1.

Match the following column -

Column I	Column II
(a) Orbital current (i) → r	(p) $\propto n^3/Z^2$
(b) Magnetic field (B) → S	(q) $\propto Z^2/n^2$
(c) Kinetic energy (K) → q	(r) $\propto Z^2/n^3$
(d) Time period (T) → p	(s) $\propto Z^3/n^5$

1.	$A \to Q$	$B \to P$	$C \to S$	$D \to R$
2	$A \to P$	$B \to R$	$C \to S$	$D \to Q$
3 ✓	$A \to R$	$B \to S$	$C \to Q$	$D \to P$
4	$A \to R$	$B \to P$	$C \to S$	$D \to Q$

$K \propto \frac{Z^2}{n^2}$

$I \propto f \propto \frac{1}{T} \propto \frac{Z^2}{n^3}$

$B \propto \frac{Z^3}{n^5}$

2.

According to Bohr correspondence principle when quantum number is very large –

(A) ✓ frequency of revolution of electron in an orbit is equal to the frequency of photon emitted when electron jumps from that orbit to next lower orbit

(B) classical physics approaches quantum physics

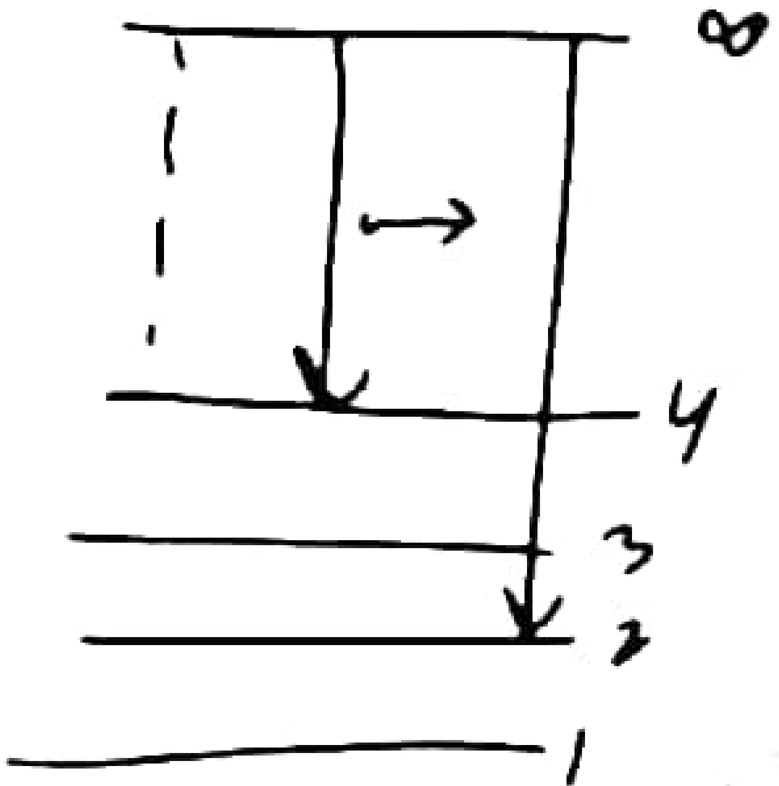
(C) wavelength of electron De Broglie wavelength does not depend on kinetic energy of electron

(D) Energy of electrons are not quantized

3.

The shortest wavelength of the Brackett series of a hydrogen like atom (atomic number = Z) is the same as the shortest wavelength of the Balmar series of hydrogen atom. The value of Z is –

(A*) 2 (B) 3 (C) 4 (D) 6



$$\frac{1}{\lambda_B} = RZ^2\left[\frac{1}{16}\right]$$

$$(\lambda_{shortest}) = \frac{16}{RZ^2}$$

$$\frac{1}{\lambda_{Balmer}} = R\left[\frac{1}{4} - 0\right]$$

$$(\lambda_{Balmer})_{S.L} = \frac{4}{R}$$

$$\frac{16}{RZ^2} = \frac{4}{R}$$

$$Z^2 = 4$$

$$Z = 2$$

4.

The distance of closest approach of an α-particle fired towards a nucleus with momentum p, is r. What will be the distance of closest approach when the momentum of α-particle is 2p ?

(A) 2r (B) 4r (C) r/2 (D*) r/4

$$K = U$$

$$\frac{p^2}{2m} = \frac{kq_1q_2}{r}$$

$$p^2 \propto \frac{1}{r}$$

$$4p^2 \propto \frac{1}{r'}$$

$$\frac{1}{4} = \frac{r'}{r}$$

$$r' = \frac{r}{4}$$

5.

