change in the reading of the spring balance if the direction of current is reversed



a) IaB
b) $2\,IaB$
c) $\frac{IaB}{2}$
d) $\frac{3}{2}IaB$

529. A current of 3A is flowing in a linear conductor having a length of 40 cm. The conductor is placed in a magnetic field of strength 500 G and makes an angle of 30° with the direction of the field. It experiences a force of magnitude

a) 3×10^{-4} N
b) 3×10^{-2} N
c) 3×10^{2} N
d) 3×10^{4} N

530. A wire in the form of a square of side 'a' carries a current i. Then the magnetic induction at the centre of the square wire is (Magnetic permeability of free space= μ_0)

a) $\frac{\mu_0 i}{2\pi a}$
b) $\frac{\mu_0 i\sqrt{2}}{\pi a}$
c) $\frac{2\sqrt{2}\mu_0 i}{\pi a}$
d) $\frac{\mu_0 i}{\sqrt{2}\pi a}$

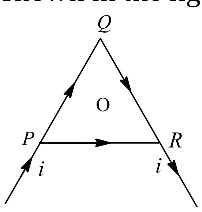
531. A cylindrical conductor of radius 'R' carries a current 'i'. The value of magnetic field at a point which is $R/4$ distance inside from the surface is $10T$. Find the value of magnetic field at point which is $4R$ distance outside from the surface

a) $4/3\,T$
b) $8/3\,T$
c) $40/3\,T$
d) $80/3\,T$

532. The magnetic field B with in the solenoid having n turns per metre length and carrying a current of i *ampere* is given by

a) $\frac{\mu_0 ni}{e}$
b) $\mu_0 ni$
c) $4\pi\mu_0 ni$
d) ni

533. An equilateral triangle of side l is formed from a piece of wire of uniform resistance. The current i is fed as shown in the figure. The magnitude of the magnetic field as its centre O is



a) $\frac{\sqrt{3}\mu_0 i}{2\pi l}$
b) $\frac{3\sqrt{2}\mu_0 i}{2\pi l}$
c) $\frac{\mu_0 i}{2\pi l}$
d) zero

534. An electron having kinetic energy E is moving in a circular orbit of radius R perpendicular to a uniform magnetic field induction $\vec{B}$. If kinetic energy is doubled and magnetic field induction is tripled, the radius will become

a) $R\sqrt{9/4}$ b) $R\sqrt{3/2}$ c) $R\sqrt{2/9}$ d) $R\sqrt{4/3}$

535. A proton and a deutron both having the same kinetic energy, enter perpendicularly into a uniform magnetic field B. For motion of proton and deuteron on circular path of radius R_P and R_d respectively, the correct statement is

a) $R_d = \sqrt{2}\,R_p$ b) $R_d = R_p/\sqrt{2}$ c) $R_d = R_p$ d) $R_d = 2R_p$

536. A straight wire of length 0.5 *metre* and carrying a current of 1.2 *ampere* is placed in a uniform magnetic field of induction 2 *tesla*. The magnetic field is perpendicular to the length of the wire. The force on the wire is

a) 2.4 N b) 1.2 N c) 3.0 N d) 2.0 N

537. Motion of a moving electron is not affected by

a) An electric field applied in the direction of motion
b) Magnetic field applied in the direction of motion
c) Electric field applied perpendicular to the direction of motion
d) Magnetic field applied perpendicular to the direction of motion

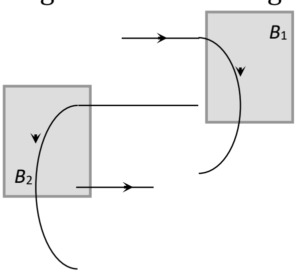
538. A long solenoid has n turns per meter and current I A is flowing through it. The magnetic field at the ends of the solenoid is

a) $\frac{\mu_0 nI}{2}$ b) $\mu_0 nI$ c) Zero d) $2\mu_0 nI$

539. The torque required to hold a small circular coil of 10 turns, 2×10^{-4} m^2 area and carrying 0.5 A current in the middle of a long solenoid of 10^3 turnsm^{-1} carrying 3 A current. With its axis perpendicular to the axis of the solenoid is

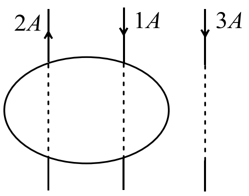
a) $12\pi \times 10^{-7}$ Nm b) $6\pi \times 10^{-7}$ Nm c) $4\pi \times 10^{-7}$ Nm d) $2\pi \times 10^{-7}$ Nm

540. Following figure shows the path of an electron that passes through two regions containing uniform magnetic fields of magnitudes B_1 and B_2. It's path in each region is a half circle, choose the correct option



a) B_1 is into the page and it is stronger than B_2
b) B_1 is into the page and it is weaker than B_2
c) B_1 is out of the page and it is weaker than B_2
d) B_1 is out of the page and it is stronger than B_2

541. Two wires with currents 2 A and 1 A are enclosed in a circular loop. Another wire with current 3 A is situated outside the loop as shown. The $\oint \vec{B}.d\vec{l}$ around the loop is



a) μ_0 b) $3\mu_0$ c) $6\mu_0$ d) $2\mu_0$

542. The helium nucleus makes a full rotation in a circle of radius 0.8 m in 2 s. The value of the magnetic field induction B in tesla at the centre of circle will be

a) $2 \times 10^{-19}\,\mu_0$ b) $10^{-19}/\mu_0$ c) $10^{-19}\,\mu_0$ d) $2 \times 10^{-20}/\mu_0$

543. An electron moving around the nucleus with an angular momentum l has a magnetic moment

a) $\frac{e}{m}l$ b) $\frac{e}{2m}l$ c) $\frac{2e}{m}l$ d) $\frac{e}{2\pi m}l$

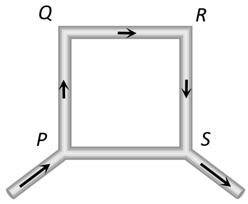
544. Electrons move at right angles to a magnetic field of 1.5×10^{-2} *tesla* with a speed of $6 \times 10^7 m/s$. If the specific charge of the electron is $1.7 \times 10^{11} C/kg$, the radius of the circular path will be

a) 2.9 *cm* b) 3.9 *cm* c) 2.35 *cm* d) 3 *cm*

545. A short bar magnet placed with its axis at30°, with a uniform external magnetic field of 0.25 T experiences a torque of 4.5×10^{-2}N-m. Magnetic moment of the magnet is

a) 0.36 J T^{-1} b) 0.72 J T^{-1} c) 0.18 J T^{-1} d) Zero

546. *PQRS* is a square loop made of uniform wire. If the current enters the loop at *P* and leaves at *S*, then the magnetic field will be



a) Maximum at the centre of the loop b) Zero at the centre of loop
c) Zero at all points inside the loop d) Zero at all points outside of the loop

547. Maximum kinetic energy of the positive ion in the cyclotron is

a) $\frac{q^2Br_0}{2m}$ b) $\frac{qB^2r_0}{2m}$ c) $\frac{q^2B^2r_0^2}{2m}$ d) $\frac{qBr_0}{2m^2}$

548. When current is passed through a circular wire prepared from a long conducting wire, the magnetic field produced at its centre is B. Now a loop having two turns is prepared from the same wire and the same current is passed through it. The magnetic field at its centre will be

a) $4B$ b) $\frac{B}{4}$ c) $\frac{B}{2}$ d) $16B$

549. An electron and a proton travel with equal speed in the same direction at 90° to a uniform magnetic field as this is switched on. They experience forces which are initially

a) Identical b) Equal but in opposite direction
c) In the same direction and differing by a factor of about 1840 d) In opposite direction and differing by a factor of about 1840

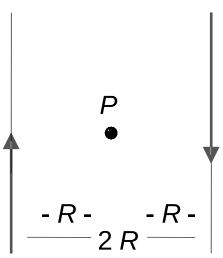
550. An ammeter has a resistance of $G\ \Omega$ and a range of i ampere. The value of resistance used in parallel to convert in into an ammeter of range in ampere is

a) $n\,G$ b) $(n-1)G$ c) $\frac{G}{n}$ d) $\frac{G}{n-1}$

551. Identify the correct statement from the following

a) Cyclotron frequency is dependent on speed of the charged particle
b) Kinetic energy of charged particle in cyclotron does not dependent on its mass
c) Cyclotron frequency does not depend on speed of charged particle
d) Kinetic energy of charged particle in cyclotron is independent of its charge

552. Two long straight wires are set parallel to each other. Each carries a current i in the opposite direction and the separation between them is $2R$. The intensity of the magnetic field midway between them is



a) Zero b) $\frac{\mu_0 i}{4\pi R}$ c) $\frac{\mu_0 i}{2\pi R}$ d) $\frac{\mu_0 i}{\pi R}$

553. A metal wire of mass m slides without friction on two rails placed at a distance l aprt. The track lies in a

uniform vertical magnetic field B. A constant current i flows along the rails across the wire and brack down the other rail. The acceleration of the wire is

a) $\frac{B\,m\,i}{l}$ b) $mBi\,l$ c) $\frac{Bil}{m}$ d) $\frac{mi\,l}{B}$

554. A coil of 100 turns and area $2 \times 10^{-2} m^2$, pivoted about a vertical diameter in a uniform magnetic field carries a current of $5A$. When the coil is held with its plane in North-South direction, it experience a torque of 0.3 Nm. When the plane is in East-West direction the torque is 0.4 Nm. The value of magnetic induction is (Neglect earth's magnetic field)

a) 0.2 T b) 0.3 T c) 0.4 T d) 0.05 T

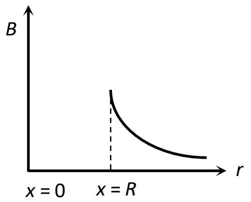
555. Two particles of masses m_a and m_b and same charge are projected in a perpendicular magnetic field. They travel along circular paths of radius r_a and r_b such that $r_a > r_b$. Then which is true?

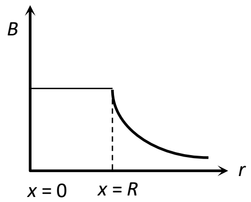
a) $m_a\, v_a > m_b\, v_b$ b) $m_a > m_b$ and $v_a > v_b$
c) $m_a = m_b$ and $v_a = v_b$ d) $m_b\, v_b > m_a\, v_a$

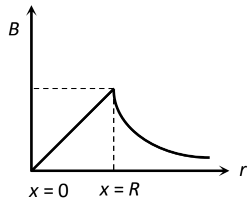
556. A long straight wire carries a current of π amp. The magnetic field due to it will be $5 \times 10^{-5} weber/m^2$ at what distance from the wire [μ_0 = permeability of air]

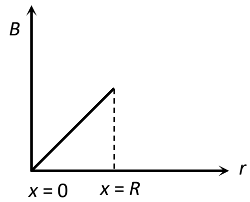
a) $10^4 \mu_0$ $metre$ b) $\frac{10^4}{\mu_0}$ $metre$ c) $10^6 \mu_0$ $metre$ d) $\frac{10^6}{\mu_0}$ $metre$

557. A long thin hollow metallic cylinder of radius 'R' has a current i $ampere$. The magnetic induction 'B'-away from the axis at a distance r from the axis varies as shown in

a) 

b) 

c) 

d) 

558. We have a galvanometer of resistance 25 Ω. It is shunted by a 2.5 Ω wire. The part of total current i_0 that flows through the galvanometer is given as

a) $(i/i_0) = (1/11)$ b) $(i/i_0) = (1/10)$ c) $(i/i_0) = (1/9)$ d) $(i/i_0) = (2/11)$

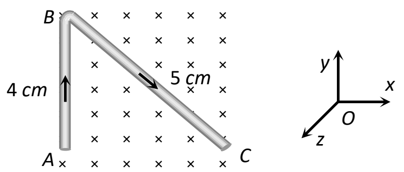
559. A particle of mass m and charge q released from the origin in a region occupied by electric field E and magnetic field B,

$B = -B_0, \hat{j}\,; E = E_0 \hat{i}$

The velocity of the particle will be

a) $\sqrt{\frac{2qE_0}{m}}$ b) $\sqrt{\frac{qE_0}{m}}$ c) $\sqrt{\frac{qE_0}{2m}}$ d) None of these

560. A uniform conducting wire ABC has a mass of $10g$. A current of $2A$ flows through it. The wire is kept in a uniform magnetic field $B = 2T$. The acceleration of the wire will be



a) Zero b) 12 ms^{-2} along y-axis
c) $1.2 \times 10^{-3} ms^{-2}$ along y-axis d) $0.6 \times 10^{-3} ms^{-2}$ along y-axis

561. The magnetic field at the point of intersection of diagonals of a square wire loop of side L carrying a current I is

a) $\frac{\mu_0 I}{\pi L}$ b) $\frac{2\mu_0 I}{\pi L}$ c) $\frac{\sqrt{2}\mu_0 I}{\pi L}$ d) $\frac{2\sqrt{2}\mu_0 I}{\pi L}$

562. The resultant magnetic moment of neon atom will be

a) Infinity b) μ_B c) Zero d) $\mu_B/2$

563. The magnetic field normal to the plane of a wire of n turns and radius r which carries a current i is measured on the axis of the coil at a small distance h from the centre of the coil. This is smaller than the

magnetic field at the centre by the fraction

a) $(2/3)r^2/h^2$ b) $(3/2)r^2/h^2$ c) $(2/3)h^2/r^2$ d) $(3/2)h^2/r^2$

564. A circular coil of radius 4 cm and of 20 turns carries a current of 3 $amperes$. It is placed in a magnetic field of intensity of 0.5 $weber/m^2$. The magnetic dipole moment of the coil is

a) 0.15 $ampere - m^2$ b) 0.3 $ampere - m^2$ c) 0.45 $ampere - m^2$ d) 0.6 $ampere - m^2$

565. A solenoid consists of 100 turns of wire and has a length of 10.0 cm. The magnetic field inside the solenoid when it carries a current of 0.500 A will be

a) 6.28×10^{-4} T b) 6.28×10^{-5} T c) 3.14×10^{-4} T d) None of these

566. An electron and a proton enter a magnetic field perpendicularly. Both have same kinetic energy. Which of the following is true?

a) Trajectory of electron is less curved
b) Trajectory of proton is less curved
c) Both trajectories are equally curved
d) Both move on straight line path

567. An electron and a proton of equal linear momentum enter in the direction perpendicular to uniform magnetic field. If the radii of their circular paths be r_e and r_p respectively, then $\frac{r_e}{r_p}$, is equal to m_e = mass of electron, m_p = mass of proton.

a) $\left(\frac{m_p}{m_e}\right)^{1/2}$ b) $\frac{m_p}{m_e}$ c) $\left(\frac{m_e}{m_p}\right)^{1/2}$ d) 1

568. The pole pieces of the magnet used in a pivoted coil galvanometer are

a) Plane surface of a bar magnet
b) Plane surface of a horse-shoe magnet
c) Cylindrical surfaces of a bar magnet
d) Cylindrical surfaces of a horse-shoe magnet

569. A voltmeter has resistance of 2000 Ω and it can measure upto 2V. If we want to increase its range by 8V, then required resistance in series will be

a) 4000 Ω b) 6000 Ω c) 7000 Ω d) 8000 Ω

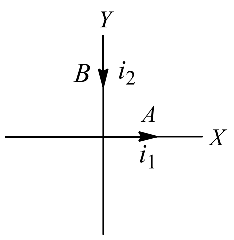
570. A square frame of side 1 m carries a current i, produces a magnetic field B at its centre. The same current is passed through a circular coil having the same perimeter as the square. The magnetic field at the centre of the circular coil is B'. The ratio B/B' is

a) $\frac{8}{\pi^2}$ b) $\frac{8\sqrt{2}}{\pi^2}$ c) $\frac{16}{\pi^2}$ d) $\frac{16}{\sqrt{2}\pi^2}$

571. The magnetic potential due to a magnetic dipole at a point on its axis distant 40 cm from its center is found to be 2.4×10^{-5} JA^1m^{-1}.The magnetic moment of the dipole will be

a) 28.6 Am^2 b) 32.2 Am^2 c) 38.4 Am^2 d) None of these

572. Two wires A and B carry currents as shown in figure. The magnetic interactions



a) Push i_2 away from i_1
b) Pull i_2 closer to i_1
c) Turn i_2 clockwise
d) Turn i_2 counterclockwise

573. Two concentric circuit coils of ten turn each are situated in the same plane. Their radii are 20 cm and 40 cm and they carry respectively 0.2 A and 0.3 A current in opposite direction. The magnetic field in tesla at the centre is

a) 35 $\mu_0/4$ T b) $\mu_0/80$ T c) 7 $\mu_0/80$ T d) 5 $\mu_0/4$ T

574. A rectangular coil 20 cm × 20 cm has 100 turns and carries a current of 1 A. It is placed in a uniform magnetic field $B = 0.5\ T$ with the direction of magnetic field parallel to the plane of the coil. The magnitude of the torque required to hold this coil in this position is

a) Zero b) 200 N-m c) 2 N-m d) 10 N-m

575. Three long straight wires are connected parallel to each other across a battery of negligible internal

resistance. The ratio of their resistances are 3 : 4 : 5. What is the ratio of distances of middle wire from the others if the net force experienced by it is zero

a) 4 : 3 b) 3 : 1 c) 5 : 3 d) 2 : 3

576. A charged particle enters a uniform magnetic field with a certain speed at right angles to it. In the magnetic field a change could occur in its

a) Kinetic energy b) Angular momentum c) Linear momentum d) Speed

577. Two straight long conductors AOB and COD are perpendicular to each other and carry currents i_1 and i_2. The magnitude of the magnetic induction at a point P at a distance a from the point O in a direction perpendicular to the plane $ABCD$ is

a) $\frac{\mu_0}{2\pi a}(i_1 + i_2)$ b) $\frac{\mu_0}{2\pi a}(i_1 - i_2)$ c) $\frac{\mu_0}{2\pi a}(i_1^2 + i_2^2)^{1/2}$ d) $\frac{\mu_0}{2\pi a} \frac{i_1 i_2}{(i_1 + i_2)}$

578. In a hydrogen atom, the electron is making 6.6×10^{15} rps in a circular path of radius 0.53 Å. What is the magnetic induction produced at the centre of orbit?

a) 6.3 T b) 12.6 T c) 18.9 T d) 25.2 T

579. On connecting a battery to the two corners of a diagonal of a square conductor frame of side a, the magnitude of the magnetic field at the centre will be

a) Zero b) $\frac{\mu_o}{\pi a}$ c) $\frac{2\mu_o}{\pi a}$ d) $\frac{4\mu_o i}{\pi a}$

580. If a copper rod carries a direct current, the magnetic field associated with the current will be

a) Only inside the rod b) Only outside the rod
c) Both inside and outside the rod d) Neither inside nor outside the rod

581. A very high magnetic field is applied to a stationary charge. Then the charge experiences

a) A force in the direction of magnetic field
b) A force perpendicular to the magnetic field
c) A force in an arbitrary direction
d) No force

582. A deutron of kinetic energy 50 keV is describing a circular orbit of radius 0.5m, is plane perpendicular to magnetic field $\vec{B}$. The kinetic energy of a proton that describes a circular orbit of radius 0.5 m in the same plane with the same magnetic field $\vec{B}$ is

a) 200 keV b) 50 keV c) 100 keV d) 25 keV

583. Two ions having masses in the ratio 1 : 1 and charges 1 : 2 are projected into uniform magnetic field perpendicular to the field with speeds in the ratio 2 : 3. The ratio of the ratio of circular paths along which the two particles move is

a) 4 : 3 b) 2 : 3 c) 3 : 1 d) 1 : 4

584. Two thin, long, parallel wires, separated by a distance d carry a current of i ampere in the same direction. They will

a) Attract each other with a force of $\frac{\mu_0 i^2}{(2\pi d)}$ b) Repel each other with a force of $\frac{\mu_0 i^2}{(2\pi d)}$
c) Attract each other with a force of $\frac{\mu_0 i^2}{(2\pi d^2)}$ d) Repel each other with a force of $\frac{\mu_0 i^2}{(2\pi d^2)}$

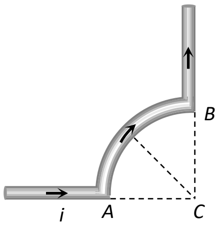
585. A particle of charge q and mass m moving with a velocity v along the x-axis enters the region $x > 0$ with uniform magnetic field B along the $\hat{k}$ direction. The particle will penetrate in this region in the x-direction upto a distance d equal to

a) Zero b) $\frac{mv}{qB}$ c) $\frac{2mv}{qB}$ d) Infinity

586. In a current carrying long solenoid, the field produced does not depend upon

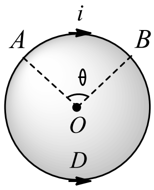
a) Number of turns per unit length b) Current flowing
c) Radius of the solenoid d) All of the above

587. A wire carrying current i is shaped as shown. Section AB is a quarter circle of radius r. The magnetic field is directed



a) At an angle $\pi/4$ to the plane of the paper
b) Perpendicular to the plane of the paper and directed in to the paper
c) Along the bisector of the angle ACB towards AB
d) Along the bisector of the angle ACB away from AB

588. Equal current i flows in two segments of a circular loop in the direction shown in figure. Radius of the loop is r. The magnitude of magnitude field induction at the centre of the loop is



a) zero
b) $\frac{\mu_0}{4\pi}\frac{i\theta}{r}$
c) $\frac{\mu_0}{2\pi}\frac{i}{r}(\pi-\theta)$
d) $\frac{\mu_0}{2\pi}\frac{i}{r}(2\pi-\theta)$

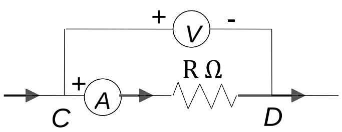
589. A one metre long wire is lying at right angles to the magnetic field. A force of 1 $kg\ wt$. is acting on it in a magnetic field of 0.98 $tesla$. The current flowing in it will be
a) 100 A
b) 10 A
c) 1 A
d) Zero

590. An electron is moving in the north direction. It experiences a force in vertically upward direction. The magnetic field at the position of the electron is in the direction of
a) East
b) West
c) North
d) South

591. The coil of a galvanometer consists of 100 turns and effective area of 1 $square\ cm$. The restoring couple is $10^{-8} N - m/radian$. The magnetic field between the pole pieces is 5 T. The current sensitively of this galvanometer will be
a) $5 \times 10^{-4} rad/\mu\ amp$
b) $5 \times 10^{-6}\ per\ amp$
c) $2 \times 10^{-7} per\ amp$
d) $5\ rad/\mu\ amp$

592. A straight conductor carries a current of $5A$. An electron travelling with a speed f $5 \times 10^6 ms^{-1}$ parallel to the wire at a distance of $0.1m$ from the conductor, experiences a force of
a) $8 \times 10^{-20} N$
b) $3.2 \times 10^{-19} N$
c) $8 \times 10^{-18} N$
d) $1.6 \times 10^{-19} N$

593. A candidate connects a moving coil voltmeter V and a moving coil ammeter A and resistor R as shown in figure?



If the voltmeter reads 10 V and the ammeter reads 2 A and than R is
a) Equal to 5 Ω
b) Greater than 5 Ω
c) Less than 5 Ω
d) Greater or less than 5 Ω depending upon its material

594. A proton and an α-particle are projected normally into a magnetic field. What will be the ratio of radii of the trajectories of the proton and α-particle?
a) 2 : 1
b) 1 : 2
c) 4 : 1
d) 1 : 4

595. A circular conductor of radius 5 cm produces a magnetic field of 7×10^{-6} T. The current flowing through the conductor is
a) 3.0 A
b) 2.25 A
c) 4.5 A
d) 0.56 A

596. A vertical straight conductor carries a current vertically upwards. A point P lies to the east of it at a small

distance and another point Q lies to the west at the same distance. The magnetic field at P is
a) Greater than at Q
b) Same as at Q
c) Less than at Q
d) Greater or less than at Q depending upon the strength of the current

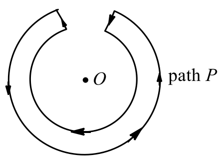
597. Under the influence of a uniform magnetic field a charged particle is moving in a circle of radius R with constant speed v. The time period of the motion
a) Depends on v and not on R
b) Depends on both R and v
c) Is independent of both R and v
d) Depends on R and not on v

598. An electron is moving with a speed of 10^8 ms^{-1} perpendicular to a uniform magnetic field of induction B. Suddenly induction of magnetic field is reduced to $B/2$. The radius of the path becomes from the original value of r
a) No change
b) Reduces to $r/2$
c) Increases to $2r$
d) Stops moving

599. A solenoid 1.5 m long and 0.4 cm in diameter possesses 10 turns/cm length. A current of 5 A falls through it. The magnetic field at the axis inside the solenoid is
a) $2\pi \times 10^{-3}$ T
b) $2\pi \times 10^{-5}$ T
c) $4\pi \times 10^{-2}$ T
d) $4\pi \times 10^{-3}$ T

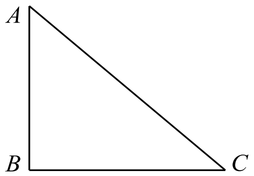
600. A cell is connected between two points of a uniformly thick circular conductor. The magnetic field at the centre of the lop will be
(Here i_1 and i_2 are the currents flowing in the two parts of the circular conductor of radius $'a'$ and μ_0 has the usual meaning)
a) Zero
b) $\frac{\mu_0}{2a}(i_1 - i_2)$
c) $\frac{\mu_0}{2a}(i_1 + i_2)$
d) $\frac{\mu_0}{a}(i_1 + i_2)$

601. In the adjacent figure is shown a closed path P. A long straight conductor carrying a current I passes through O and perpendicular to the plane of the paper. Then which of the following holds good?



a) $\int_P \mathbf{B}.\mathbf{dl} = 0$
b) $\int_P \mathbf{B}.\mathbf{dl} = \mu_0 I$
c) $\int_P \mathbf{B}.\mathbf{dl} > \mu_0 I$
d) None of these

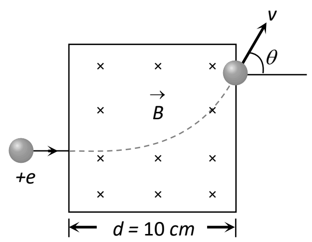
602. A current carrying closed loop in the form of a right angle isosceles triangle ABC is placed in a uniform magnetic field acting along AB. If the magnetic force on the arm BC is $\vec{F}$, the force on the arm AC is



a) $\sqrt{2}\vec{F}$
b) $-\sqrt{2}\vec{F}$
c) $-\vec{F}$
d) $\vec{F}$

603. The expression for the torque acting on a coil having area of cross-section A, number of turns n, placed in a magnetic field of strength B, making an angle θ with the normal to the plane of the coil, when a current i is flowing in it, will be
a) $ni\ AB \tan\theta$
b) $ni\ AB \cos\theta$
c) $ni\ AB \sin\theta$
d) $ni\ AB$

604. A proton accelerated by a potential difference 500 KV moves though a transverse magnetic field of 0.51 T as shown in figure. The angle θ through which the proton deviates from the initial direction of its motion is



a) 15°
b) 30°
c) 45°
d) 60°

605. Uniform magnetic B is directed vertically upwards and 3 wires of equal length L, carrying equal current i are lying in a horizontal plane such that the first one is along north, second one along north-east and the third one at 60° north of east. Force exerted by magnetic field B on them is

a) Zero on the first b) $\frac{BiL}{\sqrt{2}}$ on the second c) $\sqrt{3}\frac{BiL}{2}$ on the third d) BiL on all of them

606. Two parallel long wires carry currents i_1 and i_2 with $i_1 > i_2$. When the currents are in the same direction, the magnetic field midway between the wires is $10\mu T$. When the direction of i_2 is reversed, it becomes $40\ \mu T$. The ratio i_1/i_2 is

a) 3 : 4 b) 11 : 7 c) 7 : 11 d) 5 : 3

607. An electron moving towards the east enters a magnetic field directed towards the north. The force on the electron will be directed

a) Vertically upward b) Vertically downward c) Towards the west d) Towards the south

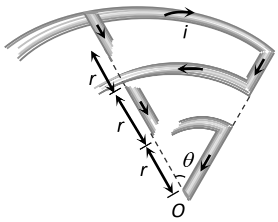
608. Cyclotron is used to accelerated

a) Electrons b) Neutrons c) Positive ions d) Negative ions

609. A current I flows along the length of an infinitely long, straight, thin walled pipe. Then

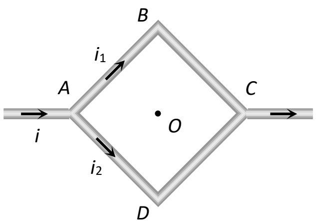
a) The magnetic field is zero only on the axis of the pipe
b) The magnetic field is different at different points inside the pipe
c) The magnetic field at any point inside the pipe is zero
d) The magnetic field at all points inside the pipe is the same, but not zero

610. Find magnetic field at O



a) $\frac{5\mu_0 i\theta}{24\pi r}$ b) $\frac{\mu_0 i\theta}{24\pi r}$ c) $\frac{11\mu_0 i\theta}{24\pi r}$ d) Zero

611. Figure shows a square loop $ABCD$ with edge length a. The resistance of the wire ABC is r and that of ADC is $2r$. The value of magnetic field at the centre of the loop assuming uniform wire is



a) $\frac{\sqrt{2}\mu_0 i}{3\pi a}\odot$ b) $\frac{\sqrt{2}\mu_0 i}{3\pi a}\otimes$ c) $\frac{\sqrt{2}\mu_0 i}{\pi a}\odot$ d) $\frac{\sqrt{2}\mu_0 i}{\pi a}\otimes$

612. A galvanometer has a resistance G and a current i_g flowing in it produces full scale deflection. S_1 is the value of the shunt which converts it into a ammeter or range 0 to i and S_2 is the value of the shunt for the range 0 to 2 i. The ratio $\frac{S_1}{S_2}$ is

a) $\left(\frac{2i - i_g}{i - i_g}\right)$ b) $\frac{1}{2}\left(\frac{i - i_g}{2i - i_g}\right)$ c) 2 d) 1

613. An ammeter has resistance R_0 and range I. What resistance should be connected in parallel with it to increase its range by nI?

a) $R_0/(n-1)$ b) $R_0/(n+1)$ c) R_0/n d) None of these

614. "On flowing current in a conducting wire the magnetic field produces around it." It is a law of

a) Lenz b) Ampere c) Ohm d) Maxwell

615. A charged particle is moving with velocity v in a magnetic field of induction B. The force on the particle will be maximum when

a) v and B are in the same direction b) v and B are in opposite directions

c) v and B are perpendicular d) v and B are at an angle of 45°

616. A particle of charge e and mass m moves with a velocity v in a magnetic field B applied perpendicular to the motion of the particle. The radius r of its path in the field is

a) $\frac{Bv}{em}$ b) $\frac{ev}{Bm}$ c) $\frac{Be}{mv}$ d) $\frac{mv}{Be}$

617. The maximum velocity to which a proton can be accelerated in a cyclotron of 10 MHz frequency and radius 50 cm is

a) 6.28×10^8 m/s b) 3.14×10^8 m/s c) 6.28×10^7 m/s d) 3.14×10^7 m/s

: ANSWER KEY :

