# 2.STRUCTURE OF ATOM

## Single Correct Answer Type

1. Beta-emission takes place
   a) From the elements above the band of stability
   b) When neutron is converted to proton
   c) With shifting of the new element one group towards right
   d) Following all the facts given above
2. The angular momentum of an electron in 4s orbital, 3p orbital, and 4th orbit are
   a) $0, \frac{1}{\sqrt{2}}, \frac{h}{\pi}, \frac{2h}{\pi}$
   b) $\frac{1}{\sqrt{2}}, \frac{h}{2}, \frac{2h}{\pi}, 0$
   c) $0, \frac{\sqrt{2}h}{\pi}, \frac{4h}{\pi}$
   d) $\frac{\sqrt{2}h}{\pi}, \frac{4h}{\pi}, 0$
3. Slow neutrons can bring about the fission of
   a) ${}_{92}U^{235}$ b) ${}_{82}U^{238}$ c) ${}_{82}Pb^{207}$ d) ${}_{88}U^{226}$
4. When passing through a magnetic field the largest deflection is experienced by
   a) $\alpha-$rays b) $\beta-$rays c) $\gamma-$rays d) All equal
5. A radioactive element decays by the sequence, and with half-lives, given below
   $X \xrightarrow[30\ \text{min}]{\alpha} Y \xrightarrow[2\ \text{days}]{2\beta} \text{Z}$
   Which of the following statements about this system are correct?
   a) After two hours, less than 10% of the initial $X$ is left
   b) Maximum amount of $Y$ present at any time before 30 min is less then 50% of the initial amount of $X$
   c) Atomic numbers of $X$ and $Z$ are same
   d) All of the above are correct statements
6. ${}_4Be^7$captures a K electron into its nucleus. What is the mass number and atomic number of the nuclide formed?
   a) 3,7 b) 4,8 c) 3,8 d) 4,7
7. When electronic transition occurs from higher energy state to lower energy state with energy difference equal to $\Delta E$ electron volts, the wavelength of the line emitted is approximately equal to
   a) $\frac{12395}{\Delta E} \times 10^{-10}\text{m}$ b) $\frac{12395}{\Delta E} \times 10^{10}\text{m}$ c) $\frac{12395}{\Delta E} \times 10^{-10}\text{cm}$ d) $\frac{12395}{\Delta E} \times 10^{10}\ \text{cm}$
8. Which of the following nuclei is unstable?
   a) ${}_5B^{10}$ b) ${}_4Be^{10}$ c) ${}_7N^{14}$ d) ${}_8O^{16}$
9. Thiosulphate ion, $S_2O_3^{2-}$ on acidification changes to $SO_2$ along with precipitation of sulphur
   ${}^{35}S^{32}SO_3^{2-} + 2H^+ \rightarrow H_2O + SO_2 + S$
   Which is the correct statement?
   a) ${}^{35}$S is in sulphur b) ${}^{35}$Sis in $SO_2$ c) ${}^{35}$Sis in both d) ${}^{35}$Sis in none
10. The electrons, identified by quantum numbers $n$ and $l$
    *1.* $n = 4, l = 1$
    *2.* $n = 4, l = 0$
    *3.* $n = 3, l = 2$
    *4.* $n = 3, l = 1$
    Can be placed in the order of increasing energy, from the lowest to highest, as
    a) iv $< ii < iii < i$ b) ii $< iv < i < iii$ c) i $< iii < ii < iv$ d) iii $< i < iv < ii$
11. After the emission of a $\beta-$particle followed by $\alpha-$particle from ${}^{214}_{83}Bi$;the number of neutrons in the

atom is

a) 130 b) 129 c) 128 d) 127

12. In the Schrodinger's wave equation Ψ represents

a) Orbit b) Wave function c) Wave d) Radial probability

13. Which of the following has the maximum penetrating power?

a) α −particle b) Proton c) γ −particle d) Positron

14. Which of the following projectiles is the best for bombarding the nuclide?

a) α −particle b) Proton c) Deuteron d) Neutron

15. Which of the following is false?

a) The energy of an electron in an orbital of a hydrogen-like species depends only on the principal quantum number $n$

b) The angular momentum of an electron of an orbital of a multielectron atom depends on the quantum numbers $l$ and $m$

c) The expression of angular momentum of an electron in an orbital is given as $\sqrt{l(l-1)}\left(\frac{h}{2\pi}\right)$

d) The $z$-component of angular momentum of an electron in an orbital is given as $m\left(\frac{h}{2\pi}\right)$

16. Which of the following elements belongs to $4n$-series?

a) Pb-207 b) Bi-209 c) Pb-208 d) Pb-206

17. The radius of second Bohr's orbit is

a) 0.053 nm b) $\frac{0.053}{4}$ nm c) $0.053 \times 4$ nm d) $0.053 \times 20$ nm

18. Sodium chloride imparts a yellow colour to the Bunsen flame. This can be interpreted due to the

a) Low ionization energy of sodium

b) Sublimation of metallic sodium to give yellow vapour

c) Emission of excess energy absorbed as a radiation in the visible region

d) Photosensitivity of sodium

19. When $n/p$ ratio of an isotope is greater than the stable isotope of that element, it emits

a) β −particles b) α −particles c) Neutron d) Positron

20. The electronic configuration of a diapositive ion $M^{2+}$is 2, 8,14 and its mass number is 56. The number of neutrons present is

a) 32 b) 42 c) 30 d) 34

21. Total binding energy of α-particles is

a) 28.3 MeV b) 2.83 MeV c) 20.5 MeV d) 0.283 MeV

22. The energy of an electron in the first Bohr orbit for hydrogen is −13.6 eV. Which one of the following is a possible excited state for electron in Bohr orbit of hydrogen atom?

a) −3.4 eV b) −6.8 eV c) −1.7 eV d) 13.6 eV

23. Rutherford's experiment, which established the nuclear model of the atom, used a beam of

a) β-particles, which impinged on a metal foil and got absorbed

b) γ-rays, which impinged on a metal foil and ejected electrons

c) Helium atom, which impinged on a metal foil and got scattered

d) Helium nuclei, which impinged on a metal foil and got scattered

24. The radiations from a naturally occurring radioactive substance, as seen after deflection by a magnet in one direction, are

a) Definitely alpha rays b) Definitely beta rays

c) Both alpha and beta rays d) Either alpha or beta rays

25. A radioisotope has half life of 10 years. What percentage of the original amount of it would you expect to remain after 20 years?

a) 0 b) 12.5 c) 25 d) 8

26. Which of the following nuclear reaction occurs in nature for the formation of tritium?

a) ${}_3Li^6 + {}_0n^1 \rightarrow {}_2He^4 + {}_1H^3$ b) ${}_5B^{10} + {}_0n^1 \rightarrow 2\ {}_2He^4 + {}_1H^3$

c) ${}_7N^{14} + {}_0n^1 \rightarrow {}_6C^{12} + {}_1H^3$ d) ${}_4Be^9 + {}_1D^2 \rightarrow 2\ {}_2He^4 + {}_1H^3$

27. The number of neutrons accompanying the formation of $_{54}Xe^{139}$ and $_{38}Sr^{94}$ from the absorption of a slow neutron by $_{92}U^{235}$, followed by nuclear fission is
    a) 0 b) 2 c) 1 d) 3
28. The first ionization potential in electron volts of nitrogen and oxygen atoms are, respectively, given by
    a) 14.6, 13.6 b) 13.6, 14.6 c) 13.6, 13.6 d) 14.6, 14.6
29. The most radioactive of the isotopes of an element is the one with the largest value of its
    a) Half-life b) Neutron number c) Atomic number d) Decay constant
30. Which of the following statements about quantum numbers is wrong:
    a) If the value of $l = 0$, the electron distribution is spherical
    b) The shape of the orbital is given by subsidiary quantum number
    c) The Zeeman's effect is explained by magnetic quantum number
    d) The spin quantum number gives the orientations of electron cloud
31. One curie of activity is equivalent to
    a) $3.7 \times 10^7$ disintegrations per second
    b) $3.7 \times 10^{10}$ disintegrations per second
    c) $3.7 \times 10^4$ disintegrations per second
    d) None
32. The ratio of the energy of photon of 2000 Å wavelength radiation to that of 4000 A radiation is
    a) $1/4$ b) 4 c) $1/2$ d) 2
33. The correct ground state electronic configuration of chromium atom is
    a) $[Ar]3d^5\ 4s^1$ b) $[Ar]3d^4\ 4s^2$ c) $[Ar]3d^6\ 4s^0$ d) $[Ar]3d^5\ 4s^2$
34. Which reaction shows artificial transmutation by $\alpha$ −bombardment?
    a) $^{14}_{7}N + ^{4}_{2}He \rightarrow ^{17}_{8}O + ^{1}_{1}H$ b) $^{238}_{92}U \rightarrow ^{234}_{90}Th + ^{4}_{2}He$
    c) $^{14}_{6}C \rightarrow ^{14}_{7}N + ^{0}_{-1}e$ d) None of the above
35. When $_{92}U^{238}$ decays it emits an α-particle. The new nuclide in turn emits a β-particle to give another nuclide X. The mass number and atomic number of X are, respectively
    a) 234 and 91 b) 234 and 96 c) 232 and 88 d) 234 and 88
36. Among the following nuclides, the highest binding energy per nucleon is found for
    a) $^{3}_{1}H$ b) $^{16}_{8}O$ c) $^{56}_{26}Fe$ d) $^{235}_{92}U$
37. $_{6}C^{14}$ in the upper atmosphere is formed by the action of neutron on
    a) $_{7}N^{14}$ b) $_{8}O^{17}$ c) $_{6}C^{12}$ d) $_{8}O^{18}$
38. The kinetic energy of the photoelectrons does not depend upon
    a) Intensity of incident radiation b) Frequency of incident radiation
    c) Wavelength of incident radiation d) Wave number of incident radiation
39. In uranium mineral, the atomic ratio $N_{U-238}/N_{Pb-206}$ is nearly equal to one. The age (in years) of the mineral is nearly (half-life period of U-238 is $4.5 \times 10^9$ yr)
    a) $3.0 \times 10^8$ b) $4.5 \times 10^9$ c) $3.0 \times 10^9$ d) $4.5 \times 10^8$
40. Hydrogen bomb is based on the principle of
    a) Nuclear fission b) Nuclear fusion c) Nuclear explosion d) Chemical reaction
41. The wave mechanical model of an atom is based upon which of the following equations?
    a) Schrodinger's equation b) De Broglie's equation
    c) Heisenberg's uncertainty principle d) All the above
42. The correct set of four quantum numbers for the valence (outermost) electron of rubidium ($Z = 37$) is
    a) $5, 0, 0, +1/2$ b) $5, 1, 0, +1/2$ c) $5, 1, 1, +1/2$ d) $6, 0, 0, +1/2$
43. The radiation that produces the greatest number of ions as it passes through matter is
    a) α b) γ c) $\beta^-$ d) $\beta^+$
44. The decay of a radioactive element follows first order kinetics. Thus,
    a) Half-life period = a constant/$K$, where $K$ is decay constant
    b) The rate of decay is independent of temperature
    c) The rate can be altered by changing chemical conditions

d) The element will be completely transformed into new element after expiry of two half-life period

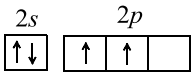
45. After three half lives, the percentage of fraction of amount left is
    a) 6.35 b) 12.5 c) 50 d) 75
46. The SI unit of radioactivity is
    a) Curie b) Micro-curie c) Rutherford d) Becquerel
47. Which nuclear reaction is not balanced?
    a) ${}^{10}_{5}\mathrm{B} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{13}_{7}\mathrm{N} + {}^{1}_{0}n$ b) ${}^{238}_{92}\mathrm{U} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{241}_{95}\mathrm{Am} + {}^{1}_{0}n$
    c) ${}^{40}_{18}\mathrm{Ar} + {}^{1}_{1}\mathrm{H} \rightarrow {}^{40}_{19}\mathrm{K} + {}^{1}_{0}n$ d) ${}^{14}_{7}\mathrm{N} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{17}_{8}\mathrm{O} + {}^{1}_{1}\mathrm{H}$
48. Atoms with the same mass number but having different nuclear charges are called
    a) Isotopes b) Isobars c) Isochors d) Isotones
49. The number of radial nodes of $3s$ and $2p$-orbitals are respectively
    a) 2, 0 b) 0, 2 c) 1, 2 d) 2, 11
50. C-14 has a life of 5760 years. 100 mg of sample containing C-14 is reduced to 25 mg in
    a) 11520 years b) 2880 years c) 1440 years d) 17280 years
51. Tritium, ${}^{3}_{1}\mathrm{H}$has a half-life of 12.26 yr. A 5.00 mL sample of tritiated water has an activity of $2.40 \times 10^{9}$cpm.How many years will it take for the activity to fall to $3.00 \times 10^{8}$cpm?
    a) 6.13 b) 12.26 c) 24.52 d) 36.78
52. If a radioactive element is placed in an evacuated container, its rate of disintegration
    a) Will be increased b) Will be decreased
    c) Will change very slightly d) Will remain unchanged
53. $\mathrm{A} \xrightarrow[N_A]{T_{50} = 100\,\mathrm{min}} B \xrightarrow[N_B]{T_{75} = 100\,\mathrm{min}} C$
    At equilibrium $N_A/N_B$ is
    a) 1 b) 2 c) 0.5 d) 20
54. In nuclear reactors heavy water is used as a
    a) Fuel b) Projectile c) Moderator d) Arrester
55. The energy of an electron in the first Bohr orbit of H atom is $-13.6$ eV. The possible energy value(s) of the excited state(s) for electrons in Bohr orbits of hydrogen is(are)
    a) $-3.4$ eV b) $-4.2$ eV c) $-6.8$ eV d) $+6.8$ eV
56. Which one of the following does not consist of charged particles of matter?
    a) α −particles b) β −rays c) γ −rays d) Anode rays
57. The phenomenon radioactivity is associated with
    a) Decay of nucleus
    b) Fussion of nucleus
    c) Emission of electrons or protons
    d) Rearrangement in the extra nuclear electron
58. Which nuclear reaction is an example of $\alpha$ −emission?
    a) ${}^{235}_{92}\mathrm{U} \rightarrow {}^{231}_{90}\mathrm{Th} + {}^{4}_{2}\mathrm{He}$ b) ${}^{75}_{34}\mathrm{Se} \rightarrow {}^{75}_{35}\mathrm{Br} + {}^{0}_{-1}e$
    c) ${}^{14}_{7}\mathrm{N} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{17}_{8}\mathrm{O} + {}^{1}_{1}\mathrm{H}$ d) None of the above
59. The ratio of energy of photon of $\lambda = 2000$ Å to that of $\lambda = 4000$ Å is
    a) 2 b) $1/4$ c) 4 d) $1/2$
60. Amongst the following elements (whose electronic configurations are given below), the one having the highest ionization energy is
    a) $[\mathrm{Ne}]3s^2\ 3p^1$ b) $[\mathrm{Ne}]3s^2\ 3p^3$ c) $[\mathrm{Ne}]3s^2\ 3p^2$ d) $[\mathrm{Ar}]3d^{10}\ 4s^2\ 4p^3$
61. REM is a unit of
    a) Radiation dosage b) Binding energy c) Packing fraction d) Radioactivity
62. The possible sub-shells in $n = 3$ energy shell are:
    a) $s, p, d$ b) $s, p, d, f$ c) $s, p$ d) $s$ only
63. In a series of three steps in radioactive disintegration sequence starting with ${}^{228}_{88}\mathrm{Ra}$,the particles emitted are, successively, $\beta^-$, $\beta^-$and α −particles. The resulting product is an isotope of

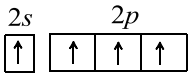
a) ${}_{92}U$ b) ${}_{90}Th$ c) ${}_{88}Ra$ d) ${}_{86}Rn$

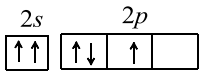
64. The work function of a metal is 4.2 eV. If radiations of 2000 Å fall on the metal, then the kinetic energy of the fastest photoelectron is:
a) $1.6 \times 10^{-19}$J b) $16 \times 10^{10}$J c) $3.2 \times 10^{-19}$J d) $6.4 \times 10^{-10}$J

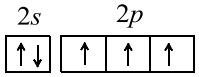
65. 1 g of ${}^{200}_{79}Au$ ($T_{50} = 13$ days)emits a $\beta -$particle forming a stable Hg atom. Hg formed at the end of 52 days is
a) 0.0625 g b) 0.9375 g c) 0.7500 g d) 0.2500 g

66. If the threshold wavelength ($\lambda_0$) for ejection of electron from metal is 330 nm, then work function for the photoelectric emission is
a) $1.2 \times 10^{-18}$J b) $1.2 \times 10^{-20}$J c) $6 \times 10^{-29}$J d) $6 \times 10^{-12}$J

67. For which of the following electron distributions is ground state, the Pauli's exclusion principle is violated?
a) 

b) 

c) 

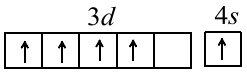
d) 

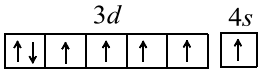

68. The transition in $He^{\oplus}$ ion that would have the same wavelength as the first Lyman line in hydrogen spectrum is
a) $2 \rightarrow 1$ b) $5 \rightarrow 3$ c) $4 \rightarrow 2$ d) $6 \rightarrow 4$

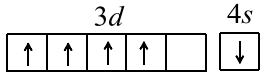
69. Aluminiu-25 decays by emitting a positron. The species immediately produced has
a) $12p, 13n, 13e^-$ b) $13p, 12n, 13e^-$ c) $12p, 13n, 12e^-$ d) $14p, 11n, 14e^-$

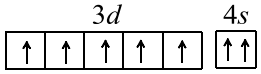
70. The reaction
${}_1D^2 + {}_1T^3 \rightarrow {}_1He^2 + {}_0n^1$
Is an example of
a) Nuclear fission b) Nuclear fusion
c) Artificial radioactivity d) Radioactive disintegration

71. Atomic mass of an element is not necessarily a whole number because
a) It contains electrons, protons, and neutrons b) It exists in allotropic forms
c) It contains isotopes d) Atoms are no longer indivisible

72. Which of the following arrangements of electrons is mostly likely to be stable?
a) 

b) 

c) 

d) 


73. A photon of frequency n causes photoelectric emission from a surface with threshold frequency $v_0$. The de Broglic wavelength λ of the photoelectron emitted is given as
a) $\Delta n = \frac{h}{2m\lambda}$ b) $\Delta n = \frac{h}{\lambda}$ c) $\left[\frac{1}{v_0} - \frac{1}{v}\right] = \frac{mc^2}{h}$ d) $\lambda = \sqrt{\frac{h}{2m\,\Delta n}}$

74. The total number of unpaired electrons are
a) 1
b) 2
c) 3
d) 4

75. Which of the following is false?
a) Bracket spectral series for which $n_1 = 4$ and $n_2 = 5,6,7, \ldots$ lies in the infrared region of the electromagnetic radiation
b) The orbital $3d_{z^2}$ is symmetrical about $z$-axis
c) The orbital $3d_{xy}$ has no probability of finding electron along$x$- and $y$-axis
d) The orbital $3d_{x^2-y^2}$ has no probability of finding electron along $x$- and $y$-axis

76. The energy equivalent to 1 amu is?
a) 931.5 MeV b) 93.15 MeV c) 460 MeV d) 554 MeV

77. 1 g atom of an α-emitting ${}_ZX^A$ (half life = 10 hr) was placed in sealed containers, $4.52 \times 10^{23}$. Helium atoms will accumulate in the container after
a) 4.52 hr b) 10.00 hr c) 9.40 hr d) 20.00 hr

78. The two electrons have the following sets of quantum numbers:
X: $3, 2, -2, +1/2$
Y: $3, 0, 0, +1/2$
What is true of the following
a) X and Y have same energy
b) X and Y have unequal energy
c) X and Y represent same electron
d) None of the statement is correct

79. For a given principal level $n = 4$, the energy of its subshells is of the order
a) $s < d < f < p$
b) $s < p < d < f$
c) $d < f < p < s$
d) $s < p < f < d$

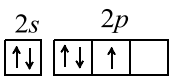
80. The unstable nucleus $^{212}_{82}$Pbdecays with $\beta$ - particle emission, having a half-life of 10 h. From this it follows that the
I. mass number of the product is 212
II. atomic number of the product is 81
III. fraction of the original isotope remaining after 20 h is $1/4$
IV. Nucleus formed is stable
Select the correct alternate
a) I, II and III
b) I and III
c) II and IV
d) IV

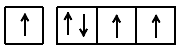
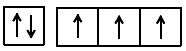
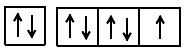
81. Which is different in isotopes of an element?
a) Atomic number
b) Mass number
c) Number of protons
d) Number of electrons

82. If uranium (mass number 238 and atomic number 92) emits an α-particle, the product has mass number and atomic number
a) 236 and 92
b) 234 and 90
c) 238 and 90
d) 236 and 90

83. Which of the following is false?
a) The angular momentum of an electron due to its spinning is given as $\sqrt{s(s+1)}\left(\frac{h}{2\pi}\right)$, where $s$ can take a value of $1/2$
b) The angular momentum of an electron due to its spinning is given as $m_s\left(\frac{h}{2\pi}\right)$, where $m_s$ can take the value of $+1/2$
c) The azimuthal quantum number cannot have negative values
d) The potential energy of an electron in an orbit is twice in magnitude as compared to its kinetic energy

84. $A \underset{T_A}{\overset{k_A}{\rightarrow}} \text{product} \quad B \underset{T_B}{\overset{k_B}{\rightarrow}} \text{product}$
$A$and $B$are two radioactive elements with half-life periods $T_A$and $T_B$(in years) and $k_A$(year$^{-1}$)and $k_B$(atom$^{-1}$year$^{-1}$). If half-life periods are equal, disintegration rate at the start of disintegration with same concentration would be
a) $k_A T_A$
b) 0.693
c) Both (a) and (b)
d) None of these

85. The orbital diagram in which the Aufbau principle is violated is
a) 

b) 
c) 
d) 

86. Two nuclei are not identical but have the same number of nucleons. These are
a) Isotopes
b) Isobars
c) Isotones
d) None

87. When $_{17}Cl^{35}$ undergoes $(n, p)$ reaction, the radioisotope formed is
a) $_{15}P^{32}$
b) $_{16}S^{35}$
c) $_{16}S^{34}$
d) $_{15}P^{34}$

88. For an $\alpha$ −emitting isotope, the value of disintegration constant is $0.49 \times 10^{-10}$per year. The amount of the isotope of a given sample will reduce to half its value after a period (in years) of nearly
a) $0.45 \times 10^{10}$
b) $0.9 \times 10^{10}$
c) $1.41 \times 10^{10}$
d) $2.82 \times 10^{10}$

89. The number of spherical nodes in $3p$ orbital are:
a) One
b) Three
c) None
d) Two

90. The transition of electrons in H atom that will emit maximum energy is
a) $n_3 \rightarrow n_2$
b) $n_4 \rightarrow n_3$
c) $n_5 \rightarrow n_4$
d) $n_6 \rightarrow n_5$

91. The end product of (4n+2) disintegration series is

a) ${}_{82}Pb^{204}$ b) ${}_{82}Pb^{208}$ c) ${}_{82}Pb^{206}$ d) ${}_{82}Pb^{209}$

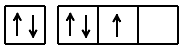
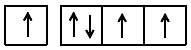
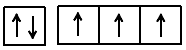
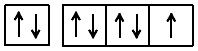
92. The limiting line in Balmer series will have a frequency of
a) $32.29 \times 10^{15} s^{-1}$ b) $3.65 \times 10^{14} s^{-1}$ c) $-8.22 \times 10^{14} s^{-1}$ d) $8.22 \times 10^{14} s^{-1}$

93. An atom bomb is based on the principle of
a) Nuclear fusion b) Nuclear fission c) Radioactivity d) Combustion

94. The heaviest subatomic particle is
a) Neutron b) Positron c) Electron d) Proton

95. The exact path of electron $2p$ orbital cannot be determined, the above statement is based upon
a) Hund's rule b) Bohr's rule c) Uncertainty principle d) Aufbau principle

96. The ratio of potential energy and total energy of an electron in a Bohr orbit of a hydrogen-like species is
a) 2 b) $-2$ c) 1 d) $-1$

97. The orbital diagram in which the Aufbau principle is violated is
a)  b)  c)  d) 

98. Which nuclear reaction is an example of fusion emission?
a) ${}^{238}_{94}Pu + {}^{4}_{2}He \rightarrow + {}^{242}_{96}Cm$ b) ${}^{22}_{11}Na \rightarrow {}^{22}_{10}Ne + {}^{0}_{1}\beta$
c) ${}^{7}_{3}Li + {}^{1}_{1}H \rightarrow {}^{1}_{0}n + {}^{7}_{4}Be$ d) ${}^{41}_{18}Ar + {}^{0}_{-1}e \rightarrow {}^{41}_{17}Cl$

99. ${}_{89}Ac^{227}$ is a member of actinium series. Another member of the same series of
a) ${}_{92}U^{235}$ b) ${}_{90}Th^{232}$ c) ${}_{89}Ac^{225}$ d) ${}_{15}P^{34}$