A H-atom moving with speed v makes a head on collision with a H-atom in rest. Both atoms are in ground state. The minimum value of velocity v for which one of atom may excite is -

(A) 6.25×10^4 m/s (B) 8×10^4 m/s

(C) 7.25×10^4 m/s (D) 13.6×10^4 m/s

(m) → v   (m) V = 0
H   H

Coll^n perf Inelastic
loss in Eng = $\frac{1}{2}\frac{m_1 m_2}{m_1+m_2}(u_1-u_2)^2$

$= \frac{1}{2} \times \frac{m}{2} \times v^2$

$\frac{1}{2} \times \frac{1}{2} m v^2 = 10.2\,eV$

$v^2 = \frac{10.2 \times 1.6 \times 10^{-19}}{1.6 \times 10^{-27}} \times 4$

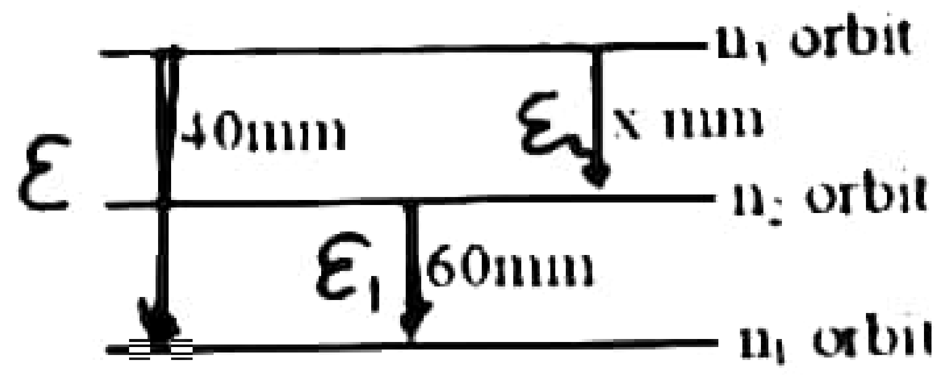
$v^2 \approx 10 \times 4 \times 10^8$

$v = 2 \times 3.1 \times 10^4$

$= 6.2 \times 10^4$ m/s.

6.

For an atom of ion having single electron, the following wavelengths are observed. What is the value of missing wavelength, x ?



(A) 20 (B) 40 (C) 60 (D) 120

$E = E_1 + E_2$

$\frac{1}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$

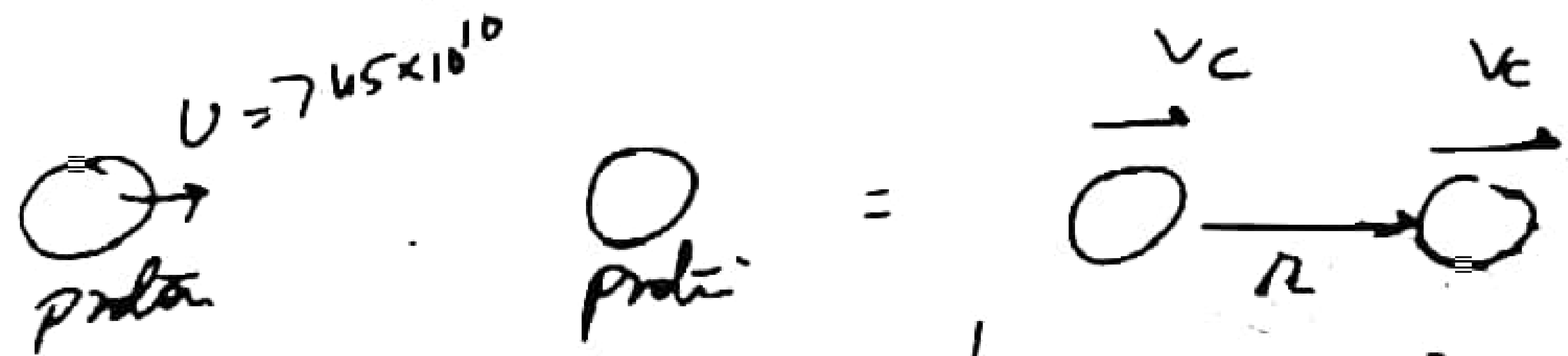
$\frac{1}{40} = \frac{1}{60} + \frac{1}{x}$

$x = 120$ mm.

7.