1)	c	2)	b	3)	b	4)	b	189)	a	190)	b	191)	d	192)	a
5)	d	6)	a	7)	c	8)	a	193)	b	194)	b	195)	d	196)	a
9)	d	10)	c	11)	b	12)	d	197)	b	198)	d	199)	b	200)	c
13)	c	14)	b	15)	b	16)	d	201)	a	202)	a	203)	a	204)	d
17)	d	18)	c	19)	d	20)	d	205)	b	206)	d	207)	b	208)	a
21)	b	22)	b	23)	a	24)	a	209)	b	210)	b	211)	c	212)	c
25)	c	26)	d	27)	c	28)	d	213)	d	214)	d	215)	d	216)	b
29)	d	30)	a	31)	b	32)	b	217)	d	218)	b	219)	d	220)	b
33)	d	34)	d	35)	a	36)	c	221)	d	222)	b	223)	d	224)	c
37)	b	38)	c	39)	c	40)	a	225)	c	226)	a	227)	c	228)	d
41)	c	42)	d	43)	c	44)	b	229)	c	230)	a	231)	c	232)	d
45)	a	46)	d	47)	a	48)	a	233)	b	234)	d	235)	d	236)	c
49)	b	50)	a	51)	c	52)	b	237)	a	238)	a	239)	a	240)	d
53)	b	54)	d	55)	b	56)	b	241)	b	242)	b	243)	c	244)	d
57)	d	58)	a	59)	d	60)	a	245)	b	246)	a	247)	a	248)	b
61)	a	62)	b	63)	d	64)	c	249)	b	250)	d	251)	a	252)	c
65)	b	66)	c	67)	b	68)	d	253)	a	254)	c	255)	c	256)	a
69)	a	70)	d	71)	b	72)	c	257)	b	258)	c	259)	d	260)	a
73)	c	74)	b	75)	a	76)	a	261)	b	262)	c	263)	a	264)	c
77)	b	78)	b	79)	a	80)	c	265)	b	266)	a	267)	d	268)	a
81)	d	82)	d	83)	d	84)	a	269)	a	270)	c	271)	d	272)	d
85)	c	86)	b	87)	b	88)	d	273)	c	274)	c	275)	c	276)	a
89)	d	90)	a	91)	a	92)	b	277)	b	278)	b	279)	b	280)	a
93)	c	94)	c	95)	d	96)	a	281)	a	282)	a	283)	c	284)	c
97)	b	98)	b	99)	a	100)	d	285)	b	286)	c	287)	c	288)	d
101)	a	102)	d	103)	a	104)	c	289)	d	290)	c	291)	b	292)	a
105)	b	106)	d	107)	a	108)	b	293)	b	294)	d	295)	b	296)	b
109)	a	110)	c	111)	a	112)	b	297)	a	298)	a	299)	a	300)	c
113)	b	114)	c	115)	c	116)	c	301)	c	302)	c	303)	d	304)	c
117)	b	118)	b	119)	c	120)	a	305)	b	306)	a	307)	d	308)	a
121)	d	122)	c	123)	b	124)	a	309)	c	310)	d	311)	c	312)	c
125)	a	126)	a	127)	d	128)	d	313)	a	314)	d	315)	d	316)	c
129)	c	130)	b	131)	d	132)	b	317)	a	318)	c	319)	d	320)	c
133)	c	134)	c	135)	b	136)	a	321)	d	322)	d	323)	a	324)	a
137)	d	138)	b	139)	c	140)	b	325)	d	326)	a	327)	c	328)	a
141)	d	142)	d	143)	c	144)	c	329)	d	330)	d	331)	b	332)	d
145)	b	146)	c	147)	c	148)	a	333)	b	334)	c	335)	a	336)	d
149)	d	150)	b	151)	d	152)	c	337)	b	338)	b	339)	c	340)	b
153)	b	154)	b	155)	c	156)	a	341)	a	342)	c	343)	d	344)	a
157)	a	158)	d	159)	c	160)	d	345)	b	346)	d	347)	a	348)	b
161)	c	162)	d	163)	c	164)	c	349)	a	350)	c	351)	c	352)	a
165)	b	166)	a	167)	a	168)	b	353)	d	354)	b	355)	c	356)	d
169)	d	170)	a	171)	c	172)	a	357)	a	358)	d	359)	b	360)	b
173)	b	174)	a	175)	c	176)	b	361)	b	362)	b	363)	a	364)	d
177)	d	178)	a	179)	b	180)	b	365)	d	366)	c	367)	d	368)	c
181)	a	182)	b	183)	c	184)	a	369)	b	370)	a	371)	d	372)	d
185)	a	186)	c	187)	a	188)	b	373)	a	374)	c	375)	a	376)	a

377)	b	378)	a	379)	a	380)	a	501)	a	502)	b	503)	d	504)	d
381)	d	382)	d	383)	d	384)	c	505)	d	506)	d	507)	a	508)	c
385)	c	386)	a	387)	c	388)	c	509)	d	510)	d	511)	b	512)	d
389)	b	390)	c	391)	a	392)	a	513)	b	514)	a	515)	b	516)	c
393)	a	394)	c	395)	c	396)	d	517)	c	518)	d	519)	a	520)	c
397)	d	398)	b	399)	b	400)	c	521)	c	522)	b	523)	d	524)	b
401)	a	402)	a	403)	b	404)	c	525)	b	526)	c	527)	c	528)	b
405)	d	406)	b	407)	b	408)	d	529)	b	530)	c	531)	b	532)	b
409)	b	410)	b	411)	d	412)	c	533)	d	534)	c	535)	a	536)	b
413)	a	414)	a	415)	d	416)	d	537)	b	538)	a	539)	a	540)	a
417)	b	418)	a	419)	c	420)	b	541)	a	542)	c	543)	b	544)	c
421)	c	422)	d	423)	d	424)	b	545)	a	546)	b	547)	c	548)	a
425)	c	426)	b	427)	b	428)	a	549)	b	550)	d	551)	c	552)	d
429)	c	430)	b	431)	c	432)	d	553)	c	554)	d	555)	a	556)	a
433)	d	434)	d	435)	a	436)	b	557)	a	558)	c	559)	a	560)	b
437)	c	438)	d	439)	d	440)	a	561)	d	562)	c	563)	d	564)	b
441)	b	442)	d	443)	c	444)	d	565)	a	566)	b	567)	d	568)	d
445)	c	446)	c	447)	c	448)	a	569)	d	570)	d	571)	c	572)	d
449)	a	450)	c	451)	b	452)	a	573)	d	574)	c	575)	c	576)	c
453)	a	454)	b	455)	c	456)	b	577)	c	578)	b	579)	a	580)	c
457)	c	458)	a	459)	c	460)	a	581)	d	582)	c	583)	a	584)	a
461)	c	462)	b	463)	c	464)	c	585)	b	586)	c	587)	b	588)	c
465)	a	466)	c	467)	a	468)	c	589)	b	590)	a	591)	d	592)	c
469)	a	470)	c	471)	a	472)	c	593)	c	594)	b	595)	d	596)	b
473)	c	474)	c	475)	b	476)	c	597)	c	598)	c	599)	a	600)	a
477)	c	478)	a	479)	c	480)	c	601)	b	602)	c	603)	c	604)	b
481)	b	482)	a	483)	d	484)	a	605)	d	606)	d	607)	b	608)	c
485)	b	486)	b	487)	d	488)	a	609)	c	610)	a	611)	b	612)	a
489)	b	490)	b	491)	a	492)	a	613)	c	614)	b	615)	c	616)	d
493)	a	494)	c	495)	b	496)	d	617)	d						
497)	c	498)	c	499)	b	500)	a								

: HINTS AND SOLUTIONS :

1 **(c)**

Frequency $f = \frac{Bq}{2\pi m}$

As proton, electron, Li^+, He^+ have same charge in magnitude and since magnetic field is also constant.

So, $f \propto \frac{1}{m}$

Among the given charged particles, Li^+ has highest mass, therefore it will have minimum frequency.

2 **(b)**

The magnetic field produced at the centre of the circular coil carrying current is given by

$$B = \frac{\mu_0 NI}{2r}$$

For one turn $N = 1$

$$B_0 = \frac{\mu_0 I}{2r}$$

As the coil is rewound

$$r' = \frac{r}{3}, \quad N' = 3$$

$$\therefore B' = \frac{\mu_0 I \times 3}{2 \times \left(\frac{r}{3}\right)}$$

$$= \frac{9\mu_0 I}{2r} = 9B_0$$

3 **(b)**

$F = qvB$ also kinetic energy $K = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{\frac{2K}{m}}$

$$\therefore F = q\sqrt{\frac{2K}{m}}B$$

$$= 1.6 \times 10^{-19}\sqrt{\frac{2 \times 200 \times 10^6 \times 1.6 \times 10^{-19}}{1.67 \times 10^{-27}}} \times 5$$

$$= 1.6 \times 10^{-10} N$$

4 **(b)**

$$B = \frac{\mu_0}{4\pi} \times \frac{2\pi NiR^2}{(R^2 + x^2)^{3/2}} \Rightarrow B \propto \frac{1}{(r^2 + x^2)^{3/2}}$$

$$\Rightarrow \frac{8}{1} = \frac{(R^2 + x_2^2)^{3/2}}{(R^2 + x_1^2)^{3/2}} \Rightarrow \left(\frac{8}{1}\right)^{2/3} = \frac{R^2 + 0.04}{R^2 + 0.0025}$$

$\Rightarrow \frac{4}{1} = \frac{R^2+0.04}{R^2+0.0025}$. On solving $R = 0.1\ m$

5 **(d)**

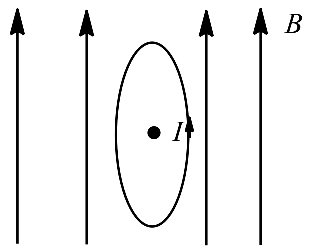
Torque (τ) acting on a loop placed in a magnetic field B is given by

$\tau = nBIA \sin\theta$

Where A is area of loop, I the current through it, n the number of turns, and θ the angle which axis of loop makes with magnetic field B.

Since, magnetic field (B) of coil is parallel to the field applied, hence $\theta = 0°$ and $\sin 0° = 0$

$\therefore \quad \tau = 0$



6 **(a)**

Magnetic field at the centre of circular coil

$$B_H = \frac{\mu_0}{4\pi}\frac{2\pi nI}{r}$$

I and r being the current and radius of circular coil respectively.

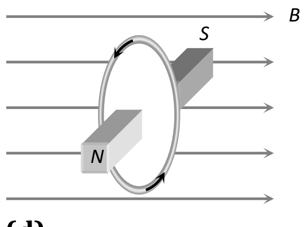
or $I = \frac{4\pi}{\mu_0} = \frac{rB_H}{2\pi n}$

$$= \frac{10^7 \times 0.1 \times 0.314 \times 10^{-4}}{2 \times 3.14 \times 10} = 0.5\ \text{A}$$

7 **(c)**

As shown in the following figure, the given situation is similar to a bar magnet placed in a uniform magnetic field perpendicularly. Hence torque on it

$\tau = MB \sin 90° = (i\pi r^2)B$



9 **(d)**

Cyclotron frequency is given by

$$v = \frac{qB}{2\pi m}$$

$$\therefore v = \frac{1.6 \times 10^{-19} \times 6.28 \times 10^{-4}}{2 \times 3.14 \times 1.7 \times 10^{-27}}$$
$$= 0.94 \times 10^4 \approx 10^4 \text{ Hz}$$

10 **(c)**

Force on the charged particle in electric field, $F = qE$; acceleration of particle, $a = F/m = q\,E/m$; using the relation $v^2 = u^2 + 2a$, we have $v^2 = 0 + 2(qE/m)y$

Or $\frac{1}{2}mv^2 = q\,E\,y$; so KE is $q\,Ey$.

11 **(b)**

Radius of circular path

$R = \frac{mv}{qB}$

But $mv = \sqrt{2mqV}$

$\therefore R = \frac{\sqrt{2mqV}}{qB}$ or $R \propto \sqrt{m}$

or $\frac{R_1^2}{R_2^2} = \frac{M_1}{M_2}$

or $\frac{M_1}{M_2} = \frac{R_1^2}{R_2^2} = \left(\frac{R_1}{R_2}\right)^2$

12 **(d)**

The charge moving on a circular orbit acts like the current loop. Magnetic field at the centre of the current loop is $B = \frac{\mu_0 2\pi\, I}{4\,\pi\, R}$

$B = \frac{\mu_0 2\pi\, q\, v}{4\,\pi\, R}$ **or** $R = \frac{\mu_0 2\pi\, q\, v}{4\,\pi\, B}$

Substituting the given values, we get

$$R = \frac{4\pi \times 10^{-7} \times 2\pi \times 2 \times 10^{-6} \times 6.25 \times 10^{12}}{4\pi \times 6.28}$$
$$= 1.25m$$

13 **(c)**

As, $qV = \frac{1}{2}mv^2$ or $v = \sqrt{\frac{2qV}{m}}$; when particle describes a circular path of radius R in the magnetic field

$q\,v\,B = \frac{mv^2}{R}$ or $R = \frac{m\,v^2}{q\,v\,B} = \frac{m\,v}{q\,B}$

Or $R = \frac{m}{q\,B}\sqrt{\frac{2\,q\,V}{m}} = \frac{1}{B}\sqrt{\frac{2\,V\,m}{q}}$

ie, $R \propto \sqrt{m}$ $\therefore \frac{m_x}{m_y} = \left(\frac{R_1}{R_2}\right)^2$

14 **(b)**

$i = \frac{k}{n\,BA}\theta$ or $\theta = \frac{n\,BA}{k}$ $ie, \theta \propto n$.

15 **(b)**

To convert a galvanometer into a voltmeter, a resistance $R = \frac{V}{i_g} - G$ is connected in series of it.

To convert galvanometer into an ammeter, a resistance $S = i_g G/(i - i_g)$ is to be connected in parallel of galvanometer.

16 **(d)**

For a point at a distance $x = +a$, the angle between $d\,\vec{I}$ and $\vec{r}$ is zero. Hence, $d\,\vec{I} \times \vec{r} = 0$.

17 **(d)**

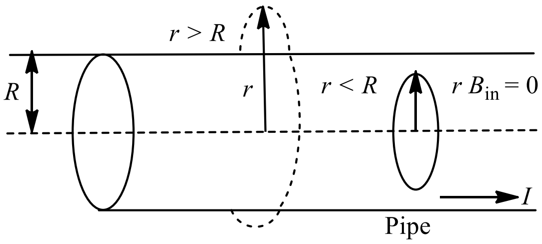
By Fleming's left hand rule

18 **(c)**

Required arrangement is shown in figure.

According to Ampere's circuital law

$B_{\text{out}} = \frac{m_0}{4p}\frac{2I}{r}$



For an internal point, $r < R$

$B_{\text{internal}} = \frac{\mu_0(0)}{2\pi r} = 0$

For a point on the pipe, $r = R$

$B = \frac{\mu_0 I}{2\pi r}$

For an external point, $r < R$

$B_{\text{external}} = \frac{\mu_0 I}{2\pi r}$

Therefore, option (c) is correct.

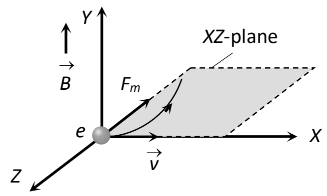
19 **(d)**

The magnetic field at any point on the axis of wire be zero

21 **(b)**

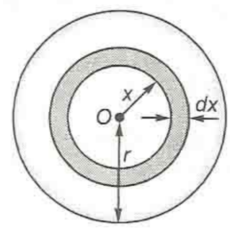
$\vec{F} = -e(\vec{v} \times \vec{B}) \Rightarrow \vec{F} = -e[v\hat{\imath} \times B\hat{\jmath}] = evB[-\hat{k}]$

$i.e.$ Force on electron is acting towards negative z-axis. Hence particle will move in a circle in xz-plane



22 **(b)**

Consider a hypothetical ring of radius x and thickness kx of a disc as shown in figure.

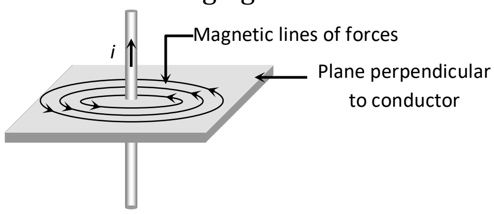


Charge on the ring, $dq = \frac{q}{\pi r^2} \times (2\pi x dx)$

Current due to rotation of charge on ring is
$di = \frac{dq}{T} = \frac{dq}{1/n} = ndq = \frac{nq2xdx}{r^2}$
Magnetic field at the centre O due to current of ring element is
$$dB = \frac{\mu_0 di}{2x} = \frac{\mu_0 nq2xdx}{r^2(2x)} = \frac{\mu_0\ nq\ dx}{r^2}$$
Total magnetic field induction due to current of whole disc is
$B = \int_0^r dx = \frac{\mu_0\ nq}{r^2}(x)_0^2 = \frac{\mu_0 nq}{r}$.

23 **(a)**
The current enclosed with in the circle
$$\frac{i}{\pi a^2}, \pi r^2 = \frac{i}{a^2} r^2$$
Ampere's law $\oint \mathbf{B}.\mathbf{dl} = \mu_0 i'$ gives
$$B.2\pi r = \frac{\mu_0 i r^2}{a^2}$$
or $B = \frac{\mu_0 ir}{2\pi a^2}$

24 **(a)**
$$B = \frac{F}{m} = \frac{1.5}{7.5 \times 10^{-2}} = 20 \text{ T or } 20 \text{ Wbm}^{-2}$$

25 **(c)**
See the following figure


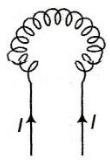
26 **(d)**
Kinetic energy in magnetic field remains constant and it is $K = q\ V \Rightarrow K \propto q\ [V = \text{constant}]$
$\therefore K_p : K_d : K_\alpha = q_p : q_d : q_a = 1:1:2$

27 **(c)**
$$B \propto \frac{1}{r} \Rightarrow \frac{B_1}{B_2} = \frac{r_2}{r_1} \Rightarrow \frac{B}{B_2} = \frac{r/2}{r} \Rightarrow B_2 = 2B$$

28 **(d)**
$$Bqv = \frac{mv^2}{r} \Rightarrow r = \frac{mv}{Bq} \quad \text{... (i)}$$
Since particle was initially at rest and gained a velocity v due to a potential difference of V volt. So,

KE of particle $= \frac{1}{2} mv^2 = qV$
$$v = \sqrt{\frac{2qV}{m}} \quad \text{... (ii)}$$
From Eqs. (i) and (ii), we get
$$r = \frac{m}{Bq}\sqrt{\frac{2qV}{m}}$$
$$r = \frac{1}{B}\sqrt{\frac{2mV}{q}}$$
$\therefore$ Diameter of the circular path
$$d = 2r = \frac{2}{B}\sqrt{\frac{2mV}{q}}$$

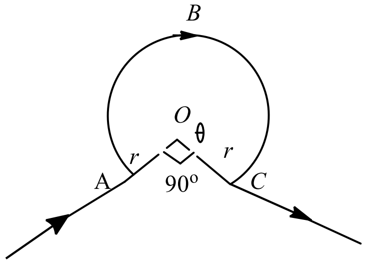
29 **(d)**
The direction of magnetic field is along the direction of motion of the charge particles, so angle will be 0°.
$\therefore$ Force $F = qvB \sin\theta$
$= qvB \sin\theta$
$= 0 \quad (\because \sin\theta = 0)$
So, there will be no change in the velocity.

30 **(a)**
Toroid is ring shaped closed solenoid.


31 **(b)**
$B = \frac{\mu_0 ni}{2} = \frac{(4\pi \times 10^{-7}) \times 800 \times 1.6}{2} = 8 \times 10^{-4}$ T.

32 **(b)**
Magnetic field at mid-point M in first case is $B = B_{PQ} - B_{RS}$
($\therefore B_{PQ}$ and B_{RS} are in opposite directions)
$= \frac{4\ \mu_0}{4\pi d} - \frac{2\ \mu_0}{4\pi d} = \frac{2\ \mu_0}{4\pi d}$
When the current 2 A is switched off, the net magnetic field at M is due to current 1 A
$$B' = \frac{\mu_0 \times 2 \times 1}{4\pi d} = B$$

33 **(d)**
Let the given circular ABC part of wire subtends an angle θ at its centre. Then, magnetic field due to this circular part is



$$B' = B_c \times \frac{\theta}{2\pi} = \frac{\mu_0}{4\pi} \times \frac{2\pi i}{e} \times \frac{\theta}{2\pi}$$

$$\Rightarrow \; B' = \frac{\mu_0}{4\pi} . \frac{i}{r}\, \theta$$

Given, $i = 40$ A, $r = 3.14$ cm $= 3.14 \times 10^{-2}$ m

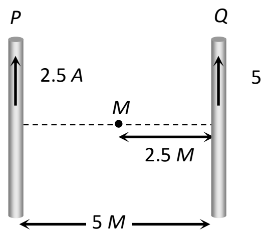
$$\theta = 360° - 90° = 270° = \frac{3\pi}{2} \text{ rad.}$$

$$\therefore B' = \frac{10^{-7} \times 40}{3.14 \times 10^{-2}} \times \frac{3\pi}{2}$$

$$B' = 6 \times 10^{-4} \text{ T}$$

34 **(d)**

In the following figure magnetic field at mid point M is given by



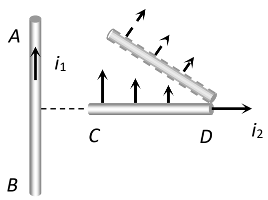
$B_{net} = B_Q - B_P$

$= \frac{\mu_0}{4\pi} . \frac{2}{r} (i_Q - i_P)$

$= \frac{\mu_0}{4\pi} \times \frac{2}{2.5} (5 - 2.5) = \frac{\mu_0}{2\pi}$

36 **(c)**

Since the force on the rod CD is non-uniform it will experience force and torque. From the left hand side it can be seen that the force will be upward and torque is clockwise



37 **(b)**

Circumference = length of the wire

$2\pi r = L$

$r = \frac{L}{2\pi}$

$r = \frac{1}{\pi}$ $\quad (\because L = 2 \text{ m})$

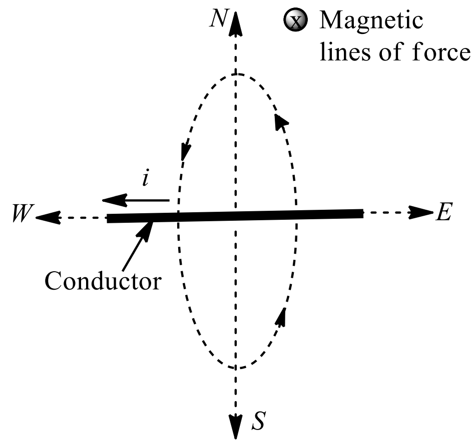
Magnetic moment $M = nIA$

$= 1 \times 1 \times \pi \left[\frac{1}{\pi}\right]^2$

$= \frac{1}{\pi}$ Am^2

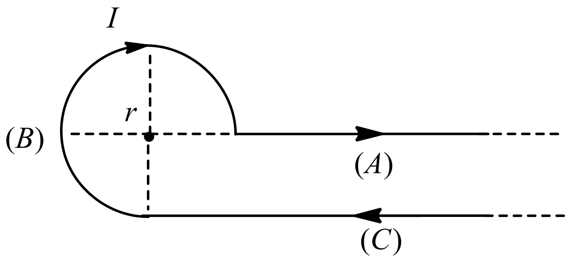
38 **(c)**

According to Maxwell's right hand screw rule, the direction of magnetic field at a point above the conductor is towards north and at a point above the conductor is towards north and at a point below the conductor is towards south.



40 **(a)**

$B_A = 0$



$B_B = \frac{\mu_0}{4\pi} \frac{(2\pi - \pi/2)I}{r} \otimes = \frac{\mu_0}{4\pi} \frac{3\pi I}{2r}$

$B_C = \frac{\mu_0 I}{4\pi r} \otimes$

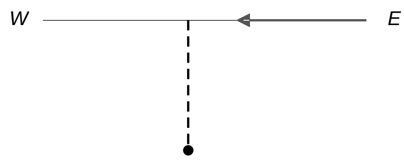
So, net magnetic field at the centre

$= B_A + B_B + B_C$

$= 0 + \frac{\mu_0}{4\pi} \frac{3\pi I}{2r} + \frac{\mu_0 I}{4\pi r} = \frac{\mu_0}{4\pi} \frac{I}{r} \left(\frac{3\pi}{2} + 1\right)$

41 **(c)**

$B = \frac{\mu_0 I}{2\pi R}$



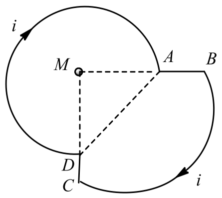
Direction is given by Right hand palm value No. 1

$B = \frac{2 \times 10^{-7} \times 100}{4}$ T towards south

42 **(d)**

(i) Magnetic field at the centre due to the curved portion $DA = \frac{\mu_0 i}{4\pi R}\left(\frac{3\pi}{2}\right)$

According to right hand screw rule, the magnetic field will be into the plane of paper.



(ii) Magnetic field at M due to AB is zero.

(iii) Magnetic field at the centre due to the curved portion BC is $\frac{\mu_0 i}{4\pi 2R}\left(\frac{\pi}{2}\right)$. According to

right hand screw rule, the magnetic field will be into the plane of paper.

(iv) Magnetic field at M due to DC is zero.

Hence, the resultant magnetic field at M

$$= \frac{3\mu_0 i}{8R} + 0 + \frac{\mu_0 i}{16R} + 0 = \frac{7\mu_0 i}{16R}$$

43 **(c)**

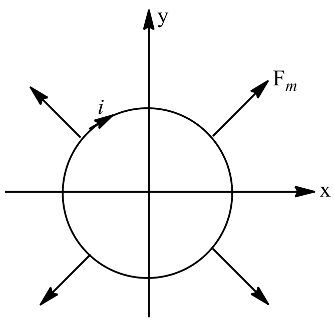
Magnetic field at the centre of the circle

$$B = \frac{\mu_0 i}{2r} \text{ or } B = \frac{\mu_0 q}{2rT}$$

$$B = \frac{4\pi \times 10^{-7} \times q}{2r}\ n$$

44 **(b)**

Net force on a current carrying loop in uniform magnetic field is zero. Hence the loop can't translate. So, options (c) and (d) are wrong. From Fleming's left hand rule we can see that if magnetic field is perpendicular to paper inwards and current in the loop is clockwise (as shown) the magnetic force $\mathbf{F}_m$ on each element of the loop is radially outwards, or the loops will have a tendency to expand.



45 **(a)**

In adjoining loops of spring, the current being in the same direction, there will be attraction. Due to which the spring gets compressed.

46 **(d)**

The minimum value of magnetic field

$$B = \frac{F}{qv \sin 90°}$$

$$= \frac{10^{-10}}{10^{-12} \times 10^5} = 10^{-3} \text{ T in } z - \text{direction}$$

47 **(a)**

$$r = \frac{mv}{Bq} = \frac{\sqrt{2E_k m}}{Bq}$$

$$= \frac{\sqrt{2 \times 6 \times 10^{-16} \times 9 \times 10^{-31}}}{6 \times 10^{-3} \times 1.6 \times 10^{-19}}$$

On solving $r = 3.42$ cm.

48 **(a)**

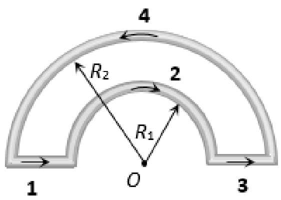
In the following figure, magnetic fields at O due to section 1, 2, 3 and 4 are considered as B_1, B_2, B_3 and B_4 respectively

$B_1 = B_3 = 0$

$B_2 = \frac{\mu_0}{4\pi} \cdot \frac{\pi i}{R_1} \otimes$

$B_4 = \frac{\mu_0}{4\pi} \cdot \frac{\pi i}{R_2} \odot$ As $|B_2| > |B_4|$

So $B_{net} = B_2 - B_4 \Rightarrow B_{net} = \frac{\mu_0 i}{4}\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \otimes$



49 **(b)**

Here, $i = 4\text{A}$; $\text{V} = 20$ Volt; so,

$R = \frac{V}{I} = \frac{20}{4} = 5\text{A}$. Since, voltmeter is connected in parallel with resistance R, the effective resistance of this combination is 5 Ω only if the resistance R is greater than 5Ω, since total resistance in parallel combination becomes less than individual resistance.

50 **(a)**

Here, $2l = 3$ cm; $d_1 = 24$ cm, $d_2 = 48$ cm.

As the magnet is short, $\frac{B_1}{B_2} = \frac{d_2^3}{d_1^3} = \left(\frac{48 \text{ cm}}{24 \text{ cm}}\right)^3 = 8$

51 **(c)**

Force on wire C due to wire D.

$F_1 = \frac{\mu_0}{2\pi}\frac{I_1 I_2}{r} l$ (repulsive)

$$= 2 \times 10^{-7} \times \frac{30 \times 10}{3 \times 10^{-2}} \times 25 \times 10^{-2}$$

$$= 2 \times 10^{-7} \times 2500 = 5 \times 10^{-4} \text{ N}$$

Force on wire C due to wire G

$F_2 = \frac{\mu_0}{2\pi}\frac{I_1 I_2}{r} l$ (repulsive)

$= \frac{2\times10^{-7}\times10\times20}{2\times10^{-2}}\times25\times10^{-2}$

$= 2\times10^{-7}\times2500 = 5\times10^{-4}$ N

Net force $= F_1 - F_2 = 5\times10^{-4}\text{ N} - 5\times10^{-4}\text{ N} = 0$

52 **(b)**

From Biot-Savart's law the magnetic field (B) due to a conductor carrying current I, at a distance r_1 is

$$B_1 = \frac{\mu_0 I_1}{2\pi r_1}$$

Magnetic field at P due to current in second conductor is

$$B_2 = \frac{\mu_0 I_2}{2\pi(r_1+d)}$$

From Fleming's right hands rule the fields at P are directed opposite.

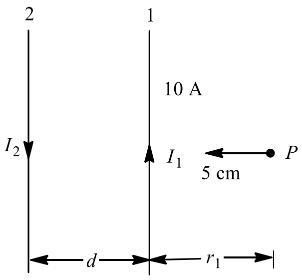
$\therefore$ Resultants, field $B_1 = B_2$

$$\therefore \frac{\mu_0 I_1}{2\pi r_1} = \frac{\mu_0 I_2}{2\pi(r_1+d)}$$

Given, $I_1 = 10$ A, $r_1 = 5, r_1 + d = 5 + 10 = 15$ cm

$$\therefore \quad I_2 = \frac{I_1}{r_1}\times(r_1+d)$$

$$I_2 = \frac{10}{5}\times15 = 30\text{ A}$$



53 **(b)**

When two infinitely long parallel conductors carrying currents i_1 and i_2 are placed a distance r apart, then force on the unit length of a conductor due to the other conductor is given by

$F = \frac{\mu_0}{4\pi}\frac{2i_1 i_2}{r}$

Here, $i_1 = i_2 = i$ and $r = b$

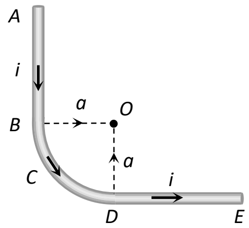
$\therefore F = \frac{\mu_0 i^2}{2\pi b}$

54 **(d)**

The field at O due to AB is $\frac{\mu_0}{4\pi}.\frac{i}{a}\hat{k}$ and that due to DE is also $\frac{\mu_0}{4\pi}.\frac{i}{a}\hat{k}$

However the field due t BCD is $\frac{\mu_0}{4\pi}.\frac{i}{a}\left(\frac{\pi}{2}\right)\hat{k}$

Thus the total field at O is $\frac{\mu_0}{4\pi}.\frac{i}{a}\left(2+\frac{\pi}{2}\right)\hat{k}$



55 **(b)**

$B = \mu_0 ni$

56 **(b)**

$B = \frac{40}{4\pi}\times\frac{\pi i}{r} = 10^{-7}\times\frac{\pi\times10}{20\times10^{-2}}$ 5πμ tesla

57 **(d)**

Cyclotron frequency, $v = \frac{Bq}{2\pi m}$

$\Rightarrow \quad v = \frac{1\times1.6\times10^{-19}}{2\times3.14\times9.1\times10^{-31}}$

$= 2.79\times10^{10}$ Hz

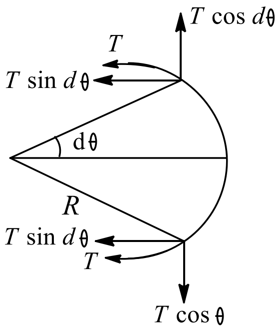
≈ 28 GHz

59 **(d)**

If force on the electron due to electric field is equal and opposite to the force on electron due to magnetic field, then electron will go undeflected.

60 **(a)**

For small element proton



$2T\sin d\theta = 2R\, d\theta$ iB

$2Td\theta = 2Ribd\theta$

$T = iRB$

61 **(a)**

$B = \mu_0 ni \Rightarrow i = \frac{B}{\mu_0 n} = \frac{20\times10^{-3}}{4\pi\times10^{-7}\times20\times100}$

$= 7.9amp = 8amp$

62 **(b)**

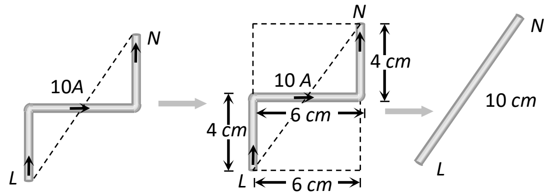
$\frac{\mu_0}{4\pi}.\frac{2\pi ni}{r} \Rightarrow B \propto ni$

63 **(d)**

The magnetic field B will be uniform inside the hollow tube, excepts near the ends. Also magnetic field is zero at any point outside the tube.

64 **(c)**
The Lorentz force acting on the current carrying conductor in the magnetic field is
$F = IBl \sin\theta$
Since, wire PQ is parallel to the direction of magnetic field, then $\theta = 0$,
$\therefore F_{PQ} = IBl \sin 0° = 0$
Also, wire QR is perpendicular to the direction of magnetic field, then $\theta = 90°$.
$\therefore F_{QR} = IBl \sin 90° = IBl$

65 **(b)**
The given wire can be replaced by a straight wire as shown below



Hence force experienced by the wire
$F = Bil = 5 \times 10 \times 0.1 = 5N$

66 **(c)**
$$B = 10^{-7}\frac{2\pi ni}{r} = 10^{-7} \times \frac{2 \times \pi \times 25 \times 4}{5 \times 10^{-2}}$$
$$= 1.257 \times 10^{-3}T$$

67 **(b)**
For a point inside the tube, using Ampere law, $\oint \vec{B}.d\vec{l} = \mu_0 i$. Here, we have $i = 0$ for inside the tube.
$\therefore B = 0$

68 **(d)**
Due to decrease in crosses (×), induced current in outer loop is anticlockwise, *i.e.*, from d to c and clockwise in inner loop *i.e.*, from $a \to b$

69 **(a)**
Magnetic field due to revolution of electron
$$B = \frac{\mu_0}{4\pi}.\frac{2\pi i}{r} = \frac{\mu_0}{4\pi}.\frac{2\pi.\left(\frac{e\omega}{2\pi}\right)}{r} = 10^{-7} \times \frac{e\omega}{r}$$
$$\Rightarrow 16 = 10^{-7} \times \frac{1.6 \times 10^{-19}\omega}{1 \times 10^{-10}} \Rightarrow \omega$$
$$= 10^{17} rad/sec$$

71 **(b)**
Deflecting couple = torque on the loop = $BiA \cos\theta$.