100. Water used as moderator in nuclear reactor is called
a) Heavy water b) Hared water c) Nuclear water d) Critical water

101. For the energy levels in an atom, which one of the following statement is correct?
a) There are seven principal electron energy levels
b) The second principal energy level has four sub-energy levels and contain a maximum of eight electrons
c) The principal energy level N can have a maximum of 32 electrons
d) The $4s$ sub-energy level has high energy than $3d$ subenergy level

102. The outermost electronic configuration of the most electronegative element is
a) $ns^2\ np^3$ b) $ns^2\ np^4$ c) $ns^2\ np^5$ d) $ns^2\ np^6$

103. One microcurie of radiation is the quantity of radioactive substance which produces
a) $3.7 \times 10^{10}$ disintegration per second (dps) b) $6.02 \times 10^4$ dps
c) $3.7 \times 10^4$ dps d) $3.7 \times 10^7$ dps

104. Ionizing radiation is
a) Radiation that only interacts with ions
b) The same as a proton
c) A neutron that has acquired a charge, thus forming an ion
d) High-energy radiation that removes electrons from atom or molecules

105. Which combinations of quantum number $n, l, m, s$, for the electron in an atom does not provide a permissible solution of the wave equation?
a) $3, 2, -2, 1/2$ b) $3,3,1,-1/2$ c) $3,2,1,1/2$ d) $3,1,1,-1/2$

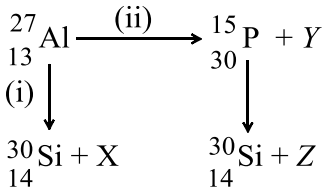
106. Which of the following is true?
a) Diapositive zinc exhibits paramagnetism due to loss of two electrons from a $3d$ orbital of neutral atom
b) In β-emission from a nucleus, the atomic number of the daughter element decreases by 1
c) The emission of one $\alpha$-particle from a radioactive atom results in the decrease of atomic number by 2 and mass number by 4
d) The successive emission of two β-particles from a radioactive atom results in the decrease of atomic number by 1

107. The term nucleon refers to
a) Electrons belonging to an atom that undergoes nuclear decay
b) Electrons that are emitted from a nucleus in a nuclear reaction
c) The nuclei of a specific isotope
d) Both protons and neutrons

108. Bohr's atomic model can explain the spectrum of
    a) Hydrogen atoms only
    b) Atoms or ions which are unielectron
    c) Atoms or ions which have only two electrons
    d) Hydrogen molecule
109. ${}^{30}_{15}X$ changes to ${}^{30}_{14}$Si by emission of
    a) $\alpha$ −particle
    b) $\beta$ −particle
    c) Positron
    d) Proton
110. 'Fat man' relates to
    a) Pu-bomb
    b) U-bomb
    c) Th-bomb
    d) Literary word from a book
111. Ionizing radiation is dangerous to living things because
    a) It causes nuclear reactions
    b) It causes thermal burns
    c) It alters the chemical structure of atom molecules
    d) It causes electrons to be captured by the nucleus
112. Select the correct statement
    a) MRI uses radiowaves to stimulate certain nuclei in the presence of magnetic field
    b) P-32 is used for leukemia therapy
    c) I-123 is used in imaging the brain
    d) All of the above
113. One atomic unit is equal to
    a) $1.492 \times 10^{-3}$ ergs
    b) $1.492 \times 10^{-2}$ ergs
    c) $1.492 \times 10^{-10}$ ergs
    d) None
114. Of the following nuclides, the one most likely to be radioactive is
    a) ${}^{31}_{15}$P
    b) ${}^{66}_{30}$Zn
    c) ${}^{14}_{7}$N
    d) ${}^{14}_{6}$C
115. Which is the best description of an alpha particle?
    a) Charge $+2$; mass of 4 amu; high penetrating power
    b) Charge $+2$;mass of 4 amu;low penetrating power
    c) Charge $-1$; mass of 0 amu;medium penetrating power
    d) Charge 0; mass of 0 amu,no penetrating power
116. The negative value of packing fraction indicates that the isotope is
    a) Unstable
    b) Very stable
    c) Artificial
    d) Stable
117. The maximum number of electrons that can have principle quantum number, $n = 3$ and spin quantum number, $m_s = -\frac{1}{2}$, is
    a) 3
    b) 5
    c) 7
    d) 9
118. To trace the flow of blood, radioisotope used is
    a) Co-60
    b) Na-24
    c) P-32
    d) I-123
119. The radiant energy from the sun is due to
    a) Combustion
    b) Nuclear fusion
    c) Nuclear fission
    d) Chemical reaction
120. The nuclear process that takes place when a hydrogen bomb is exploded is of the same nature as the process
    a) In the center of the earth
    b) In the sun and stars
    c) During a red dust storm
    d) During atom bomb fission
121. The total spin and magnetic moment for the atom with atomic number 24 are:
    a) $\pm 3, \sqrt{48}$ BM
    b) $\pm 3, \sqrt{35}$ BM
    c) $\pm \frac{3}{2}, \sqrt{48}$ BM
    d) $\pm \frac{3}{2}, \sqrt{35}$ BM
122. For two different disintegration half-lives are equal at equilibrium. This is only when
    a) $N_1 = N_2$
    b) $\lambda_1 = \lambda_2$
    c) $(T_{75})_1 = (T_{75})_2$
    d) All of these
123. Bohr's model of atom is not in agreement with
    a) Line spectra hydrogen atom
    b) Pauli's principle
    c) Planck's theory
    d) Heisenberg's principle

124. The correct ground state electronic configuration of chromium atom is
a) $[Ar]3d^5\ 4s^1$ b) $[Ar]3d^4\ 4s^2$ c) $[Ar]3d^6\ 4s^o$ d) $[Ar]4d^5\ 4s^1$

125. Bombardment of aluminium by $\alpha$particle leads to its artificial disintegration in two ways, (i) and (ii) as shown. Products $X, Y$ and $Z$ respectively are




a) Proton, neutron, positron b) Neutron, positron, proton
c) Proton, positron, neutron d) Positron, proton, neutron

126. When two electrons are placed in two degenerate orbitals of the atom, the energy is lower if their spin is parallel. The statement is based upon
a) Pauli's exclusion b) Bohr's rule c) Hund's rules d) Aufbau principle

127. At two stages of disintegration, disintegration constants are respectively $1 \times 10^{-2}s^{-1}$ and $1 \times 10^{-5}s^{-1}$.At first stage 2000 atoms are disintegrating. At second stage number of atoms disintegrating would be
a) 2 b) $2 \times 10^6$ c) $2 \times 10^{-6}$ d) $2 \times 10^9$

128. The correct set of quantum numbers for the unpaired electron of chlorine atom is:
$nIm_l$
a) 2 1 0 b) 2 1 1 c) 3 1 1 d) 3 0 0

129. The correct set of quantum numbers for the unpaired electron of chloride atom is

| | $n$ | $l$ | $m$ |
|---|---|---|---|
| a) | 2 | 1 | 0 |
| b) | 2 | 1 | 0 |
| c) | 3 | 1 | 1 |
| d) | 3 | 0 | 0 |

130. The energy released during the fission of 1 kg of uranium is
a) $9 \times 10^{23}$ ergs b) $9.0 \times 10^{10}$ ergs c) $9.0 \times 10^{18}$ ergs d) $9.0 \times 10^8$ ergs

131. $^{14}_{7}N + {}^{1}_{0}n \rightarrow {}^{14}_{6}C + {}^{1}_{1}$His written as
a) $^{14}_{7}N\ (n, e)\ ^{1}_{1}H$ b) $^{14}_{7}N\ (p, n)\ ^{14}_{6}C$ c) $^{14}_{7}N\ (n, p)\ ^{14}_{6}C$ d) $^{14}_{6}C(p, n)\ ^{14}_{7}N$

132. Rutherford's scattering experiment is related to the size of the
a) Nucleus b) Atom c) Electron d) Neutron

133. Which of the radioactive isotopes is used for temperature control in blood disease?
a) $P^{32}$ b) $H^3$ c) $Rn^{233}$ d) $I^{131}$

134. A cyclotron is used to
a) Accelerate neutrons b) Accelerate electrons c) Accelerate protons d) Accelerate α-particles

135. Heisenberg's uncertainty principle rules out the exact simultaneous measurement of:
a) Probability and intensity b) Energy and velocity
c) Charge density and radius d) Position and velocity

136. The sum of the number of neutrons and proton in the isotope of hydrogen is
a) 6 b) 5 c) 4 d) 3

137. Which of the following is not an example of ionizing radiation?
a) X-rays b) $\gamma -$ rays c) $\alpha -$ rays d) UV-rays

138. An isotope of $_{32}Ge^{76}$ is
a) $_{32}Ge^{77}$ b) $_{33}As^{77}$ c) $_{34}Se^{77}$ d) $_{34}Se^{78}$

139. Of the following nuclides, the one most likely to decay by positron ($\beta^+$)emission is
a) $^{59}Cu$ b) $^{63}Cu$ c) $^{67}Cu$ d) $^{68}Cu$

140. In vivo studies, radioisotope used is
a) Cr-51 b) Co-60 c) Na-24 d) P-32

141. Which hydrogen like species will have same radius as that of Bohr orbit hydrogen atom?
a) $n = 2, Li^{2+}$ b) $n = 2, Be^{3+}$ c) $n = 2, He^{+}$ d) $n = 3, Li^{2+}$

142. The ratio of the energy of $a$ photon of 2000 Å wavelength radiation to that of 4000 Å radiation is

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

143. The energy of an electron in the first Bohr orbit of H atom is $-13.6$ eV. The possible energy value$(s)$ of the excited state $(s)$ for electrons in Bohr orbits of hydrogen is/are
a) $-3.4$ eV b) $-4.2$ eV c) $-6.8$ eV d) $+6.8$ eV

144. Neutrons are more effective projectiles than protons because they
a) Are attracted by the nuclei b) Are not repelled by the nuclei
c) Travel with high speed d) None of above

145. $^{27}_{13}$Al is a stable isotope. $^{27}_{13}$Al is expected to disintegrate by
a) $\alpha$ −emission b) $\beta$ −emission c) Positron emission d) Neutron emission

146. If two light nuclei are fused together in nuclear reaction, the average energy per nucleon
a) Increases b) Decreases
c) Cannot be determined d) Remains same

147. A sievert is
a) The amount of radiation that produces $2.1 \times 10^9$units of charge in one $cm^3$ of air
b) A unit used to measure the amount of radiation absorbed per gram of tissue
c) A unit that allows both for the energy and the penetrating power of different types of radiation
d) The SI unit for radiation absorbed

148. Radioactive disintegration differs from a chemical change in being a/an
a) Nuclear process b) Exothermic change c) Spontaneous process d) First order kinetics

149. If Hund's rule is not followed, magnetic moment of $Fe^{2+}$, $Mn^{\oplus}$, and Cr all having 24 electrons will be in order
a) $Fe^{2+} < Mn^{\oplus} < Cr$ b) $Fe^{2+} = Cr < Mn^{\oplus}$ c) $Fe^{2+} = Mn^{\oplus} < Cr$ d) $Mn^{2+} = Cr < Fe^{2+}$

150. The nuclear reaction ( $^{10}_{5}B + {}^{1}_{0}n \rightarrow {}^{7}_{3}Li + {}^{4}_{2}He$) is of the type
a) $n, p$ b) $n, \beta$ c) $n, \alpha$ d) $\alpha, n$

151. Which of the following is artificial radioactive series?
a) $4n + 1$ b) $4n + 2$ c) $4n$ d) $4n + 3$

152. Radioactive disintegration differs from a chemical change in being
a) An exothermic change b) A spontaneous process
c) A nuclear process d) A unimolecular first-order reaction

153. The instability of a nucleus is due to
a) High proton electron ratio b) High electron neutron ratio
c) Low proton electron ratio d) Low proton neutron ratio

154. The electronic configuration of an element is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3d^5\ 4s^1$. This represents its
a) Excited state b) Ground state c) Cationic form d) Anionic form

155. The distance between nucleons in atomic nucleus is of the order of (1 Fermi $= 10^{-13}$ cm)
a) 2 Fermi b) 25 Fermi c) 100 Fermi d) 40 Fermi

156. The decreasing order of energy for the electrons represented by the following sets of quantum numbers is:
1. $n = 4, l = 0, m = 0, s = \pm 1/2$
2. $n = 3, l = 1, m = 1, s = -1/2$
3. $n = 3, l = 2, m = 0, s = +1/2$
4. $n = 3, l = 0, m = 0, s = -1/2$
a) $1 > 2 > 3 > 4$ b) $2 > 1 > 3 > 4$ c) $3 > 1 > 2 > 4$ d) $4 > 3 > 2 > 1$

157. The equipment used to carry out nuclear reaction in a controlled manner is called
a) Breeder reactor b) Nuclear reactor
c) Thermonuclear fission d) Cyclotron

158. The atomic mass and atomic number of lead are 208 and 82. The atomic mass and atomic number of bismuth are 209 and 83. The neutron/proton ratio in an atom
a) Is higher in lead than in bismuth b) Is lower in lead than in bismuth
c) Is equal in both lead and bismuth d) None

159. How many $\alpha$ −particles are emitted in the nuclear transformation: $_{84}Po^{215} \rightarrow_{82} Pb^{211} + ?\ {}_{2}He^{4}$

a) 0 b) 1 c) 2 d) 3

160. The work function (Φ) of some metals is listed below. The number of metals which will show photoelectric effect when light of 300 nm wavelength falls on the metals is :

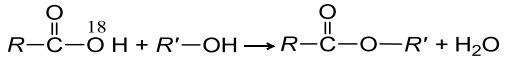
| Metal | Li | Na | K | Mg | Cu | Ag | Fe | Pt | W |
|---|---|---|---|---|---|---|---|---|---|
| Φ(e | 2.4 | 2.3 | 2.2 | 3.7 | 4.8 | 4.3 | 4.7 | 6.3 | 4.75 |

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

161. Which is the correct combination?

| | Change in Emission Number | Atomic number | Mass number | Neutron number |
|---|---|---|---|---|
| a) | α | −2 | −2 | −2 |
| b) | β− | +1 | 0 | −1 |
| c) | γ | 0 | 0 | −1 |
| d) | $\beta^+$ | −1 | 0 | 0 |

162. In the esterification of an organic acid $R-COOH$by alcohol $R'OH$, O of acid is isotopic



Which of the following statement is correct?
a) $^{18}$Ois in ester
b) $^{18}$Ois in water
c) $^{18}$Ois in both
d) $^{18}$Ois in none

163. Constituents of wine are carbon, hydrogen and oxygen. Half-lives of $^{13}$C, $^{15}$Oand $^{3}$Hare respectively 5730 yr, 124 s and 12.5 yr. A bottle of wine was sealed about 6 years ago. To confirm its age, which of the isotopes would you choose to determine its age?
a) $^{13}_{6}$C b) $^{15}_{8}$O c) $^{3}_{1}$H d) Any of these

164. Which of the following is true?
a) The electron density in the $xy$-plane in $3d_{xy}$ orbital is zero
b) The electron densities in the $xy$- and $xz$-plane in $3d_{yz}$ orbital are zero
c) The electron density in the $xy$-plane in $3d_{z^2}$ orbital is zero
d) Pauli exclusion principle is followed by bosons which have integral spin

165. Atomic weight of Th is 232 and its atomic number is 90. The number of α- and β-particles which will be lost so that an isotope of lead (atomic weight 208 and atomic number 82) is produced is
a) 4α + 6β b) 6α + 4β c) 8α + 2β d) 10α + 2β

166. $^{234}_{90}$th(IIIB) emits particles such that new element is in IIA. Particles emitted is/are
a) One $\alpha$,one $\beta$ b) One $\beta$,one $\alpha$ c) Only one $\beta$ d) Only one $\alpha$

167. The radius of the first Bohr orbit for $He^{\oplus}$ is
a) 0.529 Å b) 0.264 Å c) 0.132 Å d) 0.176 Å

168. The age of rocks on earth or the samples of rocks and dust brought back form the moon can be found by determining the proportion of radioactive …….. In the rock of dust.
a) Potassium and stable calcium b) Uranium and stable lead
c) Carbon and stable carbon d) Radium and stable lead

169. Which of the following has magic number of neutrons?
a) $_{13}Al^{27}$ b) $_{83}Bi^{209}$ c) $_{92}U^{238}$ d) $_{26}Fe^{56}$

170. The chemist who helped in the discovery of the maximum number of transuranic element is:

a) Sir Robert Robinson b) Sir J.J. Thomson c) Professor Sea Borg d) Sir N.C. Hishel-wood

171. Which of the following set of quantum numbers is an impossible arrangement?
a) $n = 3, m = -2, s = +1/2$ b) $n = 4, m = 3, s = +1/2$
c) $n = 5, m = 2, s = -1/2$ d) $n = 3, m = -3, s = -1/2$

172. Which of the following are fissile isotopes?
1. $^{238}_{92}$U 2. $^{233}_{92}$U 3. $^{239}_{94}$Pu 4. $^{232}_{90}$U
Select the correct answer from the following.
a) 1 and 2 b) 2 and 3 c) 1 and 4 d) All of these

173. Rutherford's $\alpha$-particle scattering experiment eventually led to the conclusion that
a) Mass and energy are related
b) Electrons occupy space around the nucleus
c) Neutrons are buried deep in the nucleus
d) The point of impact with matter can be precise determined

174. How many electrons in an atom with atomic number 105 can have $(n + l) = 8$?
a) 30 b) 17 c) 15 d) Unpredictable

175. The density of nucleus is about ……times the density of atom
a) $10^{-14}$ b) $10^{12}$ c) $10^{-8}$ d) $10^{10}$

176. The set of quantum numbers not applicable to an electron
a) 1,1,1, +1/2 b) 1,0,0,+1/2 c) 1,0,0,− 1/2 d) 2,0,0,+1/2

177. Weight of $^{142}$Cto have radioactivity 1 curie [$\lambda$(disintegration constant $= 4.4 \times 10^{-12} s^{-1}$] is
a) $2 \times 10^{-4}$ kg b) $0.9 \times 10^{-4}$ kg c) $1.7 \times 10^{-4}$ kg d) $3.7 \times 10^{-10}$ kg

178. The maximum binding energy per nucleon is indicated in the mass number range
a) 40-60 b) 50-60 c) 20-30 d) 55-60

179. Which of the following nuclear changes is incorrect?
a) $_{20}Ca^{40} + {}_0n^1 \rightarrow {}_{19}K^{40} + {}_1H^1$ b) $_{48}Mg^{24} + \alpha \rightarrow {}_{14}Si^{27} + {}_0n^1$
c) $_{48}Cd^{113} + {}_0n^1 \rightarrow {}_{48}Cd^{112} + {}_{-1}e^0$ d) $_{20}Co^{43} + \alpha \rightarrow {}_{21}Si^{46} + {}_1H^1$

180. The total number of $p$-electrons are
a) 6 b) 12 c) 18 d) 24

181. The triad of nuclei that are isotonic is
a) $^{14}_6$C $^{15}_7$N $^{17}_6$F b) $^{12}_6$C $^{14}_7$N $^{19}_9$F c) $^{14}_6$C $^{14}_7$N $^{17}_6$F d) $^{14}_6$C $^{14}_7$N $^{19}_9$F

182. Consider the following nuclear reactions
I. $^{14}_7$N + $^4_2$He → $^{17}_8$O + $^1_1$H
II. $^9_4$Be + $^1_1$H → $^6_3$Li + $^4_2$He
III. $^{24}_{12}$Mg + $^4_2$He → $^{27}_{14}$Si + $^1_0n$
IV. $^{10}_5$B + $^4_2$He → $^{13}_7$N + $^1_0n$
Examples of induced radioactivity would include reactions
a) III and IV b) I and II c) I, III and IV d) I, II, III and IV

183. The radius of an atomic nucleus is of the order of
a) $10^{-10}$ cm b) $10^{-13}$cm c) $10^{-15}$cm d) $10^{-8}$cm

184. Moderator used in a nuclear reactor is
a) Graphite b) Heavy water c) Both (a) and (b) d) None of these

185. Living things contain $C^{12}$ and $C^{13}$, $C^{12}$ is stable and $C^{13}$ decays and declines in proportional quantity. The technique that used this principle for determining the age of fossils skeletons, old trees, and dinosaurs is called
a) C-12 dating b) Radiocarbon dating c) Carbon age d) Fossil carbon

186. The line spectrum of two elements is not identical because
a) They do not have same number of neutrons
b) They have dissimilar mass number
c) They have different energy level schemes
d) They have different number of valence electrons

187. Which of the following nuclear reactions is an example of nuclear fusion?
a) ${}^{12}_{6}\mathrm{C} + {}^{1}_{1}\mathrm{H} \rightarrow {}^{13}_{7}\mathrm{N} + \gamma$ b) ${}^{14}_{7}\mathrm{N} + {}^{1}_{0}n \rightarrow {}^{12}_{6}\mathrm{C} + {}^{1}_{1}\mathrm{H}$
c) ${}^{2}_{1}\mathrm{H} + {}^{3}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{1}_{0}n$ d) ${}^{235}_{92}\mathrm{U} + {}^{1}_{0}n \rightarrow {}^{142}_{56}\mathrm{Ba} + {}^{91}_{36}\mathrm{Kr} + 3\,{}^{1}_{0}n$

188. The high temperature required to initiate nuclear fusion reaction is initially attained through
a) Solar energy b) Burning of hydrocarbon
c) Nuclear fission d) All of the above

189. When the quantity of radioactive substance is increased two times, the number of atoms disintegrating per unit time is
a) Doubled b) Increased by square of two
c) Increased but not to a great extent d) Not affected

190. Among the following transitions in hydrogen and hydrogen-like ion spectrum, which one emits light of longest wavelength?
a) $n = 2$ to $n = 1$ for H b) $n = 4$ to $n = 3$ for $\mathrm{Li}^{2+}$
c) $n = 4$ to $n = 3$ for $\mathrm{He}^{\oplus}$ d) $n = 5$ to $n = 2$ for H

191. Match Column I with Column II and select the correct answer

| Column I (Isotope) | | Column II (Characteristic) | |
|---|---|---|---|
| A | ${}^{40}_{20}\mathrm{Ca}$ | 1. | Unstable, $\alpha$ −emitter |
| B | ${}^{133}_{53}\mathrm{I}$ | 2. | Unstable, $\beta$ −emitter |
| C | ${}^{121}_{53}\mathrm{I}$ | 3. | Unstable, positron emitter |
| D | ${}^{232}_{90}\mathrm{Th}$ | 4. | stable |

Codes
A B C D
a) 1 2 3 4 b) 1 3 2 4
c) 4 3 2 1 d) 4 2 3 1

192. In what ratio should ${}_{17}\mathrm{Cl}^{37}$ and ${}_{17}\mathrm{Cl}^{35}$ be present so as to obtain ${}_{17}\mathrm{Cl}^{35.5}$?
a) 1:2 b) 1:1 c) 1:3 d) 3:1

193. If the wavelength of the first line of the Balmer series of hydrogen atom is 656.1 nm, the wavelength of the second line of this series would be
a) 218.7 nm b) 328.0 nm c) 486.0 nm d) 640.0 nm

194. The half-life of ${}^{99}\mathrm{Tc}$is 6.0 h. Hence, average-life is
a) 4.17 h b) 3.0 h c) 8.66 h d) 8.00 h

195. Which equation is true for transient equilibrium? ($\lambda$ = disintegration constant; $t$ = half-life)
a) $N_1\lambda_1 = N_2\lambda_2$ b) $N_1 t_2 = N_2 t_1$ c) Both (a) and (b) d) None of these

196. Which of the following statements concerning Bohr's model is false?
a) It predicts that probability of electron near nucleus is more
b) The angular momentum of electron in H atom $= nh/2\pi$
c) It introduces the idea of stationary states
d) It explains the line spectrum of hydrogen

197. ${}^{238}_{92}\mathrm{U}$(III B, actinide series) emits one $\alpha$ − particle. New element will be a/an
a) Alkali metal b) Alkaline earth metal c) Actinide d) Chalcogen

198. Which reaction is an example of chain reaction?
a) ${}^{235}_{92}\mathrm{U} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{231}_{90}\mathrm{Th}$ b) ${}^{75}_{34}\mathrm{Se} \rightarrow {}^{75}_{35}\mathrm{Br} + {}^{0}_{-1}e$
c) ${}^{123}_{53}\mathrm{I} \rightarrow {}^{123}_{53}\mathrm{I}$ + energy d) ${}^{235}_{92}\mathrm{U} + {}^{1}_{0}n \rightarrow {}^{142}_{56}\mathrm{Ba} + {}^{91}_{36}\mathrm{Kr} + 3\,{}^{1}_{0}n$

199. The nucleus of an atom is made up of $p$protons and $n$neutrons. For the most stable and abundant nuclei
a) $p$even, $n$ odd b) $p, n$both odd c) $p$odd, $n$even d) $p, n$both even

200. Eka-Hg will have IUPAC nomenclature as Uub. Its atomic number is
a) 80 b) 110 c) 111 d) 112

201. The shortest and longest wave number in H spectrum of Lyman series is ($R$ =Rydberg constant)
a) $\frac{3}{4}R, R$ b) $\frac{1}{R}, \frac{4}{3}R$ c) $R, \frac{4}{3}R$ d) $R, \frac{3}{4}R$