A proton moves with a speed of 7.45×10^5 m/s directly towards a free proton originally at rest. Find the distance of closest approach for the two protons. Take mass of a proton = 1.67×10^{-27} kg –

(A) 10^{-11} m (B) 10^{-12} m (C) 10^{-10} m (D) 10^{-9} m



Loss in K.E = Gain in P.E

$\frac{1}{2} \times \frac{m}{2} v^2 = \frac{ke^2}{r}$

$r = \frac{4ke^2}{mv^2}$

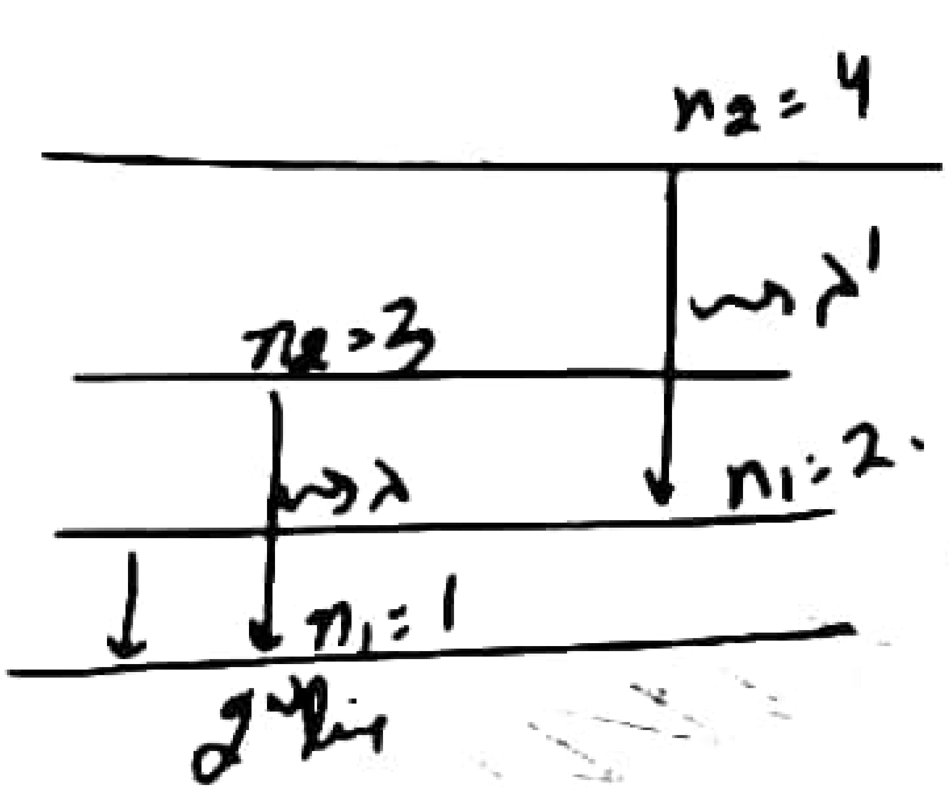
$r = \frac{4 \times 9 \times 10^9 \times 1.6 \times 1.6 \times 10^{-38}}{1.6 \times 10^{-27} \times 7.45 \times 7.45 \times 10^{10}}$

$r = 10^{-12}$ m

8.

If the wavelength of photon emitted due to transition of electron for 2nd line of lymann in hydrogen atom is λ, then the wavelength of photon emitted due to transition of electron for 2nd line of balmer will be -

(A) $\frac{128}{27}\lambda$ (B) $\frac{25}{9}\lambda$ (C) $\frac{36}{7}\lambda$ (D) None of these



$\frac{1}{\lambda} = R\left[1 - \frac{1}{9}\right]$

$\frac{1}{\lambda} = \frac{8R}{9}$

$\lambda = \frac{9}{8R}$

$\frac{1}{\lambda'} = R\left[\frac{1}{4} - \frac{1}{16}\right]$

$\lambda' = \frac{16}{3R}$

$\frac{\lambda}{\lambda'} = \frac{27}{128}$

$\lambda' = \frac{128}{27}\lambda$

9.

An electron with kinetic energy 5eV is incident on a H-atom in its ground state. The collision:

(A) must be elastic
(B) may be partially elastic
(C) must be completely inelastic
(D) may be partially inelastic

10.

The magnetic field at the centre of a hydrogen atom due to the motion of the electron in the first Bohr orbit is B. The magnetic field at the centre due to the motion of the electron in the second Bohr orbit will be -