72 **(c)**
For undeviated motion $|\overrightarrow{F_e}| = |\overrightarrow{F_m}|$, which happens when $\vec{v}, \vec{E}$ and $\vec{B}$ are mutually perpendicular to each other

73 **(c)**
$i = 30$ A, $B = 4 \times 10^{-4}$ T

$r = 2$ cm $= 2 \times 10^{-2}$ m

Initial magnetic field (parallel to the wire)

$B_1 = 4 \times 10^{-4}$ T

Magnetic field produced by the straight wire

$$B_2 = \frac{\mu_0 i}{2\pi r} = \frac{2 \times 10^{-7} \times 30}{2 \times 10^{-2}}$$

$$= 3 \times 10^{-4} \text{ T}$$

B_2 will be in the plane perpendicular to the plane of wire, so

B_1 and B_2 are perpendicular to each other.

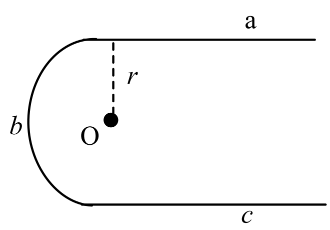
∴ Resultant magnetic field

$$B = \sqrt{B_1^2 + B_2^2}$$

$$= \sqrt{(4 \times 10^{-4})^2 + (3 \times 10^{-4})^2}$$

$$= 5 \times 10^{-4}$$

74 **(b)**
Field due to a straight wire of infinite length is $\frac{\mu_0 i}{4\pi r}$ if the point is on a line perpendicular to its length while at the centre of a semicircular coil is $\frac{\mu_0 \pi i}{4\pi r}$.



$$\therefore \quad B = B_a + B_b + B_c$$

$$= \frac{\mu_0}{4\pi}\frac{i}{r} + \frac{\mu_0}{4\pi}\frac{\pi i}{r} + \frac{\mu_0}{4\pi}\frac{i}{r}$$

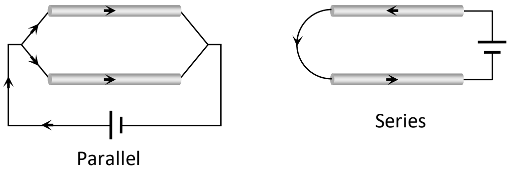
$$= \frac{\mu_0}{4\pi}\frac{i}{r}(\pi + 2) \text{ out of the page}$$

75 **(a)**
The effective magnetic field at O
$$B = B_{PE} + B_{RS} = \frac{\mu_0}{4\pi}.\frac{3}{2}\frac{\pi I}{R} + \frac{\mu_0}{4\pi}.\frac{\pi}{2}.\frac{I}{2R}$$
$$\Rightarrow B = \frac{\mu_0 I}{4R}\left[\frac{3}{2} + \frac{1}{4}\right] = \frac{7}{16}\frac{\mu_0 I}{R}$$

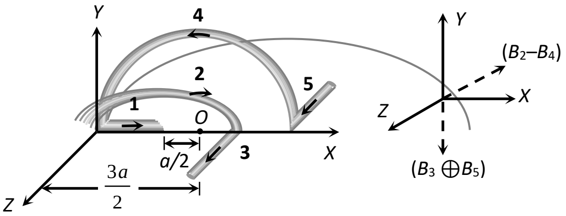
As per Fleming's Right Hand rule, direction of magnetic field is perpendicular and in the plane of paper

76 **(a)**

When connected in parallel the current will be in the same direction and when connected in series the current will be in the opposite direction



77 **(b)**



Magnetic field at 0 due to

Part (1) : $B_1 = 0$

Part (2) : $B_2 = \frac{\mu_0}{4\pi}.\frac{\pi i}{(a/2)}\otimes$ [along $-Z$-axis]

Part (3) : $B_3 = \frac{\mu_0}{4\pi}.\frac{i}{(a/2)}(\downarrow)$ [along $-Y$-axis]

Part (4) : $B_4 = \frac{\mu_0}{4\pi}.\frac{\pi i}{(3a/2)}\odot$ [along $+Z$-axis]

Part (5) : $B_5 = \frac{\mu_0}{4\pi}.\frac{i}{(3a/2)}(\downarrow)$ [along $-Y$-axis]

$B_2 - B_4 = \frac{\mu_0}{4\pi}.\frac{\pi i}{a}\left(2-\frac{2}{3}\right) = \frac{\mu_0 i}{3a}\otimes$ [along $-Z$-axis]

$B_3 + B_5 = \frac{\mu_0}{4\pi}.\frac{1}{a}\left(2+\frac{2}{3}\right) = \frac{8\mu_0 i}{12\pi a}(\downarrow)$ [along $-Y$-axis]

Hence net magnetic field

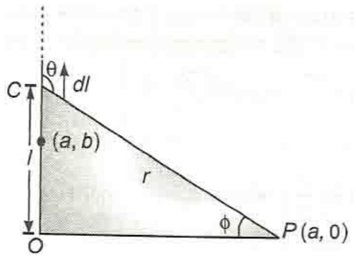
$B_{net} = \sqrt{(B_2-B_4)^2+(B_3+B_5)^2}$

$\frac{\mu_0 i}{3\pi a}\sqrt{\pi^2+4}$

78 **(b)**

As shown figure take an element dl at C of wire, where $OC = l$. Let $PC = r$ and $\angle OPC = \phi$.

According to Biot Savarts law; magnitude of magnetic field induction at P due to current element at C is



$dB = \frac{\mu_0}{4\pi}\frac{idl\sin\theta}{r^2}$

(i)

Here, $\theta = 90° + \phi; r = a\sec\phi$

And $l = a\tan\phi; dl = a\sec^2\phi\, d\,\phi$

$\therefore\ dB = \frac{\mu_0}{4\pi}\frac{i(\sec^2\phi\, d\,\phi)\sin(90°+\phi)}{a^2\sec^2\phi}$

$= \frac{\mu_0}{4\pi}\frac{1}{a}\cos\phi\, d\,\phi$

Total magnetic field induction at P is

$B = \int_{\phi_1} 90°\ \frac{\mu_0}{4\pi}\frac{1}{a}\cos\phi\, d\,\phi = \frac{\mu_0}{4\pi}\frac{1}{a}(\sin\phi)_{\phi_1}^{90°}$

$= \frac{\mu_0}{4\pi}\frac{1}{a}(1-\sin\phi_1) = \frac{\mu_0}{4\pi}\frac{1}{a}\left(1-\frac{b}{\sqrt{a^2+b^2}}\right)$

79 **(a)**

The magnetic field in between because of each will be in opposite direction

$B_{\text{in between}} = \frac{\mu_0 i}{2\pi x}\hat{\mathbf{j}} - \frac{\mu_0 i}{2\pi(2d-x)}(-\hat{\mathbf{j}})$

$= \frac{\mu_0 i}{2\pi}\left[\frac{1}{x}-\frac{1}{2d-x}\right](\hat{\mathbf{j}})$

At $x = d, B_{\text{in between}} = 0$

For $x < d, B_{\text{in between}} = (\hat{\mathbf{j}})$

For $x > d, B_{\text{in between}} = (-\hat{\mathbf{j}})$

Towards x, net magnetic field will add up and direction will be $(-\hat{\mathbf{j}})$.

Towards x', net magnetic field will add up and direction will be $(-\hat{\mathbf{j}})$.

80 **(c)**

Magnetic force on the rod $= BIl$

Weight of the rod $= mg$

For no tension in wire, $BIl = mg$

or $I = \frac{mg}{Bl} = \frac{1\times10}{2\times1} = 5$ A

81 **(d)**

Torque $\vec{\tau} = \vec{M}\times\vec{B}$ or $\tau = BM\sin\theta$, where $\vec{M}$ is perpendicular to the plane of the coil. Due to this torque, the coil will orient itself so that the torque on the coil is zero. $ie, \theta = 0^0$. It means $\vec{M}$ is parallel to $\vec{B}$. So, the plane of the coil is perpendicular to this direction of magnetic field.

82 **(d)**

$B = \frac{\mu_0}{4\pi}\frac{2I}{r}$

or $B \propto \frac{1}{r}$

$\therefore \frac{B'}{B} = \frac{r}{2r}$

or $B' = B\times\frac{r}{2r} = 0.4\times\frac{1}{2} = 0.2$ T

83 **(d)**

Magnetic force on straight wire

$F = Bil\sin\theta = Bil\sin 90° = Bil$

For equilibrium of wire in mid-air,

$F = mg$

$Bil = mg$

$$\therefore B = \frac{mg}{il} = \frac{200 \times 10^{-3} \times 9.8}{2 \times 1.5} = 0.65 \text{ T}$$

84 **(a)**

$$r = \frac{\sqrt{2mK}}{qB} \Rightarrow K \propto \frac{q^2}{m} \Rightarrow \frac{K_p}{K_\alpha} = \left(\frac{q_p}{q_\alpha}\right)^2 \times \frac{m_\alpha}{m_p}$$

$$\Rightarrow \frac{1}{K_\alpha} = \left(\frac{q_p}{2q_p}\right) \times \frac{4m_p}{m_p} = 1 \Rightarrow K_\alpha = 1\ MeV$$

85 **(c)**

Magnetic induction at the centre of the coil of radius r is

$$B_c = \frac{\mu_0 nI}{2r} \quad \ldots \text{(i)}$$

Magnetic induction on the axial line of a circular coil at a distance x from the centre is

$$B_a = \frac{\mu_0 nr^2 I}{2(r^2 + x^2)^{3/2}}$$

Given $x = r$

$$\therefore\ B_a = \frac{\mu_0 nr^2 I}{2(2r^2)^{3/2}} \quad \ldots \text{(ii)}$$

From Eqs. (i) and (ii), we get

$$\frac{B_c}{B_a} = \frac{2\sqrt{2}}{1}$$

86 **(b)**

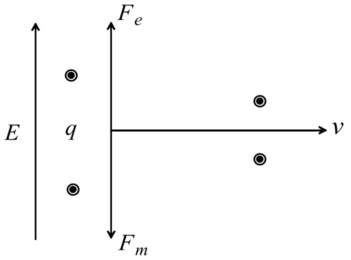
$Bev = mv^2/r$ or $v = Ber/m$

$$= \frac{10^{-3} \times 1.6 \times 10^{-19} \times 0.01}{9.0 \times 10^{-31}}$$

$= 1.77\ \times 10^6\ \text{ms}^{-1}$

87 **(b)**

If both electric and magnetic fields are present and perpendicular to each other and the particle is moving perpendicular to both of them with $F_e = F_m$. In this situation $\vec{\mathbf{E}} \neq 0$ and $\vec{\mathbf{B}} \neq 0$.



But if electric field becomes zero, then only force due to magnetic field exists. Under this force, the charge moves along a circle

88 **(d)**

Magnetic force on straight wire

$F = Bil \sin\theta$

$= Bil \sin 90° = Bil$

For equilibrium of wire in mid-air,

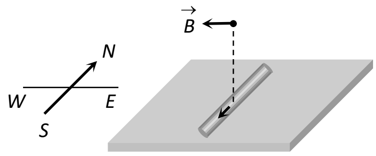
$F = mg$

$Bil = mg$

$$\therefore B = \frac{mg}{il}$$

$$= \frac{200 \times 10^{-3} \times 9.8}{2 \times 1.5} = 0.65 \text{ T}$$

89 **(d)**



90 **(a)**

$$F = \frac{\mu_0}{4\pi}\frac{2i_1 i_2}{a} = 10^{-7} \times \frac{2 \times 10 \times 5}{0.1}$$

$= 10^{-4} N$ [Repulsive]

91 **(a)**

$r = \frac{mv}{Bq}$ or $r \propto \frac{m}{q}$ for the same value of v and B.

$$\therefore\ r_P : r_d : r_\alpha = \frac{m_P}{q_D} : \frac{m_d}{q_d} : \frac{m_\alpha}{q_\alpha}$$

$$= \frac{m}{l} : \frac{2m}{l} : \frac{4m}{2l} = 1 : 2 : 2$$

92 **(b)**

$$B = \frac{\mu_0}{4\pi}\frac{\theta i}{r} = \frac{\mu_0}{4\pi} \times \frac{\pi}{2} \times \frac{i}{R} = \frac{\mu_0 i}{8R}$$

93 **(c)**

The magnetic induction due to both semicircular parts will be in the same direction perpendicular to the paper inwards

$$\therefore B = B_1 + B_2 = \frac{\mu_0 i}{4r_1} + \frac{\mu_0 i}{4r_2} = \frac{\mu_0 i}{4}\left(\frac{r_1 + r_2}{r_1 r_2}\right) \otimes$$

94 **(c)**

As, $\quad qV = \frac{1}{2}mv^2$

Or $\quad v = \sqrt{2qV/m}$;

So, $\quad v \propto \sqrt{q/m} \quad \therefore \frac{v_2}{v_1} \propto \sqrt{\frac{2q/4m}{q/m}} = \frac{1}{\sqrt{2}}$

95 **(d)**

$M = niA = ni(\pi r^2) \Rightarrow M \propto r^2$

96 **(a)**

If the particle enters in the magnetic field parallel to the direction of the field, then it will move in a straight line.

97 **(b)**

Here, $2r = 0.1$ nm $= 0.1\ \times 10^{-9}$ m $= 10^{-10}$ m;

$$i = \frac{e}{T} = \frac{e\omega}{2\pi}$$

Now, $B = \frac{\mu_0}{4\pi}\frac{2\pi ni}{r} = \frac{\mu_0}{4\pi}\frac{2\pi n}{r}\left(\frac{e\omega}{2\pi}\right)$

$= \frac{\mu_0}{4\pi}\frac{ne\omega}{r}$

Or $\omega = B.\left(\frac{4\pi}{\mu_0}\right) \times \frac{r}{ne}$

$$= 14\ \times \frac{1}{10^{-7}} \times \frac{(10^{-10})/2}{1 \times 1.6 \times 10^{-19}}$$

$= 4.4 \times 10^{16}\ \text{rads}^{-1}$.

98 **(b)**

$$\frac{mv^2}{R} = qvB$$

For proton, $R_p = \frac{mv}{Bq} = \frac{\sqrt{2M_pE}}{q_pB}$

Similarly for deuteron and α-particle

$R_d = \frac{\sqrt{2M_dE}}{q_pB}$ and $R_\alpha = \frac{\sqrt{2M_\alpha E}}{q_\alpha B}$

According to the question

$\therefore R_p : R_d : R_\alpha$

or $\frac{\sqrt{M_p}}{q_p} : \frac{\sqrt{M_d}}{q_d} : \frac{\sqrt{M_\alpha}}{q_a}$

$\therefore \frac{\sqrt{1}}{1} : \frac{\sqrt{2}}{1} : \frac{\sqrt{4}}{2}$ or $1 : \sqrt{2} : 1$

99 **(a)**

Charged particles deflect in magnetic field

100 **(d)**

$T = \frac{2\pi m}{qB} \Rightarrow T \, \alpha \, v^o$

102 **(d)**

The time period of revolution of the electrion is

$$T = \frac{2\pi m}{qB} = \frac{2 \times 3.14 \times 9.0 \times 10^{-31}}{1.6 \times 10^{-19} \times 1 \times 10^{-4}}$$

$$= 3.5 \times 10^{-7} \text{ s}$$

103 **(a)**

When a charged particle having K.E. T is subjected to a transverse uniform magnetic field, it describes a circular path in the magnetic field without any change in its speed. Thus, the K.E. of the charged particle remains T at all times

104 **(c)**

$M = NiA \Rightarrow M \propto A \Rightarrow M \propto r^2$ [As $I = 2\pi r \Rightarrow l \propto r$]

$\Rightarrow M \propto l^2$

105 **(b)**

The magnetic field at the centre of circular coil is

$$B = \frac{\mu_0 i}{2r}$$

Where, r = radius of circle $= \frac{l}{2\pi}$ $\quad (\because l = 2\pi r)$

$$\therefore B = \frac{\mu_0 i}{2} \times \frac{2\pi}{l}$$

$$= \frac{\mu_0 i \pi}{l} \qquad \text{... (i)}$$

When wire of length l bents into a circular loops of n turns, then

$$l = n \times 2\pi r'$$

$$\Rightarrow r' = \frac{1}{n \times 2\pi}$$

Thus, new magnetic field

$$B' = \frac{\mu_0 ni}{2r'} = \frac{\mu_0 ni}{2} \times \frac{n \times 2\pi}{l}$$

$$= \frac{\mu_0 i\pi}{l} \times n^2$$

$$= n^2 B$$

[From Eq. (i)]

106 **(d)**

When charged particle enters perpendicularly in a magnetic field, it moves in a circular path with a constant speed. Hence it's kinetic energy also remains constant

107 **(a)**

$r = \frac{mv}{qB} \Rightarrow \frac{e}{m} = \frac{v}{rB}$

108 **(b)**

Magnitude of the magnetic moment

$M = I\,A \begin{bmatrix} \text{where} & I & \text{is the current} \\ \text{and} & A & \text{is the area} \end{bmatrix}$

The current produced in one revolution

$$I = ev = e\frac{2\pi}{T}$$

$\therefore$ Magnetic moment $= \frac{2\pi}{T}|e|A$

As the electron is flowing in the anticlockwise direction. The current is flowing in the clockwise direction.

$\therefore M = -\frac{2\pi}{T}|e|A$

110 **(c)**

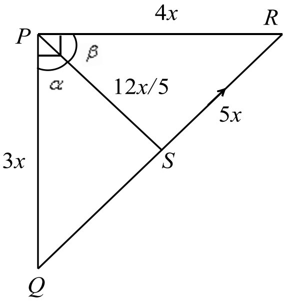
Magnetic field at P due to PQ & PR is zero

$\therefore$ Magnetic field at P due to QR

$B = \frac{\mu_0}{4\pi} \cdot \frac{I}{PS}(\sin\alpha + \sin\beta)$

Where, $B = \frac{\mu_0}{4\pi} \cdot \frac{1}{\frac{12x}{5}}\left[\frac{3}{5} + \frac{4}{5}\right]$

$B = \frac{\mu_0}{4\pi} \times \frac{1}{12x} \times 7 = \frac{7\mu_0 I}{48\,\pi x} \quad \therefore k = 7$



111 **(a)**

Using $eE = evB \Rightarrow E = vB = 5 \times 10^6 \times 0.02 = 10^5 Vm^{-1}$

113 **(b)**

Current carrying conductors will attract each other, while electron beams will repel each other

114 **(c)**

Force on the wire $= Bil$

Force per unit length $= Bi = 10^{-4} \times 10 = 10^{-3} N$

116 **(c)**

Net force on loop is zero

117 **(b)**

For charge particles, if they are moving freely in space, electrostatic force is dominant over magnetic force between them. Hence due to electric force they repel each other

118 **(b)**

$r = \sqrt{2mE}/Bq$ and $r_1 = \sqrt{2m(E/2)}/Bq$;

So, $r_1 = r/\sqrt{2}$

119 **(c)**

Here, $i_g = \frac{1}{2}i$; $S = 40\Omega$, G=?

$G = (i - i_g)S/i_g = \frac{(i-i/2)\times 40}{i/2} = 40\Omega$

120 **(a)**

For wire A,

$$B_1 = \frac{\mu_0 i_1}{2r}$$

Where $r = \frac{40}{2\pi}$

For wire B,

Circumference = length

$$n\pi r = 30$$

or $n\pi = \frac{30}{r} = \frac{30}{40/2\pi} = \frac{3}{2}\pi$

or $\theta = n\pi = \frac{3}{2}\pi$

$\therefore \quad B_2 = \frac{\mu_0}{4\pi}\left(\frac{i_2}{r}\right)\theta$

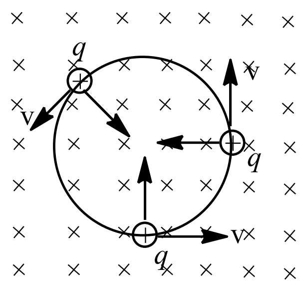
But $B_1 = B_2$

or $\frac{\mu_0 i_1}{2r} = \frac{\mu_0}{4\pi}\left(\frac{i_2}{r}\right)\theta$

or $\frac{i_1}{i_2} = \frac{3}{4}$

121 **(d)**

For perpendicular magnetic field magnetic force is provided by the force so,



$$\frac{mv^2}{r} = qvB$$

$ie, \quad r = \frac{mv}{qB}$ ... (i)

As in uniform circular motion $v = r\omega$, so the angular frequency of circular motion will be given by

$\omega = \frac{v}{r} = \frac{qB}{m}$ [Using Eq. (i)]

and hence the time period

$T = \frac{2\pi}{\omega} = \frac{2\pi m}{qB}$ ... (ii)

Given, $B = 3.534 \times 10^{-5}$ T,

$q = 1.6 \times 10^{-19}$ C, $m = 9.1 \times 10^{-31}$ kg, T =?

From Eq. (ii), we get

$$\therefore \quad T = \frac{2 \times 3.14 \times 9.1 \times 10^{-31}}{3.534 \times 10^{-5} \times 1.6 \times 10^{-19}} = 1 \times 10^{-6} \text{ s}$$
$$= 1\mu\text{s}$$

122 **(c)**

Force acting between two current carrying conductors

$F = \frac{\mu_0}{2\pi}\frac{I_1 I_2}{d}\, l$ ... (i)

Where, d = distance between the conductors,

l = length of each conductor.

Again, $F' = \frac{\mu_0}{2\pi}\frac{(-2I_1)(I_2)}{(3d)} . l$

$= -\frac{\mu_0}{2\pi}\frac{2I_1 I_2}{3d} . l$ ... (ii)

Thus, from Eqs. (i) and (ii)

$$\frac{F'}{F} = -\frac{2}{3}$$

$\Rightarrow \quad F' = -\frac{2}{3}F$

123 **(b)**

$F_{max} = evB$

$= (1.6 \times 10^{-19}) \times (0.9 \times 3 \times 10^8) \times (10^8)$

$= 4.32 \times 10^{-3}$ N

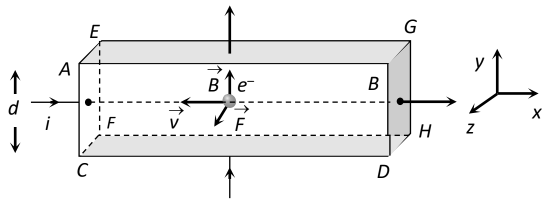
124 **(a)**

The charged particle moving in a magnetic field does not gain energy. However, the direction of its velocity changes continuously. Hence momentum changes

125 **(a)**

As the block is of metal, the charge carriers are electrons, so for current along positive x-axis, the electrons are moving along negative x-axis, $i.e. \vec{v} = -v\hat{\imath}$ and as the magnetic field is along the y-axis, $i.e. \vec{B} = B\hat{\jmath}$. So $\vec{F} = q(\vec{v} \times \vec{B})$ for this case yield $\vec{F} = (-e)[-v\hat{\imath} \times B\hat{\jmath}]$

$i.e., \vec{F} = evB\hat{k}$ [As $\hat{\imath} \times \hat{\jmath} = \hat{k}$]



As force on electrons is towards the face $ABCD$, the electrons will accumulate on it an hence it will acquire lower potential

126 **(a)**

As magnetic moments are directed along SN, angle between $\vec{M}$ and $\vec{M}$ is $\theta = 120°$

∴ Resultant magnetic moment

$= \sqrt{M^2 + M^2 + 2M\,M \cos 120°}$

$= \sqrt{M^2 + M^2 + 2M^2(-1/2)} = M$

127 **(d)**

Since, the currents are flowing in the opposite directions, the magnetic field at a point equidistant from the two wires will be zero. Hence, the force acting on the charge at this instant will be zero.

128 **(d)**

Since force is perpendicular to direction of motion, energy and magnitude of momentum remains constant

129 **(c)**

$r = \frac{\sqrt{2mK}}{qB}$ and $A = \pi r^2 \Rightarrow A = \frac{\pi(2mK)}{q^2B^2} \Rightarrow A \propto K$

130 **(b)**

Direction of magnetic field at every point on axis of a current carrying coil remains same though magnitude varies. Hence magnetic induction for whole of the x-axis will remain positive

Therefore, (c) and (d) are wrong

Magnitude of magnetic field will vary will x according to the formula, $B = \frac{\mu_0 NIR^2}{2(R^2+x^2)^{3/2}}$

Hence, at $x = 0, B = \frac{\mu_0 NI}{2R}$

and when $x \to \infty, B \to 0$

Slope of the graph will be

$$\frac{dB}{dx} = -\frac{3\mu_0 NIR^2 . x}{2(R^2 + x^2)^{5/2}}$$

It means, at $x = 0$, slope is equal to zero or tangent to the graph at $x = 0$, must be parallel to x-axis.

Hence (b) is correct and (a) is wrong

131 **(d)**

Since, the currents in the three wires are flowing in same direction so, the wire B will experience a force of attraction due to both wires A and C,

So, $F_{AB} = \frac{\mu_0}{4\pi} . \frac{2i_A i_B}{d} = \frac{\mu_0}{4\pi} . \frac{2\times1\times2}{d}$

$= \frac{4\mu_0}{4\pi d}$ ... (i)

and $F_{CB} = \frac{\mu_0}{4\pi} . \frac{2i_B i_C}{d} = \frac{\mu_0}{4\pi} \times \frac{2\times2\times3}{d}$

$= \frac{12\mu_0}{4\pi d}$ ... (ii)

As seen from Eqs. (i) and (ii) $F_{CB} > F_{AB}$ hence, the net force of attraction will be directed towards wire C.

132 **(b)**

According to Fleming's left hand rule, in figures (1) and (2) magnetic force on the electron will be directed in – ve $z -$ axis and – ve $x -$ axis respecively. In figure (3) velocity of electron and direction of magnetic field are antiparallel so, no force will act on electron.

133 **(c)**

The magnetic field in the solenoid along its axis

(i) At an internal point $= \mu_o ni$

$= 4\pi \times 10^{-7} \times 5000 \times 4 = 25.1 \times 10^{-3} Wb/m^2$

[Here $n = 50\ turns/cm = 5000\ turns/m$]

(ii) At one end

$$B_{end} = \frac{1}{2} B_{in} = \frac{\mu_0 ni}{2} = \frac{25.1 \times 10^{-3}}{2}$$
$$= 12.6 \times 10^{-3} Wb/m^2$$

134 **(c)**

On applying Fleming's left hand rule we find that the force acting on the electron is towards east, so it will deflect towards east.

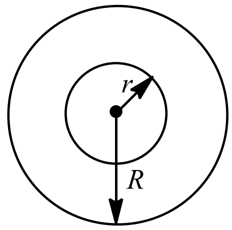
135 **(b)**

Let R be the radius of a long thin cylindrical shell.

To calculate the magnetic induction at a distance $r(r < R)$ from the axis of cylinder, a circular shell of radius r is shown in figure.

Since, no current is enclosed in the circle so, from

Ampere's circuital law, magnetic induction is zero at every point of circle. Hence, the magnetic induction at any point inside the infinitely long straight thin walled tube (cylindrical) is zero.



136 **(a)**

Sensitivity $(S) = \frac{\theta}{i} \Rightarrow \frac{S_A}{S_B} = \frac{i_B}{i_A} = \frac{5}{3} \Rightarrow S_A > S_B$

137 **(d)**

At midpoint, magnetic fields due to both the wires are equal and opposite. So $B_{Net} = 0$

138 **(b)**

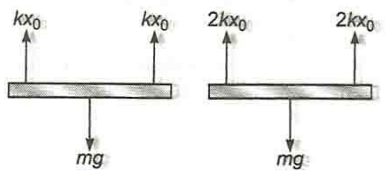
In the absence of magnetic field

$$mg = 2kx_0$$

.....(i)

the current in the rod is $i = \frac{E}{R}$

$\therefore$ Magnetic force on the rod is $F_m = BiL = \frac{ELB}{R}$



In downward direction

$\therefore \quad 2kx_0 = mg + \frac{BLE}{LE}$

.....(ii)

From Eqs. (i) and (ii); we get $4kx_0 = 2kx_0 + \frac{BLE}{R}$

$$B = \frac{2kx_0R}{EL} = \frac{mgR}{LE}$$

139 **(c)**

Magnetic field induction at a point due to a long current carrying wire is related with distance r by relation $B \propto 1/r$. Therefore graph (c) is correct.

140 **(b)**

$$B = \frac{\mu_0 Ni}{2r} = \frac{4\pi \times 10^{-7} \times 50 \times 2}{2 \times 0.5} = 1.25 \times 10^{-4} T$$

141 **(d)**

The magnetic induction at O due to the current in portion AB will be zero because O lies on AB when extended

142 **(d)**

Use Right hand palm rule, or Maxwell's Cork screw rule or any other

144 **(c)**

Magnetic field on the axis of circular current

$$B = \frac{\mu_0}{4\pi} \cdot \frac{2\pi nir^2}{(x^2 + r^2)^{3/2}} \Rightarrow B \propto \frac{nr^2}{(x^2 + r^2)^{3/2}}$$

145 **(b)**

$$M = I \times \text{Area of loop } \hat{k}$$

$$= I \times \left[a^2 + \frac{\pi a^2}{4 \times 2} \times 4\right] \hat{k}$$

$$= I \times a^2 \left[\frac{\pi}{2} + 1\right] \hat{k}$$

146 **(c)**

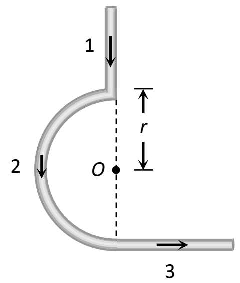
Magnetic field due to different parts are

$B_1 = 0$

$B_2 = \frac{\mu_0}{4\pi} \cdot \frac{\pi i}{r} \odot$

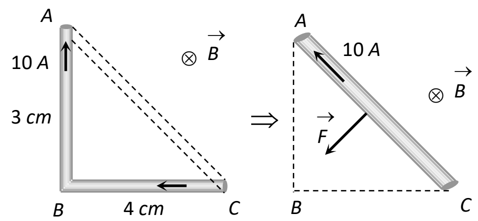
$B_3 = \frac{\mu_0}{4\pi} \cdot \frac{i}{r} \odot$

$\therefore B_{net} = B_2 + B_3 = \frac{\mu_0 i}{4r} + \frac{\mu_0 i}{4\pi r}$



147 **(c)**

According to the question figure can be drawn as shown below



Force on the conductor ABC = Force on the conductor AC

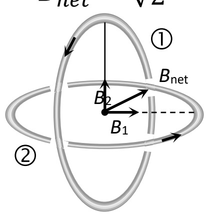
$= 5 \times 10 \times (5 \times 10^{-2}) = 2.5N$

148 **(a)**

$B_1 = B_2 = B = \frac{\mu_0}{4\pi} \times \frac{2\pi i}{r}$

$B_{net} = \sqrt{2}B$

$\Rightarrow \frac{B}{B_{net}} = \frac{1}{\sqrt{2}}$



149 **(d)**

$$B_{\text{axis}} = \frac{\mu_0 niR^2}{2(R^2+x^2)^{3/2}}$$

$$B_{\text{centre}} = \frac{\mu_0 ni}{2R}$$

At $x = \sqrt{3}R$, $\quad B_{\text{axis}} = \frac{\mu_0 niR^2}{2(R^2+3R^2)^{3/2}} = \frac{\mu_0 ni}{16R}$

$$\therefore \frac{B_{\text{centre}}}{B_{\text{axis}}} = \frac{8}{1}$$

150 **(b)**

Since particle is moving undeflected

So $qE = qvB \Rightarrow B = E/v = \frac{10^4}{10} = 10^3 Wb/m^2$

151 **(d)**

Along the axis of coil $\vec{v}$ and $\vec{B}$ are parallel, so $F = 0$

152 **(c)**

$B = \frac{\mu_0}{4\pi}\frac{2\pi i}{r}\frac{\mu_0}{4\pi}\frac{2\pi}{r}\frac{e}{(2\pi r/v)} = \frac{\mu_0}{4\pi}\frac{ev}{r^2}$

$= \frac{10^{-7}\times 1.6 \times 10^{-19}\times 7.5\times 10^{+4}}{(5.3\times 10^{-11})^2}$

On solving $B = 0.43$ Wb m^{-2}

153 **(b)**

Here, $i_g = 0.005$ A; $V = 500$ volt;

$R = 965\ \Omega$, G=?