202. The radioisotope used in the treatment of cancer is
a) C-12 b) Co-60 c) I-31 d) P-31

203. Which of the following properties of an element is a whole number?
a) Atomic mass b) Atomic volume c) Atomic radius d) Mass number

204. Which of the following particles is emitted in the nuclear reaction $_{13}\mathrm{Al}^{27} + {}_{2}\mathrm{He}^{4} \rightarrow {}_{14}\mathrm{P}^{30} + \cdots$?
a) ${}_{0}n^{1}$ b) ${}_{-1}e^{0}$ c) ${}_{1}\mathrm{H}^{1}$ d) ${}_{1}\mathrm{H}^{2}$

205. The half-life of $^{24}_{11}$Nais 15.0 h. What percentage of it remains after 60 h?
a) 0.00% b) 3.13% c) 6.25% d) 12.5%

206. Which of the following does not characterize $X$-rays?
a) The radiations can ionize gases
b) They cause ZnS to fluoresce
c) They are deflected by electric and magnetic fields
d) They have wavelengths shorter than ultraviolet rays

207. Which of the following is false?
a) The $d$ orbitals are no more degenerate in the presence of a magnetic field
b) The spin quantum number was introduced to explain the splitting of spectral lines of hydrogen atom in the presence of a magnetic field
c) Pauli exclusion principle is followed by fermions which have half integral spins
d) The energy of an orbital in an atom remains the same with increase in the positive charge in its nucleus

208. When a radioactive isotope decays into a nucleus which is also unstable and undergoes decay, and this process is repeated several times, the succession of reaction is called
a) Decay series b) Fission reaction c) Fusion reaction d) Spallation

209. The total number of s electrons are
a) 8 b) 6 c) 4 d) 10

210. If Aufbau rule is not followed in filling of suborbitals, then block of the element will change in
a) K(19) b) Sc (21) c) V (23) d) Ni (28)

211. What is X in the nuclear reaction
${}_{7}\mathrm{N}^{14} + {}_{1}\mathrm{H}^{1} \rightarrow {}_{8}\mathrm{O}^{15} + \mathrm{X}$
a) ${}_{1}\mathrm{H}^{2}$ b) ${}_{0}n^{1}$ c) $\gamma$ d) ${}_{-1}e^{0}$

212. In excited H atom, when electron drops from $n$ =4,5,6 to $n = 1$, there is emission of
a) UV light b) Visible light c) IR light d) Radio waves

213. How many unpaired electrons are there in $\mathrm{Ni}^{2+}$?
a) 0 b) 2 c) 4 d) 8

214. Which of the following is a natural radioactive element?
a) Uranium b) Radium c) Thorium d) All of these

215. The wave number of the first line of Balmer series of hydrogen is 15200 $\mathrm{cm}^{-1}$. The wave number of the first Balmer line of $\mathrm{Li}^{2+}$ ion is
a) 15200 $\mathrm{cm}^{-1}$ b) 60800 $\mathrm{cm}^{-1}$ c) 76000 $\mathrm{cm}^{-1}$ d) 136800 $\mathrm{cm}^{-1}$

216. Rutherford's scattering experiment is related to the size of the
a) Nucleus b) Atom c) Electron d) Neutron

217. An oxide of N has vapour density 46. Find the total number of electrons in its 92 g. ($N_A$ =Avogadro's number)
a) $46N_A$ b) $38N_A$ c) $54N_A$ d) $30N_A$

218. Select the correct statement
a) The more negative the packing fraction of an element, the more stable should be the nucleus
b) Packing fraction $= \frac{\text{mass defect}}{\text{isotopic mass}} \times 10^4$
c) Fe and Al have positive values of packing fraction

d) All of the above

219. The number of protons and neutrons for most stable element is
a) Even-odd b) Even-even c) Odd-odd d) Odd-even

220. $^{269}_{110}$Dsis the recently discovered element IUPAC nomenclature is
a) Unu b) Uhe c) Uun d) Nuu

221. Which of the following is true?
a) The half-filled and fully-filled electronic configurations are less stable than the other configurations having the same number of electrons
b) The symbol $s$ for the orbitals having $l = 0$has its origin from the term spherical symmetrical
c) The increasing order for the values of $e/m$ (charge/mass) for electron (e), proton (p), neutron(n), and alpha particle ($\alpha$) is $n < \alpha < p < e$
d) The energy of photon having wavelength 800 nm is larger than that having 400 nm

222. The emission of a particle from an unstable nucleus is called
a) Mutation b) Fission c) Nuclear decay d) Fusion

223. If $_{92}U^{235}$ assumed to decay only by emitting two α- and one β-particles, the possible product of decay is
a) $_{89}Ac^{231}$ b) $_{89}Ac^{235}$ c) $_{89}Ac^{236}$ d) $_{89}Ac^{227}$

224. Which results in the formation of an isotope of the parent element?
a) Emission of one$\alpha$ −particle b) Emission of two $\beta$ −particles
c) Emission of one $\alpha$ −and two $\beta$ −particles d) None of the above

225. 'Little boy' relates to
a) Pu-bomb b) U-bomb c) H-bomb d) He-bomb

226. The wavelength associated with a golf ball weighing 200 g and moving at a speed of 5 m $h^{-1}$ is of the order
a) $10^{-10}$m b) $10^{-20}$m c) $10^{-30}$m d) $10^{-40}$m

227. Which of the following is false?
a) The number of orbitals for a given value of $l$ is equal to $2l + 1$
b) The number of orbitals for a given value of $n$ is equal to $n^2$
c) An atom having unpaired electrons is diamagnetic in nature
d) All $s$ orbitals are spherical symmetrical in shape

228. An orbital with $l = 0$ is
a) Symmetrical about $X$-axis only b) Symmetrical about $Y$-axis only
c) Spherically symmetrical d) Unsymmetrical

229. The half-life of nickel-65 is 2.5 days. How much of a 100 g sample has decyed after 7.5 days?
a) 12.5 g b) 50.0 g c) 75.0 g d) 87.5 g

230. The energy released in nuclear reactions corresponding to 1 amu is about
a) 940 MeV b) 932 MeV c) 918 MeV d) 900 MeV

231. Rutherford's experiment on the scattering of $\alpha$-particles showed for the first time that the atom has
a) Electrons b) Protons c) Nucleus d) Neutrons

232. In which of the following the magic numbers of both protons and neutrons are present
a) $_{50}Sn^{123}$ b) $_{82}Pb^{208}$ c) $_{82}Pb^{206}$ d) $_{50}Sn^{118}$

233. Which product is formed by α −emission from $^{235}_{92}$U?
a) $^{231}_{90}$ Th b) $^{233}_{90}$Th c) $^{235}_{93}$Np d) $^{235}_{92}$U

234. Which of the following is true?
a) According to Pauli's exclusion principle, no two electrons in an atom can have the same values of quantum numbers $n, l$ and $m$
b) The total energy of an electron in an orbit is half of its potential energy
c) The speed of an electron in a orbit increases with increase of its quantum number $n$
d) The energy of an electron in a orbit decreases with increase of its quantum number $n$

235. The neutron/proton ratio in an isotope can be decreased by the emission of
a) An electron b) A neutron c) A gamma ray d) A positron

236. In an oil drop experiment, the following charges (in arbitrary units) were found on a series of oil droplets:

$2.30 \times 10^{-15}, 6.90 \times 10^{-15}, 1.38 \times 10^{-14}$
$5.75 \times 10^{-15}, 3.45 \times 10^{-15}, 1.96 \times 10^{-14}$
The magnitude of charge on the electron (in the same unit) is
a) $1.15 \times 10^{-15}$ b) $2.30 \times 10^{-15}$ c) $0.575 \times 10^{-15}$ d) $1.96 \times 10^{-14}$

237. The half-life period of a substance is 1600 min. How much fraction of the substance will remain after 6400 min?
a) 1/16 b) 1/4 c) 1/8 d) 1/2

238. The principal quantum number of an atom is related to the
a) Size of the orbital b) Spin angular momentum
c) Orientation of the orbital in space d) Orbital angular momentum

239. The wavelength of a spectral line for an electronic transition is inversely related to
a) The number of electrons undergoing the transition
b) The nuclear charge of the atom
c) The difference in the energy of the energy levels involved in the transition
d) The velocity of the electrons undergoing the transition

240. The number of nodal planes in a $p_x$ orbital is
a) One b) Two c) Three d) Zero

241. Which of the following sets of quantum numbers is not possible?
a) $n = 4, l = 1, m = 0, s = +1/2$ b) $n = 4, l = 3, m = -3, s = -1/2$
c) $n = 4, l = -1, m = +2, s = -1/2$ d) $n = 4, l = 1, m = 0, s = -1/2$

242. ${}^{37}_{18}\text{Ar}$ captures a K-electron into its nucleus. The product atom formed is
a) ${}^{37}_{17}\text{Cl}$ b) ${}^{38}_{18}\text{Ar}$ c) ${}^{36}_{18}\text{Ar}$ d) ${}^{38}_{17}\text{Cl}$

243. Which of the following orbitals does not have the angular node?
a) $p_x$-orbital b) $d_{z^2}$-orbital c) $p_y$-orbital d) $1s$-orbital

244. Which of the following is true?
a) Neutrino is a positively charged electron
b) The magnetic moment of an atom is related to the number of unpaired electrons in its electronic configuration
c) Bohr theory can be successfully modified to explain the electronic spectrum of multielectron atom
d) The angular momentum of an electron in an atom is given as $n\left(\frac{h}{2\pi}\right)$

245. In the nuclear reaction, ${}^{27}_{13}\text{Al} + {}^{4}_{2}\text{He} \rightarrow {}^{30}_{15}X + {}^{1}_{0}n$, ${}^{30}_{15}X$is
a) Si b) P c) S d) Ar

246. The number of spherical nodes in$4s$ orbital is
a) 4 b) ∞ c) 2 d) 3

247. Electromagnetic radiation with the maximum wavelength is
a) Ultraviolet b) Radio wave c) $X$-ray d) Infrared

248. Binding energy due to mass defect of ${}^{4}_{2}\text{He}$is 28 MeV.Thus, binding energy per nucleon is
a) 14 MeV b) 28 MeV c) 7 MeV d) 4.67 MeV

249. Which of the following is used as neutron absorber in the nuclear reactor?
a) Water b) Deuterium
c) Some compound of uranium d) Cadmium

250. The number of spectral lines obtained in Bohr spectrum of hydrogen atom when an electron is excited from 2nd orbit to 5th orbit, is
a) 3
b) 6
c) 10
d) 5

251. Which one of the following sets of quantum number represents an impossible arrangement?

| | $n$ | $l$ | $m$ | $s$ |
|---|---|---|---|---|
| a) | 3 | 2 | −2 | 1/2 |

| | $n$ | $l$ | $m$ | $s$ |
|---|---|---|---|---|
| b) | 4 | 0 | 0 | 1/2 |

c) | 3 | 2 | −3 | 1/2 |  d) | 5 | 3 | 0 | −1/2 |

252. The radius of the second Bohr orbit for $Li^{2+}$ is

a) $0.529 \times \frac{4}{3}$Å  b) $0.529 \times \frac{2}{3}$Å  c) $0.529 \times \frac{4}{9}$Å  d) $0.529 \times \frac{2}{9}$Å

253. Which of the following species will produce the shortest wavelength for the transition $n = 2$ to $n = 1$?

a) Hydrogen atom  b) Singly ionized helium
c) Deuterium atom  d) Doubly ionized lithium

254. Nuclear fission was experimentally observed by

a) Planck  b) Rutherford  c) J. J. Thomson  d) Hahn and Strassman

255. The fundamental particles which are responsible for keeping nucleons together is:

a) Meson  b) Antiproton  c) Positron  d) Electron

256. In hydrogen spectrum, the series of lines appearing in ultra violet region of electromagnetic spectrum are called

a) Balmer lines  b) Lyman lines  c) Pfund lines  d) Brackett lines

257. The ratio of kinetic energy and total energy of an electron in a Bohr orbit of a hydrogen-like species is

a) $1/2$  b) $-1/2$  c) $1$  d) $-1$

258. Atomic radii of fluorine and neon in Angstrom units are respectively given by

a) 0.72, 1.60  b) 1.60, 1.60  c) 0.72, 0.72  d) None of these

259. The wavelength associated with a golf ball weighing 200 g and moving at a speed of 5 m $h^{-1}$ is of the order

a) $10^{-10}$m  b) $10^{-20}$m  c) $10^{-30}$m  d) $10^{-40}$m

260. Which of the following pairs represents isobars?

a) $_{19}K^{40}$ and $_{11}Na^{23}$  b) $_{2}He^{3}$ and $_{2}He^{4}$  c) $_{12}Mg^{24}$ and $_{12}Mg^{25}$  d) $_{19}K^{40}$ and $_{20}Ca^{40}$

261. Least branching is found in which of the following radioactive series?

a) $4n + 2$  b) $4n$  c) $4n + 3$  d) $4n + 1$

262. All of the statements about nuclear reactions are true except

a) Nuclear reactions involve changes in the nucleus of an atom
b) The rate of a nuclear reaction is increased by the addition of a catalyst
c) A nuclear reaction is unaffected by the chemical state of the atoms involved
d) Nuclear reactions of the same element vary according to which isotope is involved

263. Which of the following is not a characteristic of Planck's quantum theory of radiation?

a) Radiations are associated with energy
b) Magnitude of energy associated with a quantum is equal to hv
c) Radiation energy is neither emitted nor absorbed continuously
d) A body can emit less or more than a 'quantum of energy'

264. All nuclides exhibit radioactivity when the atomic number exceeds

a) 80  b) 83  c) 90  d) 92

265. Which of the following pairs is not a fissionable material?

a) $U^{238}$  b) $U^{233}$  c) $Pu^{239}$  d) $U^{235}$

266. Match the radioisotopes with their applications from the alternates given

| Radioisotopes | Applications |
|---|---|
| I. Cobalt-60 | P. Leukemia therapy |
| II. Potassiu-40 | Q. Thyroid therapy |
| III. Iodine-123 | R. Geological dating |
| IV. Phosphours-32 | S. Cancer therapy |
| V. Carbon-14 | T. Archeological dating |

I II III IV V

a) P Q R S T  b) T S R Q P
c) S R Q P T  d) S R Q T P

267. The half-life period of a radioactive element is 140 days. After 560 days, one gram of the element will reduce to

a) $\frac{1}{2}$g b) $\frac{1}{4}$g c) $\frac{1}{8}$g d) $\frac{1}{16}$g

268. The orbital angular momentum of an electron in $2s$ orbital is

a) $+\frac{1}{2}\frac{h}{2\pi}$ b) Zero c) $\frac{h}{2\pi}$ d) $\sqrt{2}\frac{h}{2\pi}$

269. Which of the following sets of quantum number is allowable:

a) $n = 2, l = 1, m = 0, s = +1/2$ b) $n = 2, l = 2, m = -1, s = -1/2$

c) $n = 2, l = -2, m = 1, s = +1/2$ d) $n = 2, l = 1, m = 0, s = 0$

270. Any $p$ orbital can accommodate upto

a) Fore electrons b) Six electrons

c) Two electrons with parallel spins d) Two electrons with opposite spins

271. The missing fission product in the reaction

$^{235}_{92}\text{U} + {}^{1}_{0}n \rightarrow {}^{146}_{57}\text{La} + \cdots + 3\,{}^{1}_{0}n$is

a) $^{86}_{35}$Br b) $^{87}_{35}$Br c) $^{89}_{35}$Br d) $^{89}_{32}$Ge

272. When a radioactive substance is subjected to a vacuum, the rate of disintegration per second

a) Increases considerably

b) Increases only if the products are gaseous

c) Is not affected

d) Suffers a slight decrease

273. Select the correct alternate.

a) ${}^{1}_{1}p \rightarrow {}^{1}_{0}n$ is positron emission b) ${}^{1}_{1}p \rightarrow {}^{1}_{0}n$ is K-electron capture

c) Both (a) and (b) d) None of the above

274. Which of the properties of radioisotopes make them useful as tracers in medical or agricultural applications?

I. Their chemical behaviour is the same as non-radioactive isotope

II. They emit various types of radiation

III. The nuclear reaction is unaffected by the chemical state of the isotope

a) I only b) I and III c) I and II d) All of these

275. A certain metal when irradiated to light ($v = 3.2 \times 10^{16}$Hz) emits photoelectrons with twice kinetic energy as did photoelectrons when the same metal is irradiated by light ($v = 2.0 \times 10^{16}$Hz) The $v_0$ (threshold frequency) of metal is

a) $1.2 \times 10^{14}$Hz b) $8 \times 10^{15}$Hz c) $1.2 \times 10^{16}$Hz d) $4 \times 10^{12}$Hz

276. A method which uses radioactivity for determining the age of prehistoric materials is called

a) Carbon dating b) Deuterium dating c) Radium dating d) Uranium dating

277. What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition $n = 4$ and $n = 2$ of $\text{He}^{\oplus}$ spectrum?

a) $n_1 = 1$ to $n_2 = 2$ b) $n_1 = 2$ to $n_2 = 4$ c) $n_1 = 1$ to $n_2 = 3$ d) $n_1 = 2$ to $n_2 = 3$

278. Which is based on nuclear fusion reaction?

a) Hydrogen bomb b) Atom bomb c) RDX d) REX

279. If half-life period is 100 years, average life is nearly

a) 100 yr b) 70 yr c) 44 yr d) 90 yr

280. If velocity of an electron is 1st orbit of H atom is V, what will be the velocity in 3rd orbit of $\text{Li}^{2+}$?

a) $V$ b) $\frac{V}{3}$ c) $3V$ d) $9V$

281. From the reaction given below, deduce the group of polonium in the periodic table (Pb belongs to group 14)

$_{84}\text{Po}^{210} \rightarrow {}_{82}\text{Pb}^{206} + {}_{2}\text{He}^{4}$

a) 2 b) 14 c) 6 d) 16

282. Which of the following relates to photon both as wave motion and as a stream of particles?

a) Interference b) $E = mc^2$ c) Diffraction d) $E = hv$

283. The first use of quantum theory to explain the structure of atom was made by

a) Heisenberg b) Bohr c) Planck d) Einstein

284. Which of the following is true?
a) The outer electronic configuration of the ground state chromium atom is $3d^4\ 4s^2$
b) Gamma rays are electromagnetic radiations of wavelengths of $10^{-6}$cm to $10^{-5}$cm
c) The energy of the electron in the $3d$ orbital is less than that in the $4s$ orbital of a hydrogen atom
d) The electron density in the $xy$-plane in $3d_{x^2-y^2}$ orbital is zero

285. The increasing order (lowest first) for the values of $e/m$ (charge/mass) for electron ($e$), proton ($p$), neutron ($n$), and alpha particle ($\alpha$) is
a) $e, p, n, \alpha$ b) $n, p, e, \alpha$ c) $n, p, \alpha, e$ d) $n, \alpha, p, e$

286. Which of the following related to photons both as wave motion and as a stream of particles?
a) Interference b) $E = mc^2$ c) Diffraction d) $E = hv$

287. The total number of $d$-electrons are
a) 1 b) 2 c) 3 d) 4

288. Which of the following gave the idea of nucleus of the atom?
a) Oil drop experiment b) Davisson and Germer's experiment
c) $\alpha$-ray scattering experiment d) Austen's mass spectrogram experiment

289. The energy of hydrogen atom in its ground state is $-13.6$ eV. The energy of the level corresponding to the quantum number $n = 5$ is
a) $-0.54$ eV b) $-5.40$ eV c) $-0.85$ eV d) $-2.72$ eV

290. The experimental evidence for dual nature of matter comes from
a) Planck's experiment b) De Broglie's experiment
c) Davison and Germer's experiment d) Rutherford's experiment

291. Which of the following sets of quantum is not correctly represented in case of the indicated spectral series of hydrogen atom?
a) Lyman series $n_1 = 1;\ n_2 = 2,3,4, \ldots$ b) Balmer series $n_1 = 2;\ \ n_2 = 3,4,5, \ldots$
c) Paschen series $n_1 = 2;\ \ n_2 = 3,4,5, \ldots$ d) Lyman series $n_1 = 4;\ \ n_2 = 5,6,7, \ldots$

292. Which of the following is true?
a) The ionization energy of a hydrogen-like species in its ground state is equal to the magnitude of energy of the orbit having $n = 1$
b) The ionization energy of a hydrogen-like species in its ground state increases in proportion to the positive charge in its nucleus
c) According to the uncertainty principle, $\Delta p\ \Delta x \leq \frac{h}{4\pi}$
d) The energy of an electron in an orbital of a multielectron atom depends only on the principal quantum number $n$

293. In a radioactive series, a radioactive isotope decays to stable isotope. $^{232}_{90}$Thdecays by emission of six $\alpha$ −and four $\beta$ −particles. Stable isotope is
a) Pu-256 b) Th-232 c) Rn-220 d) Pb-208

294. Bohr's model can explain
a) The spectrum of hydrogen atom only
b) The spectrum of an atom or ion containing one electron only
c) The spectrum of a hydrogen molecule
d) The solar spectrum

295. Fuel used in a breeder-reactor is
a) Uranium-235 b) Plutonium-239 c) Uranium-238 d) All of these

296. Group displacement law was given by
a) Becquerel b) Rutherford c) Mendeleef d) Soddy and Fazan

297. A certain nuclide has a half life period of 30 min. If a sample containing 600 atoms is allowed to decay for 90 min, how many atoms will remain?
a) 200 atoms b) 450 atoms c) 75 atoms d) 150 atoms

298. For a $d$ electron, the orbital angular momentum is

a) $\sqrt{6}\left(\frac{h}{2\pi}\right)$ b) $\sqrt{2}\left(\frac{h}{2\pi}\right)$ c) $\left(\frac{h}{2\pi}\right)$ d) $2\left(\frac{h}{2\pi}\right)$

299. Which of the following has the maximum number of unpaired electrons?
a) $Mg^{2+}$ b) $Ti^{3+}$ c) $V^{3+}$ d) $Fe^{2+}$

300. At radioactive equilibrium, the ratio between the atoms of two radioactive elements $A$ and $B$ was found to be $3.1 \times 10^9 : 1$ respectively. If $T_{50}$ of the element $A$ is $2 \times 10^{10}$ yr,then $T_{50}$of the element $B$ is
a) $6.2 \times 10^9$ yr b) 6.45 yr c) $2 \times 10^{10}$ yr d) $3.1 \times 10^9$ yr

301. Which shape is associated with the orbital designated by $n = 2, l = 1$?
a) Spherical b) Tetrahedral c) Dumb-bell d) Pyramidal

302. A unit used to measure the amount of radiation absorbed per gram of tissue is
a) Curie b) Roentgen c) Rem d) Rad

303. Which out of the following configurations is incorrect?
a) $1s^2\ 2s^2\ 2p_x^2\ 2p_y^2\ 2p_z^0$ b) $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1$ c) $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1$ d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$

304. Consider the following statements
I. 'Carbon-dating' is based on the measurement of activity of $^{14}C$
II. $^{40}$Kis used to determine age of the objects up to 1 million years old
III. The uranium-lead method is based on the natural uranium-238 decay series which ends up with the production of stable lead-206
Select the correct statements
a) I, II b) II, III c) I, III d) I, II, III

305. A substance is kept for 2 hours and three-fourth of that substance disintegrates during this period. The half life of the substance is
a) 2 hr b) 1 hr c) 30 min d) 4 hr

306. The exchange of particles considered responsible for holding the nucleus together are called
a) Mesons b) Antiprotons c) Positron d) Neutrons

307. The ratio of the radii of the three Bohr orbits is
a) $1: 1/2 : 1/3$ b) 1:2:3 c) 1:4:9 d) 1:8:27

308. The spectral line obtained when an electron jumps from $n = 6$ to $n = 2$ level in hydrogen atom belongs to the
a) Balmer series b) Lyman series c) Paschen series d) Pfund series

309. An element is isobaric with the inert gas atom $_{18}A^{40}$. The electronic arrangement of the element is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$. How many neutrons does each atom of the element carry in its nucleus?
a) 22 b) 20 c) 18 d) 16

310. The ratio of the radii of the atom to the nucleus is
a) $10^4 : 1$ b) $10^{-4} : 1$ c) $10^2 : 1$ d) $10^3 : 1$

311. The wavelength of $H_\alpha$ line of Balmer series is $X$ Å. What is the $X$of $H_\beta$ line of Balmer series
a) $X\ \frac{108}{80}$ Å b) $X\ \frac{80}{108}$ Å c) $\frac{1}{X}\frac{80}{108}$ Å d) $\frac{1}{X}\frac{108}{80}$ Å

312. In which process maximum energy is attained?
a) $2\,^2_1H \rightarrow\ ^3_1H +\ ^1_1H$ b) $^2_1H +\ ^3_1H \rightarrow\ ^4_2He +\ ^1_0n$
c) $^6_3Li +\ ^2_1H \rightarrow 2\,^4_2He$ d) Equal

313. The amount of radiation that produces $2.1 \times 10^9$ units of charge in 1 $cm^3$ of air is
a) Curie b) Roentgen c) Rem d) Rad