(A) B/4 (B) B/8 (C) B/32 (D) B/64

$B \propto \frac{1}{n^5}$

$B \propto \frac{1}{1^5}$ -①

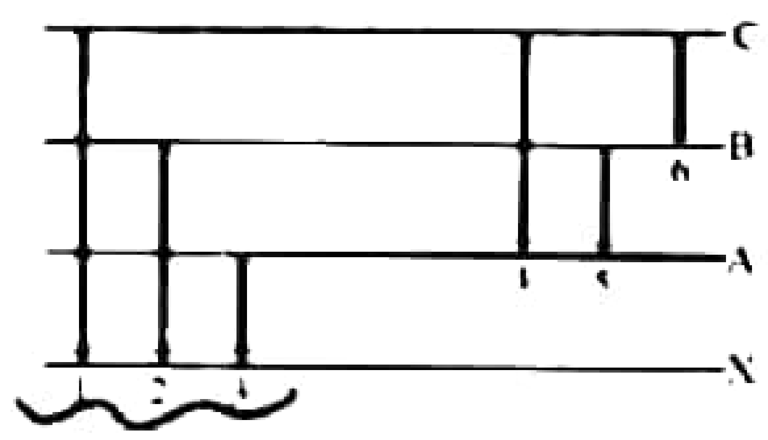
$B' \propto \frac{1}{2^5}$

$\frac{B}{B'} = 32$

$B' = B/32$

11.

The figure indicates the energy level diagram of an atom and the origin of six spectral lines in emission (e.g. line no. 5 arises from the transition from level B to A). Which of the following spectral lines will also occur in the absorption spectrum ?



(A) 4, 5, 6 (B) 1, 2, 3, 4, 5, 6

(C) 1, 4, 6 (D) 1, 2, 3

12.

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) $L_A > L_B$

$(I.E)_A > (I.E)_B$

$\frac{Z_A^2}{1^2} > \frac{Z_B^2}{1^2}$

$Z_A > Z_B$

$\rightarrow r \propto \frac{1}{Z}$

$r_A < r_B$

$\rightarrow V \propto \frac{Z}{n}$

$V_A > V_B$

$\rightarrow E = -\frac{13.6 Z^2}{n^2}$

$E_A < E_B$

$\rightarrow L = \frac{nh}{2\pi}$

$L_A = L_B$

13.

A particle of charge q and mass m moves in a circular orbit of radius r with angular speed ω. The ratio of the magnitude of its magnetic moment to that of its angular momentum depends on

(1) ω and q (B) ω, q and m (C) q and m (D) ω and m

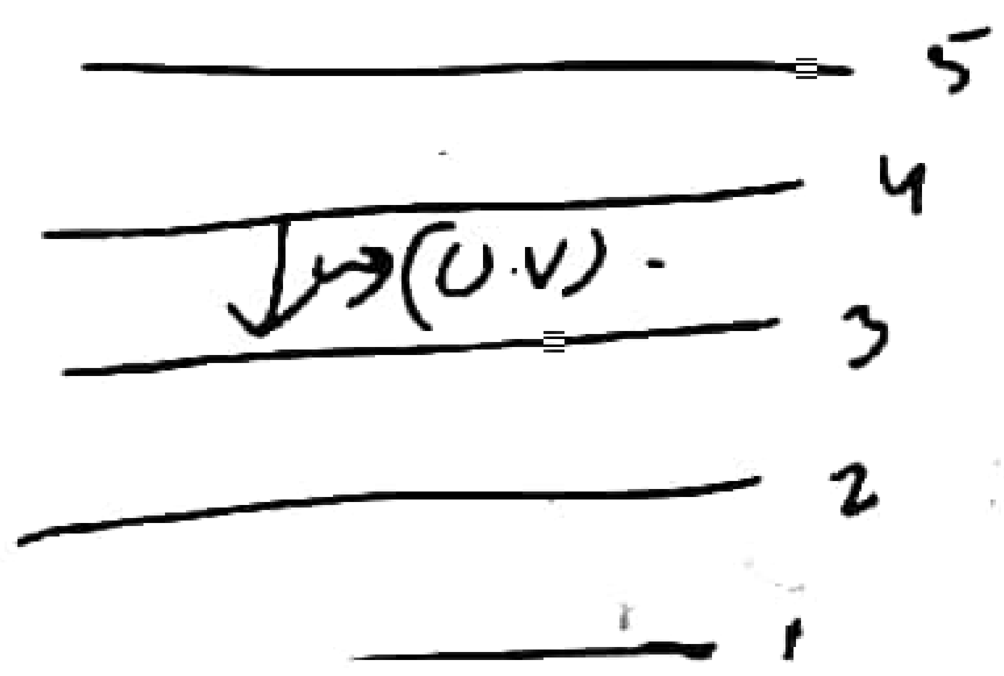
$$\frac{M}{L} = \frac{q}{2m}.$$

14.

The transition from the state n = 4 to n = 3 in a hydrogen-like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition

-

(A) $2 \rightarrow 1$ (B) $3 \rightarrow 2$ (C) $4 \rightarrow 2$ (D) $5 \rightarrow 4$



15.