$R = \frac{V}{i_g} - G$

Or $G = \frac{V}{i_g} - R = \frac{5}{0.005} - 975 = 25\Omega$

154 **(b)**

$$B = \frac{\mu_0}{4\pi}\frac{2\pi i}{r} = 10^{-7}\times\frac{2\pi\times 2}{0.0157} = 8\times 10^{-5} Wb/m^2$$

155 **(c)**

$$v = \frac{E}{B} = \frac{20}{5} = 4\ m/s$$

156 **(a)**

For first case, the wire of length L is bent to form a circular coil of one turn,

$$L = 2\pi r_1$$

Similarly for second case,

$$L = 4\pi r_2$$

Now, $2\pi r_1 = 4\pi r_2$ or $r_2 = \frac{r_1}{2}$

$$\therefore \quad B_1 = \frac{\mu_0 I}{2r_1}$$

$$B_2 = \frac{\mu_0 I}{2r_2} = \left(\frac{\mu_0 I}{2r_1}\right)\times 2$$

$$\Rightarrow \quad B_2 = 2B_1$$

157 **(a)**

Time period is given by $T = \frac{2\pi m}{qB}$

$\Rightarrow$ Frequency $v = \frac{1}{T} = \frac{qB}{2\pi m}$

158 **(d)**

The component of velocity perpendicular to H will make the motion circular while that parallel to H will make it move along a straight line. The two together will make the motion helical

160 **(d)**

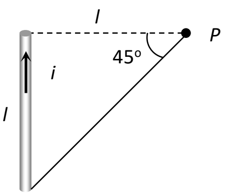
$M = iA = 0.1\times\pi\times(0.05)^2$

$= (0.1)\times 3.14\times 25\times 10^{-4}$

$= 7.85\times 10^{-4} amp - m^2$

161 **(c)**

The given situation can be redrawn as follows:



As we know the general formula for finding the magnetic field due to a finite length wire

$B = \frac{\mu_0}{4\pi}.\frac{i}{r}(\sin\phi + \sin\phi_2)$

Here $\phi_1 = 0°, \phi = 45°$

$\therefore B = \frac{\mu_0}{4\pi}.\frac{i}{r}(\sin 0° + \sin 45°) = \frac{\mu_0}{4\pi}.\frac{i}{\sqrt{2}l} \Rightarrow B$

$$= \frac{\sqrt{2}\,\mu_0 i}{8\pi l}$$

162 **(d)**

$\tau_{\max} = MB$ or $\tau_{\max} = ni\pi r^2 B$. Let number of turns in length l be n, so $l = n(2\pi r)$ or $\alpha = \frac{l}{2\pi n}$

$\Rightarrow \tau_{\max} = \frac{ni\pi Bl^2}{4\pi^2 n^2} = \frac{l^2 iB}{4\pi\, n_{\min}} \Rightarrow \tau_{\max} \propto \frac{1}{n_{\min}}$

$\Rightarrow n_{\min} = 1$

163 **(c)**

In magnetic field, the radius of circular path

$r = \frac{mv}{Bq} = \frac{v}{B(q/m)}$ $ie,\ r \propto 1/(q/m)$

164 **(c)**

Magnetic field due to solenoid is directed along its axis. The charged particle projected along the axis of solenoid does experience any magnetic force. So, velocity of charged particle remains unchanged.

165 **(b)**

$W = MB(\cos\theta_1 - \cos\theta_2)$

$= (NiA)B(\cos 0° - \cos 180°) = 2NAIB$

167 **(a)**

As revolving charge is equivalent to a current, so

$I = q\,f = q\times\frac{\omega}{2\pi}$

But $\omega = \frac{v}{R}$

Where R is radius of circle and v is uniform speed of charged particle.

Therefore, $I = \frac{qv}{2\pi R}$

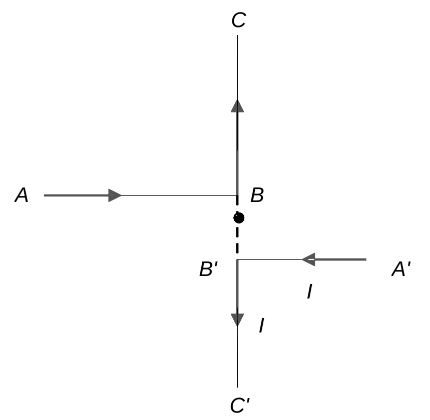
Now, magnetic moment associated with charged particle is given by

$\mu = IA = I \times \pi R^2$

or $\mu = \frac{qv}{2\pi R} \times \pi R^2 = \frac{1}{2} qvR$

168 **(b)**

Magnetic field $B = 2\left[\frac{\mu_0 I}{4\pi r}\right]$



169 **(d)**

The coil carrying current i, in clockwise coil have South polarity on that face of coil and other coil having current i_2 in counter clockwise will have North polarity on that face of coil. As south and north poles will attract each other, hence a steady attractive force acts between coils.

170 **(a)**

The magnetic field at a point on the axis of a circular loop at a distance x from the centre is

$$B = \frac{\mu_0 i R^2}{2(R^2 + x^2)^{3/2}} \quad \text{... (i)}$$

Given, $B = 54\ \mu\text{ T}, x = 4\text{ cm}, R = 3\text{ cm}$

Putting the given values in Eq. (i), we get

$$\therefore \quad 54 = \frac{\mu_0 i \times (3)^2}{2(3^2 + 4^2)^{3/2}}$$

$$\Rightarrow \quad 54 = \frac{9\mu_0 i}{2(25)^{3/2}} = \frac{9\mu_0 i}{2 \times (5)^3}$$

$$\therefore \quad \mu_0 i = \frac{54 \times 2 \times 125}{9}$$

$$\mu_0 i = 1500\ \mu\text{ T} - \text{cm} \quad \text{... (ii)}$$

Now, putting $x = 0$ in Eq. (i), magnetic field at the centre of loop is

$$B = \frac{\mu_0 i R^2}{2R^3} = \frac{\mu_0 i}{2R} = \frac{1500}{2 \times 3}$$

$$= 250\ \mu\text{T}$$

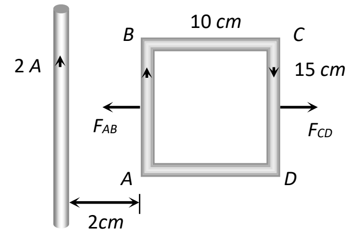
[From Eq. (ii)]

171 **(c)**

$1\ tesla = 10^4\ gauss$

172 **(a)**

Force on side BC and AD are equal but opposite so their net will be zero



But $F_{AB} = 10^{-7} \times \frac{2\times2\times1}{2\times10^{-2}} \times 15 \times 10^{-2} = 3 \times 10^{-6} N$

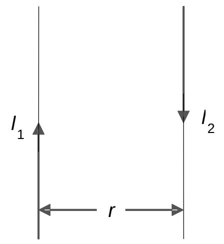
and $F_{CD} = 10^{-7} \times \frac{2\times2\times1}{(12\times10^{-2})} \times 15 \times 10^{-2} = 0.5 \times 10^{-6} N$

$\Rightarrow F_{net} = F_{AB} - F_{CD} = 2.5 \times 10^{-6} N$

$= 25 \times 10^{-7} N$, towards the wire

173 **(b)**

According to Fleming's left hand rule, if the two parallel conductors carry currents in opposite direction, they repel each other.



174 **(a)**

$$B = \frac{\mu_0}{4\pi} \cdot \frac{2i}{r} \Rightarrow \frac{B_1}{B_2} = \frac{r_2}{r_1} \Rightarrow \frac{10^{-8}}{B_2} = \frac{12}{4}$$

$\Rightarrow B_2 = 3.33 \times 10^{-9} tesla$

175 **(c)**

The magnetic field outside the cylinder at point P is

$$B = \frac{\mu_0}{4\pi} \frac{2I}{r}$$

And inside the cylinder at point P

$$B = \frac{\mu_0 Ir}{2\pi R^2}$$

At the axis $r = 0$

So, the magnetic field at the axis of the conductor is zero.

176 **(b)**

As, $F = \frac{\mu_0}{4\pi} \frac{2i_1 i_2}{r}$ $ie, F \propto i_1 i_2$. Therefore force will becomes four time ie, $4F$.

178 **(a)**

$\vec{F} = q(\vec{v} \times \vec{B}) = -2 \times 10^{-6}[\{(2\hat{\imath} + 3\hat{\jmath}) \times 10^6\} \times 2\hat{\jmath}]$

$\vec{F} = -8\hat{k}$

179 **(b)**

Since, voltage remains same in parallel, so,

$$i \propto \frac{1}{R}$$

$$\Rightarrow \frac{i_1}{i_2} = \frac{R_2}{R_1}$$

$$\frac{i_1}{i_2} = \frac{\rho l_2/A_2}{\rho l_1/A_1} \qquad \left(\because R = \frac{\rho l}{A}\right)$$

$$\Rightarrow \frac{i_1}{i_2} = \frac{l_2}{l_1} \times \left(\frac{r_1}{r_2}\right)^2 \qquad (\because A = \pi r^2)$$

$$\Rightarrow \frac{i_1}{i_2} = \frac{3}{4} \times \left(\frac{2}{3}\right)^2$$

Hence, $\frac{i_1}{i_2} = \frac{1}{3}$

180 **(b)**

$M' = \sqrt{M^2 + M^2} = \sqrt{2}M$. As magnetic moments are in a closed loop in Fig. (b)

$\therefore M = 0$

In Fig. (c) $M' = M - M = 0$

In Fig. (d)

$M' = \sqrt{M^2 + M^2 + 2MM\cos 60°} = \sqrt{3}M$

181 **(a)**

Magnetic field inside the conductor $B_{in} \propto r$ and magnetic field outside the conductor $B_{\text{out}} \propto \frac{1}{r}$

[where r is the distance of observation point from axis]

182 **(b)**

$r = \frac{\sqrt{2mK}}{qB} i.e.\ r \propto \frac{\sqrt{m}}{q}$

Here kinetic energy K and B are same

$\therefore \frac{r_e}{r_p} = \sqrt{\frac{m_e}{m_p}} \times \frac{q_p}{q_e} \Rightarrow \frac{r_e}{r_p} = \sqrt{\frac{m_e}{m_p}}\ [\because q_e = q_p]$

Since $m_e < m_p$, therefore $r_e < r_p$

183 **(c)**

$$r = \frac{mv}{Bq}$$

$$\Rightarrow r = \frac{v}{B\frac{q}{m}} = \frac{2 \times 10^5}{0.05 \times 2.5 \times 10^7}$$

$$= \frac{2 \times 10^7}{12.5 \times 10^7} = \frac{200}{12.5} \text{ cm} = 16 \text{ cm}$$

184 **(a)**

The force per unit length between two parallel wires carrying currents i_1 and i_2 separated by a distance R is given by

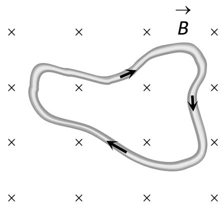
$\frac{F}{l} = \frac{\mu_0}{2\pi}\frac{i_1 i_2}{2}$

$\Rightarrow \frac{F}{l} \propto \frac{1}{R}$

Hence, graph between force per unit length and distance between wires is a straight line.

185 **(a)**

As shown in figure, since $\vec{L} = 0$



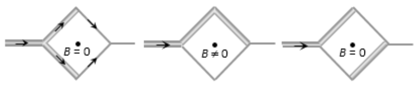
Hence according to $\vec{F} = i(\vec{L} \times \vec{B}) \Rightarrow \vec{F} = 0$

186 **(c)**

Current corresponding to the beams of protons and electrons are in opposite direction. Therefore, both will experience a force of repultion and therefore move more apart.

187 **(a)**

From figure it is clear that



$\sin\theta = \frac{d}{r}$ also $r = \frac{p}{qB}$

$\therefore \sin\theta = \frac{Bqd}{p}$

188 **(b)**

Magnetic induction at the center of circulre loop

$$B = \frac{\mu_0}{2} \cdot \frac{ni}{r}$$

Magnetic moment of the loop

$$M = niA = \frac{2BrA}{\mu_0}$$

$$= \frac{2 \times 0.1 \times 1 \times \pi \times (1)^2}{\mu_0}$$

$$= \frac{0.2\pi}{\mu_0} \qquad (\because r = 1)$$

189 **(a)**

$$dB = \frac{\mu_0(dq)}{2r}\left(\frac{\omega}{2\pi}\right)$$
$$B = \int dB = \frac{\mu_0 \omega}{4\pi}.\frac{Q}{\pi R^2}2\pi \int_0^R \frac{rdr}{r}$$
$$B = \frac{\mu_0 \omega Q}{2\pi R^2}.R$$
$$B = \frac{\mu_0 \omega Q}{2\pi R}$$
$$B \propto \frac{1}{R}$$

190 **(b)**

The field at the midpoint of BC due to AB is $\left(-\frac{\mu_0}{4\pi}.\frac{i}{d/2}\hat{k}\right)$ and the same is due to CD. Therefore the total field is $\left[-\left(\frac{\mu_0 i}{\pi d}\right)\hat{k}\right]$

191 **(d)**

$$B = \mu_0 ni = \mu_0 \frac{N}{L}i$$

193 **(b)**

$$\frac{\mu_0}{4\pi} \times \frac{2\pi i}{r} = H \Rightarrow \frac{(10^{-7}) \times 2 \times 3.142 \times i}{0.05}$$
$$= 7 \times 10^{-5}$$
$$\therefore i = \frac{7 \times 0.05 \times 10^{-5}}{2 \times 3.142 \times 10^{-7}} = \frac{35}{2 \times 3.142} = 5.6\, amp$$

194 **(b)**

$G = 100\ \Omega$

$I_g = 10^{-5}$ A

$I\ = 1$ A

$S\ = ?$

$I_g \times G = (I - I_g) \times S$

$$S\ = \left(\frac{I_g}{I - I_g}\right) \times G = \frac{10^{-5}}{1 - 10^{-5}} \times 100$$

Or $= \frac{10^{-3}}{1 - 0.00001} = 10^{-3}\ \Omega$

195 **(d)**

When a charged particle moves inside a uniform magnetic field then the radius of the circular path is

$$r = \frac{mv}{Bq} = \frac{9.1 \times 10^{-31} \times 3 \times 10^7}{5 \times 10^{-4} \times 1.6 \times 10^{-19}} = 0.34 \text{ m}$$
$$= 34 \text{ cm}$$

196 **(a)**

Biot-Savart's law in vector form is given as

$$\mathbf{dB} = \frac{\mu_0}{4\pi} i \frac{\mathbf{d1} \times \mathbf{r}}{r^3}$$

197 **(b)**

Because for inside the pipe $i = 0$

$$\therefore B = \frac{\mu_0 i}{2\pi r} = 0$$

199 **(b)**

For motion of a charged particle in a magnetic field, we have $r = mv/qB\ i.e. r \propto v$

200 **(c)**

Time period of cyclotron is

$$T = \frac{1}{v} = \frac{2\pi m}{eB}$$
$$B = \frac{2\pi m}{e}v$$
$$R = \frac{mv}{eB} = \frac{p}{eB} \Rightarrow p = eBR = e \times \frac{2\pi mv}{e}R$$
$$= 2\pi mvR$$
$$K.E. = \frac{p^2}{2m} = \frac{(2\pi m\, v\, R)^2}{2m} = 2\pi^2\, mv^2R^2$$

201 **(a)**

Force on wire B due to A,

$F_{BA} = \frac{\mu_0 \times 1 \times 2}{2\pi r} = \frac{\mu_0}{\pi r}$ towards C

Force on wire B due to C

$F_{BC} = \frac{\mu_0 \times 2 \times 3}{2\pi r} = \frac{3\mu_0}{\pi r}$ towards A

Clearly $F_{BC} > F_{BA}$ therefore force on B is directed towards A

203 **(a)**

Because $\tau = NiAB\cos\theta$

204 **(d)**

Magnetic field produced by wire at the location of charge is perpendicular to the paper inwards. Hence by applying Fleming's left hand rule, force is directed along OY

205 **(b)**

When a current flows through cylindrical shell, then according to Ampere's circuital law, magnetic induction inside it will be equal to zero. Hence energy density at $r < R$ is equal to zero Therefore, (a), (c) and (d) are wrong

When $r > R, B = \frac{\mu_0 i}{2\pi r}$

Since $U = \frac{B^2}{2\mu_0}$, therefore, outside the shell,

$U = \frac{\mu_0 i^2}{8\pi^2 r^2}$. It means, just outside the shell,

$$U = \frac{\mu_0 i}{8\pi^2 R^2}$$

And when $r \to \infty, U \to 0$

Hence (b) is correct

206 **(d)**

Magnetic field at centre due to smaller loop

$$B_1 = \frac{\mu_0}{4\pi}.\frac{2\pi i_1}{r_1} \quad \text{... (i)}$$

Due to Bigger loop $B_2 = \frac{\mu_0}{4\pi}.\frac{2\pi i_2}{r_2}$. So net magnetic field at centre

$$B = B_1 - B_2 = \frac{\mu_0}{4\pi} \times 2\pi\left(\frac{i_1}{r_1} - \frac{i_2}{r_2}\right)$$

According to question $B = \frac{1}{2} \times B_1$

$\Rightarrow \frac{\mu_0}{4\pi}.2\pi\left(\frac{i_1}{r_1}-\frac{i_2}{r_2}\right)=\frac{1}{2}\times\frac{\mu_0}{4\pi}.\frac{2\pi i_1}{r_1}$

$\frac{i_1}{r_1}-\frac{i_2}{r_2}=\frac{i_1}{2r_1}\Rightarrow\frac{i_1}{2r_1}=\frac{i_2}{r_2}\Rightarrow\frac{i_1}{i_2}=1\quad[r_2=2r_1]$

207 **(b)**

$B=\frac{\mu_0 i}{2R}\Rightarrow i=\frac{B\times 2R}{\mu_0}$

Now, $M=i\times A=i\pi R^2=\frac{B\times 2R}{\mu_0}\times\pi R^2=\frac{2\pi BR^3}{\mu_0}$

208 **(a)**

Lorentz force = centripetal force

ie, $Bqv=\frac{mv^2}{r}$

$\Rightarrow Bq=m\omega$

$\Rightarrow Bq=m2\pi f$ (as $v=r\omega$)

$\therefore\ f=\frac{Bq}{2\pi m}$

209 **(b)**

For a moving charge in a perpendicular magnetic field,

$\frac{mv^2}{r}=Bqv$

$\Rightarrow\ r=\frac{mv}{Bq}=\frac{p}{Bq}$

or $\frac{r_p}{r_d}=\frac{p_p}{p_d}$ ... (i)

(as q is same for both)

Also, momentum $p=\sqrt{2mE}$

or $\frac{p_p}{p_d}=\sqrt{\frac{m_p}{m_d}}$ ... (ii)

From Eqs. (i) and (ii), we have,

$\frac{r_p}{r_d}=\sqrt{\frac{m_p}{m_d}}=\sqrt{\frac{1}{2}}=\frac{1}{\sqrt{2}}$

210 **(b)**

$F=Bil\Rightarrow[B]=\frac{[F]}{[i][l]}=\frac{MLT^{-2}}{AL}=MT^{-2}A^{-1}$

211 **(c)**

Magnetic field at the centre of a current carrying loop is given by

$B=\frac{\mu_0 ni}{2r}$

Here, n = no. of turns in loop

i = current, r_1 = radius of loop, $r_1=r$

For $n=1$ turn

$B=\frac{\mu_0 i}{2r_1}$ ...(i)

When $n=2$ turns and radius $r_2=\frac{r}{2}, i_2=i$

$B_2=\frac{\mu_0\times 2\times i}{2\left(\frac{r}{2}\right)}$

or $B_2=\frac{2\mu_0 i\times 2}{2r}$ ...(ii)

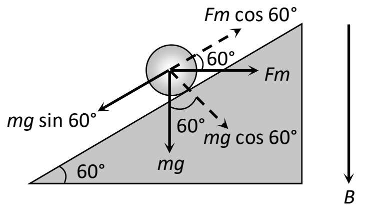
Now, from Eqs. (i) and (ii)

$\frac{B_2}{B}=4$

Hence, $B_2=4B$

212 **(c)**

The given situation can be drawn as follows



$F=ilB\Rightarrow mg\sin 60°=ilB\cos 60°$

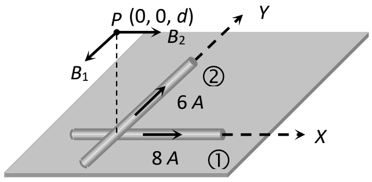
$\Rightarrow B=\frac{0.01\times 10\times\sqrt{3}}{0.1\times 1.73}=1T$

213 **(d)**

Magnetic dipole moment of coil $=NIA$

214 **(d)**

Magnetic field at P due to wire 1, $B_1=\frac{\mu_0}{4\pi}.\frac{2(8)}{d}$



and due to wire 2, $B_2=\frac{\mu_0}{4\pi}.\frac{2(6)}{d}$

$\Rightarrow B_{net}=\sqrt{B_1^2+B_2^2}=\sqrt{\left(\frac{\mu_0}{4\pi}.\frac{16}{d}\right)^2+\left(\frac{\mu_0}{4\pi}.\frac{12}{d}\right)^2}$

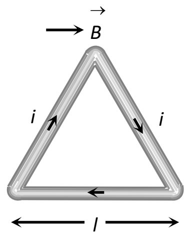
$=\frac{\mu_0}{4\pi}\times\frac{2}{d}\times 10=5\mu_0/\pi d$

215 **(d)**

Since $\theta=90°$

Hence $\tau=NIAB=1\times I\times\left(\frac{\sqrt{3}}{4}l^2\right)B$

$=\frac{\sqrt{3}}{4}l^2 B\ I$



216 **(b)**

In magnetic field, the force on charged particle

$\vec{F} = q(\vec{v} \times \vec{B})$. When particle is at rest in magnetic field the force on it is zero, hence no acceleration. When charged particle is deflected by the magnetic field, its speed does not change but direction of velocity changes because the deflecting force acts perpendicular to $\vec{v}$ and $\vec{B}$. The component of magnetic field perpendicular to the direction of motion is effective in deflecting the particle.

217 **(d)**

The direction of magnetic field is along the direction of motion of the charge particles, so angle will be 0°.

$\therefore$ Force $F = qvB \sin\theta$

$= qvB \sin 0$

$= 0 \qquad (\because \sin 0 = 0)$

So, there will be no change in the velocity.

218 **(b)**

$\frac{\mu_0 i}{4\pi}\frac{2i_1}{r} - \frac{\mu_0}{4\pi}\frac{2i_2}{r} = 10\mu\ \mathrm{T}$

$\frac{\mu_0 i}{4\pi}\frac{2i_1}{r} + \frac{\mu_0}{4\pi}\frac{2i_2}{r} = 30\ \pi\ \mathrm{T}$

On solving $i_1 = 20$ A and $i_2 = 10$ A, So, $i_1/i_2 = 2$

219 **(d)**

Force $F = Bev = 2 \times 10^{-1} \times 1.6 \times 10^{-19} \times 4 \times 10^{+6}$ N

$= 12.8 \times 10^{-14}\ \mathrm{N} = 1.28 \times 10^{-13}\ \mathrm{N}$

Now $r = \frac{mv}{Bq} = \frac{9 \times 10^{-31} \times 4 \times 10^{6}}{2 \times 10^{-1} \times 1.6 \times 10^{-19}}$ m

$= 11.25 \times 10^{-5}\ \mathrm{m} = 1.125 \times 10^{-4}\ \mathrm{m}$

221 **(d)**

If r is the radius of the circle, then

$l = 2\pi r \times 2 \quad$ or $\quad r = \frac{1}{4\pi}$

Area $= \pi r^2 = \pi l^2/16\pi^2 = l^2/16\pi$

Magnetic moment $= n\,IA = 2Il^2/16\,\pi = Il^2/8\,\pi$

222 **(b)**

At a point inside the metal wire carrying current. Magnetic field induction $B \propto r$.

$\therefore\ B' = \frac{B}{2}$

223 **(d)**

$F = \frac{\mu_0}{4\pi}\frac{2l^2}{a}$

$F_1 = \frac{\mu_0}{4\pi}.\frac{2i^2}{x}$ [Attraction]

$F_2 = \frac{\mu_0}{4\pi}\frac{2i \times 2i}{2x} = \frac{\mu_0}{4\pi}\frac{2i_2}{x}$ [Repulsion]

Thus $F_1 = -F_2$

224 **(c)**

$B \propto \frac{1}{r} \Rightarrow \frac{B_1}{B_2} = \frac{r_2}{r_1} = \frac{2r}{r} = 2$

225 **(c)**

Magnetic force on electron $= Bev \sin\theta$

$= Bev \sin 0 = \text{zero}$

Electron will not be deflected due to magnetic field. Electric force on electron $= Ee$

This force is opposite to direction of motion of the electron. The speed of electron will decrease. Hence the electron will not be deflected but its speed is decreased

226 **(a)**

Let v be velocity acquired by the charged particle when accelerated through the potential difference V

$\therefore \frac{1}{2}mv^2 = qV$

Or $v = \sqrt{\frac{2qV}{m}} \qquad$ ...(i)

As the charged particle describes a circular path of radius R in the uniform magnetic field

$\therefore \frac{mv^2}{R} = qvB$

Or $R = \frac{mv}{qB} = \frac{m}{qB}\sqrt{\frac{2qV}{m}}$ [Using (i)]

$= \frac{1}{B}\sqrt{\frac{2Vm}{q}}$

As q, B and V remain the same

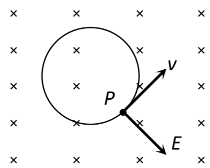
$\therefore R \propto \sqrt{m}$

$\therefore \frac{R_A}{R_B} = \sqrt{\frac{m_A}{m_B}}$

or $\frac{m_A}{m_B} = \left(\frac{R_A}{R_B}\right)^2 = \left(\frac{2}{3}\right)^2 = \frac{4}{9}$

227 **(c)**

When the particle moves along a circle in the magnetic field B, the magnetic force is radially inward. If an electric field of proper magnitude is switched on which is directed radially outwards, the particle may experience no force. It will then move along a straight line with uniform velocity. This will be the case when $qE = qvB \Rightarrow E = vB$



Also $r = \frac{mv}{qB} \Rightarrow v = \frac{qBr}{m}$

So $E = \frac{qB^2r}{m}$

$= \frac{(10 \times 10^{-6}) \times (0.1)^2 \times 10 \times 10^{-2}}{1 \times 10^{-3} \times 10^{-6}} = 10V/m$

228 **(d)**

By using Fleming's left hand rule

229 **(c)**
The direction of earth's magnetic field is south to north. Torque on current carrying loop in a uniform magnetic field, $\vec{\tau} = \vec{M} \times \vec{B}$, which will rotate the coil. The loop will come to rest when torque is zero. It will be so if angle between $\vec{M}$ and $\vec{B}$ is zero. *ie*, magnetic field is perpendicular to the plane of the coil. Therefore, the plane of the coil will be in east-west direction in equilibrium of rest.

230 **(a)**
Magnetic dipole moment of a current is given by
$M = NIA$
where $N =$ number of turns
$I =$ current in a loop
$A =$ area of the loop
From the above relation it is clear that magnetic dipole moment of a current loop is independent of the magnetic field in which it is lying.

231 **(c)**
By using $\vec{F}_m = q(\vec{v} \times \vec{B})$
$\Rightarrow \vec{F}_m = 2 \times 10^{-6}\{3 \times 10^6 \hat{\imath} \times (-0.2)\hat{k}\}$
$= -1.2(\hat{\imath} \times \hat{k}) = +1.2\hat{\jmath}$
i.e., 1.2 N in positive y direction

232 **(d)**
Mutual force between conductors A and C
$$F_1 = \frac{\mu_0}{2\pi}\frac{I_1 I_2 l}{r} = \frac{\mu_0}{2\pi}\frac{2 \times 3 \times 1}{0.05}$$
$= 2.40 \times 10^{-5}$ N (towards A)
Mutual force between conductors B and C
$$= \frac{\mu_0}{2\pi} \times \frac{4 \times 3 \times 1}{0.08}$$
$= 3 \times 10^{-5}$ N (towards B)
Hence, the resultant force experienced by C
$= (3 - 2.4) \times 10^{-5}$ N
$= 0.6 \times 10^{-5}$ N (towards B)

233 **(b)**
Two coils carry currents in opposite directions, hence net magnetic field at centre will be difference of the two fields.
$$ie, \quad B_{net} = \frac{\mu_0}{4\pi} . 2\pi N \left[\frac{i_1}{r_1} - \frac{i_2}{r_2}\right]$$
$$= \frac{10\mu_0}{2}\left[\frac{0.2}{0.2} - \frac{0.3}{0.4}\right]$$
$$= \frac{5}{4}\mu_0$$

235 **(d)**
$$\frac{B_A}{B_C} = \left(\frac{R^2}{x^2 + R^2}\right)^{3/2}$$
$$\frac{1}{8} = \left(\frac{R^2}{x^2 + R^2}\right)^{3/2} \Rightarrow \frac{1}{4} = \frac{R^2}{x^2 + R^2}$$
$\Rightarrow x^2 + R^2 = 4R^2$
$\Rightarrow x = \sqrt{3}R$

237 **(a)**
$F = Bil \sin\theta \Rightarrow 7.5 = 2 \times 5 \times 1.5 \sin\theta \Rightarrow \theta = 30°$

240 **(d)**
$$BV = \frac{\mu_0 \mu_r N i}{2\pi r} \Rightarrow 1 = \frac{4\pi \times 10^{-7} \times \mu_r \times 400 \times 2}{0.4}$$
$\Rightarrow \mu_r = 400$

241 **(b)**
PE$= -MB(\cos\theta_2 - \cos\theta_1)$
When $\theta_1 = 90°$ (position of zero PE), $\theta_2 = \theta$
PE$= -MB \cos\theta$

242 **(b)**
Kinetic energy of proton = Kinetic energy of electron
$$\frac{1}{2} m_p v_p^2 = \frac{1}{2} m_e v_e^2$$
$$\Rightarrow \frac{m_p}{m_e} = \left(\frac{v_e}{v_p}\right)^2 \qquad \text{... (i)}$$
If B is the strength of the magnetic field and m, v and q, the mass, velocity and charge of the positive ion, then
$$Bqv = \frac{mv^2}{r}$$
$As\, q_p = q_e$ and B is same for both electron and proton
$r = mv$
$$\therefore \frac{r_e}{r_p} = \frac{m_e v_e}{m_p v_p} \qquad \text{... (ii)}$$
From Eqs (i) and (ii)
$$\frac{r_e^2}{r_p^2} = \frac{m_e}{m_p}$$
$\therefore\ r^2 \propto m$
Mass of a proton is more than that of electron. Therefore, radius of proton will be more. Hence, the path of proton will be less curved.

243 **(c)**
Force on the electron due to the electric field E is
$F_E = (-e)E$
Force on the electron due to the magnetic field B is $F_B = (-e)vB$
The electron will move in the fields undeflected, if these two forces are equal and opposite
$eE = evB$ or $v = \frac{E}{B}$
Electric field between the plates is $E = \frac{\sigma}{\varepsilon_0}$
$$\therefore v = \frac{\sigma}{\varepsilon_0 B}$$

The time take by the electron to travel a distance l in the space is $t = \frac{l}{v} = \frac{l}{\frac{\sigma}{\varepsilon_0 B}} = \frac{l\varepsilon_0 B}{\sigma}$

244 **(d)**

Two parallel wires carrying currents in the same direction attract each other because magnetic forces on the two wires act towards each other

245 **(b)**

$F = qvB$ and $K = \frac{1}{2}mv^2 \Rightarrow F = qB\sqrt{\frac{2k}{m}}$

$$= 1.6 \times 10^{-19} \times 1.5\sqrt{\frac{2 \times 5 \times 10^6 \times 1.6 \times 10^{-19}}{1.7 \times 10^{-27}}}$$

$= 7.344 \times 10^{-12} N$

246 **(a)**

Magnetic field in circular coil A is

Similarly, $B_A = \frac{\mu_0 Ni}{2R}$

R is radius and i is current flowing in coil.

$$B_B = \frac{\mu_0 N(2i)}{2.(2R)}$$

$$= \frac{\mu_0 Ni}{2R}$$

$$\frac{B_A}{B_B} = \frac{1}{1} = 1$$

248 **(b)**

Magnetic field, $B = \frac{\mu_0 I}{2\pi r}$

or $B \propto \frac{1}{r}$

or $\frac{B_2}{B_1} = \frac{r_1}{r_2}$

$\therefore$ $\frac{B_2}{B} = \frac{5}{20} = \frac{1}{4}$

or $B_2 = \frac{B}{4}$

249 **(b)**

$r = \frac{mv}{Bq}$ $ie, r \propto v$ or $\frac{r_1}{r_2} = \frac{v_1}{v_2} = \frac{1}{3}$

250 **(d)**

Magnetic flux inside rod $B \propto r$ and outside the rod $B \propto \frac{i}{r}$.

251 **(a)**

Here, the particle is projected in a direction perpendicular to the uniform magnetic field, hence it will describe a circular path. The particle will not hit the *y-z* plane, if the radius of the circular path is smaller than a. For maximum value of v, the radius of circular path is just equal to a.