314. Which type of radiation is attracted towards a positive plate?
a) α b) β c) γ d) α and β

315. Atoms with the same atomic number and different mass numbers are called
a) Isobars b) Isomers c) Isotones d) Isotopes

316. If the energy of electron in H atom is given by expression,$-1312/n^2$ kJ $mol^{-1}$, then the energy required to excite the electron from ground state to second orbit is
a) 328 kJ b) 656 kJ c) 984 kJ d) 1312 kJ

317. An isotone of $_{32}Ge^{76}$ is

i. $_{32}Ge^{77}$ ii. $_{33}As^{77}$

iii. $_{34}Se^{77}$ iv. $_{34}Se^{78}$

a) Only (i) and (ii) b) Only (ii) and (iii) c) Only (ii) and (iv) d) (ii), (iii), and (iv)

318. There are 0.618 μg of $^{206}Pb$ and 0.238 μg of $^{238}U$ in a rock. If $T_{50}$ of $^{238}U$ is $1.5 \times 10^9$yr, age of the rock is

a) $1.5 \times 10^9$yr b) $3.0 \times 10^9$yr c) $4.5 \times 10^9$yr d) $0.75 \times 10^9$yr

319. Radioactivity can be used in

a) Diagnostic b) Therapeutic c) Both (a) and (b) d) None of these

320. The radius of an atomic nucleus is of the order of

a) $10^{-10}$cm b) $10^{-13}$ cm c) $10^{-15}$cm d) $10^{-8}$cm

321. Match Column I with Column II and select the correct answer, using the codes given

| Column I | | Column II | |
|---|---|---|---|
| A | $^{32}P$ | 1. | Location of tumour in brain |
| B | $^{24}Na$ | 2. | Location of blood clots and circulatory disorders |
| C | $^{60}Co$ | 3. | Radio-therapy |
| D | $^{131}I$ | 4. | Agriculture research |

Codes

A B C D

a) 4 1 2 3 b) 4 3 2 1

c) 4 2 3 1 d) 3 1 2 4

322. If wavelength is equal to the distance travelled by the electron in one second, then

a) $\lambda = h/p$ b) $\lambda = h/m$ c) $\lambda = \sqrt{h/p}$ d) $\lambda = \sqrt{h/m}$

323. The valency of element is

a) $+2$

b) $+3$

c) Both $+2$ and $+3$

d) $+1$

324. A cricket ball of 0.5 kg is moving with a velocity of 100 m $s^{-1}$. The wavelength associated with its motion is

a) 1/100 cm b) $66 \times 10^{-34}$m c) $1.32 \times 10^{-35}$m d) $6.6 \times 10^{-28}$m

325. Which of the following is false?

a) Pfund spectral series for which $n_1 = 5$ and $n_2 = 6,7, \ldots$ Lies in the far infrared region of the electromagnetic radiation

b) Visible region of electromagnetic radiations has wavelength from 400 nm to 800 nm

c) Balmer spectral series lies in the visible portion of the electromagnetic radiation

d) Lyman spectral series lies in the visible portion of the electromagnetic radiation

326. Select the correct statement

a) $\alpha$ −and $\beta$ −particles can be detected by a Geiger counter

b) Neutron can be detected by conversion into $\alpha$ −particle by addition of $^{10}_{5}B$

c) Both (a) & (b)

d) None of the above

327. The number of spectral lines obtained in Bohr spectrum of hydrogen atom when an electron is excited from ground level to 5th orbit is

a) 10 b) 5 c) 8 d) 15

328. Which electronic level would allow the hydrogen atom to absorb a photon but not to emit a photon?

a) $3s$ b) $2p$ c) $2s$ d) $1s$

329. At equilibrium, number of atoms disintegrating at two different stages are in the ration of 1 : 10.If half-life of first stage is 15 minutes, half-life second stage would be

a) 150 min b) 15 min c) 1.5 min d) 30 min

330. The magnetic quantum number of an atom is related to the
a) Size of the orbital b) Spin angular momentum
c) Orbital angular momentum d) Orientation of the orbital in space

331. $_{13}Al^{27}$ is a stable isotope. $_{13}Al^{29}$ is expected to disintegrate by
a) $\alpha$ −emission b) $\beta$ −emission c) Positron emission d) Proton emission

332. Which experimental observation given in the first column correctly accounts for the phenomenon given in the second column?

| Experimental observation | Phenomenon |
|---|---|
| a) $X$-ray spectra | p. Charge on nucleus |
| b) $\alpha$-particle scattering | q. Quantized electron orbit |
| c) Photo electric effect | r. The nuclear atom |
| d) Emission spectra | s. Quantisation of energy |

333. Any $p$ orbital can accomodate up to
a) Four electrons b) Two electrons with parallel spin
c) Six electrons d) Two electrons with opposite spin

334. The unit of radiation exposure which allows for the energy and penetrating power of different types of radiation is
a) Curie b) Roentgen c) Rem d) Sievert

335. At 200°C, hydrogen molecules have velocity $2.4 \times 10^5$cm $s^{-1}$. The de Broglie wavelength in this case is approximately
a) 1 Å b) 1000 Å c) 100 Å d) 10 Å

336. In nuclear reaction,
$^7_3Li + {}^1_1H \rightarrow 2\,{}^4_2He$
The mass loss is nearly 0.02 amu. Hence, the energy released (in units of million kcal/mol) in the process is approximately
a) 430 b) 220 c) 120 d) 50

337. A neutral atom of an element has 2K, 8L, 9M and 2N electrons. The atomic number of element is:
a) 20 b) 21 c) 22 d) 23

338. The end product of 4n series is
a) $_{82}Pb^{208}$ b) $_{82}Pb^{207}$ c) $_{82}Pb^{209}$ d) $_{82}Pb^{204}$

339. The total spin and magnetic moment for the atom with atomic number 7 are:
a) $\pm 3, \sqrt{3}$ BM b) $\pm 1, \sqrt{8}$ BM c) $\pm\frac{3}{2}\sqrt{15}$ BM d) $0, \sqrt{8}$ BM

340. If $r$ is radius of first orbit, the radius of nth orbit of the H atom will be
a) $rn^2$ b) $rn$ c) $r/n$ d) $r^2n^3$

341. Artificial radioactivity was first discovered by
a) Sea Borg b) Rutherford c) Einstein d) Irene Curie

342. Which of the following orbital does not make sense?
a) $3d$ b) $2f$ c) $5p$ d) $7s$

343. 1 amu is equal to
a) $1.66 \times 10^{-27}$ kg b) $6.02 \times 10^{23}$ kg c) 1 kg d) $1 \times 10^{-3}$ kg

344. If 8.0 g of radioactive isotope has a half life of 10 hours, the half life of 2.0 g of the same substance is
a) 2.5 hours b) 5.0 hours c) 10 hours d) 40 hours

345. The ionization potential hydrogen atom is 13.6 eV. The energy required to remove an electron in the $n = 2$ state of the hydrogen atom is
a) 3.4 eV b) 6.8 eV c) 13.6 eV d) 27.2 eV

346. The electronic configuration of an element is $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^1$. This represents its
a) Excited state b) Ground state c) Cationic form d) Anionic form

347. Magic number elements are those isotopes of elements
a) In which the number of protons or neutrons is 2,8,20,28,50,82, or 125

b) Which are relatively more abundant
c) Which are unusually stable
d) All of these

348. Assuming that only particles emitted from atoms during natural radioactive decay are αand β −particles, which of the following atoms could not possibly result from the natural decay of $^{235}_{92}\text{U}$
a) $^{231}_{89}\text{Ac}$ b) $^{227}_{89}\text{Ac}$ c) $^{225}_{89}\text{Ac}$ d) $^{207}_{82}\text{Pb}$

349. The important principles that do not help in assigning electronic configuration to atoms are
a) Aufbau rule b) Hund's rule
c) Heisenberg uncertainty principle d) Pauli's exclusion principle

350. The binding energy of an element is 64 Mev. If BE/nucleon is 6.4, then the number of nucleons are
a) 10 b) 64 c) 16 d) 6

351. The ratio of kinetic energy and potential energy of an electron in a Bohr orbit of a hydrogen-like species is
a) $1/2$ b) $-1/2$ c) $1$ d) $-1$

352. In the chain reaction.
$^{238}_{92}\text{U} \rightarrow \text{Ba} + \text{Kr} + 3\,^{1}_{0}n + \text{energy } E$
Neutrons and energy produced at $n$th step will be :
a) $3n, nE$ b) $3^n, nE$ c) $3^n, 3^{n-1}\,E$ d) $3^{n-1}, nE$

353. Due to β −emission $n/p$ ratio changes to
a) $\frac{n+1}{p-1}$ b) $\frac{n}{p+1}$ c) $\frac{n-1}{p+1}$ d) $\frac{n+1}{p+1}$

354. Which of the following is an artificial man-made series?
a) Thorium series b) Neptunium series c) Uranium series d) Actinium series

## Multiple Correct Answers Type

355. Which sets of quantum number are consistent with the theory?
a) $n = 2, l = 1, m = 0, s = -1/2$ b) $n = 4, l = 3, m = -2, s = -1/2$
c) $n = 3, l = 2, m = -3, s = +1/2$ d) $n = 4, l = 3, m = -3, s = +1/2$

356. The lightest particle is/are
a) Electron b) Proton c) Neutron d) β-particle

357. When α-particles are sent through a thin metal foil, most of them go straight through the foil because
a) α-particles are much heavier than electrons b) α-particles are positively charged
c) Most part of the atom is empty space d) $\alpha$-particles move with high velocity

358. Many elements have non-integral atomic masses because
a) They have isotopes
b) Their isotopes have non-integral masses
c) Their isotopes have different masses
d) The constituents neutrons, protons, and electrons combine to given fractional masses

359. The isotone(s) of $^{77}_{32}\text{Ge}$ is/are
a) $^{77}_{32}\text{Ge}$ b) $^{77}_{33}\text{As}$ c) $^{77}_{34}\text{As}$ d) $^{78}_{34}\text{Se}$

360. Mass defect of 1 g gives energy equal to
a) $9 \times 10^{23}\text{J}$ b) $5.625 \times 10^{32}\text{eV}$ c) $2.15 \times 10^{10}\text{kcal}$ d) $9 \times 10^{6}\text{ergs}$

361. Which of the following sets of quantum number is/are not permitted?
a) $n = 3, l = 3, m = +1, s = +\frac{1}{2}$
b) $n = 3, l = 2, m = +2, s = -\frac{1}{2}$
c) $n = 3, l = 1, m = +2, s = -\frac{1}{2}$
d) $n = 3, l = 0, m = 0, s = +\frac{1}{2}$

362. When a photon simulates the emission of another photon, the two photons have:
a) Same energy b) Same direction c) Same phase d) Same wavelength

363. Heisenberg uncertainty principle is not valid for
a) Moving electrons b) Motor car c) Stationary particles d) All of the above

364. The energy of an electron in the first Bohr orbit of H atom is $-13.6$ eV. The possible energy value (s) of the excited state(s) for electron in Bohr orbits of hydrogen is(are)
a) $-3.4$ eV b) 4.2 eV c) $-6.8$ eV d) $+6.8$ eV

365. Which of the following is true?
a) A configuration with the maximum spin multiplicity has the minimum energy and thus is most stable
b) The energy of $3d$ orbital may be greater than or lesser than, or equal to that of $4s$ orbital depending upon the atomic number of the atom
c) All p orbitals have the same type of angular dependence irrespective of the value of principal quantum number $n$
d) In a given electrical field, β-particles are deflected more than α-particles in spite of $\alpha$-particles having larger change

366. The ground state electronic configuration of nitrogen atom can be represented by
a)  b)  c)  d) 

367. Carbon-14 dating method is based on the fact that
a) Carbon-14 fraction is same in all objects
b) Carbon-14 is highly insoluble
c) Ratio of carbon-14 and carbon-12 remains constant during disintegration
d) Carbon-14 is highly soluble

368. Which of the following statement/s is/are correct for an electron of quantum number $n = 4$ and $m = 2$?
a) The value of $l$ may be 2
b) The value of $l$ may be 3
c) The value of $s$ may be $+1/2$
d) The value of $l$ may be $0, 1, 2, 3$

369. Which cannot be correct value of angular momentum of an electron in an orbit?
a) $1.2\frac{h}{\pi}$ b) $1.5\frac{h}{\pi}$ c) $0.5\frac{h}{\pi}$ d) $0.3\frac{h}{\pi}$

370. If the wavelength of light in an experiment on photoelectric effect is doubled:
a) The photoelectric emission will not take place
b) The photoelectric emission may or may not take place
c) The stopping potential will increase
d) The stopping potential will decrease

371. The Bohr's atomic model accurately predicts the spectrum of:
a) The hydrogen atom
b) The hydrogen molecule
c) Hydrogen-like species
d) All atoms

372. When nucleus of an electrically neutral atom undergoes a radioactive decay process, it will remain neutral after the decay if the process is:
a) An α-decay b) A γ-decay c) A $K$-capture process d) A β-decay

373. Which of the following is/are possible?
a) $3f$ b) $4d$ c) $2d$ d) $3p$

374. How many spherical nodes are present in 4s orbital in a hydrogen atom?
a) 0 b) 2 c) 3 d) 4

375. The half life period of a radioactive element does not depend upon:
a) Temperature
b) Pressure

c) Initial amount of radioactive element taken
d) Nature of radioactive element

376. The radial part of wave function depends on the quantum numbers
a) $n$ b) $l$ c) $l, m_1$ d) $n$ only

377. Which of the following species has (have) five unpaired electrons?
a) Cs b) Mn c) $Mn^{2+}$ d) $Fe^{2+}$

378. For emission of a-particle from uranium nucleus:
$_{92}U^{235} - _2He^4 \rightarrow _{90}Th^{231}$
Shortage of two electrons in thorium is due to
a) Conversion of electron to positron
b) Adsorption in the nucleus
c) Annihilation
d) Combination with positron to evolve energy

379. An electron jumps from $n$th level to 1st level, the fact(s) which is/are correct of H-atom, is/are:
a) Number of spectral lines $= \frac{n(n-1)}{2}$
b) Number of spectral lines $= \sum(\Delta n)$
c) If $n = 4$, the number of spectral lines $= 6$
d) Number of spectral lines $= n(n-1)$

380. The energy of an electron in the first energy level of H atom is $-13.6$ eV. The possible energy value (s) of the excited state (s) for the electron in $He^{\oplus}$ is (are)
a) $-54.4$ eV b) $-13.6$ eV c) $-3.4$ eV d) $-6.4$ eV

381. Two radioactive substances $X$ and $Y$ have disintegration constant in the ratio 2 : 1. If half-life of $Y$ is 4 days then after 12 days starting with equal mole fraction of each in mixture of $X$ and $Y$
a) Mole fraction of $X$ and $Y$ remains unchanged
b) Mole fraction of $X$ is larger than that of $Y$
c) Mole fraction of $X$ is smaller than that of $Y$
d) Half-life of $X$ is smaller than that of $Y$

382. Which orbital of the following is lower in energy in a many electron atom?
a) $2p$ b) $3d$ c) $4s$ d) $5f$

383. The maximum kinetic energy of photoelectrons is directly proportional to .... of the incident radiation
a) Wave number b) Wavelength c) Frequency d) Intensity

384. The angular momentum of P electron is
a) $\frac{h}{2\pi}\sqrt{6}$ b) $\hbar\sqrt{2}$ c) $\frac{h}{2\pi}\sqrt{2}$ d) $\hbar\sqrt{6}$

385. Decrease in atomic number is observed during
a) Alpha emission b) Beta emission c) Positron emission d) Electron capture

386. Which of the following configuration is/are correct for the first excitation state of given species?
a) Cr : $[Ar]3d^5, 4s^1$ b) $Fe^{2+}$ : $[Ar]3d^5$ c) $Mn^{3+}$ : $[Ar]3d^3, 4s^1$ d) $Co^{3+}$: $[Ar]3d^5, 4s^1$

387. Which of the following statements about radioactivity is/are true?
a) It involves outer electrons activity.
b) It is not affected by temperature or pressure.
c) It is an exothermic process.
d) The radioactivity of an element is not affected by any other element compounded by it.

388. In a sample of H-atoms, electrons make transitions from $n = 5$ to $n = 1$. If all the spectral lines are observed, then the line having the third highest energy will correspond to
a) $5 \rightarrow 3$ b) $4 \rightarrow 1$ c) $3 \rightarrow 1$ d) $5 \rightarrow 4$

389. Which among the following nuclides is/are likely to be stable?
a) $_{49}In^{114}$ b) $_{12}Mg^{24}$ c) $_{48}Cd^{114}$ d) $_{15}P^{30}$

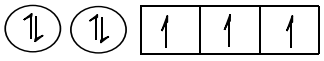
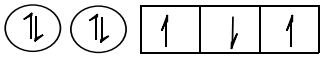
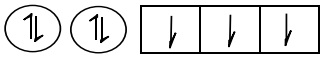
390. If electrons fall from 4th level to observant lower level finally attains 1st level in H atom, then which is/are correct?

a) Possible lines may belong to Lyman, Balmer, Paschen series
b) Possible wavelengths emitted out may be six
c) Only one wavelength will come out
d) Only Lyman series will be formed

391. Which of the following elements are isotopes
a) $C^{12}$ b) $C^{13}$ c) $C^{14}$ d) $N^{14}$

392. Which of the following statement/s is/are correct?
a) A photon is a positively charged nuclear particle
b) A photon is a particle of light energy
c) A photon is a quantum of light
d) A photon is a bundle of energy of definite magnitude but not necessarily light energy

393. The wave nature of electron was verified by
a) De Broglie b) Davisson and Germer c) G.P. Thomson d) Rutherford

394. Ground state configuration of nitrogen can be represented as:
a) 
b) 
c) 
d) 

395. The atomic nucleus contains
a) Protons b) Neutrons c) Electrons d) Photons

396. If the value of $(n + l)$ is more than 3 and less than 6, then what will be the possible number of orbitals?
a) 6 b) 9 c) 10 d) 13

397. Which of the following statements is/are correct?
a) For all values of $n$, the $p$ orbitals have the same shape, but the overall size increases as $n$ increase, for a given atom
b) The fact that there is a particular direction along which each $p$ orbital has maximum electron density, plays an important role in determining molecular geometries.
c) The charge cloud of a single electron in $2p_x$ atomic orbitals consists of two lobes of electron density
d) None is correct

398. Which among the following is/are fissible?
a) ${}_{92}U^{235}$ b) ${}_{92}U^{238}$ c) ${}_{94}Pu^{239}$ d) ${}_{94}Pu^{238}$

399. An electron has spin quantum number $(s)+1/2$ and magnetic quantum number is $-1$. It can be present in
a) $s$ orbital b) $d$ orbital c) $p$ orbital d) $f$ orbital

400. The sum of the number of neutrons and protons in the isotope of hydrogen is
a) 6 b) 5 c) 4 d) 3

401. Which of the following statement is/are correct?
a) The energy of an electron in a many electron atom generally increases with an increase in value of $n$, but for a given, the lower the value of $l$ the lower the energy
b) An electron close to the nucleus experiences a large electrostatic attraction
c) For a given value of $n$, an $s$-electron penetrates of the nucleus more than a $p$-electron, which penetrates more than a $d$-electron, and so on
d) None is correct

402. In the decay process:
$A \xrightarrow{-\alpha} B \xrightarrow{-\beta} C \xrightarrow{-\beta} D$
a) A and B are isodiaphers b) A and C are isotones
c) A and D are isotopes d) B, C, and D are isobars

403. The nuclear reaction(s) accompanied with the emission of neutron(s) is/are
a) ${}_{13}Al^{17} + {}_{2}He^{4} \rightarrow {}_{15}P^{30}$ b) ${}_{6}C^{12} + {}_{1}H^{1} \rightarrow {}_{7}N^{13}$

c) ${}_{15}\mathrm{P}^{30} \rightarrow {}_{14}\mathrm{Si}^{30}\ {}_{1}e^{0}$ d) ${}_{96}\mathrm{Am}^{241} + {}_{2}\mathrm{He}^{4} \rightarrow {}_{97}\mathrm{Bk}^{244} + {}_{1}e^{0}$

404. Radioactivity is generally does not found in
a) Light nuclei b) Stable nuclei
c) Heavy nuclei d) Nuclei of intermediate mass

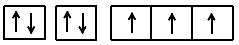
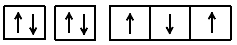
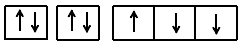
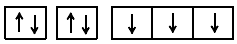
405. Select the correct statement:
a) The concept of shell was given by Bohr
b) The concept of subshells within a shell was given by Pauli
c) The degeneracy of orbitals exists in presence of magnetic field
d) The splitting of a line in fine lines under the influence of magnetic field was proposed by Zeeman

406. Let $A_n$ and $A_1$ be the area enclosed by the $n$th and first orbit in a hydrogen atom. The graph of $\ln(A_n/A_1)$ against $\ln(n)$:
a) Will pass through the origin
b) Will be a straight line with slope 4
c) Will be a monotonically increasing non-linear curve
d) Will be a circle

407. Which of the following statements are correct for an electron that has $n = 4$ and $\mathrm{m} = -2$?
a) The electron may be in a $d$-orbital
b) The electron is in the fourth principal electronic shell
c) The electron may be in a $p$-orbital
d) The electron must have the spin quantum number $= +1/2$

408. The mass defect of the nuclear reaction ${}_{5}\mathrm{B}^{8} \rightarrow {}_{4}\mathrm{Be}^{8} + {}_{1}e^{0}$ is $\Delta m$; the wrong expression is/are
a) $\Delta m =$ atomic mass of $({}_{4}\mathrm{Be}^{8} - {}_{5}\mathrm{B}^{8})$.
b) $\Delta m =$ atomic mass of $({}_{4}\mathrm{Be}^{8} - {}_{5}\mathrm{B}^{8}) +$ mass of one electron.
c) $\Delta m =$ atomic mass of $({}_{4}\mathrm{Be}^{8} - {}_{5}\mathrm{B}^{8}) +$ mass of one positron.
d) $\Delta m =$ atomic mass of $({}_{4}\mathrm{Be}^{8} - {}_{5}\mathrm{B}^{8}) +$ mass of one electrons.

409. Photoelectric effect supports quantum nature of light because:
a) There is a minimum frequency below which no photoelectrons are emitted
b) The maximum kinetic energy of photoelectrons depends only on the frequency of light and not on its intensity
c) Even when the metal surface is faintly illuminated the photoelectrons depends only on the frequency of light and not on its intensity
d) Electric charge of the photoelectrons is quantized

410. Ground state electronic configuration of nitrogen atom can be represented as
a)  b)  c)  d) 

411. The correct starting material and product of different disintegration series is/are
a) $\mathrm{Th}^{232}, \mathrm{Pb}^{208}$ b) $\mathrm{Np}^{237}, \mathrm{Bi}^{209}$ c) $\mathrm{U}^{235}, \mathrm{Pb}^{206}$ d) $\mathrm{U}^{238}, \mathrm{Pb}^{206}$

412. Which is correct statement in case of Hund's rule?
a) It states that if more than one atomic orbital of the same energy is available, electrons will occupy different atomic orbitals with parallel spins, as far as possible, in the configuration of lowest energy
b) Total energy of many electron atom with more than one electron occupying a set of degenerate orbitals is lowest, if as far as possible, electrons occupy different atomic orbitals and have parallel spins
c) Hund's rule forbid any configuration that does not violate the Pauli's exclusion principle
d) Hund's rule simply tells us which of the possible configurations is lowest in energy and other configurations are those of excited states, higher in energy than the ground state

413. Which of the following is/are correct?
a) 1 Fermi $= 10^{3}$ dps b) 1 curie $= 3.7 \times 10^{10}$ dps
c) 1 rutherford $= 10^{6}$ dps d) 1 becquerel $= 1$ dps

414. When α-particles are sent through a thin metal foil, most of them go straight through the foil because,
a) $\alpha$-particles are much heavier than electrons
b) $\alpha$-particles are positively charged

c) Most part of the atom is empty space
d) $\alpha$-particles move with high speed

415. The probability of finding the electron in $p_x$ orbital is
a) Maximum on two opposite sides of the nucleus along $X$-axis
b) $Zero$ at the nucleus
c) They produce heating effect
d) They can affect photographic plate

416. When an electron makes a transition from $(n+1)$ state to $n$ state, the frequency of emitted radiations is related to $n$ according to $(n \gg 1)$
a) $v \propto n^{-3}$ b) $v \propto n^2$ c) $v \propto n^3$ d) $v \propto n^{\frac{2}{3}}$

417. Which of the following statements is/are correct?
a) Neutron was discovered by Chadwick
b) Nuclear fission was discovered by Hahn and Strassmann.
c) Polonium was discovered by Madam Curie.
d) Nuclear fusion was discovered by Fermi.

