Explanations

1. (c) Statement in option (c) is correct, but rest are incorrect that can be corrected as

(a) Magnetic field lines form closed loops.

(b) Magnetic field lines points outward from the North pole and points inwards at the South pole of a magnet. They do not start or end at the poles.

(c) Two magnetic field lines do not intersect each other. **(1)**

2. (c) The torque on a bar magnet in a magnetic field is

$$\tau = \mathbf{M} \times \mathbf{B} = MB\sin\theta$$

Since, the bar magnet is parallel to the direction of magnetic field.

$$\therefore \quad \tau = MB\sin 0° = 0$$

Also, the force acting at the ends of bar magnet are equal but opposite in direction, so the net force is zero.

3. (b) According to Gauss' law in magnetism, the net magnetic flux through any closed loop is zero.

4. (a) Magnetic field due to a bar magnet at a distance r from the centre of magnet on axial position,

$$B = \frac{\mu_0}{4\pi} \cdot \frac{2M}{r^3}$$

$$\Rightarrow \quad \frac{B_1}{B_2} = \left(\frac{r_2}{r_1}\right)^3 = \left(\frac{48}{24}\right)^3 = 8$$

5. (b) Magnetic moment,

$$M = \frac{\tau}{B\sin\theta} = \frac{0.032}{0.16 \times \sin 30°} = 0.40 \text{ JT}^{-1}$$

6. (b) We know that,

$$W = MB\,(\cos\theta_1 - \cos\theta_2)$$

As $\theta_1 = 0°$ and $\theta_2 = 180°$

Then, $W = MB\,(\cos 0° - \cos 180°)$

$$= 2\,MB$$

7. (a) Time period, $T = 2\pi\sqrt{\frac{I}{MB}}$

As, the magnet is cut into two equal parts along axis, then for each part

$$I' = \frac{I}{2}$$

$$M' = \frac{M}{2}$$

$\therefore$ Time period of new magnet,

$$T' = \sqrt{\frac{I'}{M'B}} = \sqrt{\frac{I \times 2}{2 \times M \times B}}$$

$$\Rightarrow \quad T' = T$$

8. (a) We know that,

Intensity of magnetisation, $I = \frac{M}{V}$

where, M = magnetic moment and V = volume.

So, $M = IV$

$$= 5.0 \times 10^4 \times \frac{12}{100} \times \frac{1}{(100)^2}$$

$$= 60 \times 10^4 \times 10^{-6} = 0.6 \text{ A-m}^2$$

9. (d) As we know that, $\mu_r = 1 + \chi_m$

$$\Rightarrow \quad 5500 = 1 + \chi_m$$

$$\Rightarrow \quad \chi_m = 5500 - 1 = 5499$$

10. (a) Nickel shows ferromagnetic property at room temperature. If the temperature is increased beyond Curie temperature, then it will show a paramagnetism.

11. (b) Ferromagnetic materials used for transformers must have high permeability and low hysteresis loss.

12. (a) Since, monopoles do not exists.

So, the poles of a bar magnet cannot be separated.

13. (a) The net magnetic flux passes through a closed surface enclosing a bar magnet is zero because a bar magnet has two poles (one north and other south) and the magnetic flux (magnetic field lines) leaving the north pole is equal to the magnetic flux (magnetic field lines) entering the south pole of bar magnet.

Thus, according to Gauss's law for magnetism, the net magnetic flux througth any closed surface is zero, i.e. the net flux ϕ_B is $\phi_B = \sum_{\text{all}} \mathbf{B} \cdot \Delta\mathbf{S} = 0$.

14. (b) When we break magnet into two pieces its poles does not get separated as it again becomes a magnet. Also, when magnet is broken into two equal pieces, its magnetic moments gets reduced to half.

15. (a) According to Gauss's law in magnetism,

$$\oint \mathbf{B} \cdot d\mathbf{S} = 0$$