Hence, $\frac{mv}{Bq} = a$

Or $v = \frac{Bqa}{m}$

252 **(c)**

From Biot-Savart law the magnetic field at the centre is directly proportional to the length of current carrying segment.

$$\therefore \frac{B_1}{B_2} = \frac{\text{length of } ABC}{\text{length of } ADC}$$

$$= \frac{\text{angle subtended by } ABC}{\text{angle subtended by } ADC}$$

$$= \frac{(360° - 60°)}{60°} = \frac{300}{60} = \frac{5}{1}$$

253 **(a)**

$$B = \mu_0 ni \Rightarrow \frac{B}{B'} = \frac{n}{n'} \times \frac{i}{i'} = \frac{1}{(1/2)} \times \frac{1}{2} = 1 \Rightarrow B' = B$$

254 **(c)**

Magnetic field due to solenoid is independent of diameter

($\because B = \mu_0 nI$)

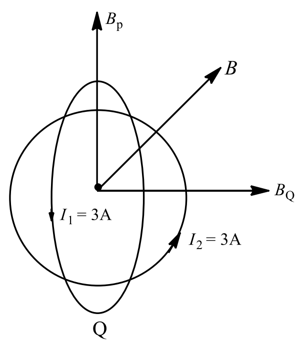
255 **(c)**

$$B_P = \frac{\mu_0 I_2}{2R}$$

$$= \frac{4\pi \times 10^{-7} \times 4}{2 \times 0.02\pi} = 4 \times 10^{-5} \text{ Wbm}^{-2}$$

$$B_Q = \frac{\mu_0 I_1}{2R}$$

$$= \frac{4\pi \times 10^{-7} \times 3}{2 \times 0.02\pi} = 3 \times 10^{-5} \text{ Wbm}^{-2}$$



$$\therefore B = \sqrt{B_P^2 + B_Q^2}$$

$$= \sqrt{(4 \times 10^{-5})^2 + (3 \times 10^{-5})^2}$$

$= 5 \times 10^{-5}$ Wbm^{-2}

256 **(a)**

$B = \frac{\mu_0}{4\pi}\frac{2\pi i}{r} = \frac{\mu_0}{4\pi}\frac{2\pi}{r} \times (ev)$

$= \frac{4\pi \times 10^{-7} \times 1.6 \times 10^{-19} \times 6.6 \times 10^{15}}{2 \times 53 \times 10^{-10}}$

$= 0.14$ Wb m^{-2}

257 **(b)**

Energy density in previous objective, at $r = 2R$, will be equal to $U = \frac{\mu_0 i^2}{32\pi^2 R^2}$ or $U \propto i^2$. It means, graph- between U and i will be a parabola, passing through origin, symmetric about U-axis and having increasing slope. Hence (b) is correct

258 **(c)**

$B_0 = B_{PQ} + B_{QR} + B_{RO}$

$= \frac{\mu_0}{2\pi}\frac{i}{r} + \frac{\mu_0(1/2)i}{2\pi} + 0$

$= \frac{\mu_0}{4\pi}\frac{2i}{r} + \frac{\mu_0}{4\pi}\frac{\pi i}{r} = \frac{\mu_0}{4\pi}\frac{i}{r}\ (2 + \pi)$

260 **(a)**

Suppose in equilibrium, wire PQ lies at a distance r above the wire AB

Hence in equilibrium $mg = Bil \Rightarrow mg = \frac{\mu_0}{4\pi}\left(\frac{2i}{r}\right) \times il$

$\Rightarrow 10^{-3} \times 10 = 10^{-7} \times \frac{2 \times (50)^2}{r} \times 0.5 \Rightarrow r$

$= 25\ mm$

261 **(b)**

$l = 2\pi r$ or $r = l/2\pi$

Area of circular loop, $A = \pi r^2$

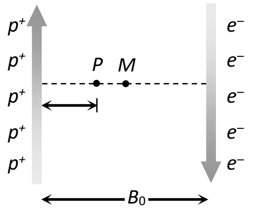
Magnetic moment $M = lA = i\pi r^2$

$= i\pi \times l^2/4\pi^2$ or $l = \sqrt{4\pi M/i}$

262 **(c)**

The magnetic field at point to the right of the proton beam acts perpendicular to the paper inwards (×). The magnetic field at points to the left of the electron beam acts perpendicular to the paper outward (·).

Magnetic field at mid point M is zero



Magnetic field at the points closer to proton beam acts perpendicular to the paper inwards ($i.e.$, (×)) and at the points closer to electron beam it acts outwards $i.e.$, (·). In the given options graph (c) satisfies all the condition

263 **(a)**

Radius, $r = \frac{1}{\pi}$

Magnetic field at the centre, $B = \frac{\mu_0 I}{4r}$

$= \frac{4\pi \times 10^{-7} \times I}{4 \times \frac{l}{\pi}}$

$= \frac{\pi^2 I \times 10^{-7}}{l}$

264 **(c)**

Applying Fleming's Left hand rule the direction of force will be westward.

265 **(b)**

The strength of magnetic field around a straight current carrying wire is given by

$B = \frac{\mu_0}{2\pi} \cdot \frac{I}{r}$

$\therefore\ B \propto \frac{1}{r}$

Therefore, magnetic field due to a straight current carrying wire is inversely proportional to the distance from the wire.

267 **(d)**

A moving charge and changing electric field both produce magnetic field

268 **(a)**

For a tangent galvanometer

$B = B_H \tan\theta$

Here, $B = \frac{\mu_0}{4\pi}\frac{2\pi ni}{a} \Rightarrow \frac{\mu_0}{4\pi}\frac{2\pi ni}{q} = B_H \tan\theta$

or $\theta \propto n$

∴ If the number of turns in the coil are doubled, the deflection will increase.

269 **(a)**

$r = \frac{\sqrt{2mK}}{qB} \Rightarrow r \propto \sqrt{K} \Rightarrow \frac{R}{R_2} = \sqrt{\frac{K}{2K}} \Rightarrow R_2 = R\sqrt{2}$

270 **(c)**

Force acts perpendicular to the velocity in a magnetic field, so speed of electron will remain same

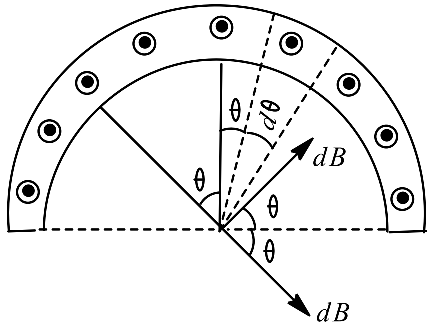
271 **(d)**

Consider the wire to be made up of large number of thin wires of infinite length. Consider such wire of thickness dl subtending an angle $d\theta$ at centre.

Current through this wire,

$dl = \frac{d\theta}{\pi} I,$

∴ Magnetic field at centre due to this portion.



$dB = \frac{\mu_0}{4\pi} . \frac{2dI}{R}$

$= \frac{\mu_0 I}{2\pi^2 R} \, d\theta$

Net magnetic field at the centre.

$B = \int_{-\pi/2}^{\pi/2} dB \cos\theta = \frac{\mu_0 I}{2\pi^2 R}$

$\int_{-\pi/2}^{\pi/2} \cos\theta \, d\theta = \frac{\mu_0 I}{\pi^2 R}$

272 **(d)**

$B = \frac{\mu_0}{4\pi} . \frac{2\pi i}{r} \Rightarrow 12.56 = 10^{-7} \times \frac{2\pi \times i}{5.2 \times 10^{-11}}$

$\Rightarrow i = 1.04 \times 10^{-3} A$

273 **(c)**

In perpendicular magnetic field magnetic force = centripetal force.

∴ By the relation

$qvB = \frac{mv^2}{r}$

$\Rightarrow \ r = \frac{mv}{qB} \Rightarrow r \propto \frac{m}{q}$

Since, $\frac{m}{q}$ ratio for deuteron and α-particle is same.

$\left(\frac{m}{q} = \frac{4}{2} = 2 \text{ for } \alpha - \text{particle}\right)$ and $\frac{m}{q} = \frac{2}{1} = 2$ for deuteron.

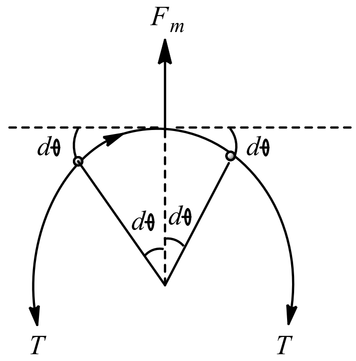
Hence, radius is same for both.

274 **(c)**

$L = 2\pi R$

$\therefore \ R = \frac{L}{2\pi}$

$2T \sin(d\theta) = F_m$



For small angles, $\sin(d\theta) \approx d\theta$

$\therefore \qquad 2T(d\theta) = I\,(dL) B \sin 90°$

$= I\,(2R\,.\,d\theta).\,B$

• $\therefore \qquad T = IRB = \frac{ILB}{2\pi}$

275 **(c)**

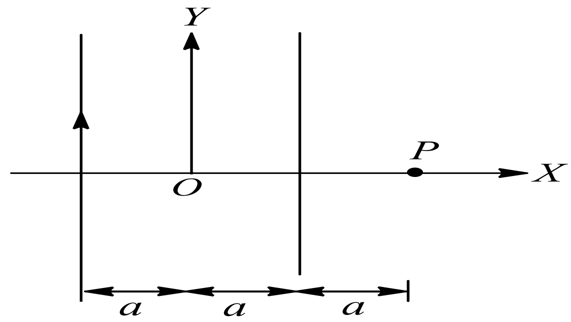
$r = 0.2\, m, B = \frac{1}{\pi}, Q = 60°, a = ?$

$\phi = BA\cos\theta = B(\pi r^2)\cos\theta$

$= \frac{1}{\pi}(\pi \times 0.2 \times 0.2)\cos 60° = 0.02 Wb$

276 **(a)**

For a circular coil of radius a carrying a current i, the magnetic field at point P, distance x from coil is given by



$B = \frac{\mu_0 i a^2}{2(a^2 + x^2)^{3/2}}$ NA^{-1} m^{-1} ... (i)

At the centre of coil $x = 0$

$\therefore B' = \frac{\mu_0 i}{2a}$ NA^{-1} m^{-1} ... (ii)

Given, $B = \frac{1}{8} B'$

$\therefore \ \frac{\mu_0 i a^2}{2(a^2 + x^2)^{3/2}} = \frac{1}{8}\left(\frac{\mu_0 i}{2a}\right)$

$\Rightarrow \frac{a^2}{(a^2 + x^2)^{3/2}} = \frac{1}{8a}$

$\Rightarrow 8a^3 = (a^2 + x^2)^{3/2}$

$\Rightarrow a^2 + x^2 = 4a^2$

$\Rightarrow x = \sqrt{3}.a$

Given, $a = R$

$\therefore x = \sqrt{3}R$

277 **(b)**
A current carrying conductor produces magnetic fields only.

278 **(b)**
As magnetic potential in broadside on position is zero, therefore, the ratio must be infinite.

279 **(b)**
According to the definition

280 **(a)**
$r_1 : r_2 = 1:2$ and $B_1 : B_2 = 1:3$. We know that
$$B = \frac{\mu_0}{4\pi} \cdot \frac{2\pi ni}{r} \Rightarrow \frac{i_1}{i_2} = \frac{B_1 r_1}{B_2 r_2} = \frac{1 \times 1}{3 \times 2} = \frac{1}{6}$$

281 **(a)**
Number of lines cut per second $= Blv$
$= 10 \times 5 \times 0.30 \times 10^{-4}$
$\therefore \varepsilon_{\text{induced}} = -1.5 \times 10^{-3} V/m$
$\therefore$ From west to east, $\varepsilon = +1.5 \times 10^{-3} V/m$

282 **(a)**
$\vec{v} \times \vec{B} = -\vec{E}$

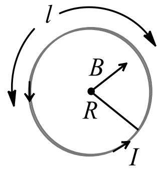
283 **(c)**
Given, $N = 100, r = 8 \text{ cm} = 0.08 \text{ m}$
$I = 0.4 \text{ A}$
$B = ?$
$$B = \frac{\mu_0 NI}{2r} = \frac{4\pi \times 10^{-7} \times 100 \times 0.4}{2 \times 0.08} = \pi \times 10^{-4} \text{ T.}$$

284 **(c)**
Magnetic force acts on moving charge

285 **(b)**
Because $B = \mu_0 ni \Rightarrow B \propto ni$

286 **(c)**
The magnetic field at a point along the axis at distance R from the centre of a circular coil of radius R carrying i is
$$B_A = \frac{\mu_0 2\pi i R^2}{4\pi(R^2 + R^2)^{3/2}}$$
$$= \frac{\mu_0 i}{2\sqrt{8}R} = \frac{B}{\sqrt{8}} \left[B_{\text{centre}} = B = \frac{\mu_0 i}{2R}\right]$$

287 **(c)**
Magnetic field at the centre of loop
$$B = \frac{\mu_0}{4\pi} \cdot \frac{I.2\pi R}{R^2} \quad \ldots \text{(i)}$$
For the wire which is looped double let radius becomes r
Then, $\frac{l}{2} = 2\pi r; \frac{1}{4\pi} = (r)$
$$\therefore B'' = \frac{\mu_0}{4\pi} \cdot \frac{I.2\pi \times 2}{r^2}$$

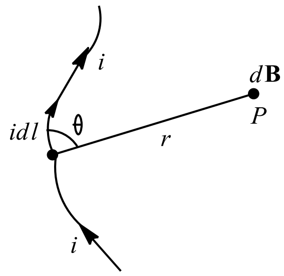


$$\Rightarrow B'' = \frac{\mu_0}{4\pi} \cdot \frac{I.\frac{l}{2}.2}{\left(\frac{1}{4\pi}\right)^2}$$
$$\Rightarrow B'' = \frac{\mu_0}{4\pi} \cdot \frac{Il \times 16\pi^2}{l^2} \quad \ldots \text{(iii)}$$
Now, $B = \frac{\mu_0}{4\pi} \cdot \frac{I.l}{\left(\frac{l}{2\pi}\right)^2} \left[R = \frac{l}{2\pi}\right]$ ...(iii)
Dividing equation (ii) by Equation (iii), we get
$$\frac{B''}{B} = \frac{\frac{\mu_0}{4\pi} \cdot \frac{I.l.16\pi^2}{l^2}}{\frac{\mu_0}{4\pi} \cdot \frac{Il.4\pi^2}{l^2}} \Rightarrow \frac{B''}{B} = 4 \Rightarrow B'' = 4B$$

288 **(d)**
$$B_1 = \frac{\mu_0}{4\pi} \frac{2\pi i}{r} \quad \text{and} \quad B_2 = \frac{\mu_0}{4\pi} \frac{2\pi(i)}{(2r)} = \frac{\mu_0}{4\pi} \frac{2\pi i}{2r}$$
$\therefore \frac{B_1}{B_2} = \frac{2}{1}$

290 **(c)**
$\vec{F} = q\vec{v} \times \vec{B}$

291 **(b)**
From Biot-Savar's law, the magnetic field $d\mathbf{B}$ at P due to the current element $i\ dl$ is given by
$$dB = \frac{\mu_0}{4\pi} \frac{i\ dl \sin\theta}{r^2}$$
Where θ is angle between id **I** and **r**. Maximum value of $\sin\theta = 1$, when $\theta = 90°$. Hence, for magnetic field to be maximum the angle is 90°.

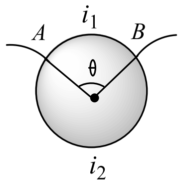


292 **(a)**
Magnetic field at the centre of current carrying coil is
$$B = \frac{\mu_0}{4\pi} \cdot \frac{2\pi ni}{r} = \frac{\mu_0 ni}{2r}$$

294 **(d)**
By using $B = \frac{\mu_0 i}{2\pi r}\left(\frac{r^2 - a^2}{b^2 - a^2}\right)$, here $r = \frac{3R}{2}, a = R, b = 2R$,
We get $B = \frac{\mu_0 i}{2\pi\left(\frac{3R}{2}\right)} \times \left\{\frac{\left(\frac{3R}{2}\right)^2 - R^2}{(2R)^2 - R^2}\right\} = \frac{5.\mu_0 i}{36\pi\ R}$

295 **(b)**

For a current flowing into a circular arc, magnetic induction at the centre



$$B=\frac{\mu_0 i}{4\pi}\int\frac{dl\times r}{r^3}=\frac{\mu_0}{4\pi}\int\frac{r^2 d\theta}{r^3}=(\frac{\mu_0 i}{4\pi})\theta$$

The total current is divided into two arcs

$$i_1=\frac{E}{R_1}=\frac{E}{(R/2\pi r)l_1}=\frac{E}{((R/2\pi r))(r\,\theta)}=\frac{2\pi E}{R\theta}$$

$$i_1\theta=\frac{2\pi E}{R}=\text{costant}$$

Similarly, $i_2=\frac{E}{R_2}=\frac{E}{(R/2\pi r)l_2}$

$$=\frac{E}{((R/2\pi r))\{r(2\pi-\theta)\}}=\frac{2\pi E}{R(\pi-\theta)}=\text{constant}$$

$$B=B_1-B_2=\frac{\mu_0}{4\pi r}\left(\frac{2\pi E}{R}-\frac{2\pi E}{R}\right)=0$$

296 **(b)**

Magnetic field (B) at the centre of a coil of radius r, having N turns carrying current i is given by

$$B=\frac{\mu_0 Ni}{2r}\ \text{NA}^{-1}\text{m}^{-1}$$

The direction of magnetic field is perpendicular to the plane of the coil, that is, along the axis of the coil. Hence, magnetic field is inversely proportional to r.

297 **(a)**

$$B=\frac{\mu_0}{4\pi}.\frac{2i}{r}\Rightarrow B\propto i$$

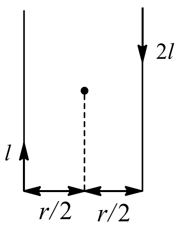
298 **(a)**

The magnetic field induction at P due to currents through both wise is

$$B=\frac{\mu_0}{4\pi}\frac{2i}{r/2}+\frac{\mu_0}{4\pi}\frac{2(2i)}{r/2}$$

$=\frac{\mu_0}{4\pi}\times\frac{12i}{r}$ acting perpendicular to plane of wire inwards.

Now, $\vec{B}$ and $\vec{V}$ are acting in the same direction $ie, \theta=0^0$.



Force on charged particle is $F=qvB\sin\theta=q\,v\,B\times 0=0$.

299 **(a)**

$$F=ma=qvB\Rightarrow a=\frac{qvB}{m}$$

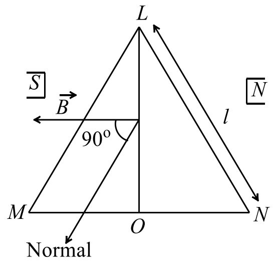
$$=\frac{1.6\times10^{-19}\times2\times3.4\times10^{7}}{1.67\times10^{-27}}$$

$$=6.5\times10^{15}m/\sec^2$$

300 **(c)**

Torque acting on equilateral triangle in a magnetic field $\vec{B}$ is

$\tau=iAB\sin\theta$ ... (i)



Area of triangle LMN

$$A=\frac{\sqrt{3}}{4}l^2$$

And $\theta=90°$

$$\therefore\ \tau\times\frac{\sqrt{3}}{4}l^2B\sin 90°$$

$=\frac{\sqrt{3}}{4}il^2B$ [$\because\sin 90°=1$]

Hence, $l=2\left(\frac{\tau}{\sqrt{3}Bi}\right)^{1/2}$

301 **(c)**

Force on charged particle

$F=qvB\sin\theta$

Force will be maximum if $\theta=90°$

i.e., if v is perpendicular to B

303 **(d)**

Magnetic field inside the hollow conductor (tube) is zero

304 **(c)**

Biot-Savart law states

$$\mathbf{dB}=\frac{\mu_0}{4\pi}\frac{i\mathbf{dL}\times\mathbf{r}}{r^3}$$

$\therefore$ Direction of **dB** is perpendicular to both **dL** and **r**.

305 **(b)**

Electric field can deviate the path of the particle in the shown direction only when it is along negative y-direction. In the given option $\vec{E}$ is either zero or along x-direction. Hence it is the magnetic field which is really responsible for its curved path. Option (a) and (c) can't be accepted as the path will be helix in that case (when the velocity vector makes an angle other than 0°, 180° or 90° with the magnetic field, path is a helix). Option (d) is wrong because in that case component of net force on the particle also comes in k direction which is not acceptable as the particle is moving in x-y plane. Only in option (b) the particle can moves in x-y plane.

In option (d): $\vec{F}_{net} = q\vec{E} + q(\vec{v} + \vec{B})$

Initial velocity is along x-direction. So let $\vec{v} = v\hat{\imath}$

$\therefore \vec{F}_{net} = qa\hat{\imath} + q[(v\hat{\imath}) \times (c\hat{k} + b\hat{\jmath})]$

$= qa\hat{\imath} - quc\hat{\jmath} + qvb\hat{k}$

In option (b) $\vec{F}_{net} = q(a\hat{\imath}) + q[(v\hat{\imath}) \times (c\hat{k} + a\hat{\imath}) = qa\hat{\imath} - qvc\hat{\jmath}$

306 **(a)**

Since $\vec{F}$ and $\vec{v}$ are perpendicular to each other work done by force is zero. Hence K.E. is constant

307 **(d)**

$B = \frac{F}{q\,v\sin 90°} = \frac{10^{-10}}{10^{-12} \times 10^{5}} = 10^{-3}$ T in z- direction.

308 **(a)**

Lorentz force is given by

$\vec{F} = \vec{F_e} + \vec{F_m} = q\vec{E} + q(\vec{v} \times \vec{B}) = q[\vec{E} + (\vec{v} \times \vec{B})]$

309 **(c)**

Magnetic field (B) at the centre of a coil of radius (r) carrying current (i) is

$$B = \frac{\mu_0 i}{2r}$$

$$\Rightarrow \quad i = \frac{2rB}{\mu_0}$$

Given, $B = 0.5 \times 10^{-5}$ T, $r = 0.05$ m

$$i = \frac{2 \times 0.5 \times 10^{-5} \times 0.05}{4\pi \times 10^{-7}} = 0.398 \text{ A}$$

$\Rightarrow i \approx 0.4$ A

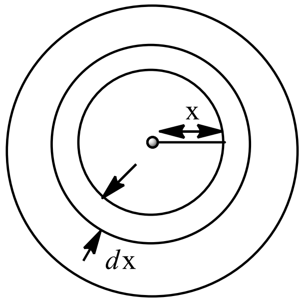
310 **(d)**

Let us consider the disc to be made up of large number of concentric elementary rings.

Consider one such ring of radius x and thickness dx.

Charge on this elementary ring,

$dq = \sigma \times 2\pi x dx$



$= 2\pi\sigma x dx$

Current associated with this elementary ring,

$$dI = \frac{dq}{dt}$$

$$= dr \times f = \sigma\omega x dx$$

Magnetic moment of this elementary ring,

$$dM = dI\pi x^2 = \pi\sigma\omega x^3 dx$$

$\therefore$ Magnetic moment of the entire disc,

$$M = \int_0^R dM$$

$$= \pi\sigma\omega \int_0^R x^3 dx = \frac{1}{4}\pi R^4 \sigma\omega$$

311 **(c)**

When particle enters perpendicularly in a magnetic field, it moves along a circular path with constant speed

312 **(c)**

Magnetic induction at the centre of a circular coil

$$B = \frac{\mu_0}{2} \cdot \frac{ni}{R}$$

$$\Rightarrow \quad B \propto \frac{n}{R}$$

Here, $n_1 = 1, n_2 = 2,$

$$l = 2\pi R_1 = 2 \times 2\pi R_2$$

$$\Rightarrow \quad R_2 = \frac{R_1}{2}$$

$$\therefore \quad \frac{B_1}{B_2} = \frac{n_1}{n_2} \times \frac{R_2}{R_1}$$

$$= \frac{1}{2} \times \frac{R_1/2}{r} = \frac{1}{4}$$

$B_1 : B_2 = 1 : 4$

313 **(a)**

$r = \frac{mv}{Bq}$

r is least when $\left(\frac{m}{q}\right)$ is least.

$\left(\frac{m}{q}\right)$ is least for electron *ie.* plane is D

314 **(d)**

Magnetic field due to a current carrying wire at a point P which lies at a perpendicular distance R from the wire is given as

$B = \frac{\mu_0}{4\pi}\frac{i}{R}(\sin\phi_1 + \sin\phi_2)$

When the linear conductor is of infinite length, then

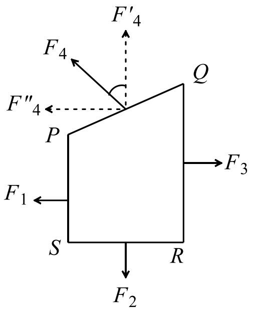
$\phi_1 = \phi_2 = 90°$

So, $B = \frac{\mu_0}{4\pi R}\, i\, [\sin 90° + \sin 90°]$

$= \frac{\mu_0}{4\pi}\frac{2i}{R} = \frac{\mu_0}{2\pi}\frac{i}{R}$

315 **(d)**

Since all the given forces are lying in plane, so the given loop is in equilibrium



$F_4'' = F_4 \cos\phi = F_2$

$F_4'''' = F_4 \sin\phi = F_3 - F_1$

$\Rightarrow F_4^2 = F_2^2 + (F_3 - F_1)^2$

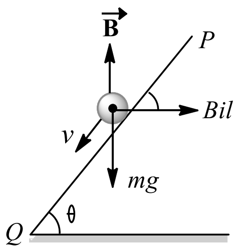
$\Rightarrow F_4 = \sqrt{F_2^2 + (F_3 - F_1)^2}$

317 **(a)**

$r = \frac{mv}{Bq} = \frac{v}{(q/m)B} = \frac{2 \times 10^5}{5 \times 10^7 \times 4 \times 10^{-2}} = 0.1m$

318 **(c)**

Magnetic force on the rod $F_m = Bil$. It acts in the direction as shown in figure. The rod will move with a constant speed if the net force on the rod is zero. It will be so if



$Bil \cos\theta = mg\sin\theta$

Or $B = \frac{mg}{il}\frac{\sin\theta}{\cos\theta} = \frac{mg}{il}\tan\theta$

319 **(d)**

$\frac{B_c}{B_a} = \left(1 + \frac{x^2}{a^2}\right)^{3/2} = \left(1 + \frac{a^2}{a^2}\right)^{3/2} = (1+1)^{3/2}$

$= 2\sqrt{2}$

320 **(c)**

Length of the component dl which is parallel to wire (1) is $dl\cos\theta$, so force on it

$F = \frac{\mu_0}{4\pi}.\frac{2i_1i_2}{r}(dl\cos\theta) = \frac{\mu_0 i_1 i_2 dl\cos\theta}{2\pi r}$

321 **(d)**

By Fleming's left hand rule

322 **(d)**

The force between two parallel current carrying wires is independent of the radii of the wires.

324 **(a)**

$M = iA \Rightarrow i = M/A$

325 **(d)**

Magnetic field exerts force **(F)** on moving charge (q) is given by

$\mathbf{F} = q\mathbf{v} \times \mathbf{B} = q\mathbf{vB}\sin\theta$

Where **v** is velocity, **B** the magnetic field, and θ the angle between the two. F is maximum when $\sin\theta$ is maximum.

Therefore, $\theta = \frac{\pi}{2}, \sin\frac{\pi}{2} = 1$

326 **(a)**

The oscillator frequency should be same as proton's cyclotron frequency

Cyclotron frequency, $v_c = \frac{qB}{2\pi m}$

or $B = \frac{2\pi\, m v_c}{q}$

$= \frac{2 \times 3.14 \times 1.67 \times 10^{-27} \times 12 \times 10^6}{1.6 \times 10^{-19}}$

$= 78.6 \times 10^{-2} T = 0.8\, T$

327 **(c)**

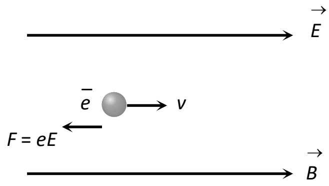
In the position shown. AB is outside and CD is inside the plane of the paper. The Ampere force on AB acts into the paper. The torque on the loop will be clockwise, as seen from above. The loop must rotate through an angle $(90° + \theta)$ before the plane of the loop becomes normal to the direction of the direction of B and the torque becomes zero

328 **(a)**

When current is passed, the spring will contact, breaking the contact with mercury. As contact is broken, magnetic effects become zero. Due to weight the coil will restore its contact with mercury and so on. The coil will have oscillatory behavior.

329 **(d)**

Since electron is moving parallel to the magnetic field, hence magnetic force on it $F_m = 0$



The only force acting on the electron is electric force which reduces it's speed

330 **(d)**

When the currents are in the same direction then magnetic field

$B = \frac{\mu_0}{4\pi} \times \frac{2}{d} [i_1 - i_2]$

$6 \times 10^{-6} = \frac{\mu_0}{4\pi} \times \frac{2}{d} [i_1 - i_2]$ ... (i)

When the currents are in the reversed direction then magnetic field

$B_2 = \frac{\mu_0}{4\pi} \times \frac{2}{d} [i_1 - (-i_2)]$

$6 \times 10^{-6} = \frac{\mu_0}{4\pi} \times \frac{2}{d} [i_1 - i_2]$ ... (i)

When the currents are in the reversed direction then magnetic field

$B_2 = \frac{\mu_0}{4\pi} \times \frac{2}{d} [i_1 - (-i_2)]$

or $B_2 = \frac{\mu_0}{4\pi} \times \frac{2}{d} [i_1 + i_2]$

or $3 \times 10^{-5} = \frac{\mu_0}{4\pi} \times \frac{2}{d} [i_1 + i_2]$ ... (ii)

Dividing Eq. (i) by Eq. (ii)

$\frac{i_1 - i_2}{i_1 + i_2} = \frac{6 \times 10^{-6}}{3 \times 10^{-5}}$

or $\frac{i_1 - i_2}{i_1 + i_2} = \frac{2}{10}$

or $5i_1 - 5i_2 = i_1 + i_2$

or $4i_1 = 6i_2$

$\frac{i_1}{i_2} = \frac{6}{4}$

$\frac{i_1}{i_2} = \frac{3}{2}$

331 **(b)**

$F = \frac{\mu_0}{4\pi} \frac{2i_1 i_2}{r} l$

$= \frac{10^{-7} \times 2 \times 10 \times 2}{0.1} \times 2 = 8 \times 10^{-5}$ N

332 **(d)**

$M = NiA$

333 **(b)**

$B_0 = \frac{\mu_0 NI}{2a} = \frac{\mu_0 I \times 1}{2a} = \frac{\mu_0 I}{2a}$ for 1 turn

For rewinding the coil in three turns, new radius $a/3$, number of turns $(N') = 3$

$\therefore$ New magnetic field $= \frac{\mu_0 I \times 3}{2 \times (a/3)} = \frac{9\mu_0 I}{2a} = 9B_0$

Short trick : $B' = n^2 B_0 = (3)^2 B_0 = 9B_0$

334 **(c)**

$r = mv/qB$

Since both have same momentum, therefore the circular path of both will have the same radius

335 **(a)**

$W = BM\cos 60° = \frac{MB}{2}; MB = 2W$

$\tau = MB\sin\theta = (2W)\sin 60° = 2W\frac{\sqrt{3}}{2} = W\sqrt{3}$

336 **(d)**

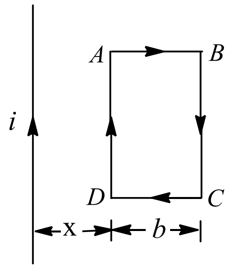
$\vec{F} = q(\vec{v} \times \vec{B}) = 0$ as $\vec{v}$ and $\vec{B}$ are parallel

337 **(b)**

The charge will not experience any force it $|\vec{F_e}| = |\vec{F_m}|$. This condition is satisfied in option (b) only

338 **(b)**

The magnetic force on AB and CD are equal and opposite due to symmetry and opposite currents in these sides. The magnetic force on AD.



$F_1 = \frac{\mu_0 i}{2\pi x}$ attractive

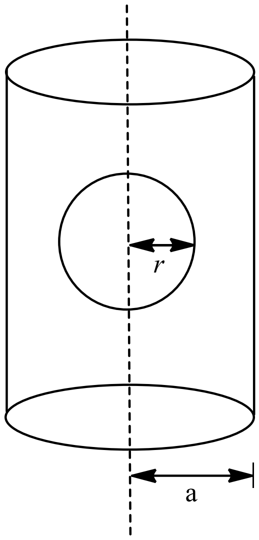
Magnetic force on BC

$F_2 = \frac{\mu_0 i}{2\pi(x+b)}$ repulsive

Therefore, magnetic force will be experiences towards wire.