If Bohr's Theory is applicable to $_{100}Fm^{257}$ then radius of 5^{th} orbit in Bohr's unit is –

(A) 100 (B) 1/4 (C) 4 (D) 257

$$r = r_0 \cdot \frac{n^2}{Z}$$

$$= r_0 \times \frac{25}{100} = \frac{1}{4} r_0$$

16.

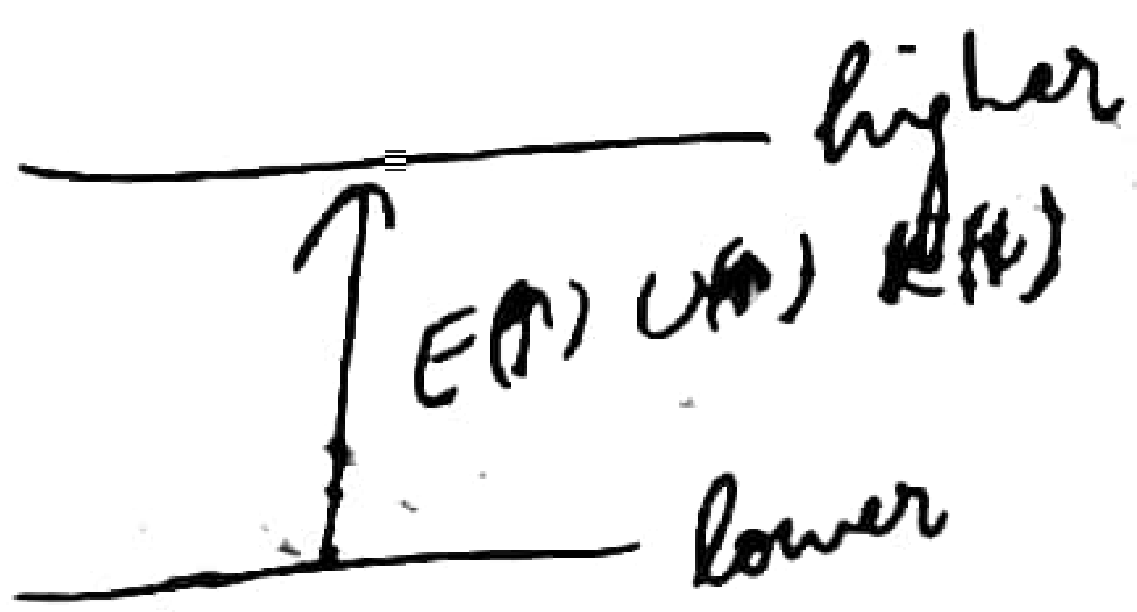
When an electron in an atom goes from a lower to a higher orbit, then choose correct statement for its kinetic energy (K.E.) and potential energy (P.E.) -

(A) K.E. increases but P.E. decreases

(B) K.E. increases and P.E. also increases

(C) K.E. decreases but P.E. increases

(D) K.E. decreases and P.E. also decreases



17.

SATEMENT-1 : 75% of radioactive nucleus remains active after 200 days for an element of half life 100 days. incorrect

SATEMENT-2 : $N = N_0 (1/2)^{t/T}$ where symbols have usual meaning. correct

(A) Both **SATEMENT-1** and **SATEMENT-2** are true

(B) Both **SATEMENT-1** and **SATEMENT-2** are false

(C) **SATEMENT-1** is true but the **SATEMENT-2** is false.

✓(D*) **SATEMENT-1** is false but **SATEMENT-2** is true

Sol

$$N = \frac{N_0}{2^{t/T}} = \frac{N_0}{2^{\frac{200}{100}}} = \frac{N_0}{4}$$

$$\text{active Nuclei} = \frac{N}{N_0} \times 100 = 25\%$$

18.

In Rutherford's α-particle scattering experiment, the ratio of number of α-particles scattered through an angle of 60º and 120º is -

(A) 1 : 2 (B) $\sqrt{3}$: 1 (C) 3 : 1 (D*) 9 : 1

$$N \propto \frac{1}{\sin^4\left(\frac{\theta}{2}\right)}$$

$$\frac{N_1}{N_2} = \frac{\sin^4(60)}{\sin^4(30)} = \left[\frac{\sqrt{3} \times 2}{2 \times 1}\right]^4 = \frac{9}{1}$$

19.

When electron revolve in a stable orbit then which one acceleration produces -

(A*) Radial (B) Tangential (C) Both (D) None

20.