418. Which of the following are α-emitters?
a) $Po^{213}$ b) $Pb^{215}$ c) $Rn^{222}$ d) $Ra^{226}$

419. Which of the following products in a hydrogen atom are independent of the principle quantum number $n$? The symbol(s) has/have their usual meanings:
a) $vn$ b) $Er$ c) $En^2$ d) $vr$

420. Which of the following contain (s) material particles?
a) $\alpha-$rays b) $\beta-$rays c) $\gamma-$rays d) Anode rays

421. Which of the following is/are correct configuration(s)?
a) ${}_{46}Pd : [Kr]5d^{10}$ b) ${}_{29}Cu^{+}: [Ar]3d^{10}$ c) ${}_{24}Cr : [Ar]3d^5, 4s^1$ d) ${}_{25}Mn^{+} : [Ar]3d^5, 4s^1$

422. Magnetic moment of V$(Z=23)$, Cr$(Z=24)$,and Mn$(Z=25)$ are $x, y, z,$ respectively, hence
a) $x=y=z$ b) $x<y<z$ c) $x<z<y$ d) $z<y<x$

423. Which of the following statements concerning Bohr's model is/are true?
a) It predicts that probability of electron near nucleus is more
b) Angular momentum of electron in H atom $= nh/2\pi$
c) It introduces the idea of stationary states
d) It explains line spectrum of hydrogen

424. Rutherford's $\alpha$-scattering experiment led to the following conclusions:
a) Atom has largely empty space
b) The centre of the atom has positively charged nucleus
c) The size of the nucleus is very small as compared to the size of the atom
d) Electrons revolve around the nucleus

425. Which of the followings nuclides belong to actinium ($U^{235}$) series?
a) $Pb^{207}$ b) $Po^{215}$ c) $Po^{213}$ d) ${}_1H^3$

426. The nuclide X undergoes α-decay and another nuclides Y undergoes $\beta^{\ominus}$-decay, which of the following statements is/are correct?
a) The $\beta^{\ominus}$-particles emitted by Y may have widely different speeds.
b) The α-particles emitted by X may have widely different speeds.
c) The α-particles emitted by X will have almost same speed.
d) The β-particles emitted by X will have almost same speed.

427. Which of the following statements is/are correct?
a) There is no probability of finding a $p$-electron right at the nucleus
b) The orbital $d_z^2$ has two lobes of electron density directed along the $z$-axis anda ring of electron density (called dough nut) centred in the $xy$-plane
c) The orientation of $p$ and $d$ orbitals minimizes electron-electron repulsion in many electron atoms
d) None is correct

428. Which statement (s) about cathode rays is/are correct?
   a) They travel in straight lines towards cathode
   b) They produce fluorescent discharge through the walls of the tube
   c) They produce heating effect
   d) They can affect photographic plate
429. What transition in $He^+$ ion shall have the same wave number as the first line in Balmer series of H atoms?
   a) $7 \rightarrow 5$ b) $6 \rightarrow 4$ c) $5 \rightarrow 3$ d) $4 \rightarrow 2$
430. Which of the following is/are not indicated by the sign of lobes in an atom?
   a) Sign of charges b) Sign of probability distribution
   c) Sign of wave function d) Presence or absence of electron
431. The charge cloud of a single electron in a $2p_x$ atomic orbital has two lobes of electron density. This means
   a) There is a high probability of locating the electron in the $2p_x$ atomic orbital at values of $x > 0$
   b) There is a high probability of locating it at values of $x > 0$ but no probability at all of the locating it any where in the $yz$-plane along which $x = 0$
   c) There is a great probability of finding a $p$ electron right at the nucleus
   d) All are correct
432. Which of the following statements are correct?
   a) The electronic configuration of Cr is $[Ar]3d^5, 4s^1$ (atomic number of Cs $= 24$)
   b) The magnetic quantum number may have a negative value
   c) In Silver atom, 23 electrons have a spin of one type and 24 of the opposite type. (Atomic number of Ag $= 47$)
   d) The oxidation state of nitrogen in $NH_3$ is $-3$
433. When the intensity of a light source is increased:
   a) The number of photons emitted by the source in unit time increases
   b) The total energy of the photons emitted per unit time increases
   c) More energetic photons are emitted
   d) Faster photons are emitted
434. Which of the following statements is/are correct?
   a) The electronic configuration of Cr is $[Ar]3d^5 4s^1$ (atomic number of Cr is 24)
   b) The magnetic quantum number may have a negative value
   c) In silver atom, 23 electrons have a spin of one type and 24 of the opposite type (atomic number of Ag is 47)
   d) The oxidation state of nitrogen in $HN_3$ is $-3$
435. Select the correct statement(s)
   a) $^{131}$Iis used for the treatment of thyroid cancer
   b) $^{59}$Cocannot be used for treatment of cancer
   c) $^{33}$Pis used for treatment of leukemia
   d) Excessive use of radioactive elements cause cancer
436. Which statement (s) is/are correct?
   a) Electrons in motion behave as if they are waves
   b) $s$-orbital is non-directional
   c) An orbital can accommodate a maximum of two electrons with parallel spins
   d) The energies of the various sub-levels in the same shell of H atom are in order $s > p > d > f$
437. $^{238}_{92}$U(III B) undergoes follows emissions

   $^{238}_{92}\text{U} \xrightarrow{-\alpha} A \xrightarrow{-\alpha} B \xrightarrow{-\beta} C$

   Which is/are correct statements?
   a) $A$ will be of IB group b) $A$ will be of IIIB group
   c) $B$ will be of IIA (alkaline earth metal) group d) $C$ will be of IIIA (boron family) group
438. Half-life period for ratioactive element is
   a) Always constant b) Variable

c) Independent of final concentration d) Independent of initial concentration

439. Which of the following statement(s) is/are correct?
   a) Electrons behaves as a wave
   b) $s$-orbital is non-directional
   c) An orbital can accommodate a maximum of two electrons with parallel spins
   d) The energies of the various sub-shells in the same shell are in the order $s > p > d > f$
440. Consider the ground state of Cr atom($Z = 24$). The number of electrons with the azimuthal quantum number, $l = 1$ and 2, respectively, are
   a) 16 and 5 b) 12 and 5 c) 16 and 5 d) 12 and 4
441. Which of the following nuclei are doubly magic?
   a) ${}_{92}\mathrm{U}^{238}$ b) ${}_{2}\mathrm{He}^{4}$ c) ${}_{0}\mathrm{O}^{16}$ d) ${}_{82}\mathrm{Pb}^{208}$
442. The magnitude of spin angular momentum of an electron is given by
   a) $S = s\frac{h}{2\pi}$ b) $S = \frac{\sqrt{3}}{2} \times \frac{h}{2\pi}$ c) $S = \sqrt{s(s+1)}\frac{h}{2\pi}$ d) $S = \pm\frac{1}{2} \times \frac{h}{2\pi}$
443. In a nuclear reactor, oxides of which of the following metals are used as fuel material?
   a) Uranium b) Thorium c) Actinium d) Plutonium
444. Which of the following statement/s is/are correct?
   a) The oxidation state of nitrogen in $HN_3$ is 3
   b) The electronic configuration of Cr is $(3d^5)(4s^1)$
   c) In silver atom, 23 electrons have a spin of one type and 24 of the opposite type (At. No. 47)
   d) The magnetic quantum number may have negative values
445. Which of the following properties are possessed by cathode ray?
   a) Dual nature b) Travel with speed of light
   c) Have negative charge d) Possess magnetic effect
446. Which of the following are isotones?
   a) ${}_{18}\mathrm{Ar}^{40}$ b) ${}_{20}\mathrm{Ca}^{42}$ c) ${}_{21}\mathrm{Sc}^{43}$ d) ${}_{21}\mathrm{Sc}^{41}$
447. Which of the following does not relate to photon both as wave motion and as stream of particles?
   a) $E = hv$ b) $E = mc^2$ c) Interference d) Diffraction
448. A hydrogen-like atom in ground state absorbs $n$ photons having the same energy and its emits exactly $n$ photons when electrons transition takes placed. Then, the energy of the absorbed photon may be
   a) 91.8 eV b) 40.8 eV c) 48.4 eV d) 54.4 eV
449. An electron is not deflected on passing through a certain region because
   a) There is no magnetic field in that region
   b) There is a magnetic field but velocity of the electron is parallel to the direction of magnetic field
   c) The electron is a chargeless particle
   d) None of the above
450. Which of the following is/are incorrect?
   a) 1 curie $= 3.7 \times 10^{10}$ dis
   b) Actinium series starts with $\mathrm{U}^{238}$.
   c) Nuclear isomers contain the same number of protons and neutrons.
   d) The decay constant is independent of the amount of the substance taken.
451. Select the correct statement (s).
   a) Neutron-proton ratio after a nuclide, ${}^{238}_{92}$Uloses an $\alpha$ −particle is 1.6
   b) ${}^{27}_{13}$Alcan be converted to ${}^{30}_{15}$Pby $(\alpha, n)$ reaction
   c) Nuclear fusion reactions are known as thermonuclear reactions
   d) Larger the value of disintegration constant, greater the stability of radioactive element
452. Which of the following series in H-spectra occurs in 1R region
   a) Lyman b) Pashen c) Bracket d) Balmer
453. Which of the following is/are not radioactive element(s)?
   a) Sulphur b) Tellurium c) Selenium d) Polonium

454. Radioactive disintegration rate is affected by
a) Temperature b) Pressure c) Electric field d) None of these

455. Which statement(s) concerning light is/are true?
a) It is a form of energy
b) It can be deflected by a magnet
c) It consists of photons of same energy
d) It is part of electromagnetic spectrum

456. Which of the following are correct?
a) Only Lyman series is observed in emission and absorption spectrum both
b) The continuum in line spectrum is noticed after a certain value of $n$
The wavelength of $m^{\text{th}}$ line of Balmer series is
c) $\frac{1}{\lambda} = R_{\text{H}} Z^2 \left[\frac{1}{2^2} - \frac{1}{m^2}\right]$
d) The number of spectral lines given when electron drops from 5th to 2nd shell are six

457. Which of the following is/are the examples of induced radioactivity?
a) ${}_7\text{N}^{14} + {}_2\text{He}^4 \rightarrow {}_8\text{O}^{17} + {}_1\text{H}^1$ b) ${}_4\text{Be}^9 + {}_1\text{H}^1 \rightarrow {}_3\text{Li}^9 + {}_2\text{He}^4$
c) ${}_{12}\text{Mg}^{24} + {}_2\text{He}^4 \rightarrow {}_{14}\text{Si}^{27} + {}_0n^1$ d) ${}_5\text{B}^{10} + {}_2\text{He}^4 \rightarrow {}_7\text{N}^{13} + {}_0n^1$

458. Which of the following is/are correct when a nuclide of mass number $(A)$ and atomic number $(Z)$ undergoes radioactive process?
a) Both $A$ and $Z$ decrease, the process is called α-decay.
b) $A$ remains unchanged and $Z$ decreases by 1. The process is called $\beta^{\oplus}$ or positron decay or $K$-electron capture.
c) Both $A$ and $Z$ remain unchanged, the process is called γ-decay.
d) Both $A$ and $Z$ increase, the process is called nuclear isomerism.

459. Which of the following is/are true?
a) The most radioactive element present in pitchblende is uranium.
b) P-32 is used for the treatment of leukaemia.
c) $CO_2$ present in the air contains C-12 only.
d) Omission of γ-rays changes the mass number but not atomic number

460. Which of the following statements about radioactivity are correct?
a) It is a nuclear property
b) It does not involve any rearrangement of electrons
c) It is not affected by the presence of other elements
d) Its rate is affected by the change in temperature and/or pressure

461. Which of the following statement/s is/are correct?
a) Stark effect is the splitting of spectral lines when source is placed in electric field
b) Beyond a certain limit in spectrum of an atom, there is continuum
c) The intensities of spectral line in line spectrum decreases with increase in the value of $n$
d) Shielding effect is possible in H-atom

462. Bohr's atomic model is based on the following postulates:
a) An atom consists of nucleus
b) An electron can rotate only in certain energy levels
c) An electron remains moving with continuous loss of energy
d) None of the above

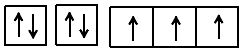
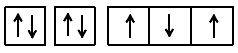
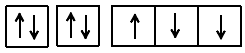
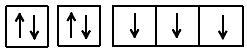
463. A radioactive element A decays by the sequence and with half-lives given below:
$\text{A} \underset{30\text{ min}}{\overset{\alpha}{\rightarrow}} \text{B} \underset{2\text{ days}}{\overset{2\beta}{\rightarrow}} \text{C}$
Which of the following statements about this system are correct?
a) The mass number of B is greater than A
b) After two hours, less than 10% of the initial A is left
c) Maximum amount of B present at any time is less than 50% of the initial amount of A

d) The atomic numbers of A and C are the same

464. Which of the following orbitals has (have) one spherical node?

a) $1s$ b) $2s$ c) $2p$ d) $3p$

465. Ground state electronic configuration of nitrogen atom can be represented by

a)  b)  c)  d) 

466. Which of the following statements are incorrect?

a) The third ionization energy of lithium is 9 times the second ionization energy of helium

b) The second ionization energy of helium is 4 times the first ionization of hydrogen

c) Radius of third orbit of $Li^{2+}$ is 3 times the radius of third orbit of hydrogen atom

d) For designating an orbital three quantum numbers are needed

467. In a nuclear reactor, heavy water is used to

a) Increases the speed of neutrons b) Decreases the speed of neutrons

c) Transfer the heat from the reactor d) None of above

468. Which of the following is/are correct?

a) α −rays are more penetrating than β-rays.

b) α −rays have greater ionizing power than β-rays.

c) β-particles are not present in the nucleus, yet they are emitted from the nucleus.

d) α −rays are not emitted simultaneously with α −and β-rays.

469. Which of the following statement about quantum number is correct?

a) If the value of $l = 0$, the electron distribution is spherical

b) The shape of orbital is given by subsidiary quantum number

c) The Zeeman's effect is explained by magnetic quantum number

d) The spin quantum number gives the orientations of electron cloud

470. The total energy of the electron of H-atom in the second quantum state is $\pm E_2$. The total energy of the $He^+$ atom in the third quantum state is

a) $-\left(\frac{16}{9}\right)E_2$ b) $+\left(\frac{4}{9}\right)E_2$ c) $-\left(\frac{16}{9}\right)E_2$ d) $\pm\left(\frac{3}{2}\right)E_2$

471. Which of the following provides wave nature to light?

a) Diffraction b) Interference c) Photoelectric effect d) $E = hv$

472. Target nucleus $A$ is converted to product nucleus $B$ by $(p, n)$ as :$(A(p, n)\ B$

In this case

a) $A$ and $B$ are isotopes b) $A$ and $B$ are isobars

c) $A$ and $B$ are isotones d) $B$ has higher atomic number than that of $A$

473. Ionization energy of a hydrogen-like ion $A$ is greater than that of another hydrogen-like ion $B$. Let $r, u, E$ and $L$ represent the radius of the orbit, speed of the electron, energy of the atom and orbital angular momentum of the electron respectively. in ground state:

a) $r_A > r_B$ b) $u_A < u_B$ c) $E_A < E_B$ d) $L_A > L_B$

474. In which of the following situations the heavier of the two particles have smaller de Broglie wavelength? The two particles :

a) Move with the same speed

b) Move with same linear momentum

c) Move with the same kinetic energy

d) Have fallen through the same height

475. The angular momentum of $d$ electron is

a) $\frac{h}{2\pi}\sqrt{6}$ b) $\hbar\sqrt{6}$ c) $\hbar\sqrt{2}$ d) $\frac{h}{2\pi}\sqrt{2}$

## : ANSWER KEY :

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1) | d | 2) | a | 3) | a | 4) | b | 189) | a | 190) | c | 191) | d | 192) | c |
| 5) | d | 6) | a | 7) | a | 8) | b | 193) | c | 194) | c | 195) | c | 196) | a |
| 9) | a | 10) | a | 11) | c | 12) | b | 197) | c | 198) | d | 199) | d | 200) | d |
| 13) | c | 14) | d | 15) | b | 16) | c | 201) | a | 202) | c | 203) | d | 204) | c |
| 17) | c | 18) | c | 19) | a | 20) | c | 205) | c | 206) | c | 207) | d | 208) | a |
| 21) | a | 22) | a | 23) | d | 24) | d | 209) | a | 210) | a | 211) | c | 212) | a |
| 25) | c | 26) | c | 27) | d | 28) | a | 213) | b | 214) | d | 215) | d | 216) | a |
| 29) | d | 30) | d | 31) | b | 32) | d | 217) | a | 218) | d | 219) | b | 220) | c |
| 33) | a | 34) | a | 35) | a | 36) | c | 221) | c | 222) | c | 223) | d | 224) | c |
| 37) | a | 38) | a | 39) | b | 40) | b | 225) | b | 226) | c | 227) | c | 228) | c |
| 41) | d | 42) | b | 43) | a | 44) | a | 229) | d | 230) | b | 231) | c | 232) | b |
| 45) | b | 46) | a | 47) | b | 48) | b | 233) | a | 234) | b | 235) | a | 236) | a |
| 49) | a | 50) | a | 51) | d | 52) | d | 237) | a | 238) | a | 239) | c | 240) | b |
| 53) | b | 54) | c | 55) | a | 56) | c | 241) | c | 242) | a | 243) | d | 244) | b |
| 57) | a | 58) | a | 59) | a | 60) | b | 245) | b | 246) | d | 247) | b | 248) | c |
| 61) | a | 62) | a | 63) | c | 64) | c | 249) | d | 250) | b | 251) | c | 252) | a |
| 65) | b | 66) | b | 67) | c | 68) | c | 253) | d | 254) | d | 255) | a | 256) | b |
| 69) | c | 70) | b | 71) | c | 72) | a | 257) | d | 258) | a | 259) | c | 260) | d |
| 73) | d | 74) | a | 75) | d | 76) | a | 261) | d | 262) | b | 263) | d | 264) | b |
| 77) | d | 78) | b | 79) | b | 80) | b | 265) | a | 266) | c | 267) | d | 268) | b |
| 81) | b | 82) | b | 83) | b | 84) | c | 269) | a | 270) | d | 271) | b | 272) | c |
| 85) | b | 86) | b | 87) | b | 88) | c | 273) | c | 274) | d | 275) | d | 276) | a |
| 89) | a | 90) | a | 91) | c | 92) | c | 277) | a | 278) | a | 279) | c | 280) | a |
| 93) | b | 94) | a | 95) | c | 96) | a | 281) | d | 282) | d | 283) | b | 284) | c |
| 97) | b | 98) | c | 99) | a | 100) | a | 285) | d | 286) | d | 287) | a | 288) | c |
| 101) | c | 102) | c | 103) | c | 104) | d | 289) | a | 290) | c | 291) | c | 292) | a |
| 105) | b | 106) | c | 107) | d | 108) | b | 293) | d | 294) | b | 295) | d | 296) | d |
| 109) | c | 110) | a | 111) | c | 112) | d | 297) | c | 298) | a | 299) | d | 300) | b |
| 113) | a | 114) | d | 115) | b | 116) | d | 301) | c | 302) | d | 303) | a | 304) | d |
| 117) | d | 118) | b | 119) | b | 120) | b | 305) | b | 306) | a | 307) | c | 308) | a |
| 121) | a | 122) | d | 123) | d | 124) | a | 309) | b | 310) | a | 311) | b | 312) | c |
| 125) | a | 126) | c | 127) | b | 128) | c | 313) | b | 314) | b | 315) | d | 316) | c |
| 129) | c | 130) | a | 131) | c | 132) | a | 317) | c | 318) | b | 319) | c | 320) | b |
| 133) | a | 134) | c | 135) | d | 136) | d | 321) | c | 322) | d | 323) | c | 324) | c |
| 137) | d | 138) | a | 139) | a | 140) | a | 325) | d | 326) | c | 327) | a | 328) | d |
| 141) | c | 142) | d | 143) | a | 144) | b | 329) | a | 330) | d | 331) | b | 332) | d |
| 145) | d | 146) | b | 147) | d | 148) | a | 333) | d | 334) | c | 335) | a | 336) | a |
| 149) | b | 150) | c | 151) | a | 152) | c | 337) | b | 338) | a | 339) | c | 340) | a |
| 153) | d | 154) | b | 155) | a | 156) | c | 341) | d | 342) | b | 343) | a | 344) | c |
| 157) | b | 158) | d | 159) | b | 160) | b | 345) | a | 346) | b | 347) | a | 348) | c |
| 161) | b | 162) | b | 163) | c | 164) | b | 349) | c | 350) | a | 351) | b | 352) | d |
| 165) | b | 166) | d | 167) | b | 168) | b | 353) | c | 354) | b | 1) | a,b,c | 2) | |
| 169) | b | 170) | c | 171) | d | 172) | c | | a,d | 3) | c | 4) | a,c | | |
| 173) | b | 174) | b | 175) | b | 176) | a | 5) | b,d | 6) | c | 7) | a,b,c | 8) | |
| 177) | a | 178) | b | 179) | c | 180) | b | | a, b, c, d | | | | | | |
| 181) | a | 182) | d | 183) | b | 184) | c | 9) | b,c | 10) | a | 11) | a,b,c,d | 12) | |
| 185) | b | 186) | c | 187) | c | 188) | c | | a,d | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 13) | c<br>b, d | 14) | a, b, c | 15) | a, d | 16) | | 121) | a,b |
| 17) | a, c | 18) | b,c | 19) | b,d | 20) | c | | |
| 21) | a,b,c<br>c,d | 22) | a,b | 23) | b,c | 24) | | | |
| 25) | a, b, c | 26) | b,d | 27) | c, d | 28) | a | | |
| 29) | a,c<br>c, d | 30) | b,c | 31) | a,c,d | 32) | | | |
| 33) | b,c,d<br>a, b | 34) | c | 35) | b,c | 36) | | | |
| 37) | a,b,c<br>a, d | 38) | b, c | 39) | a,b | 40) | | | |
| 41) | a,b<br>a,c | 42) | d | 43) | a,b,c | 44) | | | |
| 45) | b,c,d<br>a,c,d | 46) | d | 47) | a,b,c | 48) | | | |
| 49) | a,d<br>a, b | 50) | a,b,d | 51) | a,d | 52) | | | |
| 53) | b,d<br>a,d | 54) | a,b,c | 55) | a, b, c | 56) | | | |
| 57) | a,d<br>a,c | 58) | a,b,c,d | 59) | c,d | 60) | | | |
| 61) | a,b,d<br>a,d | 62) | a | 63) | a,b,c | 64) | | | |
| 65) | a, b<br>68) | 66) | a,b,d<br>c | 67) | a, b, c, d | | | | |
| 69) | b,c,d<br>b,c | 70) | a,b,c | 71) | a,b | 72) | | | |
| 73) | a,b,c<br>a,b,d | 74) | b, c, d | 75) | b | 76) | | | |
| 77) | a,b,c<br>a,b,c | 78) | a,b,c | 79) | a, b | 80) | | | |
| 81) | a, b<br>a,d | 82) | a, b | 83) | b, c | 84) | | | |
| 85) | a,b<br>b,c | 86) | b | 87) | b,c,d | 88) | | | |
| 89) | a, b, d<br>a,b,c | 90) | b,c,d | 91) | a,b,c,d | 92) | | | |
| 93) | b,c,d<br>c,d | 94) | a,b | 95) | a,b | 96) | | | |
| 97) | a, b, c | 98) | b,c | 99) | a,b,c | 100) | a | | |
| 101) | a, d<br>a,b,c | 102) | a, b, d | 103) | a,b,c,d | 104) | | | |
| 105) | b,c<br>a, b | 106) | a,b,c | 107) | a, b, c | 108) | | | |
| 109) | b,d<br>a,b,c | 110) | b,d | 111) | a,d | 112) | | | |
| 113) | b,c<br>a,c | 114) | b,c,d | 115) | a,b,c | 116) | | | |
| 117) | a, b, d<br>a, c, d | 118) | b, d | 119) | b, c | 120) | | | |

## : HINTS AND SOLUTIONS :

2 **(a)**

2K, 8L, 9M, and 2N

$1s^2 2s^2\ 2p^6 3s^2\ 3p^6\ 3d^1 4s^2$

$\begin{pmatrix}\text{K means } n=1, \text{L means } n=2\\ \text{M means } n=3, \text{N means } n=4\end{pmatrix}$

Structure is $3d^1, 4s^2$

Atomic number 21

The total number of $pe^-$

$2p^6 + 3p^6 = 12$

5 **(d)**

$${}_AX \xrightarrow[30\text{ min}]{-\alpha} {}_{A-2}Y \xrightarrow[2\text{ days}]{-2\beta} {}_AZ$$

$A$ is atomic number of $X$

Half-life period of $X = 30$ min

Total time $= 2$ h $= 120$ min

$(y)$ number of half-lives $= \frac{120}{30} = 4$

$X$ left after 4 half-lives $N = N_0\left(\frac{1}{2}\right)^4$

$= 100\left(\frac{1}{16}\right) = 6.25\%$

Thus, (a) is true

Before 30 min ( = half-life) amount of $X$ left $> 50\%$

Hence, $Y$ formed $< 50\%$

(since half-life of $Y$) is 2880 min >> half-life of $A$)

Thus, (b) is correct

$X$ and $Y$ are isotopes with same atomic number $A$, thus, (c) is correct

6 **(a)**

${}_4\text{Be}^7 + {}_{-1}\text{e}^0 \rightarrow {}_3\text{Li}^7$

So, atomic number=3, mass number=7

7 **(a)**

$$\lambda = \frac{hc}{\Delta E} = \frac{6.62 \times 10^{-34}\text{ J s} \times 3 \times 10^8\text{ m s}^{-1}}{E \times 1.602 \times 10^{-19}\text{ J}}$$

$= 12395 \times 10^{-10}$m

10 **(a)**

iv $<$ ii $<$ $iii$ $<$ $i$

According to Aufbau's principle, filling of electrons in various subshells of an atom takes place in the increasing order of energy, starting with the lower most

The following order is observed:

$1s\ 2s\ 2p\ 3s\ 3p\ 4s\ 3d\ 4p\ 5s\ 4d\ 5p\ 6s\ 4f\ 5d\ 6p\ 7s$ ..