339 **(c)**

Current density $J = \frac{i}{\pi a^2}$



From Ampere's circuital law

$$\oint B.dl = \mu_0 \cdot i_{\text{enclosed}}$$

For $r < a$

$$B \times 2\pi r = \mu_0 \times J \times \pi r^2$$

$$\Rightarrow B = \frac{\mu_0 i}{\pi a^2} \times \frac{r}{2}$$

At $r = \frac{a}{2}$

$$B_1 = \frac{\mu_0 i}{4\pi a}$$

For $r > a$

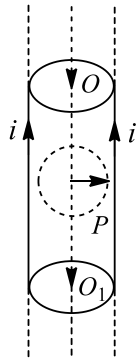
$$B \times 2\pi r = \mu_0 i \Rightarrow B = \frac{\mu_0 i}{2\pi r}$$

At $r = 2a$, $B_2 = \frac{\mu_0 i}{4\pi a}$

So, $\frac{B_1}{B_2} = 1$

340 **(b)**

Figure shows infinitely, long, straight, thin-walled pipe carrying current I
Let P be any point at a distance r from the axis OO_1 of the pipe. Let B be magnetic field at P. Consider a closed circular path passing through point P as shown in figure. From Ampere's circuital theorem, $\oint B\ dl = \mu_0 i$



i = current through the closed path. Obviously, $i = 0$
$\therefore\ 2\pi RB = 0$ or $B = 0$.

341 **(a)**

$F = qvB\sin\theta = qvB\sin 0 = 0$

342 **(c)**

The given portion of the curved wire may be treated as a straight wire of length $2L$ which experience a magnetic force $F_m = Bi(2L)$

343 **(d)**

AB and DC, AD and BC are in the opposite direction pairs. They are so situated that currents of each pair produce equal and opposite magnetic fields at the centre O of the loop. Hence, the resultant magnetic field induction at the centre O of the loop is zero

344 **(a)**

$$F = \frac{\mu_0}{4\pi}\frac{2i_1 i_2}{a} = 10^{-7} \times \frac{2 \times 10 \times 10}{0.1} = 2 \times 10^{-4} N$$

Direction of current is same, so force is attractive

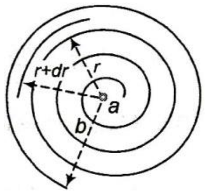
345 **(b)**

Force per unit length on two parallel current carrying conductors is given by $\frac{F}{l} = 10^{-7} \times 2\frac{i_1 i_2}{a}$

$$\Rightarrow \frac{F}{l} = 10^{-7} \times 2 \times \frac{1 \times 1}{1} = 2 \times 10^{-7} N/m$$

346 **(d)**

Consider an element of thickness dr at a distance r from the centre of spiral coil.



Number of turns in coil $= n$
Number of turns per unit length

$$= \frac{n}{b - a}$$

Number of turns in element $dr = dn$
Number of turns per unit length in element dr

$$= \frac{ndr}{b - a}$$

ie, $dn = \frac{ndr}{b-a}$

Magnetic field at its centre due to element dr is

$$dB = \frac{\mu_0 Idn}{2r} = \frac{\mu_0 I}{2}\frac{n}{(b-a)}\frac{dr}{r}$$

$$\therefore B = \int_a^b \frac{\mu_0 Indr}{2(b-a)r} = \frac{\mu_0 In}{2(b-a)}\int_a^b \frac{dr}{r}$$

$$= \frac{\mu_0 In}{2(b-a)}\log_e\left(\frac{b}{a}\right)$$

348 **(b)**

By Fleming left hand rule

349 **(a)**

$\overrightarrow{F_m} = q(\vec{v}\times\vec{B})$

When the angle between $\vec{v}$ and $\vec{B}$ is 180°, $F_m = 0$

350 **(c)**

In a perpendicular magnetic field, the radius of circular path travelled by electron beam is

$$r = \frac{mv}{eB}$$

$$\therefore\ r = \frac{9\times10^{-31}\times1.6\times10^{7}}{1.6\times10^{-19}\times0.1}$$

$$= 9\times10^{-4}\ \text{m}$$

351 **(c)**

$W = F.d\cos 90° = 0$

353 **(d)**

$\tau = MB\sin\theta \Rightarrow \tau_{\max} = NiAB,\qquad [\theta = 90°]$

354 **(b)**

B represents the magnetic field

355 **(c)**

$$r = \frac{\sqrt{2mK}}{qB} i.e. r \propto \frac{\sqrt{m}}{q}$$

Here kinetic energy K and B are same

$$\therefore \frac{r_p}{r_\alpha} = \frac{\sqrt{m_p}}{\sqrt{m_\alpha}}.\frac{q_\alpha}{q_p} = \frac{\sqrt{m_p}}{\sqrt{4m_p}}.\frac{2q_p}{q_p} = 1$$

356 **(d)**

$$B = \frac{\mu_0 ia}{4\pi r} = \frac{\mu_0}{4\pi a}.\frac{3\pi}{2}$$

$$= \frac{3\mu_0 i}{8a}$$

357 **(a)**

Magnetic field due to a long solenoid is given by

$$B = \mu_0 ni$$

From given data,

$6.28\times10^{-2} = \mu_0\times200\times10^{2}\times i$ ...(i)

and $B = \mu_0\times100\times10^{2}\times\left(\frac{i}{3}\right)$ ...(ii)

Solving Eqs. (i) and (ii), we get

$$B = 1.05\times10^{-2}\ \text{Wb/m}^2$$

358 **(d)**

In P and R, current divides equally in two halves because of equal resistances in the two halves. Due to equal currents in two halves the magnetic field at the centre will be zero.

359 **(b)**

Radius of circular paths is proportional to square root of mass,

$R \propto \sqrt{m}$

$$\frac{R_d}{R_p} = \sqrt{\frac{m_d}{m_p}} = \frac{\sqrt{2}}{1}$$

$$\Rightarrow \frac{R_p}{R_d} = \frac{1}{\sqrt{2}}$$

Also, $\frac{R_d}{R_\alpha} = \frac{\sqrt{M_d}}{\sqrt{M_\alpha}} = \frac{\sqrt{2}}{\sqrt{4}} = \frac{1}{\sqrt{2}}$

Hence, ratio is $1 : \sqrt{2} : \sqrt{2}$.

360 **(b)**

$r = \frac{p}{qB} \Rightarrow p \propto q\quad [\because r \text{ and } B \text{ are constant}]$

$$\frac{p_p}{p_\alpha} = \frac{q_p}{q_\alpha} = \frac{q_p}{(2q_p)} = \frac{1}{2}$$

361 **(b)**

Hole reduces the effective length of the magnet and hence magnetic moment reduces.

362 **(b)**

Magnetic field at the centre of current carrying loop

$B = \frac{\mu_0 i}{2r}$ ...(i)

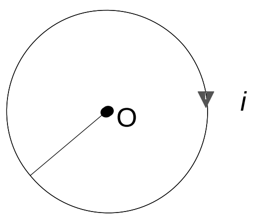
Where r is the radius of loop and i the current.

Given, $r_2 = 2r$

$$\therefore\ \frac{B_1}{B_2} = \frac{1}{r}\times\frac{2r}{1} = \frac{2}{1}$$

$$\Rightarrow\ B_2 = \frac{B_1}{2} = \frac{B}{2}$$

Hence, magnetic field is halved.



364 **(d)**

$F = 10^{-7} \times \frac{2i^2}{a} \times l \Rightarrow 30 \times 10^{-7}$

$= 10^{-8} \times \frac{2i^2}{0.15} \times 9$

$\Rightarrow i = 0.5\,A$

365 **(d)**

Given $A = 2 \times 10^{-2}$ m^2

$N = 100$

$I = 5$ A

When the coil is held with its plane in North-South direction then its torque

$\tau_1 = 0.3$ Nm

$\tau_2 = MB \sin\theta$

When the plane is in East-West direction then it's torque

$\tau_2 = 0.4$ Nm

$\tau_2 = MB \sin(90° - \theta)$

$\tau_2 = MB \cos\phi$

$\therefore \frac{MB\sin\theta}{MB\cos\theta} = \frac{\tau_1}{\tau_2}$

$\tan\theta = \frac{3}{4}$

or $\theta = \tan^{-1}\left(\frac{3}{4}\right)$

or $\theta = 370°$

Then $\sin\theta = 0.6$

$B = \frac{\tau_1}{M\sin\theta}$

$\Rightarrow B = \frac{0.3}{NIA\sin\theta}$

$\Rightarrow B = \frac{0.3}{100 \times 5 \times 2 \times 10^{-2} \times 0.6}$

$B = 0.05$ T

366 **(c)**

For no deflection is mutually perpendicular electric and magnetic field $v = \frac{E}{B} = \frac{3.2\times10^5}{2\times10^{-3}} = 1.6 \times 10^8\ m/s$.

If electric field is removed then due to only magnetic field radius of the path described by electron

$r = \frac{mv}{qB} = \frac{9.1 \times 10^{-31} \times 1.6 \times 10^8}{1.6 \times 10^{-19} \times 2 \times 10^{-3}} = 0.45\ m$

367 **(d)**

$\vec{F} = i[\vec{l} \times \vec{B}]$

$= 3.5\,[10^{-2}\hat{\imath} \times (0.74\,\hat{\jmath} - 0.36\,\hat{k})$

$= (2.59\hat{k} - 1.25\,\hat{\jmath}) \times 10^{-2}$ N.

368 **(c)**

$i = 6.6 \times 10^{15} \times 1.6 \times 10^{-19} = 10.5 \times 10^{-4} amp$

$A = \pi R^2 = 3.142 \times (0.528)^2 \times 10^{-20} m^2$

$\Rightarrow M = iA = 10.5 \times 10^{-4} \times 3.142 \times (0.528)^2 \times 10^{-20}$

$= 10 \times 10^{-24} units = 1 \times 10^{-23} units$

370 **(a)**

Here magnetic force is zero, but the velocity increases due to electric force

371 **(d)**

Magnetic field due to current through a linear conductor from the left to right at a point below the conductor is acting horizontally upwards. The electron beam moving from left to right will cause current right to left. The force on the electron will be vertically downwards according to Fleming's hand rule.

372 **(d)**

The magnetic field is given by $B = \frac{\mu_0}{4\pi}\frac{2i}{r}$

It is independent of the radius of the wire

373 **(a)**

$\frac{\mu_0 I_c}{2R} = \frac{\mu_0 I}{2\pi H} \Rightarrow H = \frac{I_e R}{\pi I_c}$

374 **(c)**

$r = \frac{mv}{qB} \Rightarrow r \propto v$

375 **(a)**

For no force on wire C, force on wire C due to wire D = force on wire C due to wire B

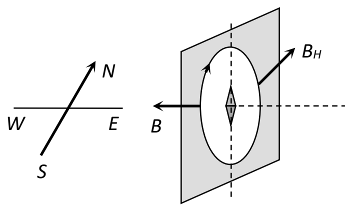
$\Rightarrow \frac{\mu_0}{4\pi} \times \frac{2 \times 15 \times 5}{x} \times l \times \frac{\mu_0}{4\pi} \times \frac{2 \times 5 \times 10}{(15 - x)} \times l \Rightarrow x$

$= 9cm$

376 **(a)**

In adjoining loops of spring, the current being in the same direction, there will be attraction. Due to which the spring gets compressed.

377 **(b)**



378 **(a)**

Corresponding current $i = en$

So $B = \frac{\mu_0}{4\pi}.\frac{2\pi(en)}{r} = \frac{\mu_0 ne}{2r}$

379 **(a)**

Both the rings rotate due to magnetic field induction of the other, till both come along the common plane.

380 **(a)**

$F=\frac{\mu_0}{4\pi}.\frac{6M_1M_2}{r^4}=\frac{6M_1M_2}{r^4}$

$\therefore\left[\text{In CGS system},\frac{\mu_0}{4\pi}=1\right]$

$=\frac{6\times800\times400}{20\times20\times20\times20}=12$ dyne.

381 **(d)**

Pole strength does not depend on length.

382 **(d)**

As energy can neither be created nor destroyed, therefore, its energy will remain constant and will acquire no extra energy.

383 **(d)**

Magnetic field induction at the centre of circular coil carrying current is $B=\frac{\mu_0}{4\pi}\frac{2\pi ni}{r}$ $ie, B\propto n/r$

But, $2\pi r=3\times2\pi r_1$ or $r_1=r/3$

So, $\frac{B_1}{B}=\frac{n_1}{r_1}\times\frac{r}{n}=\frac{3\times r}{(r/3)\times1}=9$

384 **(c)**

$r=\frac{\sqrt{2mK}}{qB}\Rightarrow q\propto\sqrt{mK}\Rightarrow K\propto\frac{q^2}{m}$

$\Rightarrow\frac{K_\alpha}{K_p}=\left(\frac{q_\alpha}{q_p}\right)^2\times\frac{m_p}{m_\alpha}\Rightarrow\frac{K_\alpha}{8}=\left(\frac{2q_p}{q_p}\right)^2\times\frac{m_p}{4m_p}=1$

$\Rightarrow K_\alpha=8\,eV$

385 **(c)**

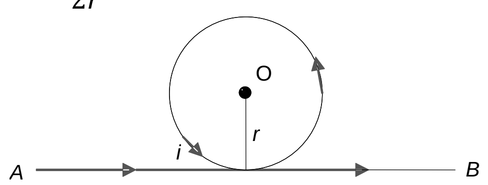
The magnitude of the magnetic field at point O due to straight part of wire is

$B_1=\frac{\mu_0 i}{2\pi r}$

B_1 is perpendicular to the plane of the page, directed upwards (right hand plam rule 1).

The field at the centre O due to the current loop of radius r is

$B_2=\frac{\mu_0 i}{2r}$



B_2 is also perpendicular to the page, directed upwards (right hand screw rule).

$B_1+B_2=\frac{\mu_0 i}{2r}\left(\frac{1}{\pi}+1\right)$

$=\frac{\mu_0 i}{2\pi r}(\pi+1)$

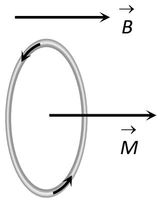
387 **(c)**

$B_1/B_2=r_2/r_1$ or $B_2=B_1\,r_1/r_2$

$=10^{-3}\times4/1=4\times10^{-3}$ T

388 **(c)**

In equilibrium angle between $\vec{M}$ and $\vec{B}$ is zero. It happens when plane of the coil is perpendicular to $\vec{B}$



389 **(b)**

$r=\frac{p}{qB}\Rightarrow r\propto p$

390 **(c)**

$B=\mu_0 ni=4\pi\times10^{-7}\times(100\times100)\times5$

$=2\pi\times10^{-3}\text{ T}=2\pi\times10^{-3}\times10^4\text{ G}=20\pi\text{G}.$

391 **(a)**

In this case path of charged particle is circular and magnetic force provides the necessary centripetal force $ie, Bqv=\frac{mv^2}{r}$

$\Rightarrow$ Radius of path $r=\frac{mv}{Bq}$

Since v and B will remain same, so $r\propto\frac{m}{q}$. The ratio is least for electron, therefore, it will describe the smallest circle.

392 **(a)**

$B\propto\frac{1}{r}\Rightarrow\frac{B_1}{B_2}=\frac{r_2}{r_1}\Rightarrow\frac{0.04}{B_2}=\frac{40}{10}\Rightarrow B_2=0.01\,T$

393 **(a)**

Magnetic field in the middle of the solenoid is maximum, magnetic field at it's one end is half of the $M.F.$ at the centre

$i.e. B_{end}=\frac{1}{2}B_{\text{centre}}$

394 **(c)**

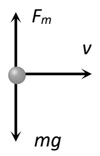
$r=\frac{mv}{qB}\Rightarrow r\propto v\Rightarrow r_2=2r_1=2\times2=4cm$

395 **(c)**

Particle will move with uniform velocity when it's acceleration is zero

$i.e., |F_m|=mg\Rightarrow mg=qvB$

$\Rightarrow B=\frac{mg}{qv}=\frac{0.6\times10^{-3}\times10}{25\times10^{-9}\times1.2\times10^4}=20\,T$



396 **(d)**

For a loop, magnetic induction at centre,

$$B = \frac{\mu_0}{4\pi} \times \frac{2\pi i}{R}$$

When loop subtends angle θ at centre, then

$$B = \frac{\mu_0}{4\pi} \times \frac{\theta i}{R}$$

In the given problem, $\theta = 3\pi/2$

$$\therefore b = \frac{\mu_0}{4\pi} \times \frac{3\pi}{2} \times \frac{i}{R} = \frac{3\mu_0 i}{8R}$$

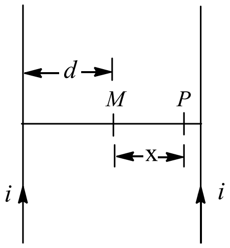
397 **(d)**

The magnetic field B will be uniform inside the long hollow tube, excepts near the ends. Also magnetic field is zero at any point outside the tube.

398 **(b)**

The magnetic field due to first wire

$$B_1 = \frac{\mu_0 i}{2\pi(d+x)}$$



$$B_2 = \frac{\mu_0 i}{2\pi(d-x)}$$

Both the magnetic field act in opposite direction.

$$\therefore\ B = B_2 - B_1 = \frac{\mu_0}{2\pi}\left[\frac{1}{d-x} - \frac{1}{d+x}\right]$$

$$= \frac{\mu_0 i}{2\pi}\left[\frac{d+x-d+x}{d^2-x^2}\right] = \frac{\mu_0 i x}{\pi(d^2-x^2)}$$

399 **(b)**

Here, $\vec{E}$ and $\vec{B}$ are acting along x-axis and $\vec{V}$ is acting along y-axis *ie*, perpendicular to both $\vec{E}$ and $\vec{B}$. Therefore, the path of charged particle is a helix with increasing speed. Speed of particle at time t is

$$v = \sqrt{v_x^2 + v_y^2} \qquad \text{(i)}$$

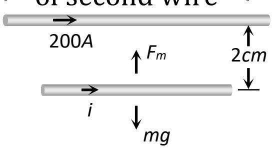
Here, $v_y = v_0; v_x = \frac{qE}{m} t$ and $v = \frac{\sqrt{5}}{2} v_0$

Putting values in Eq. (i), we get $t = \frac{m\, v_0}{2\, q\, E}$

400 **(c)**

For floating the second wire

$$\left|\begin{matrix}\text{Downward weight} \\ \text{of second wire}\end{matrix}\right| = \left|\begin{matrix}\text{Magnetic force} \\ \text{on it}\end{matrix}\right|$$



$$\Rightarrow mg = \frac{\mu_0}{4\pi} . \frac{2 i_1 i_2}{a} \times l$$

$$\Rightarrow \left(\frac{m}{l}\right) g = \frac{\mu_0}{4\pi} . \frac{2 i_1 i_2}{a}$$

$$\Rightarrow 10^{-2} \times 9.8 = 10^{-7} \times \frac{2 \times 200 \times i}{2 \times 10^{-2}} \Rightarrow i = 49A$$

(Direction of current is same to first wire)

401 **(a)**

Magnetic field at the centre of a circular loop of radius R carrying current I is $B = \frac{\mu_0 2\pi I}{4\pi R} = \frac{\mu_0 I}{2r}$

Its magnetic moment is $M = IA = I(\pi R^2)$

$$\therefore \frac{B}{M} = \frac{\mu_0 I}{2R} \times \frac{1}{I\pi R^2} = \frac{\mu_0}{2\pi R^2} = x \quad \text{[Given]}$$

When both the current and radius is doubled, the ratio becomes $\frac{B'}{M'} = \frac{\mu_0}{2\pi(2R)^3} = \frac{1}{8}\left(\frac{\mu_0}{2\pi R^3}\right) = \frac{x}{8}$

402 **(a)**

$$\tau = NBiA = 100 \times 0.2 \times 2 \times (0.08 \times 0.1)$$
$$= 0.32 N \times m$$

Direction can be found by Fleming's left hand rule

403 **(b)**

Here, $v = 3 \times 10^6 ms^{-1}$,

$B = 2 \times 10^{-4} wb\ m^{-2} = 2 \times 10^{-4} T$

$R = 6cm = 6 \times 10^{-2} m$. As $Bqv = \frac{mv^2}{R}$ or $\frac{q}{m} = \frac{v}{BR}$

Substituting the given values, we get

$$\frac{q}{m} = \frac{3 \times 10^6}{2 \times 10^{-4} \times 6 \times 10^{-2}} = 0.25 \times 10^{12} C/kg$$
$$= 2.5 \times 10^{11} C/kg$$

404 **(c)**

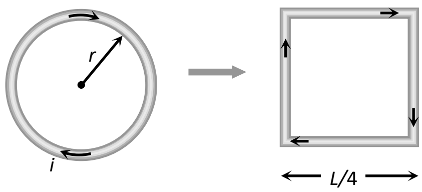
$$B = \frac{\mu_0}{4\pi} \times \frac{\pi i}{r} \Rightarrow B = 10^{-7} \times \frac{\pi \times 10}{5 \times 10^{-2}}$$
$$= 6.28 \times 10^{-5} T$$

405 **(d)**

Initially for circular coil $L = 2\pi r$ and $M = 1 \times \pi r^2$

$$= i \times \pi \left(\frac{L}{2\pi}\right)^2 = \frac{iL^2}{4\pi} \qquad \text{... (i)}$$

Finally for square coil $M' = i \times \left(\frac{L}{4}\right)^2 = \frac{iL^2}{16}$ ... (ii)



Solving equation (i) and (ii) $M' = \frac{\pi M}{4}$

406 **(b)**

A moving coil galvanometer has N number of turns in a coil of effective area A, it carries a current I. The magnetic field B is radial. The torque acting on the coil is

407 **(b)**

$$V = i_g R \quad \text{and } V' = i_g R' \quad \text{or } \frac{R'}{R} = \frac{V'}{V}$$

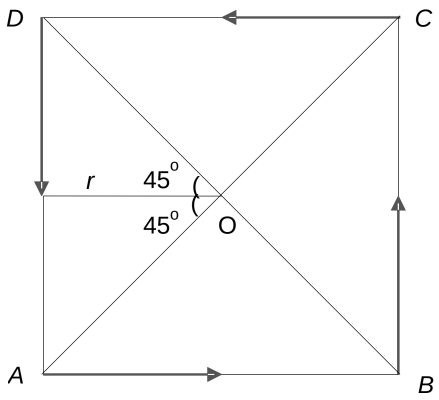
Or $R' = \frac{V'}{V} R = \frac{3V}{V} \times 50 \times 10^3 = 1.5 \times 10^5 \Omega$

∴ Additional resistance

$= 1.5 \times 10^5 - 0.5 \times 10^5 = 10^5\ \Omega$

408 **(d)**

From Biot-Savart's law, magnetic field due to current carrying conductor is



$$B = \frac{\mu_0}{4\pi}\frac{i}{r}(\sin\phi_1 + \sin\phi_2)$$

Where, $\phi_1 = 45°, \phi_2 = 45°$

$$B = \frac{\mu_0}{4\pi}\cdot\frac{i}{r}\left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right) = \frac{\mu_0 i\sqrt{2}}{4\pi r}$$

Since, square consists of four sides, total magnetic field is

$$B' = 4B = \frac{4}{4\pi r}\cdot\mu_0 i\sqrt{2} = \frac{\mu_0 i\sqrt{2}}{\pi r}$$

From figure, $r = \sqrt{\left(\frac{L\sqrt{2}}{2}\right) - \left(\frac{L}{2}\right)^2}$

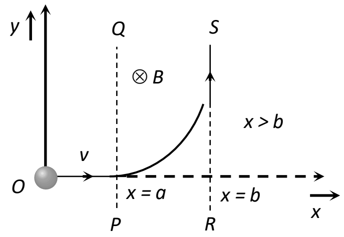
$$= \sqrt{\frac{2L^2}{4} - \frac{L^2}{4}}$$

$$= \sqrt{\frac{L^2}{4}} = \frac{L}{2}$$

$$\therefore B = \frac{\mu_0 I\sqrt{2}}{\pi\frac{L}{2}} = \frac{\mu_0 I.\,2\sqrt{2}}{\pi L}$$

409 **(b)**

In the figure, the z-axis points out of the paper, and the magnetic field is directed into the paper, existing in the region between PQ and RS. The particle moves in a circular path of radius r in the magnetic field. It can just enter the region $x > b$ for $r \geq (b - a)$



Now, $r = \frac{mv}{qB} \geq (b - a)$

Or $v \geq \frac{q(b-a)B}{m} \Rightarrow v_{\min} = \frac{q(b-a)B}{m}$

410 **(b)**

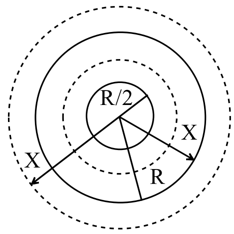
$$r = \frac{\sqrt{2mK}}{qB} = \frac{1}{B}\sqrt{\frac{2mV}{q}}$$

$$= \frac{1}{10^{-3}}\sqrt{\frac{2 \times 9 \times 10^{-31} \times 12000}{1.6 \times 10^{-19}}} = 0.367\ m$$

$$= 36.7\ cm$$

411 **(d)**

Case-I $x < \frac{R}{2}$



$|\vec{B}| = 0$

Case-II $\frac{R}{2} \leq x < R$

$$\int \vec{B}.d\vec{\ell} = \mu_0 l$$

$$|\vec{B}|2\pi x = \mu_0\left[\pi x^2 - \pi\left(\frac{R}{2}\right)^2\right]J$$

$$|\vec{B}| = \frac{\mu_0 J}{2x}\left(x^2 - \frac{R^2}{4}\right)$$

Case-III $x \geq R$

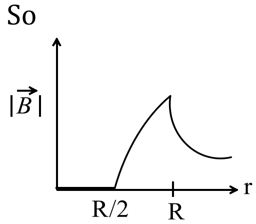
$$\int \vec{B}.d\vec{\ell} = \mu_0 l$$

$$|\vec{B}|2\pi x = \mu_0\left[\pi R^2 - \pi\left(\frac{R}{2}\right)^2\right]J$$

$$|\vec{B}| = \frac{\mu_0 J}{2x}\frac{3}{2}R^2$$

$$|\vec{B}| = \frac{3\mu_0 J R^2}{8x}$$

So



412 **(c)**

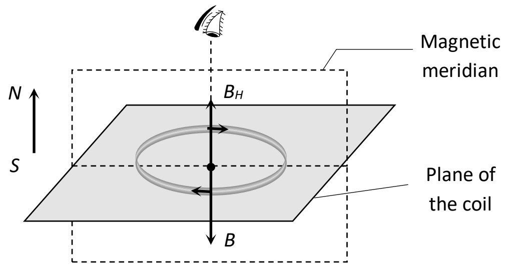
Force, $F = Bil\sin\theta$

$$= 500 \times 10^{-4} \times 3 \times (40 \times 10^{-2}) \times \frac{1}{2}$$
$$= 3 \times 10^{-2} \text{ N}$$

413 **(a)**
The two conductors are attracting each other, which means that currents flowing are parallel in direction.

414 **(a)**
$\tau = NBiA \sin\theta$
So the graph between τ and θ is a sinusoidal graph

415 **(d)**
Magnetic meridian is a vertical N-S plane, the earth's magnetic field (B_H) lies in it. (For more details see magnetism)
To obtain neutral point at the centre of coil, magnetic field due to current (B) and B_H must cancel each other. Hence plane of the coil and magnetic meridian must be perpendicular to each other as shown



416 **(d)**
Magnetic field on the axis of conductor is zero

417 **(b)**
The current through loop is anticlockwise. Hence, magnetic field at the points within the loop is perpendicular to paper outwards. As the magnetic lines of force form a closed path and tangent to line of force tells the direction of magnetic field at that point. Hence, magnetic field at O is perpendicular to paper inwards.

418 **(a)**
$L = n_1\, 2\pi r_1 = n_2 2\pi r_2 \Rightarrow n_1 r_1 = n_2 r_2 \Rightarrow \frac{r_1}{r_2} = \frac{n_2}{n_1}$
$B = \frac{\mu_0 ni}{2r} \Rightarrow \frac{B_1}{B_2} = \frac{\mu_0 n_1 i/2r_1}{\mu_0 n_2 i/2r_2}$
$= \frac{n_1}{n_2} . \frac{r_2}{r_1} = \left(\frac{n_1}{n_2}\right)^2 = \frac{1}{4}$

419 **(c)**
Energy of proton $= 2$ MeV
$$= 2 \times 1.6 \times 10^{-19} \times 10^6$$
$$E = 3.2 \times 10^{-13} \text{ J}$$
Magnetic field $(B) = 2.5$ T
Mass of proton $(m) = 1.6 \times 10^{-27}$ kg
Energy of proton, $E = \frac{1}{2}\, mv^2$

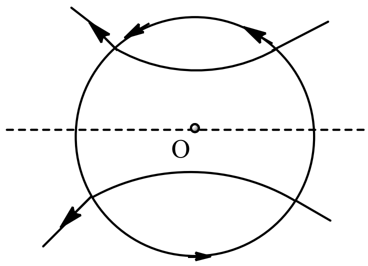
$\therefore v = \sqrt{\frac{2E}{m}}$ ... (i)

Magnetic force on proton
$F = B\, qv \sin 90° = Bqv$
Substituting the value of v from Eq. (i)
$$F = Bq\sqrt{\frac{2E}{m}}$$
$$= 2.5 \times 1.6 \times 10^{-19} \sqrt{\frac{2 \times 3.2 \times 10^{-13}}{1.6 \times 10^{-27}}}$$
$$= 8 \times 10^{-12} \text{ N}$$

420 **(b)**
$r = \frac{mv}{qB} = eV = evB \Rightarrow v = \frac{E}{B}$
Radius of electron's orbit will be more, so proton's trajectory will be less curved.

421 **(c)**
$B = \frac{\mu_0 NI}{l}$, where $N =$ Total number of turns, $l =$ length of the solenoid
$\Rightarrow 0.2 = \frac{4\pi \times 10^{-7} \times N \times 10}{0.8} \Rightarrow N = \frac{4 \times 10^4}{\pi}$
Since N turns are made from the winding wire so length of the wire $(L) = 2\pi r \times N [2\pi r =$ length of each turns$]$
$\Rightarrow L = 2\pi \times 3 \times 10^{-2} \times \frac{4 \times 10^4}{\pi} = 2.4 \times 10^3 m$

423 **(d)**
According to Fleming's left hand rule, direction of magnetic field at the centre O.
The force on the current carrying conductor is



$F = i\mathbf{dl} \times \mathbf{B}$
As angle between dl and $\mathbf{B}$ is zero
$\therefore \quad F = 0$
The straight with will not exert any force on the circular loop.

424 **(b)**
On applying Fleming's left hand rule

425 **(c)**
$B = \frac{\mu_0 I}{2r} = \frac{\mu_0}{2r} \times \frac{eV}{2\pi r}$
$= \frac{4\pi \times 10^{-7} \times 1.6 \times 10^{-19} \times 10^5}{2\pi(2 \times 0.4 \times 10^{-10})(0.4 \times 10^{-10})}$

$$= \frac{4 \times 10^{-26+10+5}}{4 \times 10^{-11}} = \frac{4 \times 10^{-26+15}}{4 \times 10^{-11}} = \frac{4 \times 10^{-11}}{4 \times 10^{-11}}$$
$$= 1 \omega b/m^2$$

427 **(b)**

As magnetic moment ∝ pole strength ∝ area of cross section and $M \propto m \propto A$

$M_1 : M_2 : M_3 = 1 : 2 : 6$

428 **(a)**

We have the relation

$\Rightarrow \; r = \frac{mv}{eB}$

Given, $m = 9.1 \times 10^{-31}$ kg, $e = 1.6 \times 10^{-19}$ C

$r = 0.5$ m, $v = 10^6$ ms^{-1}

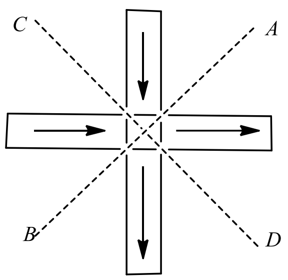
$\therefore B = \frac{mv}{re} = \frac{9.1 \times 10^{-31} \times 10^6}{0.5 \times 1.6 \times 10^{-19}}$

$= \frac{9.1 \times 10^{-25}}{0.8 \times 10^{-19}} = \frac{91}{8} \times 10^{-6}$

$= 11.3 \times 10^{-6} = 1.13 \times 10^{-5}$ J

429 **(c)**

Magnetic field due to both currents at each point online CD being equal and opposite cancel while at each point on line AB they are added up.



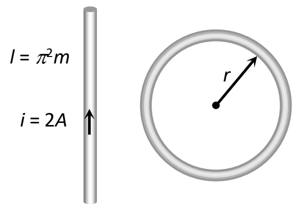
Hence, magnetic induction in region I and IV will be zero.

430 **(b)**

If a wire of length l is bent in the form of a circle of radius r then $2\pi r = l \Rightarrow$

$r = \frac{l}{2\pi}$

$r = \frac{l}{2\pi} = \frac{\pi^2}{2\pi} = \frac{\pi}{2}$



Magnetic field due to straight wire $B_1 = \frac{\mu_0}{4\pi} . \frac{2i}{r} = \frac{\mu_0}{4\pi} \times \frac{2\times2}{1\times10^{-2}}$ also magnetic field due to circular loop $B_2 = \frac{\mu_0}{4\pi} . \frac{2\pi i}{r} = \frac{\mu_0}{4\pi} . \frac{2\pi \times 2}{\pi/2} \Rightarrow \frac{B_2}{B_1} = \frac{1}{50}$

431 **(c)**

Distance between two linear conductor = 6-2= 4 cm. Let the distance of the point on scale from conductor carrying current i be x cm where resultant magnetic field is zero. Then the distance of this point from other conductor is $(4 - x)$ cm.