An energy of 24.6 eV is required to remove one of the electrons from a neutral helium atom. The energy in eV required to remove both the electrons from the neutral helium atoms is -

(A*) 79 (B) 51.8

(C) 49.2 (D) 38.2

$E_{Total} = 24.6 eV + 54.4 eV$

$= 79 eV$

He^+ $E = 13.6 \times \frac{Z^2}{n^2}$

$= 13.6 \times \frac{4}{1}$

$E = 54.4 eV$

21.

The mean lives of a radioactive substance are 1620 year and 405 year for α-emission and β-emission respectively. Find the time during which three-fourth of a sample will decay if it is decaying both by α-emission and β-emission simultaneously.

(A) 249 years (B*) 449 years

(C) 133 years (D) 99 years

$\lambda_{eq} = \lambda_1 + \lambda_2$

$\frac{1}{\tau_{eq}} = \frac{1}{\tau_1} + \frac{1}{\tau_2}$

$= \frac{1}{1620} + \frac{1}{405} = \frac{1}{405}\left(\frac{1}{4} + 1\right) = \frac{1}{405} \times \frac{5}{4} = \frac{1}{324}$

$= \frac{1}{81} \times \frac{5}{4}$

$\tau_{eq} = 324 yr = \frac{t_{1/2}}{0.7}$

$\rightarrow N = \frac{N_0}{2^n}$

$\frac{N_0}{4} = \frac{N_0}{2^n}$

$n = 2$

$t_g = 2 \times t_{1/2}$

$= 2 \times 324 \times 0.7$

$t_{gin} = 449 yr$

22.

The phenomenon in which the masses of a particle and an antiparticle disappear to reappear as energy is called -

(A) Pair production
(B*) Annihilation
(C) Cerenkov radiation
(D) Compton scattering

23.

Tritium (^3_1H) has a half-life of 12.5y against beta decay. What fraction of a sample of tritium will remain undecayed after 25y ?

(A*) 1/4 (B) 3/4 (C) 1/2 (D) 3/8

$t_{1/2} = 12.5\,yr$

$N = \frac{N_0}{2^{25/12.5}} = \frac{N_0}{4}$

Fraction remain $= \frac{N}{N_0} = \frac{1}{4}$

24.

Two radioactive sources A and B of half lives of 1 hour and 2 hours respectively initially contain the same number of radioactive atoms. At the end of two hours, their rates of disintegration are in the ratio of -

(A) 1 : 4 (B) 1 : 3 (C) 1 : 2 (D*) 1 : 1

A: $t_{1/2} = 1\,hr$, N_0

B: $t_{1/2} = 2\,hr$, N_0

$\frac{dN}{dt} = \lambda N$

$\frac{\left(\frac{dN}{dt}\right)_A}{\left(\frac{dN}{dt}\right)_B} = \frac{\lambda_A}{\lambda_B} \times \frac{N_A}{N_B} = \frac{t_B}{t_A} \times \frac{2^{n_B}}{2^{n_A}} = \frac{2}{1} \times \frac{2^{2/2}}{2^{2/1}}$

$= 2 \times \frac{2^1}{2^2} = 1$

25.

The activity of a radioactive element decreases to one-third of the original activity I_0 in a period of nine years. After a further lapse of nine years its activity will be -

(A) I_0 (B) $\frac{2}{3}I_0$ (C) $\frac{I_0}{9}$ (D) $\frac{I_0}{6}$

I_0

A ⟶ B

t = 9 yr $\frac{I_0}{3}$

t = 18 y A = ?

$A = \frac{A_0}{2^n}$

$\frac{I_0}{3} = \frac{I_0}{2^{9/t}}$

$\frac{1}{3} = \frac{1}{2^{9/t}}$ — (1)

$\frac{1}{9} = \frac{1}{2^{18/t}}$

$A = \frac{I_0}{2^{18/t}}$

$A = \frac{I_0}{9}$

26.

A freshly prepared radio active source of half life 2 hours emits radiation of intensity which is 64 times the permissible safe level. The minimum time after which it would be possible to work safely with this source is–

(A) 6 h (B) 12 h (C) 24 h (D) 128 h

A_0

X ⟶ Y

t = ? $\frac{A_0}{64}$

$A = \frac{A_0}{2^n}$

$\frac{A_0}{64} = \frac{A_0}{2^n}$

$\frac{1}{2^6} = \frac{1}{2^n}$

n = 6

t = 6 × 2 = 12 hr

27.

22Ne nucleus, after absorbing energy, decays into two α- particles and an unknown nucleus. The unknown nucleus is -

(A) Nitrogen (B) Carbon (C) Boron (D) Oxygen

$${}_{10}Ne^{22} \xrightarrow{\text{Energy}} {}_{6}Y^{14} + 2\alpha\,({}_{2}He^{4})$$

28.