According to Bohr-Bury rule, $(n + l)$ rule, the subshell with the lower value of $(n + l)$is filled first. If the values for $(n + l)$ are equal, the one with the smaller value of $n$ is filled first

| | $n$ | $l$ | $(n + l)$ |
|---|---|---|---|
| **i.** | 4 | 1 | 5 |
| **ii.** | 4 | 0 | 4 |
| **iii.** | 3 | 2 | 5 |
| **iv.** | 3 | 1 | 4 |

11 **(c)**

$${}^{214}_{83}\text{Bi} \xrightarrow[-\beta]{} {}^{214}_{84}X \xrightarrow[-\alpha]{} {}^{210}_{82}\text{Y}$$

Neutron $= 210 - 82 = 128$

12 **(b)**

Ψ=wave function

14 **(d)**

Neutron is the best projectile

15 **(b)**

1. **True**

2. **False**. The angular momentum depends only on the azimuthal quantum number

3. **True**

4. **True**

16 **(c)**

Pb-208 belongs to $4n$ series

17 **(c)**

$$r_n = \frac{r_1\text{ for H} \times n^2}{Z}$$

$$= \frac{0.53\text{ Å} \times 2^2}{1}$$

$= 0.53 \times 4$ Å $= 0.053 \times 4$ nm

$= (1\text{ Å} = 10^{-10}\text{m}, 1\text{ nm} = 10^{-9}\text{ m})$

19 **(a)**

Isotope must have some number of proton, therefore β-particle will be emitted

20 **(c)**

Electronic configuration of $\text{M}^{2+} = 2 + 8 + 14 = 24\text{e}^-$

Since two $\text{e}^-$ has been lost in forming $\text{M}^{2+}$ ion

from metal, so total number of protons should be $= 24 + 2 = 26$

Hence, number of neutrons $= 56 - 26 = 30$

22 **(a)**

$$E_n \text{ for } H_2^{\oplus} = \frac{E_1 \text{ for H} \times Z^2}{n^2}$$

$E_1 = -13.6$ eV

The possible excited state values are:

$E_2 = \frac{-13.6}{4} = -3.4$ eV

$E_3 = \frac{-13.6}{9} = -1.5$ eV

$E_4 = \frac{-13.6}{16} = -0.85$ eV

So, the value is only $-3.4$ eV

25 **(c)**

$t_{1/2} = 10$ year; $T = 20$ years

We know , $T = nt_{1/2} \Rightarrow n = \frac{20}{10} = 2$

And $N = \left(\frac{1}{2}\right)^n N_0$

$\frac{N}{N_0} = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$

% of $\frac{N}{N_0} = \frac{1}{4} \times 100 = 25\%$

27 **(d)**

$_{92}U^{235} + {}_0n^1 \rightarrow {}_{54}Xe^{139} + {}_{38}Sr^{94} + 3\ {}_0n^1$

28 **(a)**

Ionization potential of nitrogen is more that of oxygen. This is because nitrogen has more stable fully half-filled $p$ orbitals

29 **(d)**

$-\frac{dN}{dt} = \lambda[A]$

Greater the values of $\lambda$(decays constant) greater the activity

30 **(d)**

Spin does not give the orientation of electron cloud

32 **(d)**

$E = h\nu$ and $\Delta E = \frac{hc}{\lambda}$

$\frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1} = \frac{4000}{2000} = 2$

33 **(a)**

Cr$(Z = 24)$

$[Ar]3d^5\ 4s^1$

This is because $d^5$ is a more stable half-filled configuration. Reasons for the stability of half-filled and fully filled orbitals are symmetry and exchange energy

34 **(a)**

$^{14}_{7}$Nis bombarded by $\alpha$ −particle

35 **(a)**

$_{92}U^{238} \rightarrow {}_ZX^A + {}_2He^4 + {}_{-1}e^0$

Equating mass number of both sides

$238 = A + 4 + 0$

$\therefore A = 238 - 4 = 234$

Equating atomic number of both sides

$92 = Z + 2 - 1$

$\therefore Z = 92 - 1 = 91$

37 **(a)**

$_7N^{14} \rightarrow {}_1n^0 + {}_6C^{14}$

39 **(b)**

$$\left(1 + \frac{N_{U\ (238)}}{N_{pb\ (206)}}\right) = (2)^n$$

$(1 + 1) = (2)^n$

$\therefore n = 1 = \frac{t}{T_{50}}$

$\therefore t = T_{50} = 4.5 \times 10^9$yr

42 **(b)**

Rb$(z = 37)$

$[Kr]_{36}\ 5s^1$

For the last electron:

$n = 5, l = 0, m = 0, s = 1/2$

44 **(a)**

$t_{1/2} = \frac{0.693}{K}$

45 **(b)**

Given $n = 3$, we know that $N = \left(\frac{1}{2}\right)^n N_0$

$\therefore \left(\frac{N}{N_0}\right) = \left(\frac{1}{2}\right)^n = \frac{1}{8}$

Or $\frac{N}{N_0}\% = \frac{1}{8} \times 100 = 12.5\%$

47 **(b)**

$^{238}_{92}U + {}^4_2He \rightarrow {}^{241}_{95}Am + {}^1_0n$

| | LHS | RHS | |
|---|---|---|---|
| Mass number | 242 | 242 | balanced |
| Atomic number | 94 | 95 | unbalanced |

48 **(b)**

Isobars have different mass number

49 **(a)**

Number of radial nodes $= (n - l - 1)$

For $3s, n = 3, l = 0$(number of radial node=2)

For $2p, n = 2, l = 1$(number of radial node=0)

51 **(d)**

$C = C_0\left(\frac{1}{2}\right)^y$

$(3.00 \times 10^8) = (2.40 \times 10^9)\left(\frac{1}{2}\right)^y$

$\left(\frac{1}{2}\right)^y = \left(\frac{1}{8}\right) = \left(\frac{1}{2}\right)^3$

$\therefore y = 3$ or $\frac{t}{T_{50}} = 3$

$\therefore t = 3 \times T_{50} = 36.78$ yr

52 **(d)**

The rate of disintegration does not depend upon environmental factors

53 **(b)**

If $T_{75}$ of $B \rightarrow C$ is 100 min, then $T_{50} = 50$ min

Thus, $N_A T_B = N_B T_A$

$\frac{N_A}{N_B} = \frac{T_A}{T_B} = \frac{100}{50} = 2$

54 **(c)**

Heavy water ($D_2O$) works as a moderator to slow down the speed of neutron

55 **(a)**

The energy of an electron in Bohr orbits of hydrogen atom is given by the expression

$E_n = -\frac{\text{Constant}}{n^2}$

Where $n$ takes only integral values. For the first Bohr orbit, $n = 1$, and it is given that $E_1 = -13.6$ eV. Hence

$E_n = -\frac{13.6 \text{ eV}}{n^2}$

Of the given values of energy, only $-3.4$ eV can be obtained by substituting $n = 2$ in the above expression

56 **(c)**

γ −rays are neutral particles

59 **(a)**

$E_1 = hv_1 = h\frac{c}{\lambda_1} = \frac{hc}{2000}$

$E_2 = hv_2 = h\frac{c}{\lambda_2} = \frac{hc}{4000}$

$\frac{E_1}{E_2} = \frac{hc \times 4000}{2000 \times hc} = 2$

63 **(c)**

$^{228}_{88}\text{Ra} \xrightarrow[-\beta]{} {}^{228}_{90}X \xrightarrow[-\alpha]{} {}^{224}_{88}\text{Y}$

64 **(c)**

KE = (Energy of radiation − Work function)

$= \left(h \times \frac{c}{\lambda} - 4.2\right)$

$= \left(\frac{6.6 \times 10^{-34} \text{ Js} \times 3 \times 10^8 \text{ m}}{2000 \times 10^{-10} \text{ m}}\right)$

$-(4.2 \times 1.602 \times 10^{-19} \text{ J})$

$= (9.9 \times 10^{-19} \text{ J}) - (6.7 \times 10^{-19} \text{ J})$

$= 3.2 \times 10^{-19}$ J

65 **(b)**

$(b) \quad {}^{200}_{79}\text{Au} \longrightarrow {}^{200}_{80}\text{Hg} + {}^{0}_{-1}e \quad (\beta\text{-particle})$

isobars

Number of half-life $= \frac{52}{13} = 4$

Au left after 52 days, $C = C_0\left(\frac{1}{2}\right)^n = 1\left(\frac{1}{2}\right)^4 = \frac{1}{16}$

Hg formed $= 1 - \frac{1}{16} = \frac{15}{16} = 0.9375$ g

66 **(b)**

Work function = Threshold energy

$= hv_0 = \frac{hc}{\lambda_o}$

$= \frac{6.6 \times 10^{-34} \text{ Js} \times 3 \times 10^8 \text{ m}}{330 \times 10^{-9} \text{ m}} = 6.6 \times 10^{-29}$ J

68 **(c)**

$\overline{\nu}_{\text{He}^{\oplus}} = \frac{1}{\lambda} = R \times 2^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$= R\left(\frac{4}{n_1^2} - \frac{4}{n_2^2}\right)$...(i)

$\overline{\nu}_{H_2^{\oplus}} = \frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$...(ii)

Compare equations (i) and (ii), we get

$\therefore \frac{1}{1^2} = \frac{4}{n_1^2}, n_1^2 = 4, n_1 = 2$

$\frac{4}{n_2^2} = \frac{1}{2^2}, n_2^2 = 16, n_2 = 4$

$(4 \rightarrow 2)$

69 **(c)**

$^{25}_{13}\text{Al} \rightarrow {}^{0}_{1}e + {}^{25}_{12}\text{Mg}$

Proton changes to neutron $^{1}_{1}\text{H} \rightarrow {}^{1}_{0}n + {}^{0}_{1}e$

$^{25}_{12}$Mghas 12 protons

13 neutrons

12 electrons

71 **(c)**

Atomic number

$$= \frac{(\%\text{ Abundance}) \times (\text{Isotope})_1 + \%\text{ of } (\text{Isotope})_2}{100}$$

73 **(d)**

$E_i = \text{IE} + \text{KE}$

Or$E_1$ =Threshold $E$ or Work function +KE

$\left(hv = hv_0 + \frac{1}{2}mu^2\right)$

Or

$hn = hn_0 + \frac{1}{2}mu^2$

$\frac{1}{2}mu^2 = h(n - n_0) = h\,\Delta n$ ....(i)

$\left(\lambda = \frac{h}{mu}, \therefore u = \frac{h}{m\lambda}\right)$

Substitute the value of $u$ in equation (i)

$\frac{1}{2}m \cdot \frac{h^2}{m^2\lambda^2} = h\,\Delta n$

$\frac{h}{2\lambda^2 m} = \Delta n$

$\therefore \lambda = \sqrt{\frac{h}{2m\Delta n}}$

74 **(a)**

2K, 8L, 9M, and 2N

$1s^2 2s^2\ 2p^6 3s^2\ 3p^6\ 3d^1 4s^2$

$\begin{pmatrix}\text{K means } n = 1, \text{L means } n = 2\\ \text{M means } n = 3, \text{N means } n = 4\end{pmatrix}$

Structure is $3d^1, 4s^2$

Atomic number 21

Total number of unpaired $d$ $e^-$

$3d_1 = 1$

75 **(d)**

5. **True**.
6. **True**. See fig (i) below
7. **True**. See fig (e) below
8. **False**. See fig (h) below

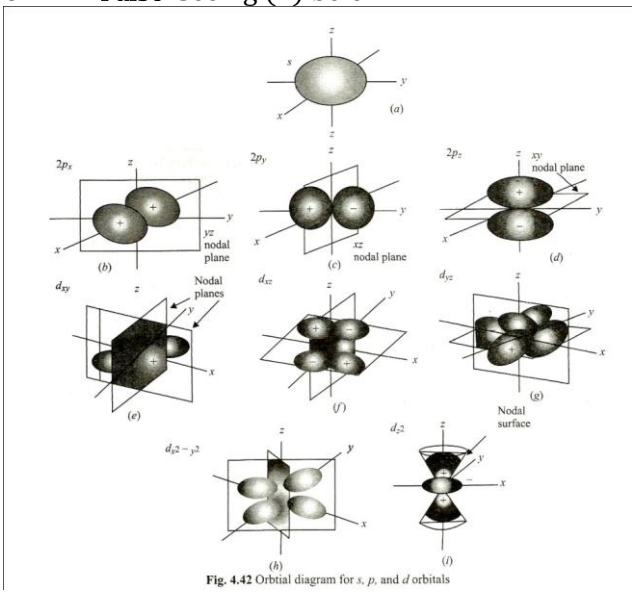


Fig. 4.42 Orbtial diagram for *s*, *p*, and *d* orbitals

76 **(a)**

1 amu = 931.5 MeV

78 **(b)**

In X; $l = d$

In Y, $l = s$

Energy of $d > s$

79 **(b)**

$s < p < d < f$

80 **(b)**

$^{212}_{82}\text{Pb} \rightarrow\ ^{212}_{82}\text{Bi} +\ ^{0}_{-1}\text{e}$

$(\beta)$

$N = N_0\left(\frac{1}{2}\right)^y = N_0\left(\frac{1}{2}\right)^2 = \frac{N_0}{4}$

Where, $y = \frac{\text{total time}}{\text{half-life}} = \frac{20}{10} = 2$

Thus, I and III are true

81 **(b)**

Isotopes have same atomic number but different mass number

82 **(b)**

Emission of an α-particle means mass is decreased by 4 units and charge by 2 units. Thus,

$_{92}\text{U}^{238} \xrightarrow{-\alpha}\ _{90}\text{U}^{234}$

Thus, the mass number = 234

Atomic number = 90

83 **(b)**

**True**.

**False**. The expression $m_s\left(\frac{h}{2\pi}\right)$ is that of $z$-component of angular momentum

**True**. The azimuthal quantum number has the value $0, 1, 2, \ldots, (n-1)$

**True**. The expressions are

$$\text{KE} = \frac{1}{2}mv^2 = \frac{1}{2}\frac{Ze^2}{(4\pi\varepsilon_0)r}$$

$$\text{PE} = -\frac{Ze^2}{(4\pi\varepsilon_0)r}$$

84 **(c)**

Based on units of $k$ (disintegration constant) we conclude that disintegration of $A$ follows first-order kinetics and that of $B$ follows second-order kinetics

$T_{50}(A) = \dfrac{0.693}{k_A}$

$T_{50}(B) = \dfrac{1}{k_B[B]}$

Also, $T_{50}(A) = T_{50}(B)$(given)

$\dfrac{0.693}{k_A} = \dfrac{1}{k_B[B]}$

$\therefore \frac{k_A}{k_B} = 0.693\ [B] = 0.693[A]$given $[A] = [B]$

$(\text{Rate})_A = k_A[A]$

$(\text{Rate})_B = k_B[B]^2 = k_B[A]^2$

$\dfrac{(\text{Rate})_A}{(\text{Rate})_B} = \dfrac{k_A[A]}{k_B[A]^2} = \dfrac{k_A}{k_B[A]} = 0.693$

Also, $k_A T_A = k_A \times \frac{0.693}{k_A} = 0.693$

Thus, (a) and (b) are true

88 **(c)**

Half-life $= \frac{0.693}{\lambda} = \frac{0.693}{0.49\times10^{-10}}$yr

$= 1.41 \times 10^{10}$ yr

89 **(a)**

Angular nodes =1,

Spherical nodes $= n - l - 1 = 3 - 1 - 1 = 1$

90 **(a)**

$n_3 \rightarrow n_2$

92 **(c)**

The limiting line of Balmer series refers to the transition from ∞ to 2nd orbit

$v = 3.29 \times 10^{15}\left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2}\right)\text{s}^{-1}(n_1 = 2, n = \infty)$

$= 3.29 \times 10^{15} \times \dfrac{1}{4} = 8.22 \times 10^{14}\text{s}^{-1}$

94 **(a)**

Neutron

96 **(a)**

$\dfrac{\text{KE}}{E_{\text{Total}}} = \dfrac{-Ze^2}{r_n} \Big/ \dfrac{-Ze^2}{2r_n} = 2$

97 **(b)**

According to Aufbau's principle, filling of electrons in various subshells of an atom takes place in the increasing order of energy, starting with the lower most. The following order is observed:

$1s\ 2s\ 2p\ 3s\ 3p\ 4s\ 3d\ 4p\ 5s\ 4d\ 5p\ 6s\ 4f\ 5d\ 6p\ 7s$ ..

Filling of $2p$ orbital cannot start before the completion of the $2s$ orbital

**Incorrect**:

| | | | |
|---|---|---|---|
| ↑ | ↑↓ | ↑ | ↑ |

**Correct:**

| | | | |
|---|---|---|---|
| ↑↓ | ↑ | ↑ | ↑ |

98 **(c)**

Smaller nuclei fuse to form heavier nuclei in nuclear fusion reaction

99 **(a)**

Both belong to $4n + 1$ series

102 **(c)**

$ns^2, np^5$ is the electronic configuration of a halogen, and halogens are most electronegative

103 **(c)**

1 curie $= 3.8 \times 10^{10}$ dps

Hence, 1 microcurie $= 1 \times 10^{-6}$ curie

$= 3.7 \times 10^{10} \times 10^{-6}$dps

$= 3.7 \times 10^{4}$dps

106 **(c)**

**False**. The electronic configuration of$Zn^{2+}$ (atomic number 30) is
$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}$. There are no unpaired electrons, hence, it is diamagnetic

**False**. In β emission, the atomic number of daughter element is increased by 1, due to the basic conversion of neutron into proton in the nucleus

**True**. An $\alpha$-particle is $^4_2\text{He}^{2+}$. Hence, atomic number and mass number of daughter element are decreased by 2 and 4, respectively

**False**. There will occur an increase in atomic number by 2

$^m_n A \xrightarrow{-\beta} {}^m_{n+1} B \xrightarrow{-\beta} {}^m_{n+2} C$

107 **(d)**

Nucleon consists of protons and neutrons

108 **(b)**

Bohr can explain hydrogen-like elements

114 **(d)**

$^{14}_{6}\text{C}\ n = 14 - 6 = 8$

$p = 6$

$\frac{n}{p} = \frac{8}{6} = 1.33 > 1$

Hence, $^{14}_{6}$Chas $\frac{n}{p}$ratio greater than 1. It emits particles to have $\frac{n}{p} = 1$.Thus, neutron changes to proton by emission of $\alpha$ −particles

$^{14}_{6}\text{C} \rightarrow\ ^{14}_{7}\text{N} +\ ^{0}_{-1}\text{e}$

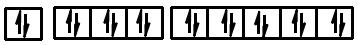
115 **(b)**

$(\ _{2}\text{He}^{4})^{2+}$

α − particles have low penetrating power. It is positively (+2) charged helium nucleus

117 **(d)**

When $n = 3, l = 0, 1, 2\ i.e.$, there are $3s$, $3p$ and $3d$-orbital's. If all these orbitals are completely occupied as



Total 18 electrons, 9 electrons with $s = +\frac{1}{2}$ and 9 with

$$s = -\frac{1}{2}.$$

119 **(b)**

$^{1}_{1}\text{H} +\ ^{1}_{1}\text{H} \rightarrow\ ^{2}_{1}\text{H}$

$^{2}_{1}\text{H} +\ ^{1}_{1}\text{H} \rightarrow\ ^{3}_{2}\text{He}$ ...

120 **(b)**

In hydrogen bomb, nuclear fusion takes place

121 **(a)**

Atomic number =24

Structure is $3d^5, 4s^1, n = 6$

Total spin $= \pm\frac{1}{2} \times 6 = \pm 3$

Magnetic moment $= \sqrt{n(n+2)} = \sqrt{6(6+2)} = \sqrt{48}$ BM

122 **(d)**

$N_1\lambda_1 = N_2\lambda_2$at equilibrium

$\frac{N_1}{t_1} = \frac{N_2}{t_2}$ $t_1$and $t_2$ are half-lives

If $t_1 = t_2$then $N_1 = N_2$

If $\lambda_1 = \lambda_2$then $N_1 = N_2$

Since, $T_{75} = 2T_{50}$

Hence, if $(T_{75})_1 = (T_{75})_2$

Then $N_1 = N_2$

126 **(c)**

Hund's rule

127 **(b)**

For disintegration

$N_1\lambda_1 = N_2\lambda_2$

$\text{N}_2 = \frac{\lambda_1}{\lambda_2}N_1 = \frac{1 \times 10^{-2}}{1 \times 0^{-5}} \times 200$

$= 2 \times 10^6$

129 **(c)**

Cl$(Z = 18)$

$[\text{Ne}]3s^2 3p^5$

For the last electron:

$n = 3, l = 1, m = -1, 0,$ or$+1$

130 **(a)**

$E = mc^2$

$= m \times 931$ MeV

131 **(c)**

Neutron is absorbed $(n)$

Proton is released $(p)$

$^{14}_{7}\text{N}(n, p)\ ^{14}_{6}\text{C}$

132 **(a)**

According to Rutherford's model of atom, an atom consists of a positively chargedheavy part called nucleus where most of the mass of the atom is concentrated. Protons and neutrons are present in the nucleus. Size of the nucleus is very small compared to the size of the atom

Around the nucleus, there is extranuclear part in which there are electrons

Electrons revolve around the nucleus in circular orbit like planets around the sun and they are called planetary electrons

136 **(d)**

$\text{H}_1^2\ ;\ \text{T}_1^3$

138 **(a)**

Atoms having same number of protons are called isotopes

141 **(c)**

Radius of orbit $(r) = \frac{n^2h^2}{4\pi^2me^2} \times \frac{1}{Z}$

In it $h, \pi, m$ and $e$ are constants, so after

substituting these values, we get

$r = \frac{0.529n^2}{Z}$ Å

$Z = 1$ for H

$\therefore \quad r_H = \frac{0.529n^2}{1}$ Å ... (i)

The transition from $n = 2$ to $n = 1$ in H-atom will have the same wavelength as the transition from $n = 4$ to $n = 2$ in $He^+$ ion.

143 **(a)**

$E_n = \frac{-13.6}{n^2} Z^2$ eV

For $n = 2$, for H atom,

$E = \frac{-13.6}{2^2} 1^2 \text{eV} = -3.4$ eV

Other values cannot be obtained for $n = 3,4,5,6$ etc

144 **(b)**

γ −particles are neutral, hence they do not get repelled by the electrostatic force of nuclei

145 **(d)**

$^{29}_{13}\text{Al} \rightarrow {}^{27}_{13}\text{Al} + 2\,{}^{1}_{0}n$

146 **(b)**

Due to mass defect some energy is lost as heat energy

148 **(a)**

Radioactive disintegration is a nuclear process

149 **(b)**

$Fe^{2+}$: [Ar]$3d^6$unpaired electron=0

$Mn^{2+}$: [Ar]$3d^5 4s^1$ unpaired electron=2

Cr: [Ar]$3d^4 s^2$ unpaired electron=0

If Hund's rule is not followed

150 **(c)**

It capture neutrons and emits $\alpha$ −particle

Thus, $(n, \alpha)\ {}^{10}_{5}\text{B} \xrightarrow[n \uparrow \text{captured}]{\alpha \downarrow \text{emitted}} {}^{7}_{3}\text{Li}$

151 **(a)**

Artificial series is $(4n + 1)$

152 **(c)**

Radioactive disintegration is a nuclear process

153 **(d)**

The nucleus is unstable, if $p/n <> 1$

154 **(b)**

$_{24}\text{Cr} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$

This is the ground state electronic configuration for chromium. There is only one electron in the $4s$ orbital because $d^5$ is a more stable half-filled configuration. Reasons for the stability of the half-filled and fully filled orbitals are symmetry and exchange energy

158 **(d)**

$_{82}\text{Pb}^{208}; p = 82; n = 208 - 82 = 126$

$_{83}\text{Bi}^{209}; p = 83; n = 209 - 83 = 126$

$n/p$ for Pb $= \frac{126}{82} = 1.53$

$n/p$ for Bi $= \frac{126}{83} = 1.51$

$\therefore \frac{n}{p}$ for Pb $> \frac{\text{n}}{\text{p}}$ for Bi

159 **(b)**

Let $x$ α −particles are emitted

$_{84}\text{Po}^{215} \rightarrow_{82} \text{Pb}^{211} + x\ {}_{2}\text{He}^{4}$

Equating the atomic mass of both sides

$215 = 211 + 4x$

$\therefore x = \frac{215 - 211}{4} = \frac{4}{4} = 1$

Therefore, one α −particle is emitted

160 **(b)**

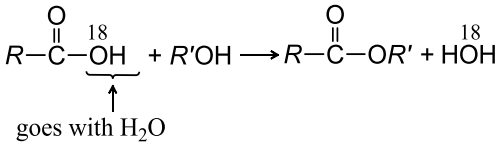
Energy of photon= $\frac{hc}{\lambda}\text{J} = \frac{hc}{e\lambda}\text{eV}$

$= \frac{6.625 \times 10^{-34} \times 3 \times 10^{8}}{300 \times 10^{-9} \times 1.602 \times 10^{-19}} = 4.14$ eV

For photoelectric effect to occur, energy of incident photons, must be greater than work functions of metal. Hence, only Li, Na, K and Mg have work functions less than 4.14 V.