As per question

$\frac{\mu_0}{4\pi} \frac{2i}{r \times 10^{-2}} = \frac{\mu_0}{4\pi} \frac{2(3i)}{(4-x) \times 10^{-2}}$

Or $3x = 4 - x - x$ or $x = 1$ cm.

$\therefore$ Location of point on scale $= 2 + 1 = 3$ cm mark.

432 **(d)**

$B = \frac{\mu_o}{4\pi} . \frac{2\pi N i R^2}{r^3} \Rightarrow B \propto \frac{1}{r^3}$

433 **(d)**

For such a motion, magnetic force = centripetal force

$$qvB = \frac{mv^2}{r}$$

$\Rightarrow \quad qB = \frac{mv}{r}$

$\Rightarrow \quad r = \frac{mv}{qB}$

$\therefore \quad \frac{r_p}{r_c} = \frac{m_p v_p}{qB} \times \frac{qB}{m_e v_e}$

but $\quad K_e = K_p$

(given)

$\Rightarrow \quad \frac{1}{2} m_e v_e^2 = \frac{1}{2} m_p v_p^2$

$\Rightarrow \quad \frac{m_p}{m_e} = \left(\frac{v_e}{v_p}\right)^2$

$\therefore \quad \frac{r_p}{r_e} = \left(\frac{v_e}{v_p}\right)^2 \frac{v_p}{v_e} = \frac{v_e}{v_p}$

Hence, the electron and proton will follow circular paths but with different radii.

434 **(d)**

In a perpendicular magnetic field,

Magnetic force = centripetal force

ie, $\quad Bqv = \frac{mv^2}{r}$

$\Rightarrow \; r = \frac{mv}{Br} \Rightarrow r \propto v^2$

$\therefore \; \frac{r_2}{r} = \frac{v_2^2}{v_1^2} = \left(\frac{2v}{v}\right)^2 = 4$

$\Rightarrow r_2 = 4r$

436 **(b)**

Radius of path

$$R = \frac{1}{B}\sqrt{\frac{2MV}{q}} \Rightarrow \frac{q}{m} = \frac{2V}{B^2R^2} \Rightarrow \frac{q}{m} \propto \frac{1}{R^2}$$

438 **(d)**

Perpendicular to O from PQ.

Or QR, $a = r\sin\theta/2$

Magnetic field induction at O due to current through PQ and QR is

$B = \frac{\mu_0}{4\pi}\frac{i}{a}$ [sin(90° − θ/2)+ sin90°] × 2

$$= \frac{\mu_0}{2\pi}\frac{i}{\sin\theta/2}(\cos\theta/2 + 1) = \frac{\mu_0}{2\pi}\frac{i}{r}\frac{(1+\cos\theta/2)}{\sin\theta/2}$$

439 **(d)**

The force acting on the loop $PQRS$ due to current i_1 through the long wire are acting in the plane of loop. Due to which the torque on loop is zero.

440 **(a)**

Magnetic field of 1 A turn m^{-1}

$$= 4\pi \times 10^{-7}\ \text{T}$$

Field at centre $B = \frac{\mu_0 NI}{2r} = \frac{\mu_0 N}{2r} \times \frac{V}{R}$

or $V = \frac{2rRB}{\mu_0 N}$

$$\therefore\ V = \frac{2 \times (5 \times 10^{-2}) \times 10 \times (30 \times 4\pi \times 10^{-7})}{(4\pi \times 10^{-7}) \times 5}$$

or $V = 6$ volt

To nullify the horizontal component of magnetic field of earth, plane of the coil should be normal to magnetic meridian.

441 **(b)**

Suppose, the length of wire is l.

When, wire formed in circular loop then radius of loop,

$r = \frac{1}{2\pi}$ $(\because l = 2\pi r)$

Magnet dipole, $M_1 = iA$

$$= i\pi r^2 = i\pi \times \left(\frac{1}{2\pi}\right)^2 = i \times \frac{l^2}{4\pi}$$

When, wire formed in square loop then the side of loop,

$$a = \frac{1}{4}$$

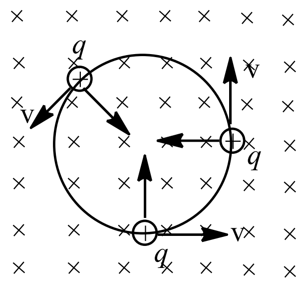
Magnet dipole, $M_2 = iA$

$$= i \times a^2 = i \times \frac{l^2}{16}$$

$$\therefore\ \frac{M_1}{M_2} = \frac{4}{\pi}$$

442 **(d)**

For perpendicular magnetic field magnetic force is provided by the force so,



$\frac{mv^2}{r} = qvB$

$ie,\quad r = \frac{mv}{qB}$ ... (i)

As in uniform circular motion $v = r\omega$, so the angular frequency of circular motion will be given by

$\omega = \frac{v}{r} = \frac{qB}{m}$ [Using Eq. (i)]

and hence the time period

$T = \frac{2\pi}{\omega} = \frac{2\pi m}{qB}$ ... (ii)

Given, $B = 3.534 \times 10^{-5}$ T,

$q = 1.6 \times 10^{-19}$ C, $m = 9.1 \times 10^{-31}$ kg, $T = ?$

From Eq. (ii), we get

$$\therefore\ T = \frac{2 \times 3.14 \times 9.1 \times 10^{-31}}{3.534 \times 10^{-5} \times 1.6 \times 10^{-19}} = 1 \times 10^{-6}\ \text{s}$$

$$= 1\mu\text{s}$$

443 **(c)**

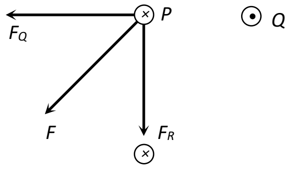
A man carrying suitable instruments will measure both electric and magnetic fields when the passes by a stationary electron. If can be solved by assuming the instruments to be at rest and the electron to be moving with velocity V in opposite direction to that of man, due to which there will be magnetic field as well as electric field

444 **(d)**

As the currents are in opposite directions, the magnetic field induction due to current in each wire will add up at O. The direction of magnetic field is perpendicular to $X - Y$ plane and is directed inward *ie*, along negative Z-axis.

445 **(c)**

The force F_Q and F_R are the forces applied by wires Q and R respectively on the wire P as shown in figure. Their resultant force F is best shown by C



446 **(c)**

According to Fleming's left hand rule, the direction of magnetic field is towards the east

447 **(c)**

For each half pole strength m becomes half $M = m \times 21$becomes half and volume $V = a \times 2l$ also becomes half therefore,$I = W/V$, remains constant.

448 **(a)**

Force acting on a charged particle moving with velocity $\vec{v}$ subjected to magnetic field $\vec{B}$ is given by

$\vec{F} = q(\vec{v} \times \vec{B})$ or, $F = qvB \sin\theta$

(i) When $\theta = 0°, F = qvB \sin 0° = 0$

(ii) When $\theta = 90°, F = qv \sin 90° = qvB$

(iii) When $\theta = 180°, F = qvB \sin 180° = 0$

This implies force acting on a charged particle is non-zero, when angle between $\vec{v}$ and $\vec{B}$ can have any value other than zero and 180°

449 **(a)**

$$B = \frac{\mu_0}{4\pi} \cdot \frac{2i}{r} \Rightarrow 10^{-5} = 10^{-7} \times \frac{2i}{(10 \times 10^{-2})} \Rightarrow i$$
$$= 5A$$

450 **(c)**

When a charged particle is projected into a region of magnetic field such that magnetic field is perpendicular to the velocity vector of charged particles then charged particles will follow circular path.

451 **(b)**

$F = 10^{-7} \frac{2i_1 i_2}{a} = 10^{-7} \times \frac{2\times5\times5}{0.5} = 10^{-5}N$

[repulsive]

452 **(a)**

In a magnetic field, perpendicular to velocity of particle

$\frac{mv^2}{r} = Bq\sqrt{2m\,E_k}v$ or $r = \frac{mv}{Bq}$ and $E_k = \frac{1}{2}mv^2$

$mv = \sqrt{2m\,E_k}v$ so, $r = \frac{\sqrt{2m\,E_k}v}{Bq}$ or $r \propto \frac{\sqrt{m}}{q}$

For same value of E_k and B.

$$r_P : r_d : r_\alpha = \frac{\sqrt{m}}{l} : \frac{\sqrt{2m}}{l} : \frac{\sqrt{4m}}{2l}$$
$$= 1 : \sqrt{2} : 1$$

453 **(a)**

If the solenoid is of infinite length and the point is well inside the solenoid, $B_{in} = \mu_0 ni$.

454 **(b)**

The coil of a moving coil galvanometer is wound over a metal frame in order to provide electromagnetic damping by which the galvanometer becomes dead beat.

455 **(c)**

Total magnetic field induction at O is

$$\vec{\mathbf{B}} = \vec{\mathbf{B}}_{LR} + \vec{\mathbf{B}}_{RP} + \vec{\mathbf{B}}_{MS} + \vec{\mathbf{B}}_{SQ}$$
$$= 0 + \frac{\mu_0}{2\pi}\frac{i}{r} + 0 + \frac{\mu_0}{2\pi}\frac{i}{r} = \frac{\mu_0}{2\pi}\frac{2i}{r}$$
$$= \frac{2\times10^{-7}\times2\times10}{0.02} = 2 \times 10^{-4}\text{ T}$$

456 **(b)**

$$\omega = \frac{2\pi}{T} = \frac{qB}{m} \Rightarrow \omega \propto v^\circ \left[\because T = \frac{2\pi m}{qB}\right]$$

457 **(c)**

$$B = \frac{\mu_0}{4\pi} \cdot \frac{2\pi Ni}{r}$$
$$\Rightarrow 3.14 \times 10^{-3} = \frac{10^{-7} \times 2 \times 3.14 \times N \times 10}{(10 \times 10^{-2})} \Rightarrow N$$
$$= 50$$

459 **(c)**

$$r = \frac{mv}{qB} \Rightarrow \frac{r_\alpha}{r_p} = \frac{m_\alpha}{m_p} \times \frac{q_p}{q_\alpha} = \frac{4}{1} \times \frac{1}{2} = \frac{2}{1}$$

460 **(a)**

$i = 50\,k$; $i_g = 20k$, where k is the figure of metit of galvanometer; $S = i_g G/(i - i_g)$;

So, $12 = \frac{20k.G}{(50k-20k)}$

On solving we get $G = 18\Omega$.

461 **(c)**

$$M = 2000 \times 1.5 \times 10^{-4} \times 2 = 6 \times 10^{-1}$$
$$\tau = MB \sin 30 = 0.6 \times 5 \times 10^{-2} \times \frac{1}{2}$$
$$\tau = 1.5 \times 10^{-2}Nm$$

462 **(b)**

$$i = \frac{q}{t} = 100 \times e$$
$$B_{\text{centre}} = \frac{\mu_0}{4\pi} \cdot \frac{2\pi i}{r} = \frac{\mu_o}{4\pi} \cdot \frac{2\pi \times 100e}{r}$$
$$= \frac{\mu_o \times 200 \times 1.6 \times 10^{-19}}{4 \times 0.8} = 10^{-17}\mu_o$$

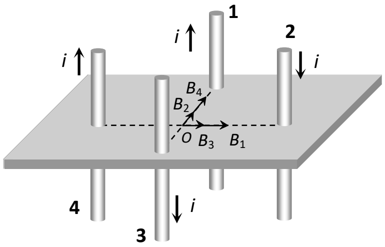
463 **(c)**

Direction of magnetic field (B_1, B_2, B_3 and B_4) at origin due to wires 1, 2, 3 and 4 are shown in the following figure

$B_1 = B_2 = B_2 = B_4 = \frac{\mu_0}{4\pi}.\frac{2i}{x} = B$. So net magnetic field at origin O

$B_{net} = \sqrt{(B_1 + B_3)^2 + (B_2 + B_4)^2}$

$= \sqrt{(2B)^2 + (2B)^2} = 2\sqrt{2}B$



464 **(c)**

In this case $|\vec{F_e}| = |\vec{F_m}|$ and both forces are opposite to each other

465 **(a)**

$B_1 = \frac{\mu_0 I}{2R}$

$B_2 = \frac{\mu_0(2I)}{2R}$

$B_{net} = \sqrt{B_1^2 + B_2^2}$

$= \frac{\mu_0(I)}{2R}\sqrt{1+4} = \frac{\sqrt{5}\mu_0 I}{2R}$

466 **(c)**

$B = 10^{-7} \times \frac{2i}{r} = 10^{-7} \times \frac{2 \times 1}{1} = 2 \times 10^{-7} T$

467 **(a)**

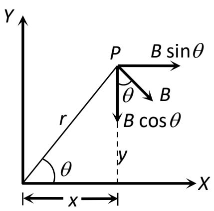
Magnetic field at P is $\vec{B}$, perpendicular to OP in the direction shown in figure

So, $\vec{B} = B \sin\theta \hat{i} - B\cos\theta\,\hat{j}$

Here $B = \frac{\mu_0}{2\pi}\frac{I}{r}$

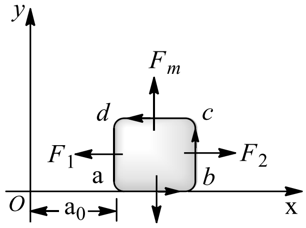
$\sin\theta = \frac{y}{r}$ and $\cos\theta = \frac{x}{r}$

$\therefore \vec{B} = \frac{\mu_0 I}{2\pi}.\frac{1}{r^2}(y\hat{i} - x\hat{j}) = \frac{\mu_0 I(y\hat{i} - x\hat{j})}{2\pi(x^2+y^2)}$ [as $r^2 = x^2 + y^2$]



468 **(c)**

The magnetic force near side ad is



$\vec{F}_1 = B_0\left[1 + \frac{a_0}{l}\right]\hat{k}$

The magnetic force on wire ab and cd is equal and opposite. The magnetic field near side be is

$\vec{F}_2 = B_0\left[1 + \frac{a_0 + l}{l}\right]$

The net force on the loop $= F = F_2 = F_1$

$= ilB_0\left(1 + \frac{l + a_0}{l}\right) - iB_0 l\left[1 + \frac{a_0}{l}\right]$

$= B_0 il$

469 **(a)**

Magnetic field a B

$B_1 = \frac{\mu_0}{2\pi}\frac{i\Delta l}{r}$

Magnetic field at A

$B_2 = \frac{\mu_0}{2\pi}\frac{i\Delta l}{r}$

The resultant magnetic field at the centre

$|B_A| = |B_B|$

So, magnetic field become is zero.

471 **(a)**

Magnetic field due to one side of the square at centre O

$B_1 = \frac{\mu_0}{4\pi}.\frac{2i\sin 45°}{a/2} \Rightarrow B_1 = \frac{\mu_0}{4\pi}.\frac{2\sqrt{2}i}{a}$

Hence magnetic field at centre due to all sides

$B = 4B_1 = \frac{\mu_0(2\sqrt{2}i)}{\pi a}$

Magnetic field due to n turns

$B_{net} = nB = \frac{\mu_0 2\sqrt{2}ni}{\pi a} = \frac{\mu_0 2\sqrt{2}ni}{\pi(2l)} = \frac{\sqrt{2}\mu_0 ni}{\pi l}$ $(\because a = 2l)$

472 **(c)**

$M = i\pi r^2$

473 **(c)**

The induction due to AB and CD will be zero. Hence the whole induction will be due to the semicircular part BC. $B = \frac{\mu_0 i}{4r}$

474 **(c)**

Since, the magnetic field, due to current through wire CD at various locations on wire AB is not uniform, Therefore, the wire AB, carrying current i_1 is subjected to variable magnetic field. Due to which, neither the force nor the torque on the wire AB will be zero. As a result of which the wire

AB will have both translation and rotational motion.

475 **(b)**

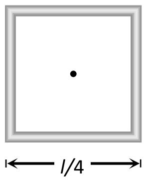
$r = \sqrt{\frac{2m_1E_{k_1}}{Bq_1}} = \sqrt{\frac{2m_2E_{k_2}}{Bq_2}}$

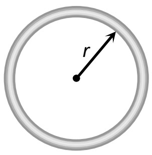
Or $E_{k_2} = \frac{m_1}{m_2}\frac{q_2}{q_1} E_{k_1}$

$= \frac{2m}{m} \times \frac{q}{q} \times 50 \text{ keV} = 100 \text{ keV}$

476 **(c)**

Suppose length of each wire is l. $A_{square} = \left(\frac{l}{4}\right)^2 = \frac{l^2}{16}$





$A_{circle} = \pi r^2 = \pi\left(\frac{l}{2\pi}\right)^2 = \frac{l^2}{4\pi}$

∵ Magnetic moment

$M = iA$

$\Rightarrow \frac{M_{square}}{M_{circle}} = \frac{A_{square}}{A_{circle}}$

$= \frac{l^2/16}{l^2/4\pi} = \frac{\pi}{4}$

478 **(a)**

As $\tau = MB \sin\theta, \frac{d\tau}{d\theta} = MB \cos\theta$. It will be maximum, when $\theta = 0°$

479 **(c)**

$F = \frac{\mu_0}{4\pi}\frac{2i_1i_2}{a} = 10^{-3}N$

When current in both the wires is doubled, then

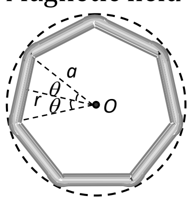
$F' = \frac{\mu_0}{4\pi}\frac{2(2i_1 \times 2i_2)}{a} = 4 \times 10^{-3}N$

480 **(c)**

$U = -MB\cos\theta$; where θ = Angle between normal to the plane of the coil and direction of magnetic field

481 **(b)**

Magnetic field at the centre due to one side



$B_1 = \frac{\mu_0}{4\pi}.\frac{2i\sin\theta}{r}$, where $r = a\cos\theta$

So $B_1 = \frac{\mu_0}{4\pi}.\frac{2i\sin\theta}{a\cos\theta} = \frac{\mu_0 i}{2\pi a}\tan\theta$

Hence net magnetic field

$B_{net} = n \times \frac{\mu_0 i}{2\pi a}\tan\frac{\pi}{n}$

482 **(a)**

$\sigma_i = \frac{\theta}{i} = \frac{\theta}{iG}.G = \sigma_v\, G$: $\frac{\sigma_i}{G} = \sigma_v$

483 **(d)**

$dB = \frac{\mu_0}{4\pi}\cdot\frac{idl\sin\theta}{r^2} \Rightarrow d\vec{B} = \frac{\mu_0}{4\pi}\cdot\frac{i(d\vec{l}\times\vec{r})}{r^3}$

484 **(a)**

$\vec{B} = \vec{B}_1 + \vec{B}_2$

$|\vec{B}_1| = |\vec{B}_2| = \frac{\mu_0 i}{4R}$

$|\vec{B}| = \sqrt{B_1^2 + B_2^2}$

$|\vec{B}| = \frac{\mu_0 i}{4R}\sqrt{2} = \frac{\mu_0 i}{2\sqrt{2}R}$

485 **(b)**

$F = qvB\sin\theta$; Independent of mass

486 **(b)**

Here, area of circular orbit of electron, $A = \pi r^2$; current due to motion of electron

$i = \frac{e}{t} = \frac{e}{(2\pi r/v)} = \frac{ev}{2\pi r}$

∴ Magnetic moment $= i\,A = \frac{ev}{2\pi r} \times \pi r^2$

$= \frac{e\,v\,r}{2}$

487 **(d)**

Force on SR and PQ are equal but opposite so their net will be zero.

Force between two parallel conductors carrying currents I_1 and I_2

$F = \frac{\mu_0}{2\pi}\frac{I_1I_2l}{r}$

Where r = distance between two parallel conductors

$F_{PS} = \frac{10^{-7} \times 2 \times 20 \times 20 \times 15 \times 10^{-2}}{2 \times 10^{-2}}$

$= 6 \times 10^{-4}$ N

$F_{QR} = \frac{10^{-7} \times 2 \times 20 \times 20 \times 15 \times 10^{-2}}{12 \times 10^{-2}}$

$= 1 \times 10^{-4}$ N

$F_{net} = F_{PS} - F_{QR}$

$= 6 \times 10^{-4} - 1 \times 10^{-4} = 5 \times 10^{-4}$ N

488 **(a)**

If we take a small strip of dr at distance r from centre, then number of turns in this strip would be,

$dN = \left(\frac{N}{b-a}\right)dr$

Magnetic field due to this element at the centre of the coil will be

$$dB = \frac{\mu_0 (dN) I}{2r} = \frac{\mu_0 NI}{2(b-a)} \frac{dr}{r}$$

$$B = \int_{r=a}^{r=b} dB = \frac{\mu_0 NI}{2(b-a)} \ln\left(\frac{b}{a}\right)$$

489 **(b)**

Let r be the radius of the coil and n be the number of turns formed. Then

$l = 2\pi rn$ or $r = \frac{1}{2\pi n}$ (i)

Maximum torque, $\tau_{\max} = B\, n\, iA = Bni\pi r^2$

$= B\, ni\, \pi \times \frac{l^2}{4\pi^2 n^2} = \frac{iBl^2}{4\pi n}$

Torque will be maximum if $n = 1$

$\therefore\ \tau_{\max} = \frac{Bil^2}{4\pi}$

491 **(a)**

Here, Magnetic field, $B = 1.2mT = 1.2 \times 10^{-3}T$

Mass of the proton, $m_p = 1.67 \times 10^{-27}kg$

Speed of the proton enters a uniform magnetic field perpendicular to its velocity, it follows a circular path and whose radius is given by

$R = \frac{m_p v}{qB}$ ... (i)

Centripetal acceleration of the proton is $a_c = \frac{v^2}{R}$

$= \frac{v^2}{\left(\frac{m_p v}{qB}\right)} = \frac{vqB}{m_p}$ [Using (i)]

$= \frac{(3 \times 10^7 ms^{-1}) \times (1.6 \times 10^{-19}C) \times (1.2 \times 10^{-3}T)}{(1.67 \times 10^{-27}kg)}$

$= 3.45 \times 10^{12} ms^{-2}$

492 **(a)**

The magnetic needle will be deflected towards south if initially the direction of force on the needle due to current carrying conductor is towards west. It will be so if the direction of the current is vertically upwards and the wire is held vertically upwards (according to Fleming's left hand rule).

493 **(a)**

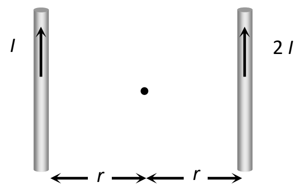
$eE = evB \Rightarrow v = \frac{E}{B}$

Here, $E = 1\ \text{Vcm}^{-1} = 100\ \text{Vm}^{-1}, B = 2\ \text{T}$

$\therefore\ v = \frac{100}{2} = 50\ \text{ms}^{-1}$

494 **(c)**

When two parallel conductors are carrying current I and $2I$ in same direction, then magnetic field at the midpoint is



$B = \frac{\mu_0 2l}{2\pi r} - \frac{\mu_0 I}{2\pi r} = \frac{\mu_0 I}{2\pi r}$

When current $2I$ is switched off then magnetic field due to conductor carrying current I is $B = \frac{\mu_0 I}{2\pi r}$

495 **(b)**

B at the centre of a coil carrying a current, i is

$B_{Coil} = \frac{\mu_0 i}{2r}$ [upward]

B due to wire $B_{wire} = \frac{\mu_0 i}{2\pi r}$ [downward]

Given $i = 8A; r = 10 \times 10^{-2}m$

$\frac{\mu_0}{4\pi} = 10^{-7}$

Magnetic field at centre C,

$B_C = B_{coil} + B_{wire}$

$= \frac{\mu_0 i}{2r}$(upward) $+ \frac{\mu_0 i}{2\pi r}$ [downward]

$= \frac{\mu_0 i}{2r} - \frac{\mu_0 i}{2\pi r} = \frac{\mu_0 i}{2r}\left(1 - \frac{1}{\pi}\right)$ upward

$= \frac{4\pi \times 10^{-7} \times 8}{2 \times 10 \times 10^{-2}}\left(1 - \frac{1}{3.14}\right)$ upward

$= \frac{4 \times 3.14 \times 10^{-7} \times 8 \times 2.14}{2 \times 10 \times 10^{-2} \times 3.14}$

$= 3.424 \times 10^{-5}$ upward

496 **(d)**

$KE = \frac{1}{2} m \left(\frac{Bqr_0}{m}\right)^2$ & $v = \frac{Bq}{2\pi m}$

$KE = 5.1\ MeV$

497 **(c)**

$M_1 = l^2\, i,$ and

$M_2 = \sqrt{\left(\frac{l}{2} \times l \times i\right)^2 + \left(\frac{l}{2} \times l \times i\right)^2} = \frac{l^2 i}{\sqrt{2}}$

$\therefore\ \frac{M_1}{M_2} = \sqrt{2}$

498 **(c)**

$\tau_{\max} = NiAB = 1 \times i \times (\pi r^2)$

$\times B$ $\left[2\pi r = L, \Rightarrow r = \frac{L}{2\pi}\right]$

$\tau_{\max} = \pi\, i \left(\frac{L}{2\pi}\right)^2 B = \frac{L^2 iB}{4\pi}$

500 **(a)**

A moving charge gains energy in electric field only because in magnetic field energy remains constant

501 **(a)**

$F = MB, \sin\theta$

$F = (I.\pi r^2).B\sin\theta$

$\frac{F_1}{F_2} = \frac{I_1 B_1}{I_2.B_2} \Rightarrow \frac{F}{2F} = \frac{I.B}{I_2.B} \Rightarrow I_2 = 2I$

502 **(b)**

$F = qvB\sin\theta = 1.6\times10^{-19}\times2.5\times2.5 \times10^7\sin30°$

$F = 1.6\times10^{-19}\times6.25\times10^7\times\frac{1}{2} = 5\times10^{-12}N$

503 **(d)**

Magnetic lines of forces from closed loops.

505 **(d)**

$B = \frac{\mu_0}{4\pi}\frac{2\pi i}{r} = \frac{\mu_0}{4\pi}$ or $i = \frac{2\,B\,r}{\mu_0}$;

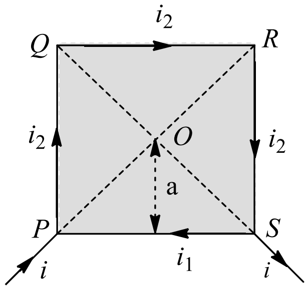
Also, $A = \pi r^2$ or $r = \left(\frac{A}{\pi}\right)^{1/2}$

Magnetic moment, $M = iA = \frac{2Br}{\mu_0}A$

$= \frac{2BA}{\mu_0}\times\left(\frac{A}{\pi}\right)^{1/2} = \frac{2\,BA^{3/2}}{\mu_0\pi^{1/2}}$

506 **(d)**

The resistance of arm $PQRS$ is 3 times the resistance of arm PS. If resistance of arm $PS = r$, then resistance of arm $PQRS = 3\,r$.



Potential difference across P and $S = i_1\,r = i_2\times3r$

Magnetic field induction at O due to current through arm $PS\,is$, $B_1 = \frac{\mu_0}{4\pi}\frac{i_1}{a}[\sin45° + \sin45°]$ acting perpendicular to the loop upwards.

May field due to PQ and RS are equal and opposite. Therefore natural each other magnetic field due to QR.

$B_2 = \frac{\mu_0}{4\pi}.\frac{I_1}{a}[\sin45° + \sin45°]$

Perpendicular to the loop in downwards.

$\therefore$ Resultant magnetic field at centre $\vec{\mathbf{B}} = \vec{\mathbf{B}}_1 + \vec{\mathbf{B}}_2 = 0$

507 **(a)**

$B = \frac{\mu_0 I}{2r} \Rightarrow B = \frac{\mu_0}{2r}\times\frac{e\omega}{2\pi} = \frac{\mu_0 e\omega}{4\pi r}$

$\Rightarrow 14 = \frac{10^{-7}\times1.6\times10^{-19}\times\omega}{0.5\times10^{-9}}$

$\Rightarrow \omega = \frac{14\times0.5\times10^{-9}}{1.6\times10^{-26}} = \frac{7}{1.6}\times10^{26-9}$

$\Rightarrow \frac{70}{16}\times10^{17} = \frac{35}{8}\times10^{17} = 4.4\times10^7 rad/sec$

508 **(c)**

Correct answer is option (c), because induced electric field lines (produced by change in magnetic field) and magnetic field lines form closed loops.

509 **(d)**

$\vec{F} = q(\vec{v}\times\vec{B})$; if $\vec{v}||\vec{B}$, then $\vec{F} = 0$

510 **(d)**

$B \propto \frac{1}{r}$

Hence, graph will be a rectangular hyperbola.

511 **(b)**

When two infinitely long parallel conductors carrying current I_1 and I_2 are placed a distance r apart, then force on the unit length of a conductor due to the other conductor is given by

$F = \frac{\mu_0}{4\pi}.\frac{2I_1I_2}{r}$

The force is attractive, if current in two conductors is in same direction; and repulsive, if currents are in opposite directions.

512 **(d)**

$\tau = NiAB \propto A$

For given periphery circle has maximum area.

513 **(b)**

Sensitivity $= \frac{NAB}{C}$

514 **(a)**

$\frac{r_p}{r_\alpha} = \frac{m_p}{m_\alpha}\times\frac{q_\alpha}{q_p}$

$= \frac{1}{4}\times\frac{2}{1} = \frac{1}{2}.$

515 **(b)**

$M = iA = i\times\pi R^2$ also $i = \frac{Q\omega}{2\pi} \Rightarrow M = \frac{1}{2}Q\omega R^2$

516 **(c)**

The time period of electron moving in a circular orbit

$T = \frac{\text{circumference of cirular path}}{\text{speed}} = \frac{2\pi r}{v}$

And equivalent current due to electron flow

$I = \frac{e}{T} = \frac{e}{(2\pi r/v)} = \frac{ev}{2\pi r}$

Magnetic field at centre of circle

$B = \frac{\mu_0 I}{2r} = \frac{\mu_0 ev}{4\pi r^2} \Rightarrow r \propto \sqrt{\frac{v}{B}}$

517 **(c)**

Force of attraction on the arm SP of loop due to conductor will be stronger than the force of repulsion on arm QR of the loop. Due to which the loop will move towards the conductor.

518 **(d)**

$F = Bil = (0.2 \times 10^{-4}) \times 30 \times 1$

$= 6 \times 10^{-4}$ east to west.

519 **(a)**

Because $\tau_{\max} = BiNA \Rightarrow \tau \propto B$

520 **(c)**

Here, magnetic moment due to loop 1

$M_1 = iA_1$

$= i\,\pi r_1^2$

$= 7 \times \pi\,(0.20)^2 = 0.28\,\pi$

Similarly magnetic moment due to loop 2

$M_2 = iA_2 = i\pi r_2^2$

$= 7 \times \pi\,(0.30)^2 = 0.63\,\pi$

Net magnetic moment

$= M_1 - M_2$

$= 0.63\,\pi - 0.28\,\pi = 61.1\ \mathrm{Am}^2$

521 **(c)**

Kinetic energy of the ions,

$\frac{1}{2}mv^2 = \frac{q^2B^2R^2}{2m}$

For α particle, the charge is two times that of the proton but mass is 4 times that of the proton

Therefore, compared to proton' kinetic energy, for the same conditions in the cyclotron, energy of alpha particle is E

522 **(b)**

Here, $dl = dx = 1$ cm $= 10^{-2}$m;

$i = 10$Am, $r = 0.5$ m

$d\vec{B} = \frac{\mu_0}{4\pi}\frac{(d\vec{l} \times \vec{r})}{r^3}$

$= \frac{\mu_0}{4\pi}\frac{i\,dl}{r^2}(\hat{\imath} \times \hat{\jmath}) = \frac{\mu_0}{4\pi}\frac{i\,dl}{r^2}\,\hat{k}$

$= \frac{10^{-7} \times 10 \times 10^{-2} \sin 90°}{(0.5)^2}\hat{k}$

$= 4 \times 10^{-8}\,\hat{k}$ T.

523 **(d)**

$\vec{F} = q(\vec{v} \times \vec{B}) = 10^{-11}(10^8\hat{j} \times 0.5\hat{\imath})$

$= 5 \times 10^{-4}(\hat{j} \times \hat{\imath}) = 5 \times 10^{-4}N(-\hat{k})$

524 **(b)**

$qvB = mr\omega^2 = mr4\pi^2/T^2$ or $T \propto \sqrt{m}$. As mass of proton is higher than that of electron so $T_P > T_e$.