A radioactive isotope is being produced at a constant rate X. Half-life of the radioactive substance is Y. After some time the number of radioactive nuclei become constant. The value of this constant is:

(A) $\frac{XY}{\ln(2)}$ (B) XY (C) (XY) ln (2) (D) $\frac{X}{Y}$

Rate of prodn = X → A (N) → B, $t_{1/2} = Y$

For 'N' to be const, Rate of formation = Rate of disintegrn.

$X = \lambda N$

$N = \frac{X}{\lambda} = \frac{X \times t_{1/2}}{0.693} = \frac{XY}{2.3\log_{10}2}$

$N = \frac{XY}{\ln 2}$

29.

There are two radioactive substances A and B. Decay constant of B is two times that of A. Initially both have equal number of nuclei. After n half lives of A rate of disintegration of A is 8 times rate of disintegration of B. The value of n is:

(A) 1 (B) 2 (C) 4 (D) all of these

A B

λ_A $\lambda_B = 2\lambda_A$

N_0 N_0

$t_g = n\, t_A$ $n_B = \frac{t_g}{(t_{1/2})_B} = \frac{n \times (t_{1/2})_A}{(t_{1/2})_B} = n\frac{\lambda_B}{\lambda_A} = 2n$

$\left(\frac{dN}{dt}\right)_A = 8\left(\frac{dN}{dt}\right)_B$

$\lambda_A N_A = 8\lambda_B N_B$

$N_A = 16 N_B$

$\frac{N_0}{2^n} = \frac{16 N_0}{2^{2n}}$

$2^n = 16$

$2^n = 2^4$

$n = 4$

30.

A γ-ray photon in emitted:

(A) after ionization of an atom

(B) due to conversion of a neutron into a proton in the nucleus

(C) after de-excitation of a nucleus

(D) due to conversion of a proton into a neutron in the nucleus

31.

A nucleus with Z = 92 emits the following in a sequence :

$\alpha, \beta^-, \beta^-, \alpha, \alpha, \alpha, \alpha, \alpha, \beta^-, \beta^-, \beta^+, \alpha, \beta^+, \alpha$.

The Z of the resulting nucleus is -

(A) 74 (B) 76 (C) 78 (D) 82

$_{92}X \longrightarrow {}_{Z}Y + 8\alpha\,({}_2He^4) + 4\beta^-\,({}_{-1}e^0) + 2\beta^+\,({}_{+1}e^0)$

$92 = Z + 16 - 4 + 2$

$92 = Z + 14$

$Z = 78$

32.

The radioactivity of a sample is R_1 at a time T_1 and R_2 at a time T_2 If the half-life of the specimen is T, the number of atoms that have disintegrated in the time $(T_2 - T_1)$ is proportional to -

(A) $(R_1 T_1 - R_2 T_2)$ (B) $(R_1 - R_2)$ (C) $(R_1 - R_2)\ T$ (D) $(R_2 - R_1)/T$

A ⟶ B $t_{1/2} = T = \frac{0.693}{\lambda}$

T_1 $R_1 = \lambda N_1$

T_2 $R_2 = \lambda N_2$

No of atom disint.: $N_1 - N_2 = \frac{R_1 - R_2}{\lambda} = \frac{(R_1 - R_2)}{0.693} \times T$

$N_1 - N_2 \propto (R_1 - R_2) T$

33.

The counting rate observed from radioactivity source at t = 0 second was 1600 counts per second and at t = 8 seconds it was 100 counts per second. The counting rate observed, as counts per second at t = 6 seconds will be