162 **(b)**

OH of acid is lost in esterification of acid




164 **(b)**

5. **False**. See fig.(e) below
6. **True**. See fig (g) below
7. **True**. See fig (i) below
8. **False**. Bosons does not follow Pauli exclusion principle

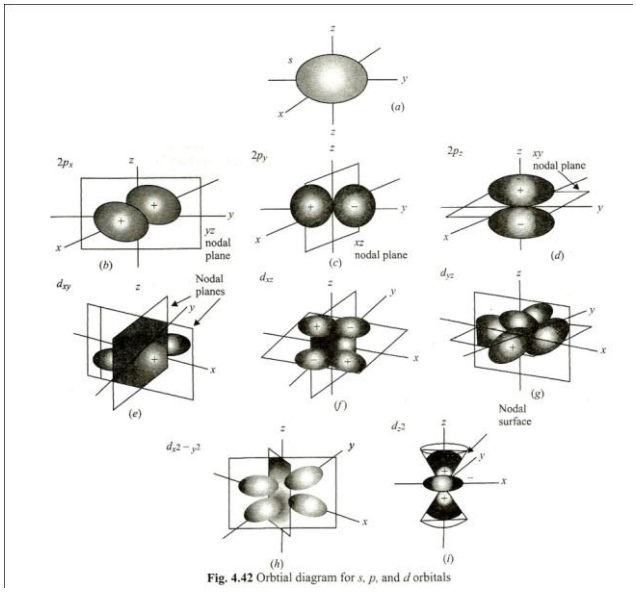


Fig. 4.42 Orbtial diagram for *s*, *p*, and *d* orbitals

165 **(b)**

Let the reaction emits $x$ α-particles and $y$ β-particles ${}_{90}\text{Th}^{232} \rightarrow x\ {}_{2}\text{He}^{4} + y\ {}_{-1}e^{0} + {}_{82}\text{Pb}^{208}$

Equating atomic mass number of both sides

$232 = 4x + y(0) + 208$

$\therefore x = \dfrac{232 - 208}{4} = \dfrac{24}{4} = 6$

$\therefore$ α-particle emitted $= 6$

Equating atomic number of both sides

$90 = 82 + 6 \times 2 + y(-1)$

$\therefore y = 94 - 90 = 4$

$\therefore$ β-particle emitted $= 4$

166 **(d)**

${}^{234}_{90}\text{th} \xrightarrow{-\alpha_1} {}^{230}_{88}\text{Rn}$

**Note** Element with atomic number 88 belongs to IIA

171 **(d)**

$n \neq m$

173 **(b)**

According to Rutherford's model of atom, an atom consists of a positively charged heavy part called nucleus where most of the mass of the atom is concentrated. Protons and neutrons are present in the nucleus

Size of the nucleus is very small compared to the size of the atom

Around the nucleus, there is extranuclear part in which there are electrons

Electrons revolve around the nucleus in circular orbits, like planets around the sun, and they are called plantary electrons

174 **(b)**

$5f^{14}, 6d^{3} \Rightarrow 17\text{e}^{-}$

$5f^{14} = (n + l) = 5 + 3 = 8$

$6d^{3} = (n + l) = 6 + 2 = 8$

177 **(a)**

$1$ curie $= 3.7 \times 10^{10}$ dps

$$-\frac{dN}{dt} = kN$$

$$3.7 \times 10^{10} = 4.4 \times 10^{-12} \times \frac{w}{14} \times 6.02 \times 10^{23}$$

$$w = 1.96 \times 10^{-1}\text{g} \approx 2 \times 10^{-4}\text{kg}$$

179 **(c)**

In the given reaction, conservation of atomic mass and atomic number is violated

180 **(b)**

2K, 8L, 9M, and 2N

$1s^2 2s^2\ 2p^6 3s^2\ 3p^6\ 3d^1 4s^2$

$\begin{pmatrix}\text{K means } n = 1, \text{L means } n = 2\\ \text{M means } n = 3, \text{N means } n = 4\end{pmatrix}$

Structure is $3d^1, 4s^2$

Atomic number 21

The total number of $pe^{-}$

$2p^6 + 3p^6 = 12$

181 **(a)**

Isotonic means having the same number of neutrons

| | ${}^{15}_{7}\text{N}$ | ${}^{14}_{6}\text{C}$ | ${}^{14}_{9}\text{F}^{\ominus}$ |
|---|---|---|---|
| Neutrons | 8 | 8 | 8 |

182 **(d)**

In all cases daughter elements change to stable nuclei

${}^{17}_{8}\text{O} \rightarrow {}^{16}_{8}\text{O} + {}^{1}_{0}n$ etc

183 **(b)**

$r \approx 10^{-13}$cm

190 **(c)**

Longest $\lambda$ or shortest $E$

1. $\dfrac{1}{\lambda} = r\left(\dfrac{1}{1} - \dfrac{1}{4}\right) = \dfrac{3R}{4} = 0.75R$

2. $\dfrac{1}{\lambda} = R \times Z^2\left(\dfrac{1}{3^2} - \dfrac{1}{4^2}\right) = R \times 9 \times \dfrac{7}{144} = 0.4375R$

3. $\dfrac{1}{\lambda} = R \times 2^2\left(\dfrac{1}{3^2} - \dfrac{1}{4^2}\right) = R \times 4 \times \dfrac{7}{144} = 0.194R$

4. $\dfrac{1}{\lambda} = R\left(\dfrac{1}{2^2} - \dfrac{1}{5^2}\right) = R \times \dfrac{21}{100} = 0.21R$

Lowest value of $1/\lambda$ or highest value of $\lambda$ or lowest $E$ is in (c)

192 **(c)**

Let $x\%$ of$Cl^{37}$and $(100-x)\%$ of $Cl^{35}$be present in $_{17}Cl^{35.5}$

$\therefore 35.5 = \dfrac{x \times 37 + (100-x) \times 35}{100}$

Solve for $x$,

$x = 25$

$\therefore$ % of $Cl^{37} = 25$

$\therefore$ % of $Cl^{35} = 75$

$\therefore$ Ratio is 1:3

193 **(c)**

$\bar{v}_1 = \dfrac{1}{\lambda_1} = R\left(\dfrac{1}{2^2} - \dfrac{1}{3^2}\right) = \dfrac{5R}{36}$

$\lambda = \dfrac{36}{5R}$

$\bar{v}_2 = \dfrac{1}{\lambda_2} = R\left(\dfrac{1}{2^2} - \dfrac{1}{4^2}\right) = \dfrac{3R}{16}$

$\lambda_2 = \dfrac{16}{3R}$

When $\frac{36}{5R} \rightarrow 656.1$ nm

$\therefore \dfrac{16}{3R} = \dfrac{656.1 \times 5R \times 16}{36 \times 3R} = 486$ nm

194 **(c)**

Average life $= 1.443 \times$ half-life

$= 1.443 \times 6.0 = 8.658$ h

195 **(c)**

For transient equilibrium

$$\left(\frac{dN}{dt}\right)_{\text{parent element}} = \left(\frac{dN}{dt}\right)_{\text{daughter element}}$$

$\lambda_1 N_1 = \lambda_2 N_2$

$\lambda_1$and $\lambda_2$are disintegration constant $N_1$and $N_1$are the number of atoms

Also, $\lambda_1 \propto \frac{1}{\text{half-life } t_1}$and $\lambda_2 \propto \frac{1}{t_2}$

Thus, $N_1\lambda_1 = N_2\lambda_2$

$\frac{N_1}{t_1} = \frac{N_2}{t_2}$ or $N_1 t_2 = N_2 t_2$

197 **(c)**

$^{238}_{92}U \rightarrow {}^{234}_{90}th + {}^{4}_{2}He$

lllB $\alpha -$ particle

Elements with atomic number 90 to 103 form $5f$ series and are called actinides. They are placed in group IIIB

198 **(d)**

Three neutrons are released due to attack of one neutron. Additional two electrons further attack U-nucleus and thus a chain reaction starts

199 **(d)**

$^{12}_{6}C$, $^{16}_{8}O$, $^{24}_{12}Mg$with even neutrons are even protons are satble

200 **(d)**

U u b

↑ ↑ ↑

1 1 2

201 **(a)**

Shortest $\bar{v}$ means shortest $E$ and vice versa

When,$n = 1, n_2 = 2$

$\bar{v} = R\left(\dfrac{1}{1^2} - \dfrac{1}{2^2}\right) = \dfrac{3}{4}R$

Longest $\bar{v}$means longest $E$

When $n_1 = 1, n_2 = \infty$

$\bar{v} = R\left(\dfrac{1}{1^2} - \dfrac{1}{\infty^2}\right) = R$

203 **(d)**

Mass number is a whole number

204 **(c)**

$_{13}A^{27} + {}_{2}He^{4} \rightarrow {}_{14}P^{30} + {}_{Z}X^{A}$

Equating mass number of both sides

$27 + 4 = 30 + A$

$\therefore A = 31 - 30 = 1$

Equating atomic number of both sides

$13 + 2 = 14 + Z$

$\therefore Z = 1$

$\therefore$ Particle is $_{1}H^{1}$

205 **(c)**

$^{24}_{11}Na \rightarrow {}^{24}_{12}Mg + {}^{0}_{-1}e$

(β)

$y =$ number of half-life $= \frac{60}{15} = 4$

$N = N_0\left(\dfrac{1}{2}\right)^{y}$

$= 100\left(\dfrac{1}{2}\right)^{4} = \dfrac{100}{16} = 6.25\%$

206 **(c)**

X-rays are not having any charge, therefore they are not deflected by electric and magnetic fields

207 **(d)**

**True**. It is true to the fact that the electron interacts in different manner with the

external magnetic field

**True**. This splitting is known as Zeeman effect

**True**.

**False**. It decreases with increase in the value of atomic number as is evident from the expression

$$E = -\frac{1}{n^2}\left[\frac{2\pi^2 m\left(\frac{Ze^2}{4\pi\varepsilon_0}\right)^2}{h^2}\right]$$

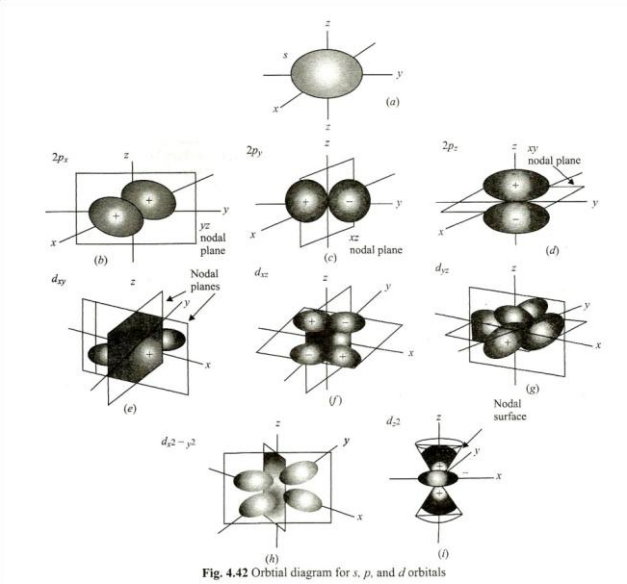


Fig. 4.42 Orbtial diagram for *s*, *p*, and *d* orbitals

209 **(a)**

2K, 8L, 9M, and 2N

$1s^2 2s^2\ 2p^6 3s^2\ 3p^6\ 3d^1 4s^2$

$\begin{pmatrix}\text{K means } n=1, \text{L means } n=2\\ \text{M means } n=3, \text{N means } n=4\end{pmatrix}$

Structure is $3d^1, 4s^2$

Atomic number 21

The total number of $s$ $e^-$

$1s^2 + 2s^2 + 3s^2 + 4s^2 = 8$

210 **(a)**

If Aufbau rule is not followed, electronic configuration is K: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^1$. Last electron is in $3d$(instead of $4s$), hence $d$ block (but it is of $s$ block)

211 **(c)**

$_7N^{14} + {}_1H^1 \rightarrow {}_8O^{15} + {}_ZX^A$

Equating mass number of both sides

$14 + 1 = 15 + A$

$\therefore A = 0$

Equating atomic number of both sides

$7 + 1 = 8 + Z$

$\therefore Z = 0$

The particle is γ

213 **(b)**

Ni$(Z = 28)$ or $3d^8\ 4s^2$

$\therefore Ni^{2+} = d^8$

215 **(d)**

$\bar{v}_{H_2^{\oplus}} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = 15200\ \text{cm}^{-1}$

$\bar{v}_{Li^{2+}} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = 3^2 \times 15200$

$= 136800\ \text{cm}^{-1}$

217 **(a)**

Vapour density = 46

Molecular weight= 92

So, compound is $N_2O_4$

Total number of $e^- = 7 \times 2 + 8 \times 4 = 46$

Total number of $e^-$ in 1 mole= $46N_A$

219 **(b)**

When both neutron and protons are even the nucleus is most stable

220 **(c)**

$_{110}D$ is U u n

↑ ↑ ↑

1 1 0

221 **(c)**

**False**. The half-filled and fully-filled electronic configurations are more stable. It is due to the larger exchange energy

**False**. The symbol $s$stands for sharp-a term used in the characterization of spectral lines. The symbols $p$, $d$ and $f$ stand for principal, diffuse, and fundamental, respectively

**True**.

**False**. The expression is $E = hc/\lambda$

Hence, energy and wavelength are inversely related

223 **(d)**

$_{92}U^{235} \rightarrow {}_ZX^A + 2\ {}_2He^4 + {}_{-1}e^0$

Equating the mass number of both sides

$235 = A + 2 \times 4 + 0$

$\therefore A = 235 - 8 = 227$

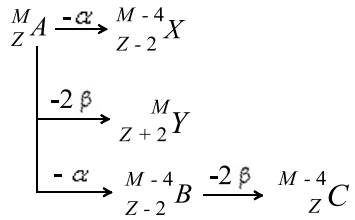
Similarly, equating atomic number of both sides

$92 = Z + 2 \times 2 - 1$

$\therefore Z = 92 - 3 = 89$

$\therefore {}_ZX^A = {}_{89}Ac^{227}$

224 **(c)**




*A* and C have same atomic number and are thus isotopes. Thus, emission of one α −and two β −particles result in the formation of an isotope

226 **(c)**

The de Broglie wavelength is

$\lambda = \frac{h}{mv} = \frac{(6.626 \times 10^{-34}\text{J s})}{(0.200\text{ kg})\{5\text{m}/(60 \times 60\text{ s})\}}$

$= 2.4 \times 10^{-30}\text{m}$

227 **(c)**

1. **True**. The number of orbitals for a given value $l$ is equal to the permitted value of $m$ which can take values $0, \pm1, \pm2, \ldots, \pm l$, at total of $2l + 1$ values

2. **True**.

3. **False**. A diamagnetic atom has no unpaired electrons

4. **True**.

228 **(c)**

$l = 0$ or *s*orbital

229 **(d)**

$y =$ number of half-life $= \frac{7.5}{2.5} = 3$

$N = N_0\left(\frac{1}{2}\right)^y$

$= 100\left(\frac{1}{2}\right)^3$

Amount left $= \frac{100}{8} = 12.5$ g

Amount decayed $= 100 - 12.5 = 87.5$ g

230 **(b)**

1 amu $= 1.66 \times 10^{-24}$ g $= 1.66 \times 10^{-27}$ kg

$E = mc^2$

$= 1.66 \times 10^{-27} \times (3 \times 0^8)^2$

$= 1.4950 \times 10^{-10}$ J

$= \frac{1.4950 \times 10^{-10}\text{ J}}{1.602 \times 10^{-19}\text{J/eV}}$

$= 933.21 \times 10^6$ eV

$= 933.21$ MeV

231 **(c)**

According to the conclusions of Rutherford's α-scattering experiment,most of the atom is empty. So, the α-particles go across undeflected. The positive charge is concentrated in a very small space in the atom, which deflected the positively charged α-particles. This small and positively charged heavy centre is called the nucleus. α-particles that happen to travel in line with the nucleus get deflected by 180°

233 **(a)**

$^{235}_{92}\text{U} \rightarrow {}^{\text{b}}_{\text{a}}\text{X} + {}^{4}_{2}\text{He}$

b + 4 = 235 thus b = 231

a + 2 = 92 and a = 90

thus, $^{\text{b}}_{\text{a}}\text{X}$ is $^{231}_{90}\text{X}$

234 **(b)**

**False**. The correct statement is as under:

No two electrons in an atom can have the same values of all the four quantum numbers $n, l, m$, and $m_s$

**True**. The expressions are

$\text{PE} = -\frac{Ze^2}{(4\pi\varepsilon_0)r}$

$E = \text{KE} + \text{PE}$

$= \frac{1}{2}\frac{Ze^2}{(4\pi\varepsilon_0)r} - \frac{Ze^2}{(4\pi\varepsilon_0)r} = -\frac{1}{2}\frac{Ze^2}{(4\pi\varepsilon_0)r}$

**False**. The expression of velocity is $v = \frac{1}{n}$ (constant)

**False**. The expression of velocity is $E = -\frac{1}{n^2}$ (constant)

235 **(a)**

If proton increases, then neutron/proton ratio decreases. When neutron changes to proton, a $\beta$ −particle (electron) is emitted

$${}^{1}_{0}n \rightarrow {}^{1}_{1}\text{H} + {}^{0}_{-1}\text{e}$$

Thus, $n$ (neutron) decreases and $p$ (proton) increases. Thus, neutron/proton decreases

236 **(a)**

The magnitude of the charge should be smallest and other charges should be integral multiple of that smallest charge, so, in this problem, smallest charge is $2.30 \times 10^{-15}$, but, other charges are not integral multiple of this charge

So, smallest charge is $1.15 \times 10^{-15}$ because other charges are integral multiple of this charge

237 **(a)**

$t_{1/2} = 1600$ min, T = 6400 min

Number of half lines $= \frac{6400}{1600} = 4$

We know that $N = \left(\frac{1}{2}\right)^{n} N_0$

Or $\frac{N}{N_0} = \left(\frac{1}{2}\right)^{n} = \left(\frac{1}{2}\right)^{4} = \frac{1}{16}$

238 **(a)**

The larger the value of the principle quantum number, larger the size of the shell and hence the orbital

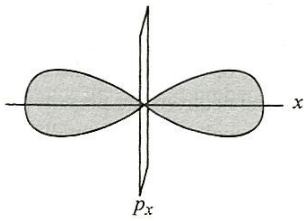
239 **(c)**

$\Delta E = h\nu$ and $\Delta E = \frac{hc}{\lambda}$

The wavelength of a spectral line for an electronic transition is inversely related to the difference in the energy of the energy levels involved in the transition

240 **(b)**

$yz$-plane




| Orbital | $m$ | Shape | Nodal plane |
|---|---|---|---|
| $p_x$ | $\pm 1$ | Dumb-bell | $yz$ |
| $p_y$ | $\pm 1$ | Dumb-bell | $zx$ |
| $p_z$ | 0 | Dumb-bell | $xy$ |

242 **(a)**

${}^{37}_{18}\text{Ar} + {}^{0}_{-1}\text{e} \rightarrow {}^{37}_{17}\text{X}$

${}^{37}_{17}$Xwith atomic number 17 is Cl

Thus, ${}^{37}_{17}\text{Cl}$

243 **(d)**

$s$orbitals are independent of angular wave function. Thus, they do not have any angular node. They have only spherical node. The number of spherical nodes in $s$ orbitals are given by $(n-1)$, where $n$ is the principal quantum number

244 **(b)**

**False**. The neutrino has zero charge and seems to have rest mass equal to zero. It is emitted along with the emission of a position (positive charge of +1e and mass equal to electron). For example

${}^{19}_{10}\text{Ne} \rightarrow {}^{19}_{9}\text{F} + {}^{0}_{1}\text{e} + \text{V}$

Antineutrino is emitted along with the emission of β-particle

**True**. The expression of magnetic moment is

$$\mu_m = \sqrt{n(n+2)}\mu_B$$

**False**

**False**. The correct expression is

$$L = \sqrt{l(l+2)}\left(\frac{h}{2\pi}\right)$$

245 **(b)**

${}^{30}_{15}$Xwith atomic number – 15 is isotope of phosphorus

247 **(b)**

| Name | Wavelength (Å) |
|---|---|
| Radiowave | $3 \times 10^{14} - 3 \times 10^{7}$ |
| Infrared (IR) | $6 \times 10^{6} - 7600$ |
| Ultraviolet (UV) | $3800 - 150$ |
| X-rays | $150 - 0.1$ |

248 **(c)**

Binding energy per nucleon $= \frac{\text{Total energy}}{\text{number of nucleon}}$

$= \frac{28}{4} = 7$ MeV

250 **(b)**

Number of spectral lines from $n_1$ to $n_2$

$= \frac{(n_2 - n_1 + 1)(n_2 - n_1)}{2}$

$= \frac{(5-2+1)(5-2)}{2} = 6$

251 **(c)**
For every value of $l, m$ can be from $-l$to$+l$ through 0(zero). For $l = 2, m$ cannot be $-3$

252 **(a)**
$r_n = \frac{r_1 \text{for H} \times n^2}{Z} = \frac{0.529\ \text{Å} \times n^2}{Z}$
$r_2 \text{for Li}^{2+} = \frac{0.529 \times 2^2}{3} = \frac{0.529 \times 4}{3}$ Å

253 **(d)**
Shortest λ will be produced in the ion, which has high $Z$ value
$Z \text{ for } H_2^{\oplus} = 1,\ Z \text{ for } He^{\oplus} = 2$
Z for$D = 2,\ Z$for $\text{Li}^{2+} = 3$

255 **(a)**
Meson

256 **(b)**
Lyman series

257 **(d)**
$\frac{\text{KE}}{E_{\text{Total}}} = \frac{1}{2}\frac{-Ze^2}{r_n} \Big/ -\frac{Ze^2}{2r_n} = -1$

258 **(a)**
Electronic configuration of fluorine and neon are 2,7 and 2, 8, respectively

259 **(c)**
$m = 200\ \text{g} = 0.2\ \text{kg}$
$v = 5\ \text{m h}^{-1} = \frac{5}{60 \times 60}\ \text{m s}^{-1} = 0.00139\ \text{m s}^{-1}$
$\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}}{0.2 \times 0.00139} = 2.3 \times 10^{-30}\ \text{m}$

260 **(d)**
Isobars have same atomic mass number

262 **(b)**
Catalyst has no effect on nucleus reactions

264 **(b)**
Radioactive element has atomic number > 83

267 **(d)**
$T = n \times t_{1/2}$
$\therefore n = \frac{T}{t_{1/2}} = \frac{560}{140} = 4$
Now, $N_t = N_0 \left(\frac{1}{2}\right)^n = 1 \times \left(\frac{1}{2}\right)^4 = \frac{1}{16}\text{g}$

268 **(b)**
The orbital angular momentum is: $\frac{h}{2\pi}\sqrt{l(l+1)}$
The orbital angular momentum for an electron in $s$orbital ($l = 0$) is 0

270 **(d)**
Any orbital can have a maximum of two electrons and with opposite spins. This is according to Pauli's exclusion principle

271 **(b)**
Unknown species is ${}^{b}_{a}X$
$235 + 1 = 146 + b + 3$
$b = 87$
$92 + 0 = 67 + a$
$a = 35$
Thus, ${}^{b}_{a}X$ is ${}^{87}_{35}\text{Br}$

272 **(c)**
Rate of disintegration does not depend upon the environmental factor

274 **(d)**
I, II and III are true

275 **(d)**
$\text{KE} = hv_0 - hv_0$
$hv_1 - hv_0 = 2(hv_2 - hv_0)$
$v_0 = 2(v_2 - v_1)$
$= 2(2.0 \times 10^{16}) - (3.2 \times 10^{16})$
$= 8 \times 10^{15}\text{s}^{-1} = 8 \times 10^{15}\ \text{Hz}$

277 **(a)**
$\overline{v}_{H_2^{\oplus}} = \frac{1}{\lambda_{H_2^{\oplus}}} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ ...(i)
$\overline{v}_{He^{\oplus}} = \frac{1}{\lambda_{He^{\oplus}}} = RZ^2\left(\frac{1}{2^2} - \frac{1}{4^2}\right)$
$= R \times 4\left(\frac{1}{4} - \frac{1}{16}\right)$
$= R \times \left(\frac{4}{4} - \frac{4}{16}\right) = R \times \left(1 - \frac{1}{4}\right)$...(ii)
Comparing equations (i) and (ii)
$\therefore \frac{1}{n_1^2} = 1, n_1 = 1$
$\frac{1}{n_2^2} = \frac{1}{4}, n_2 = 2$