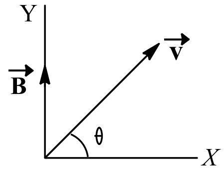
525 **(b)**

In moving coil galvanometer $i \propto \theta$

526 **(c)**

Since, the proton is entering the magnetic field at some angle other than 90°, its path is helix. Component velocity of proto along X-axis,

$v_x = v\cos 60° = 2 \times 10^6 \times 1/2 = 10^6\ \mathrm{ms}^{-1}$



Due to component velocity v_x, the radius of the helix described is given by the relation

$r = \frac{mv_x}{qB} = \frac{1.67 \times 10^{-27} \times 10^6}{1.6 \times 10^{-19} \times 0.104} = 0.1$ m.

Now, $T = \frac{2\pi r}{v_x} = \frac{2\pi \times 0.1}{10^6} = 2\pi \times 10^{-7}$s.

528 **(b)**

Initially $F_1 = mg + IaB$ (downwards)

When the direction of current is reversed

$F_2 = mg - IaB$ (downward) $\Rightarrow \Delta F = 2IaB$

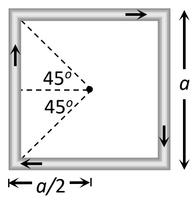
529 **(b)**

$F = ilB\sin\theta = 3 \times 0.40 \times (500 \times 10^{-4}) \times \sin 30°$

$= 3 \times 10^{-2}$ N

530 **(c)**

$B_0 = 4 \times \frac{\mu_0}{4\pi} \times \frac{i}{(a/2)}[\sin 45° + \sin 45°]$



$= 4 \times \frac{\mu_0}{4\pi} \times \frac{2i}{a} \times \frac{2}{\sqrt{2}}$

$= \frac{\mu_0 i 2\sqrt{2}}{\pi a}$

531 **(b)**

Magnetic field inside the cylindrical conductor

$B_{in} = \frac{\mu_0}{4\pi}.\frac{2ir}{R^2}$ ($R =$ Radius of cylinder, $r =$ distance of observation point from axis of cylinder)

Magnetic field out side the cylinder at a distance r' from it's axis $B_{out} = \frac{\mu_0}{4\pi}.\frac{2i}{r'}$

$\Rightarrow \frac{B_{in}}{B_{out}} = \frac{rr'}{R^2} \Rightarrow \frac{10}{B_{out}} = \frac{\left(R - \frac{R}{4}\right)(R + 4R)}{R^2} \Rightarrow B_{out}$

$= \frac{8}{3}T$

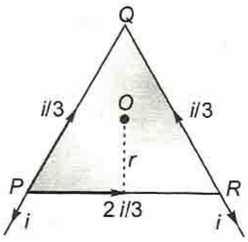
532 **(b)**

Magnetic field inside the solenoid $B_{in} = \mu_0 ni$

533 **(d)**

Magnetic field at O due to PR

$B_1 = \frac{\mu_0}{4\pi}\frac{2i/3}{r}[\sin 30° + \sin 30°]$



$= \frac{\mu_0}{4\pi}\frac{2i}{3r}$

It is directed outside the paper. Magnetic field at O, due to PQR,

$B_2 = 2 \times \frac{\mu_0}{4\pi}\frac{(i/3)}{\mu}[\sin 30° + \sin 30°]$

$= \frac{\mu_0}{4\pi}\frac{2i}{3r}$

It is directed inside the paper.

$\therefore$ Resultant magnetic field at O,

$B = B_1 - B_2 = 0$

534 **(c)**

$E = \frac{B^2q^2r^2}{2m}$ or $r = \frac{\sqrt{2mE}}{Bq}$

So, $r \propto \sqrt{E}/B$

$\therefore \frac{r_2}{r_1} = \sqrt{\frac{2E}{E}} \times \frac{B}{3B} = \sqrt{\frac{2}{9}}$

$\therefore r_2 = \sqrt{\frac{2}{9}}r_1 = \sqrt{\frac{2}{9}}R.$

535 **(a)**

$\frac{mv^2}{R} = qvB$. For proton $R_p = \frac{mv}{qB} = \frac{\sqrt{2m_pE}}{qB}$

and for deuteron $R_d = \frac{\sqrt{2m_dE}}{qB}$

$\Rightarrow \frac{R_d}{R_p} = \sqrt{\frac{m_d}{m_p}} = \sqrt{2} \Rightarrow R_d = \sqrt{2}R_p$

536 **(b)**

$F = Bil = 2 \times 1.2 \times 0.5 = 1.2N$

537 **(b)**

When field is parallel to the direction of motion of charge, magnetic force on it is zero

538 **(a)**

B at ends of solenoid is $\frac{\mu_0}{2}ni$

539 **(a)**

Magnetic dipole moment of current loop is

$M = NiA = 10 \times 0.5 \times 2 \times 10^{-4} = 10^{-3}$ Am^2

Magnetic field the solenoid carrying current

$B = \mu_0 ni = 4\pi \times 10^{-7} \times 10^{-2} \times 3$

$= 12\pi \times 10^{-4}$ T

$\therefore$ Torque, $\tau = MB\sin\theta$

$= 10^{-3} \times 12\pi \times 10^{-4} \times \sin 90°$

$= 12\pi \times 10^{-7}$ Nm

540 **(a)**

Direction of field can be found using Fleming's left hand rule and $r \propto \frac{1}{B}$

541 **(a)**

According to Ampere's circuital law

$\oint \vec{B}.d\vec{l} = \mu_0 I_{\text{enclosed}} = \mu_0[2A - 1A] = \mu_0$

Since currents $2A$ and $1A$ are in the opposite direction

542 **(c)**

$B = \frac{\mu_0}{4\pi}\frac{2\pi i}{R}$

Where $i = \frac{2e}{t} = \frac{2 \times 1.6 \times 10^{-19}}{2} = 1.6 \times 10^{-19}$ A

$\therefore B = \frac{\mu_0 i}{t} = \frac{\mu_0 \times 1.6 \times 10^{-19}}{2 \times 0.8}$

$= \mu_0 \times 10^{-19}$ T

543 **(b)**

$\frac{\mu}{L} = \frac{1}{2}\frac{e}{m}$

$\mu = \frac{1}{2}\frac{eL}{m} = \frac{eL}{2m}$

544 **(c)**

$r = \frac{mv}{qB} = \frac{6 \times 10^7}{1.7 \times 10^{11} \times 1.5 \times 10^{-2}} = 2.35\ cm$

545 **(a)**

From $\tau = MB\sin\theta, M = \frac{\tau}{B\sin\theta}$

$= \frac{4.5 \times 10^{-2}}{0.25 \sin 30°} = 0.36$ JT^{-1}

547 **(c)**

$K_{\text{max}} = \frac{1}{2}mv^2$ and $r_0 = \frac{mv}{qb} \Rightarrow v = \frac{qBr_0}{m}$

$\Rightarrow K_{\text{max}} = \frac{1}{2}m\left(\frac{qBr_0}{m}\right)^2 = \frac{q^2B^2r_0^2}{2m}$

548 **(a)**

Magnetic field at the centre of current carrying coil is given by

$B = \frac{\mu_0}{4\pi}\frac{2\pi Ni}{r}$

$\Rightarrow B \propto \frac{N}{r}$

$\frac{B_1}{B_2} = \frac{N_1}{N_2} \times \frac{r_2}{r_1}$

In second condition, a loop having two turns is prepared from the same wire.

So, $N_1 = N$

$N_2 = 2N$

$r_1 = r$

$r_2 = 2r$

$\Rightarrow \frac{B}{B_2} = \frac{1}{2} \times \frac{r/2}{r} = \frac{1}{4} \Rightarrow B_2 = 4B$

549 **(b)**

Force on moving electron in perpendicular magnetic field

$= -e|\vec{V} \times \vec{B}|$

Force on moving proton in perpendicular magnetic field

$= e\,|\vec{V} \times \vec{B}|$

550 **(d)**

$$S = \frac{i_g G}{i - i_g} = \frac{iG}{ni - i} = \frac{G}{n-1}$$

551 **(c)**

Cyclotron frequency

$$n = \frac{1}{T} = \frac{v}{2\pi r}$$

or $n = \frac{v}{2\pi}\left(\frac{Bq}{mv}\right)$ $\left(\because r = \frac{mv}{Bq}\right)$

or $n = \frac{Bq}{2\pi m}$

Thus, cyclotron frequency does not depend upon the speed of the charged particle.

552 **(d)**

Magnetic field at mid-point due to wire AB

$$B_1 = \frac{\mu_0 i}{2\pi R}$$

Magnetic field at mid-point due to wire CD

$$B_2 = \frac{\mu_0 i}{2\pi R}$$

Resultant of Magnetic field $B = B_1 + B_2$

$$= \frac{\mu_0 i}{2\pi R} + \frac{\mu_0 i}{2\pi R}$$

$$B = \frac{\mu_0 i}{\pi R}$$

553 **(c)**

Force on wire, $F = Bil \sin 90° = Bil$. It acts perpendicular to the magnetic field as well as the length of wire. The acceleration in the wire

$$a = \frac{F}{m} = \frac{Bil}{m}$$

554 **(d)**

$N = 100$ turns, area $\pi r^2 = 2 \times 10^{-2} m^2, i = 5A$

In north-south, torque $= 0.3\ Nm = \tau_1$

When plane is in east-west direction, torque $= 0.4\ Nm = \tau_2$

$$B = \frac{\mu_0 Ni}{2r}$$

$M = NiA = 100 \times 5 \times 2 \times 10^{-2} = 10$

$\tau_1 = MB \sin\theta$; $\tau_2 = MB\cos\theta$

$\therefore \frac{\tau_1}{\tau_2} = \tan\theta$

$\therefore \tan\theta = \frac{0.3}{0.4}$

$\tau_1^2 = M^2B^2\sin^2\theta$; $\tau_2^2 = M^2B^2\cos^2\theta$

$\therefore \tau_1^2 + \tau_2^2 = (MB)^2$

$\therefore (0.09 + 0.16) = 10^2\, B^2$

$$B^2 = \frac{0.25}{100} \Rightarrow B = \frac{0.5}{10} = 0.05\ T$$

555 **(a)**

Radius of circular path $r_a = \frac{m_a v_a}{qB}$

And $r_b = \frac{m_b v_b}{qB}$

According to question

$r_a > r_b$

$\therefore \frac{m_a v_a}{qB} > \frac{m_b v_b}{qB}$

or $m_a v_a > m_b v_b$

556 **(a)**

$$B = \frac{\mu_0\, i}{2\pi\, r} \Rightarrow 5 \times 10^{-5} = \frac{\mu_0}{2\pi} \times \frac{\pi}{r} \Rightarrow r$$

$$= 10^4 \mu_0\ metre$$

557 **(a)**

Magnetic field inside the hollow metallic cylinder $B_{in} = 0$, and magnetic field outside it $B_{out} \propto \frac{1}{r}$

558 **(c)**

$$i_g = \frac{iS}{G+S} = \frac{i_0 \times 2.5}{25 + 2.5} = \frac{i_0}{9}.$$

559 **(a)**

Since, the magnetic field does not perform any work, therefore, whatever has been gain in kinetic energy it is only because of the work done by electric field. Applying work-energy theorem,

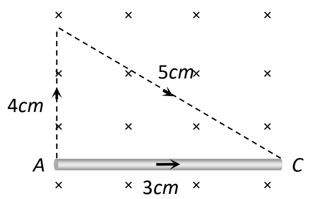
$W = \Delta E$

$qE_0 = \frac{1}{2}\,mv^2 - 0$

Or $v = \sqrt{\frac{2qE_0}{m}}$

560 **(b)**

The given curved wire can be treated as a straight wire as shown



Force acting on the wire $AC, F = Bil = 2 \times 2 \times 3 \times 10^{-2}$

$= 12 \times 10^{-2} N$ along y-axis

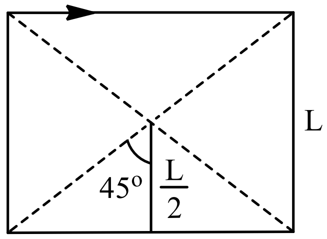
So acceleration of wire $= \frac{F}{m} = \frac{12\times10^{-2}}{10\times10^{-3}} = 12\ m/s^2$

561 **(d)**

$$B = 4\left[\frac{\mu_0}{4\pi}\frac{I}{\left(\frac{1}{2}\right)}\ (\sin 45° + \sin 45°)\right]$$

$= \frac{\mu_0}{4\pi}\frac{2I}{L}\cdot\frac{2}{\sqrt{2}}$

$B = \frac{\mu_0}{\pi}\frac{2\sqrt{2}I}{L}$



562 **(c)**

Neon molecule is diatomic, so it's net magnetic moment is zero

563 **(d)**

$B_1 = \frac{\mu_1}{4\pi}\frac{2\pi ni}{r}$ and $B_2 = \frac{\mu_0}{4\pi}\frac{2\pi nir^2}{(r^2+h^2)^{3/2}}$

So, $\frac{B_2}{B_1} = \left(1+\frac{h^2}{r^2}\right)^{-3/2}$

Fractional decrease in the magnetic field will be

$= \frac{B_1 - B_2}{B_1} = \left(1 - \frac{B_2}{B_1}\right)$

$= \left[1 - \left(1+\frac{h^2}{r^2}\right)^{-3/2}\right]$

$= 1 - \left(1 - \frac{3}{2}\frac{h^2}{r^2}\right) = \frac{3}{2}\frac{h^2}{r^2}$

564 **(b)**

$M = NiA = 20 \times \frac{22}{7}(4\times10^{-2})^2 3 = 0.3A - m^2$

565 **(a)**

If the solenoid is of infinite length and the point taken is inside the solenoid, then

$B_{in} = \mu_0 ni$

$= 4\pi \times 10^{-7} \times \frac{100}{10\times10^{-2}} \times 0.5$

$= 6.28 \times 10^{-4}$ T

566 **(b)**

$E = \frac{1}{2}mv^2$ or $\sqrt{2E/m}$;

$r = \frac{mv}{Bq} = \frac{m}{Bq}\sqrt{2E/m}$

Or $r = \frac{\sqrt{2Em}}{Bq}$ or $r \propto \sqrt{m}$;

As , $m_e < m_P$; so, $r_e < r_P$

Therefore, trajectory of proton is less curved

567 **(d)**

Given, linear momentum of electron = linear momentum of proton.

or $m_e v_e = m_p v_p$

The radius of circular path is

$r = \frac{mv}{qB}$

For an electron the radius of circular path is

$r_e = \frac{m_e v_e}{qB}$

For a proton the radius of circular path is

$r_p = \frac{m_p v_p}{qB}$

Hence, $\frac{r_e}{r_p} = 1$

569 **(d)**

$i_g = \frac{2}{2000} = \frac{1}{1000}$ A;

New range, $V = 8V + 2V = 10V$

$R = \frac{V}{i_g} - G = \frac{10}{(1/1000)} - 2000 = 8000\Omega$

570 **(d)**

$OF = CF = \frac{1}{2}$ m

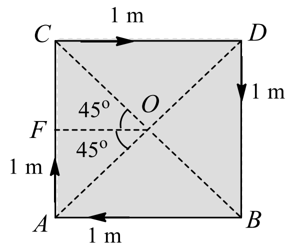
$B = \frac{\mu_0}{4\pi}\frac{1}{(1/2)}[\sin 45° + \sin 45°] \times 4$

$= \frac{\mu_0}{4\pi}\frac{16i}{\sqrt{2}}$

When the frame is taken as circular of radius r, then

$2\pi r = 4$

Or $r = 2/\pi$



$B' = \frac{\mu_0}{4\pi}\frac{2\pi i}{r} = \frac{\mu_0}{4\pi}\frac{2\pi i}{2/\pi} = \frac{\mu_0}{4\pi}\pi^2 i$

$\therefore \frac{B}{B'} = \frac{16}{\sqrt{2}\,\pi^2}$

571 **(c)**

Here, $r = 40$ cm $= 0.4$ m

$\theta = 0°$ (an axial line)

$V = 2.4 \times 10^{-5}$J/A –m; $M = ?$

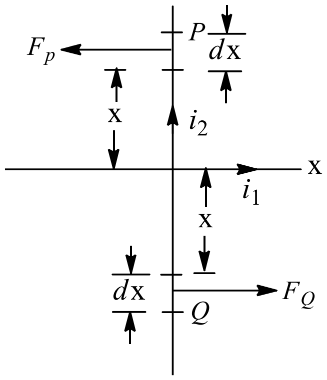
As $V = \frac{\mu_0}{4\pi}\frac{M\cos\theta}{r^2}$

$2.4 \times 10^{-5} = 10^{-7}\frac{M \times 1}{(0.4)^2}$

$M = 38.4$ Am^2

572 **(d)**

Magnetic field at point P due to $i_1, B_1 = \frac{\mu_0 i_1}{2\pi x}$ upward perpendicular to plane paper. Therefore, magnetic force on element P



$F_P = B_1 i_2 dx = \frac{\mu_0 i_1 i_2}{2\pi x}\ dx$, along x-axis

Magnetic field at point Q due to i_1

$B_2 = \frac{\mu_0 i_1}{2\pi x}$, downward perpendicular to plane of paper.

$F_Q = B_2 i_x dx = \frac{\mu_0 i_1 i_2}{2\pi x}\ dx$, along (+) x-axis

So, wire i_2 will be anticlockwise.

573 **(d)**

$$B = \frac{\mu_0 n i_1}{2r_1} - \frac{\mu_0 n i_2}{2r_2}$$

$$= \mu_0 \left[\frac{10 \times 0.20}{2 \times 0.20} - \frac{10 \times 0.30}{2 \times 0.40}\right] = \frac{5}{4}\mu_0.$$

574 **(c)**

$$\tau = NBiA = 100 \times 0.5 \times 1 \times 400 \times 10^{-4}$$
$$= 2\ N - m$$

575 **(c)**

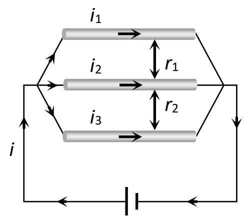
The wire are in parallel and ratio of their resistances are 3 : 4 : 5, hence currents in wires are in the ratio

$\frac{1}{3} : \frac{1}{4} : \frac{1}{5}$

$i_1 = \frac{k}{3}$

$i_2 = \frac{k}{4}$

$i_3 = \frac{k}{5}$



Force between top and middle wire $F_1 = \frac{\mu_0}{4\pi} . \frac{2 i_1 i_2}{r_1}$ $= \frac{\mu_0}{4\pi} \times \frac{2\left(\frac{1}{3}\right)\left(\frac{1}{4}\right)k^2}{r_1}$. Force between bottom and middle wire $F_2 = \frac{\mu_0}{4\pi} \times \frac{\left(\frac{1}{4}\right)\left(\frac{1}{5}\right)k^2}{r_2}$. As the forces are equal and opposite so $F_1 = F_2 \Rightarrow \frac{r_1}{r_2} = \frac{5}{3}$

577 **(c)**

The point P is lying symmetrically w.r.t. the two long straight current carrying conductors. The magnetic field at P due to these current carrying conductors are mutually perpendicular.

$B_1 = \frac{\mu_0}{2\pi} . \frac{i_1}{a}$

$B_2 = \frac{\mu_0}{2\pi} . \frac{i_2}{a}$

$$B = \sqrt{B_1^2 + B_2^2} = \frac{\mu_0}{2\pi a}\ (i_1^2 + i_2^2)^{1/2}$$

578 **(b)**

Magnetic field $\quad B_{\text{centre}} = \frac{\mu_0 I}{2r}$

But $\quad I = ne$

$$\therefore\ B_{\text{centre}} = \frac{\mu_0 ne}{2r}$$

$$\Rightarrow B_{\text{centre}} = \frac{4\pi \times 10^{-7} \times 6.6 \times 10^{15} \times 1.6 \times 10^{-19}}{2 \times 0.53 \times 10^{-10}} = 12.6\ \text{T}$$

580 **(c)**

Magnetic field lies inside as well as outside the solid current carrying conductor

581 **(d)**

$F_m = qvB \sin\theta$, if $v = 0 \Rightarrow F_m = 0$

582 **(c)**

$$r = \frac{\sqrt{2mE}}{Bq} = \frac{\sqrt{2m_1 E_1}}{Bq}$$

Or $\quad E_1 = \frac{mE}{m_1} = \frac{(2m_1)}{m_1} \times 50\ \text{keV} = 100\ \text{keV}$

583 **(a)**

$m_1 : m_2 = 1 : 1$

$q_1 : q_2 = 1 : 2$

$v_1 : v_2 = 2 : 3$

Radius of path of charged particle moving in uniform magnetic field,

$$r = \frac{mv}{Bq}$$

$$\therefore \frac{r_1}{r_2} = \left(\frac{m_1}{m_2}\right)\left(\frac{v_1}{v_2}\right) \times \left(\frac{q_2}{q_1}\right) = \frac{1}{1} \times \frac{2}{3} \times \frac{2}{1} = \frac{4}{3}$$

$r_1 : r_2 = 4 : 3$

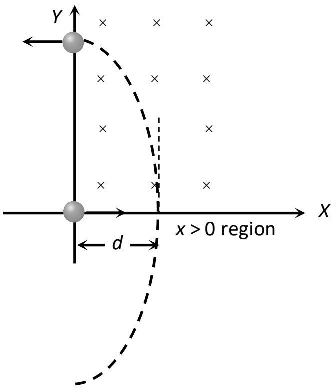
584 **(a)**

The force per unit length between the two wires is

$$\frac{F}{l} = \frac{\mu_0}{4\pi} . \frac{2i^2}{d} = \frac{\mu_0 i^2}{2\pi d}$$

The force will be attractive as current directions in both are same.

585 **(b)**
It is easy to understand the given problem, along with the following figure
$d =$ radius of path
$= \frac{mv}{qB}$



586 **(c)**
Here $B = \mu_0 ni$
Where n is number of turns per unit length $= \frac{N}{l}$

587 **(b)**
Use Right hand palm rule or Maxwell's Cork screw rule

588 **(c)**
Magnetic field induction at O due to current through ACB is $B_1 = \frac{\mu_0 i\theta}{4\pi r}$
It is acting perpendicular to the paper downwards.
Magnetic field induction at O due to current through ABD is $B_2 = \frac{\mu_0}{4\pi} \frac{i(2\pi-\theta)}{r}$
It is acting perpendicular to paper upwards.
$\therefore$ Total magnetic field at O due to current loop is
$B = B_2 - B_1 = \frac{\mu_0}{4\pi}\frac{i}{r}(2\pi - \theta)\frac{\mu_0}{4\pi}\frac{i}{r}\theta$
$= \frac{\mu_0}{2\pi}\frac{i}{r}(\pi - \theta)$

589 **(b)**
$F = Bil \Rightarrow 1 \times 9.8 = 0.98 \times i \times 1 \Rightarrow i = 10\ A$

590 **(a)**
By Fleming's left hand rule

591 **(d)**
Current sensitivity $\frac{\theta}{i} = \frac{NBA}{C}$
$\Rightarrow \frac{\theta}{i} = \frac{100 \times 5 \times 10^{-4}}{10^{-8}} = 5\ rad/\mu\ amp$

592 **(c)**
Magnetic field produced by wire is perpendicular to the motion of electron and it is given by
$B = \frac{\mu_0}{4\pi} . \frac{2i}{a} = 10^{-7} \times \frac{2 \times 5}{0.1} = 10^{-5} Wb/m^2$
Hence force on electron
$F = qvB = (1.6 \times 10^{-19}) \times 5 \times 10^6 \times 10^{-5}$
$= 8 \times 10^{-18} N$

593 **(c)**
Potential difference across C and $D = 10$ V. If x is the resistance of ammeter, than
$x + R = 10/2 = 5$ or $R = 5 - x < 5\ \Omega$

594 **(b)**
In perpendicular magnetic field

Magnetic force = centripetal force

$$qvB = \frac{mv^2}{r} \Rightarrow r = \frac{mv}{qB}$$

For proton $q_1 = e, m_1 = m$

For α-particle $q_2 = 2e, m_2 = 4m$

$$\therefore \quad \frac{r_1}{r_2} = \frac{m_1 v}{q_1 B} \times \frac{q_2 B}{m_2 v}$$

$$\frac{r_1}{r_2} = \frac{m}{e} \times \frac{2e}{4m}$$

$$\frac{r_1}{r_2} = \frac{1}{2}$$

595 **(d)**
$B = \frac{\mu_0}{4\pi}\frac{2\pi i}{r}$
or $7 \times 10^{-6} = \frac{10^{-7} \times 2\pi \times i}{5 \times 10^{-2}}$
$i = 0.56$ Å

596 **(b)**
If distance is same, field will be same $\left[\because B = \frac{\mu_0}{4\pi} \cdot \frac{2i}{r}\right]$

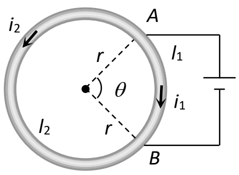
597 **(c)**
When magnetic field is perpendicular to motion of charged particle, then
Centripetal force = magnetic force
ie, $\frac{mv^2}{R} = Bqv$
or $R = \frac{mv}{Bq}$
Further, time period of the motion
$T = \frac{2\pi R}{v} = \frac{2\pi\left(\frac{mv}{Bq}\right)}{v}$
or $T = \frac{2\pi m}{Bq}$
It is independent of both R and v.

598 **(c)**
$B\,e\,v = mv^2/r$ or $B \propto 1/r$; so, $r_2 = r_1\,B_1/B_2$
$= r\,B\,/(B/2) = 2r$

599 **(a)**

Magnetic field at the axis inside the solenoid
$B = \mu_0 ni$
Here, $n = 10$ turns $cm^{-1} = 1000$ turns $m^{-1}, i = 5$ A
$\therefore B = 4\pi \times 10^{-7} \times 1000 \times 5$
$= 2\pi \times 10^{-3}$ T

600 **(a)**
Direction of currents in two parts is different, so direction of magnetic fields due to these currents is opposite. Also applying Ohm's law across AB



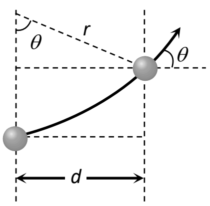
$i_1R_1 = i_2R_2 \Rightarrow i_1l_2 = i_2l_2$
$\left[\because R = \rho \frac{l}{A}\right]$
Also $B_1 = \frac{\mu_o}{4\pi} \times \frac{i_1l_1}{r^2}$ and $B_2 = \frac{\mu_o}{4\pi} \times \frac{i_2l_2}{r^2}$ $[\because l = r\theta]$
$\therefore \frac{B_2}{B_1} = \frac{i_1l_1}{i_2l_2} = 1$
Hence, two field induction's are equal but of opposite direction. So, resultant magnetic induction at the centre is zero and is independent of θ

601 **(b)**
A long straight conductor carrying current I passes through O, then by symmetry, all points of the circular path are equivalent and hence the magnitude of magnetic field should be same at these points.

The circulation of magnetic field along the circle is

$\oint \mathbf{B}.\mathbf{dl} = \mu_0 I$ (using Ampere's law)

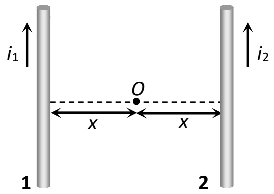
604 **(b)**
According to the following figure, $\sin\theta = \frac{d}{r}$



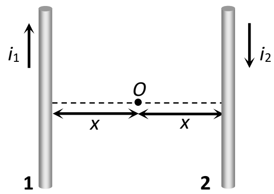
Also $r = \frac{\sqrt{2mk}}{qB} = \frac{1}{B}\sqrt{\frac{2mV}{q}}$
$\therefore \sin\theta = Bd\sqrt{\frac{q}{2mV}}$
$= 0.51 \times 0.1\sqrt{\frac{1.6 \times 10^{-19}}{2 \times 1.67 \times 10^{-27} \times 500 \times 10^3}}$
$= \frac{1}{2} \Rightarrow \theta = 30$

605 **(d)**
$F = I.(L_{eff})B$
$L_{eff} = L + L\cos 45° + L\sin 60°$
$= L + L \times \frac{1}{\sqrt{2}} + L \times \frac{\sqrt{3}}{2}$
$= L\left(\frac{2 + \sqrt{2} + \sqrt{3}}{2}\right)$
Force on each wire $= I.L.B\sin\theta$ [Because angle between current element and magnetic field $= 90°$]
$= I.L.B.\sin 90° = I.L.B.$

606 **(d)**
Initially when wires carry currents in the same direction as shown:
Magnetic field at mid point O due to wires 1 and 2 are respectively



$B_1 = \frac{\mu_0}{4\pi}.\frac{2i_1}{x} \otimes$
and $B_2 = \frac{\mu_0}{4\pi}.\frac{2i_2}{x} \odot$
Hence net magnetic field at O $B_{net} = \frac{\mu_0}{4\pi} \times \frac{2}{x} \times (i_1 - i_2)$
$\Rightarrow 10 \times 10^{-6} = \frac{\mu_0}{4\pi}.\frac{2}{x}(i_1 - i_2)$ ... (i)
If the direction of i_2 is reversed then

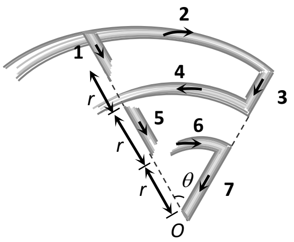


$B_1 = \frac{\mu_0}{4\pi}.\frac{2i_1}{x} \otimes$
and $B_2 = \frac{\mu_0}{4\pi}.\frac{2i_2}{x} \otimes$
So $B_{net} = \frac{\mu_0}{4\pi}.\frac{2}{x}(i_1 + i_2)$
$\Rightarrow 40 \times 10^{-6} = \frac{\mu_0}{4\pi}.\frac{2}{x}(i_1 + i_2)$ ... (ii)
Dividing equation (ii) by (i) $\frac{i_1 + i_2}{i_1 - i_2} = \frac{4}{1} \Rightarrow \frac{i_1}{i_2} = \frac{5}{3}$

607 **(b)**
Apply Fleming's left hand rule

609 **(c)**
Using Ampere's circuital law the magnetic field at any point inside the pipe is zero.

610 **(a)**
$B_1 = B_3 = B_5 = 0$



$B_2 = \frac{\mu_0}{4\pi}.\frac{\theta i}{3r} \otimes, B_4 = \frac{\mu_0}{4\pi}.\frac{\theta i}{2r} \odot$

and $B_6 = \frac{\mu_0}{4\pi}.\frac{\theta i}{r} \otimes$

∴ Net magnetic field at O,

$$B_{net} = B_2 - B_4 + B_6 = \frac{\mu_0}{4\pi}.\frac{\theta i}{r}\left(\frac{1}{3} - \frac{1}{2} + 1\right)$$

$$= \frac{5\mu_0 \theta i}{24\pi r}$$

611 **(b)**

According to question, resistance of wire ADC is twice that of wire ABC. Hence current flowing through ADC is half that of ABC, $i.e., \frac{i_2}{i_1} = \frac{1}{2}$. Also

$i_1 + i_2 = i$

$\Rightarrow i_1 = \frac{2i}{3}$ and $i_2 = \frac{i}{3}$

Magnetic field at centre O due to wire AB and BC (part 1 and 2) $B_1 = B_2 = \frac{\mu_0}{4\pi}.\frac{2i_1 \sin 45°}{a/2} \otimes = \frac{\mu_0}{4\pi}.\frac{2\sqrt{2}i_2}{a} \otimes$

And magnetic field at centre O due to wires AD and DC

$[i.e.$ part 3 and 4$]$ $B_3 = B_4 = \frac{\mu_0}{4\pi}\frac{2\sqrt{2}i_2}{a} \odot$

Also $i_1 = 2i_2$. So $(B_1 = B_2) > (B_3 = B_4)$

Hence net magnetic field at centre O

$B_{net} = (B_1 + B_2) - (B_3 + B_4)$

$$= 2 \times \frac{\mu_0}{4\pi}.\frac{2\sqrt{2} \times \left(\frac{2}{3}i\right)}{a} - \frac{\mu_0}{4\pi}.\frac{2\sqrt{2}\left(\frac{i}{3}\right) \times 2}{a}$$

$$= \frac{\mu_0}{4\pi}.\frac{4\sqrt{2}i}{3a}(2-1) \otimes = \frac{\sqrt{2}\mu_0 i}{3\pi a} \otimes$$

612 **(a)**

$$S_1 = \frac{i_g G}{i - i_g}; S_2 = \frac{i_g G}{2i - i_g}; \text{so}, \frac{S_1}{S_2} = \left(\frac{2i - i_g}{i - i_g}\right)$$

613 **(c)**

Given, $i_g = i, G = R_0$;

$i \ = n\,i + i = (n+1)\ i$

$$\therefore\ S = \frac{i_g G}{i - i_g} = \frac{iR_0}{(n+1)i - i} = \frac{R_0}{n}$$

615 **(c)**

Lorentz force $F = q(v \times B)$ or $|F| = qvB \sin\theta$

F will be maximum when $\theta = 90°$

616 **(d)**

$$r = \frac{mv}{Bq} = \frac{mv}{Be}$$

617 **(d)**

The motion of proton is magnetic field will be circular.

$v = 2\pi r f$

$= 2 \times 3.14 \times 50 \times 10^{-2} \times 10 \times 10^6$

$= 3.14 \times 10^7$ m/s