279 **(c)**
Average life $= 1.44 \times T_{50} = 144$ yr

280 **(a)**
$V_{H_2^{\oplus}} = \frac{2\pi Ze^2}{nh}$ or $V \propto \frac{Z}{n}$
$\therefore V_{H_2^{\oplus}} \propto 1(Z = 1, n = 1)$
$V_{\text{Li}^{2+}} \propto \frac{Z}{n} \propto \frac{3}{3} \propto 1(Z = 3, n = 3)$
Therefore, velocity of $e^-$ in the third orbit of $\text{Li}^{2+}$is the same velocity of an $e^-$ in the first orbit of H atom, i.e., $V$

281 **(d)**

According to the group displacement law

283 **(b)**

The first use of quantum theory to explain the structure of atom was made by Bohr

284 **(c)**

1. **False**. The configuration is $3d^5 4s^1$

2. **False**. The wavelength of gamma rays is of the order of $10^{-11}$m

3. **True**. In hydrogen atom, the energy of an electron depends only on the principal quantum number of the orbital which it occupies

4. **False**. In $xz$-plane, there is no electron density if an electron occupies $3d_{x^2-y^2}$ orbital

285 **(d)**

| | $n$ | $\alpha$ | $p$ | $e$ |
|---|---|---|---|---|
| $e$ | 0 | 2 | 1 | 1 |
| $m$ | 1 | 4 | 1 | 1/183 |
| $e/m$ | 0 | 0.5 | 1 | 1837 |

286 **(d)**

For photon, $E = hv$ (in form of particle and wave)

287 **(a)**

2K, 8L, 9M, and 2N

$1s^2 2s^2\ 2p^6 3s^2\ 3p^6\ 3d^1 4s^2$

$\begin{pmatrix} \text{K means } n=1, \text{L means } n=2 \\ \text{M means } n=3, \text{N means } n=4 \end{pmatrix}$

Structure is $3d^1, 4s^2$

Atomic number 21

Total number of unpaired $e^-$

$3d_1 = 1, n = 1$

289 **(a)**

$$E_n = \frac{E \text{ for H} \times Z^2}{n^2} = \frac{-13.6 \times 1^2}{25} = -0.54 \text{ eV}$$

292 **(a)**

**True**. For ionization, $n_2 = \infty$. Hence

$$\Delta E = R\left(\frac{1}{n_1^2}\right)$$

**False**. The ionization energy increases in proportion to the square of the positive charge in the nucleus as is evident from the expression

$$R = \frac{2\pi^2 m \left(\frac{Ze^2}{4\pi\varepsilon_0}\right)^2}{h^3 c}$$

$$\Delta\tilde{E}_i = R$$

**False**. The correct expression is $\Delta P \Delta x \geq \frac{h}{4\pi}$

**False**. For a multi-electron atom, the energy of an orbital depends on both principal and azimuthal quantum numbers. The larger the value of $n + l$, the larger the energy. For the same value of $n + l$, the larger the value of $n$, the larger the energy

293 **(d)**

$(d)$ ${}^{232}_{90}\text{Th} \xrightarrow{-6\alpha} {}^{208}_{78}X$ loss of 12 protons (atomic number) and 24 units atomic mass

$\downarrow -4\beta$

${}^{208}_{82}Y$ increase in 4 units of atomic number

Thus, ${}^{208}_{82}\text{Pb}$

294 **(b)**

Bohr's model is only applicable to a single electron species ($H, H_2^{\oplus}, Li^{2+}, Be^{3+}$)

297 **(c)**

$t_{1/2} = 30, T = 90\ \therefore n = \frac{T}{t_{1/2}} = \frac{90}{30} = 3$

$\therefore$ Number of half lives $= 3$

We know that $N = \left(\frac{1}{2}\right)^n N_0$

$\therefore N$ (Number of atom left after) $= \left(\frac{1}{2}\right)^3 \times 600$ disintegration)

$\therefore N = \frac{1}{8} \times 600 = 75$ atoms

298 **(a)**

The orbital angular momentum is: $\frac{h}{2\pi}\sqrt{l(l+1)}$

The orbital angular momentum for an electron in $d$ orbital ($l = 2$) is

$$\frac{h}{2\pi}\sqrt{l(l+1)} = \frac{h}{2\pi}\sqrt{2(2+1)} = \frac{h}{2\pi}\sqrt{6}$$

299 **(d)**

| Ion | Electronic configuration | Unpaired electrons |
|---|---|---|
| $Mg^{2+}$ | $1s^2, 2s^2\ 2p^6$ | 0 |
| $Ti^{3+}$ | $[Ar]4s^0\ 3d^1$ | 1 |
| $V^{3+}$ | $[Ar]4s^0\ 3d^2$ | 2 |
| $Fe^{2+}$ | $[Ar]3s^0\ 3d^6$ | 4 |

300 **(b)**

$$\frac{N_A}{N_B} = \frac{(T_{50})_A}{(T_{50})_B}$$

$$3.1 \times 10^9 = \frac{2 \times 10^{10}}{(T_{50})_B}$$

$$(T_{50})_B = 6.45 \text{ yr}$$

301 **(c)**

$l = 1$, therefore $p$orbitals

303 **(a)**

$1s^2, 2s^2, 2p_x^1, 2p_y^1, 2p_z^1$ (Pauli's exclusion principle)

305 **(b)**

Given,

Amount left $N = 1 - \frac{3}{4} = \frac{1}{4}$

$$N = N_0 \left(\frac{1}{2}\right)^n \Rightarrow \left(\frac{N}{N_0}\right) = \left(\frac{1}{2}\right)^n$$

$$\Rightarrow \left(\frac{1}{4}\right) = \left(\frac{1}{2}\right)^n \text{ or } n = 2$$

We know $T = n \times t_{1/2} \Rightarrow t_{1/2} = \frac{2}{2} = 1$ hr

307 **(c)**

$$r = \frac{n^2 a_0}{z}, \; n = 1$$

$z = 1$

$r_1 = a_0$

$r_2 = 4a_0$

$r_3 = 9a_0$

Hence, ratio is 1:4:9

309 **(b)**

Atomic number of inert gas atom = 20

Atomic mass of inert gas atom = 40 (isobaric to $Ar^{40}$)

$\therefore$ Number of neutron $= 40 - 20 = 20$

311 **(b)**

$H_\alpha$ line of Balmer series means first line of Balmer series

$n_1 = 2, n_2 = 3$

$$\bar{v} = \frac{1}{\lambda_\alpha} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = \frac{5R}{36}$$

$$\therefore \lambda_\alpha = \frac{36}{5R} = X$$

$H_\beta$ line of Balmer series means, second line of Balmer series, $n_1 = 2, n_2 = 4$

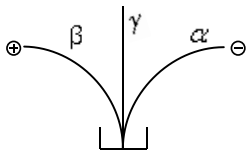
$$\bar{v} = \frac{1}{\lambda_\beta} = R\left(\frac{1}{2^2} - \frac{1}{4^2}\right) = \frac{3R}{16}$$

$$\therefore \lambda_\beta = \frac{16}{3R} = X$$

When $\frac{36}{3R} = X$

Then $\frac{16}{3R} = \frac{X \times 5R \times 36}{36 \times 3R} = \frac{80\,X}{108}$ Å

314 **(b)**




β −particles are negatively charged hence attracted towards positive plate

316 **(c)**

$$\frac{-1321}{4} - \left(\frac{1312}{1}\right) = 984 \text{ kJ}$$

317 **(c)**

Isotones have same number of neutrons

$_{32}Ge^{76}$ $n = 76 - 32 = 44$

1. $_{32}Ge^{77} n = 77 - 32 = 45$
2. $_{33}As^{77} n = 77 - 33 = 44$
3. $_{34}Se^{77} n = 77 - 34 = 43$
4. $_{34}Se^{78} n = 78 - 34 = 44$

So answer is (c)

318 **(b)**

Based on rock-dating

$$(1 + \frac{[\text{Pb}]}{[\text{U}]} = (2)^n$$

$$\left(1 + \frac{\frac{0.618 \times 10^{-6}}{206}}{\frac{0.238 \times 10^{-6}}{238}}\right) = (2)^n$$

$$(2)^2 = (2)^n$$

$$n = 2$$

$$2 = \frac{t}{T_{50}}$$

$$t = 2 \times T_{50} = 3 \times 10^9 \text{yr}$$

320 **(b)**

The radius of an atomic nucleus is of the order of $10^{-13}$ cm

322 **(d)**

$\lambda = \frac{h}{mv}$ distance travelled in one second by velocity $V = vcm = \lambda$

$$\lambda = \frac{h}{m\lambda} \Rightarrow \lambda^2 = \frac{h}{m} \Rightarrow \lambda = \sqrt{\frac{h}{m}}$$

323 **(c)**

2K, 8L, 9M, and 2N

$1s^2 2s^2\ 2p^6 3s^2\ 3p^6\ 3d^1 4s^2$

$\begin{pmatrix}\text{K means } n=1, \text{L means } n=2\\ \text{M means } n=3, \text{N means } n=4\end{pmatrix}$

Structure is $3d^1, 4s^2$

Atomic number 21

Valency of element in

Structure is $3d^1, 4s^2$

So, $e^-$ can be excited form $4s$ and $3d$ both (since energy difference between $3d$ and $4s$ is very very small)

So, valency is $+2$ and $+3$ both

324 **(c)**

$\lambda = \frac{h}{mv} = \frac{6.62 \times 10^{-34}}{0.5 \times 100} = 1.324 \times 10^{-34} \times 10^{-1}$

$= 1.324 \times 10^{-35}$m

325 **(d)**

5. **True**.
6. **True**.
7. **True**.
8. **False**. Lyman spectral series lies in the ultraviolet region

327 **(a)**

Number of spectral lines from the ground state

$= \frac{n(n-1)}{2} = \frac{5 \times 4}{2} = 10$

328 **(d)**

The lowest energy state is $1s$. It is not possible from this state to lose energy

329 **(a)**

Smaller the half-life, larger the number of atoms thus,

$\frac{N_1}{t_1} = \frac{N_2}{t_2}$

$N_1 t_2 = N_2 t_1$

$t_2 = \frac{N_2}{N_1} t_1 - \frac{10}{1} \times 15 = 150$ min

331 **(b)**

The species $_{13}Al^{29}$ (number of neutrons = 16) contains more neutrons than the isotope $_{13}Al^{27}$ (number of neutrons = 14). Neutrons on decomposition show β-emission

$_0n^1 \rightarrow {}_1H^1 + {}_{-1}e^0$

β −particle

333 **(d)**

Hund's rule

335 **(a)**

$\lambda = \frac{h}{mv} = \frac{6.6 \times 10^{-27} \text{erg s}}{\frac{2}{N_A} \times 2.4 \times 10^5 \text{cm s}^{-1}}$

$\left(\text{Mass of 1 molecule of} H_2 = \frac{2}{6.02 \times 10^{23}}\right)$

$= \frac{6.6 \times 10^{-27} \times 6.02 \times 10^{23}}{2 \times 2.4 \times 10^5}$

$= 8.27 \times 10^{-9}$cm

$= 0.8 \times 10^{-8}$ cm $= 0.8$ Å $\approx 1$ Å

336 **(a)**

Mass defect = 0.02 amu

$= \frac{0.02}{N_0}$ g atom$^{-1}$ $= \frac{0.02}{N_0} \times N_0$ g mol$^{-1}$

$= 0.02$ g mol$^{-1}$

$E = mc^2 = 0.02 \times 9 \times 10^{20}$erg mol$^{-1}$

$= \frac{0.02 \times 9 \times 10^{20} \times 0.002}{8.314 \times 10^7 \times 10^6}$ million kcal mol$^{-1}$

$\approx 430 \begin{pmatrix}1 \text{ million} = 10^6\\ 8.314 \times 10^7 \text{erg} = 0.002 \text{ kcal}\end{pmatrix}$

337 **(b)**

2K, 8L, 9M, and 2N

$1s^2 2s^2\ 2p^6 3s^2\ 3p^6\ 3d^1 4s^2$

$\begin{pmatrix}\text{K means } n=1, \text{L means } n=2\\ \text{M means } n=3, \text{N means } n=4\end{pmatrix}$

Structure is $3d^1, 4s^2$

Atomic number21

339 **(c)**

Atomic number =7

Structure is $1s^2, 2s^2, 2p^3$ [1] [1] [1]

$n = 3$,

Total spin = $\pm\frac{1}{2}n = \pm\frac{1}{2} \times 3 = \pm\frac{3}{2}$

Magnetic moment = $\sqrt{n(n+2)}$

$= \sqrt{3(3+2)} = \sqrt{15}$ BM

342 **(b)**

For $f$ orbital, $l = 3$, here $n = 2$

But $n < l$

344 **(c)**

Half life is independent to the initial amount of substance

346 **(b)**

The element is chromium atom in the ground state

348 **(c)**

If $\alpha$ −particles are emitted, difference in atomic mass should be in multiple of 4 units

(a) 235-231 = 4 units Yes

(b) 235-227 = 8 units Yes

(c) 235-225 = 10 units No

(d) 235-207 = 28 units Yes

350 **(a)**

Binding energy = 64 MeV

Binding energy/nucleon = 6.4

$\therefore$ number of nucleon $= \frac{64}{6.4} = 10$

351 **(b)**

$$\begin{bmatrix} \text{PE} = -\frac{Ze^2}{r_n}, \text{KE} = \frac{1}{2}\frac{Ze^2}{r_n} \\ E_{\text{Total}} = \frac{-Ze^2}{r_n} + \frac{1}{2}\frac{Ze^2}{r_n} = \frac{-Ze^2}{2r_n} \\ E_{\text{Total}} = \frac{1}{2}\text{PE} \\ \text{KE} = -\frac{1}{2}\text{ PE} \end{bmatrix}$$

$$\frac{\text{KE}}{\text{PE}} = \frac{1}{2}\frac{Ze^2}{r_n} \Big/ \frac{-Ze^2}{2r_n} = -\frac{1}{2}$$

352 **(d)**

In the chain reaction.

| | Energy | Neutrons |
|---|---|---|
| First step | $E$ | 3 |
| Second step | $3E$ | 9 |
| Third step | $9E$ | 27 |
| $n$th step | $3^{n-1}E$ | $3^n$ |

353 **(c)**

Due to β −emission, neutron changes to proton

${}^{1}_{0}n \rightarrow {}^{1}_{1}\text{H} + {}^{0}_{-1}\text{e}$

${}^{M}_{Z}A \rightarrow {}^{M}_{Z+1}B + {}^{0}_{-1}\text{e}$

Neutron $n = M - Z$ | Neutron $= M - (Z+1)$ $= M - Z - 1$

Proton $p = Z$ | Proton = Z + 1

Neutron decreases by 1 unit and proton increases by 1 unit

Thus, new ratio is $\left(\frac{n-1}{p+1}\right)$

355 **(a,b,c)**

In $d, n = l$, i.e., 3 but $l \neq n$

357 **(c)**

When α-particles are sent through a thin metal foil, most of them go straight the foil because most part of the atom is an empty space

358 **(a,c)**

Most of the elements are found in nature as a mixture of isotopes which have different atomic masses. Therefore, the atomic mass of any element is the average of the atomic masses of isotopes of that element

**Example:**

Given that the abundance of isotopes ${}^{54}\text{Fe}$, ${}^{56}\text{Fe}$ and ${}^{57}\text{Fe}$ is 5%, 90% and 5% respectively, the atomic mass of Fe is calculated as follows:

Atomic mass of iron $= \frac{(5\times54)+(90\times56)+(5\times57)}{100} =$ 55.95

359 **(b,d)**

Species having the same number of neutrons are called isotones

| | ${}^{76}_{32}\text{Ge}$ | ${}^{77}_{33}\text{As}$ | ${}^{78}_{34}\text{Se}$ |
|---|---|---|---|
| Neutrons | 34 | 34 | 34 |

363 **(b,c)**

Heisenberg principle is only for microscopic particles which are moving with very high speed

364 **(a)**

Excited state is given as $= \frac{-13.6 \text{ eV}}{n^2}$

e. g. , $n = 2, E = \frac{-13.6}{4} = -3.4$ eV

366 **(a,d)**

Both (a) and (d) are correct because each *p*orbital has one electron with parallel spin. This is correct in accordance with Hund's rule of maximum multiplicity

372 **(b,c)**

γ −particle is neutral while in K-capture electrical neutrality is maintained by capturing an electron fron K-shell

373 **(b,d)**

Angular quantum number ($l$) may have value less than the principal quantum number

i.e. $l < n$

**a**.$4f: n = 3, l = 3$

**c**.$2d: n = 2, d = 2$

374 **(c)**

Number of nodes= $n - l - 1 = 4 - 0 - 1 = 3$

377 **(b,c)**

Mn(atomic number = 25)

Electronic configuration

$= 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5 4s^2$

$3d^5 =$

| ↑ | ↑ | ↑ | ↑ | ↑ |
|---|---|---|---|---|

$\text{Mn}^{2+}$

Electronic configuration

$= 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$

$3d^5 =$

| ↑ | ↑ | ↑ | ↑ | ↑ |
|---|---|---|---|---|

380 **(b,d)**

The possible energy values of the excited state for an electron must be integral, multiple to the

ground state energy. In other words, energy absorbed or emitted must be integral multiple (Planck's theory)

382 **(a)**

According to $(n+l)$ rule

For $2s, n=2, l=0$

$\therefore n+l=2$

Similarly for $3d=(n+l)=5$

$4s=(4+0)=4$

$5f \rightarrow 5f=(5+3)=8$

$\therefore 2s$ is lower in energy

383 **(a,c)**

The maximum kinetic energy of photoelectrons is directly proportional to wave number $(\overline{v})$ and frequency $(v)$ of the incident radiation because energy $(E)$ of photon is given by the relation

$E=hv=hc\overline{v}$

$E \propto \overline{v} \propto v$

384 **(b,c)**

Angular momentum $=\sqrt{l(l+1)}\frac{h}{2\pi}$

For $d$ electron, $l=2$

$\therefore$ Angular momentum $=\sqrt{2(2+1)}\frac{h}{2\pi}=\sqrt{6}\cdot\frac{h}{2\pi}$

Or $\hbar=\frac{h}{2\pi}$

$\therefore$ Angular momentum $=\sqrt{6}\cdot\hbar$

385 **(a,c,d)**

${}_{Z}X^{A} \xrightarrow{-\alpha} {}_{Z-2}Y^{A-4}$ (α-emission)

${}_{Z}X^{A} \xrightarrow{-\beta} {}_{Z+1}Y^{A}$

(β-emission)

${}_{Z}X^{A} \xrightarrow{-{}_{+1}e^{0}} {}_{Z+1}Y^{A}$ (positron –emision)

${}_{Z}X^{A} + {}_{-1}e^{0} \rightarrow {}_{Z-1}Y^{A}$ (electron capture)

388 **(c)**

Third highest energy between : $n=5$ and $n=1$

$\Rightarrow 3 \rightarrow 1$

389 **(b,c)**

Both have even number of neutrons and protons and $n/p$ ratio of Mg $=1$ and Cd $\approx 1$

391 **(a,b,c)**

**Isotopes**: Elements that contain same atomic number

395 **(a,b)**

The atomic nucleus contains protons and neutrons

396 **(d)**

It corresponds to

$3p(3), 3d(5), 4s(1), 4p(3), 5s(1)=13$

400 **(d)**

Tritium is an isotope of hydrogen which has one proton and two neutrons. So, the total is 3

403 **(a,d)**

${}_{13}Al^{27} + {}_{2}He^{4} \rightarrow {}_{15}P^{30} + {}_{0}n^{1}$

${}_{96}Am^{241} + {}_{2}He^{4} \rightarrow {}_{97}Bk^{244} + {}_{1}e^{0} + {}_{0}n^{1}$

407 **(b,d)**

$n=4$ (principal shell)

$m=-2$

$s=+1/2$

410 **(a,d)**

In singly filled orbital electrons must align in one direction or they all must be spin-up (↑) or spin-down (↓)

416 **(a)**

$$v=\frac{c}{\lambda}=RcZ^{2}\left(\frac{1}{n^{2}}-\frac{1}{(n+1)^{2}}\right)$$

$$=RcZ^{2}\left(\frac{1+2n}{n^{2}(n+1)^{2}}\right)$$

$$\approx RcZ^{2}\frac{(2n)}{n^{4}} \propto n^{-3}$$

422 **(c)**

$V$: 3 unpaired electrons$\Rightarrow x$

Cr: 6 unpaired electrons $\Rightarrow y$

Mn:5 unpaired electrons$\Rightarrow z$

$\therefore y>z>x$

424 **(a,b,c)**

Refer to Rutherford's atomic experiment

425 **(a,b)**

Both $Pb^{207}$ and $Po^{215}$ belong to $4n+3$ series

429 **(b)**

For H atom, first Balmar linein series is

$$E_3-E_2=\frac{-E_1(\mathrm{H})}{(3)^2}-\frac{E_1(\mathrm{H})}{(2)^2}=\frac{5E_1(\mathrm{H})}{36}$$

For $He^{\oplus}$ion $(Z=2)$

$$E_6-E_4=-\frac{E_1(\mathrm{H})\times(2)^2}{6^2}-\frac{E_1(\mathrm{H})\times(2)^2}{4^2}$$

$$=-E_1(\mathrm{H})\times 2^2\left|\frac{16-36}{16\times 36}\right|$$

$$=\frac{4\times 20}{36\times 16}E_1(\mathrm{H})=\frac{5E_1(\mathrm{H})}{36}$$

434 **(a,b,c)**

Cr$(Z=24)$

$[\mathrm{Ar}]3d^{5}\,4s^{1}$

This is because $d^5$ is a more stable half-filled configuration. Reasons for the stability of half-filled and fully filled orbitals are symmetry and exchange energy

For every value of $l, m$ can be from $-l$ to $+l$ through 0

Ag$(z=47)$

$1s^{2}\,2s^{2}\,2p^{6}\,3s^{2}\,3p^{6}\,4s^{2}\,3d^{10}\,4p^{6}\,5s^{1}\,4d^{10}$

23 electrons have a spin of one type and 24 of the opposite type

The oxidation state of N in $HN_3$ is not $-3$ but $-1/3$

438 **(a,d)**

$t_{1/2} = \dfrac{0.693}{K}$

Therefore, $t_{1/2}$ is always constant and independent of initial concentration

439 **(a,b)**

Order of energies of different orbital is $s < p < d < f$

440 **(b)**

Cr: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5 (Z = 24$ for Cr)

$l = 1 \Rightarrow p$ orbital $\Rightarrow$ 12 electrons

$l = 2 \Rightarrow d$ orbital$\Rightarrow$ 5 electrons

441 **(b,c,d)**

Both neutron and proton are magic numbers

442 **(b,c)**

Spin angular momentum $= \sqrt{s(s+1)} \cdot \frac{h}{2\pi}$

$S = \sqrt{\dfrac{1}{2}\left(\dfrac{1}{2}+1\right)}\dfrac{h}{2\pi}$

$= \dfrac{\sqrt{3}}{2} \times \dfrac{h}{2\pi}$

444 **(b,c,d)**

The choice (a) is incorrect as the oxidation state of nitrogen in $HN_3$ is $-\frac{1}{3}$ and not $-3$

446 **(a,b,c)**

**Isotones:** Elements that contain same number of neutrons

448 **(a,b)**

**Exp**: Number of dark lines (in absorption), i.e., excitation = Number of bright lines (in emission), i.e., $de$-excitation

It is possible only when the $e^-$ is excited to $n = 2$ from ground state

Clearly, $\Delta E = 91.8$ eV and 40.8 eV are possible

$(Li^{2+})$ $(He^{\oplus})$

450 **(c,d)**

Nuclear isomers have same atomic number and atomic mass number. The decay constant depends upon initial amount of substance,

$K = \dfrac{2.303}{t}\log\dfrac{a}{a-x}$

453 **(a,b,c)**

Polonium is a radioactive element

457 **(a,b,c,d)**

In all reactions, an artificial disintegration of a stable nuclei leads to a radioactive isotope

463 **(b,d)**

2 hours = 4 half lives, therefore, amount left = 6.25% of original. Loss of one α-particles does not change the atomic number

465 **(a,d)**

Only the configuration of (a) and (d) follow Hund's rule

466 **(a,b,c)**

IE of hydrogen like species = IE(H)$\times Z^2/n^2$

Radius of orbits in hydrogen like species is given by the relation

$r_n = 0.529 \times \dfrac{n^2}{Z}$ Å

470 **(a,c)**

Energy of electrons in $n$th state $= -\frac{Z^2}{n^2} \times 13.6$ eV

$E_2(\text{H}) = -\frac{13.6}{4}$eV

$E_3(\text{He}^+) = -\dfrac{13.6 \times 4}{9}$

$\dfrac{E_2}{E_3} = \dfrac{9}{16}$

$E_3 = \dfrac{16}{9}E_2$

For negative value of $E_2$, $E_3$ will be, negative and for positive value of $E_2$, it will also be positive

475 **(a,b)**

Angular momentum $= \sqrt{l(l+1)}\,\frac{h}{2\pi}$

For $d$ electron, $l = 2$

$\therefore$ Angular momentum $= \sqrt{2(2+1)}\,\frac{h}{2\pi} = \sqrt{6} \cdot \frac{h}{2\pi}$

Or $\hbar = \frac{h}{2\pi}$

$\therefore$ Angular momentum $= \sqrt{6} \cdot \hbar$