(A) 400 (B) 300 (C) 200 (D) 150

$t = 0$ $A_0 = 1600\ c/s$

X ⟶ Y

$t = 8s$ $A = 100\ c/s$

$t = 6s$ $A = ?$

$A = \frac{A_0}{2^n}$

$100 = \frac{1600}{2^n}$

$n = 4$

$\frac{8}{t_{1/2}} = 4$ $\boxed{t_{1/2} = 2s}$

$A(t = 6s) = \frac{A_0}{2^n}$

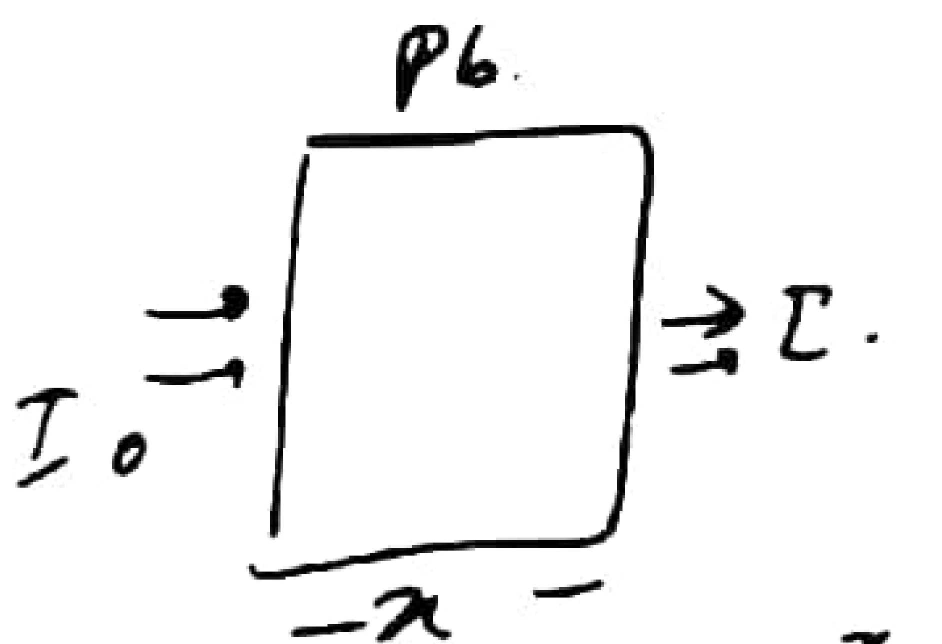
$= \frac{1600}{2^{6/2}}$

$= \frac{1600}{8} = 200\ c/s$

34.

The intensity of gamma radiation from a given source is I. On passing through 36 mm of lead, it is reduced to I/8. The thickness of lead which will reduce the intensity to I/2 will be -

(A) 6 mm (B) 9 mm (C) 18 mm (D) 12 mm



$I = I_0 e^{-\mu x}$

$\frac{1}{8} = e^{-\mu \times 36 mm}$ — ①

$\left(\frac{1}{2}\right)^3 = e^{-3\mu x}$ — ②

$\frac{1}{8} = e^{-3\mu x}$

$e^{-36\mu} = e^{-3\mu x}$

$36\mu = 3\mu x$

$x = 12 mm$

35.

The fraction of atoms of radioactive element that decays in 6 days is 7/8. The fraction that decays in 10 days will be -

(A) 70/80 (B) 77/88 (C) 31/32 (D) 35/36

$A = \frac{A_0}{2^{6/t_{1/2}}}$

$\frac{A_0}{8} = \frac{A_0}{2^{6/t_{1/2}}}$

$6/t_{1/2} = 3$

$t_{1/2} = 2$ days

$N = \frac{N_0}{2^{10/2}} = \frac{N_0}{32}$

$\therefore$ fraction decay $= \frac{N_0 - N}{N_0} = \frac{31}{32}$

36.

The activity of a radioactive sample is A_1 at time t_1 and A_2 at time t_2. If τ is average life of sample then the number of nuclei decayed in time $(t_2 - t_1)$ is -

(A) $A_1 t_1 - A_2 t_2$ (B) $\frac{(A_1 - A_2)}{2}\tau$

(C) $(A_1 - A_2)(t_2 - t_1)$ (D) $(A_1 - A_2)\tau$

$A_1 = \lambda N_1$ at t_1

$A_2 = \lambda N_2$ at t_2.

No of Nuclei decay $= N_1 - N_2 = \frac{A_1 - A_2}{\lambda} = (A_1 - A_2)\tau$

37.

Consider the nuclear reaction $X^{200} \to A^{110} + B^{80}$. If the binding energy per nucleon for X, A and B are 7.4 MeV, 8.2 MeV and 8.1 MeV respectively, then the energy released in the reaction -

(A) 70 MeV (B) 200 MeV (C) 190 MeV (D) 10 MeV

$X^{200} \longrightarrow A^{110} + B^{80}$

BE $= 7.4 \times 200$ MeV, 8.2×110 MeV, 8.1×80 MeV

$Q = 902 + 648 - 1480$

$= 70$ MeV

38.

When a free neutron decays to form a proton and an electron, then choose the incorrect statement.

(A) the reaction may be expressed as ${}_0n^1 \rightarrow {}_1P^1 + {}_{-1}e^0$ ✗

(B) every electron comes out with the same energy ✗

(C) the electron shares the major part of the energy released ✗

(D) all the above

$${}_0n^1 \rightarrow {}_1p^1 + {}_{-1}e^0 + \bar{\nu}$$

39.

Let F_{pp}, F_{pn} and F_{nn} denote the magnitude of the net force by a proton on a proton, by a proton on a neutron and by a neutron on a neutron respectively. Neglect gravitational force. When the separation is 1 fm, -

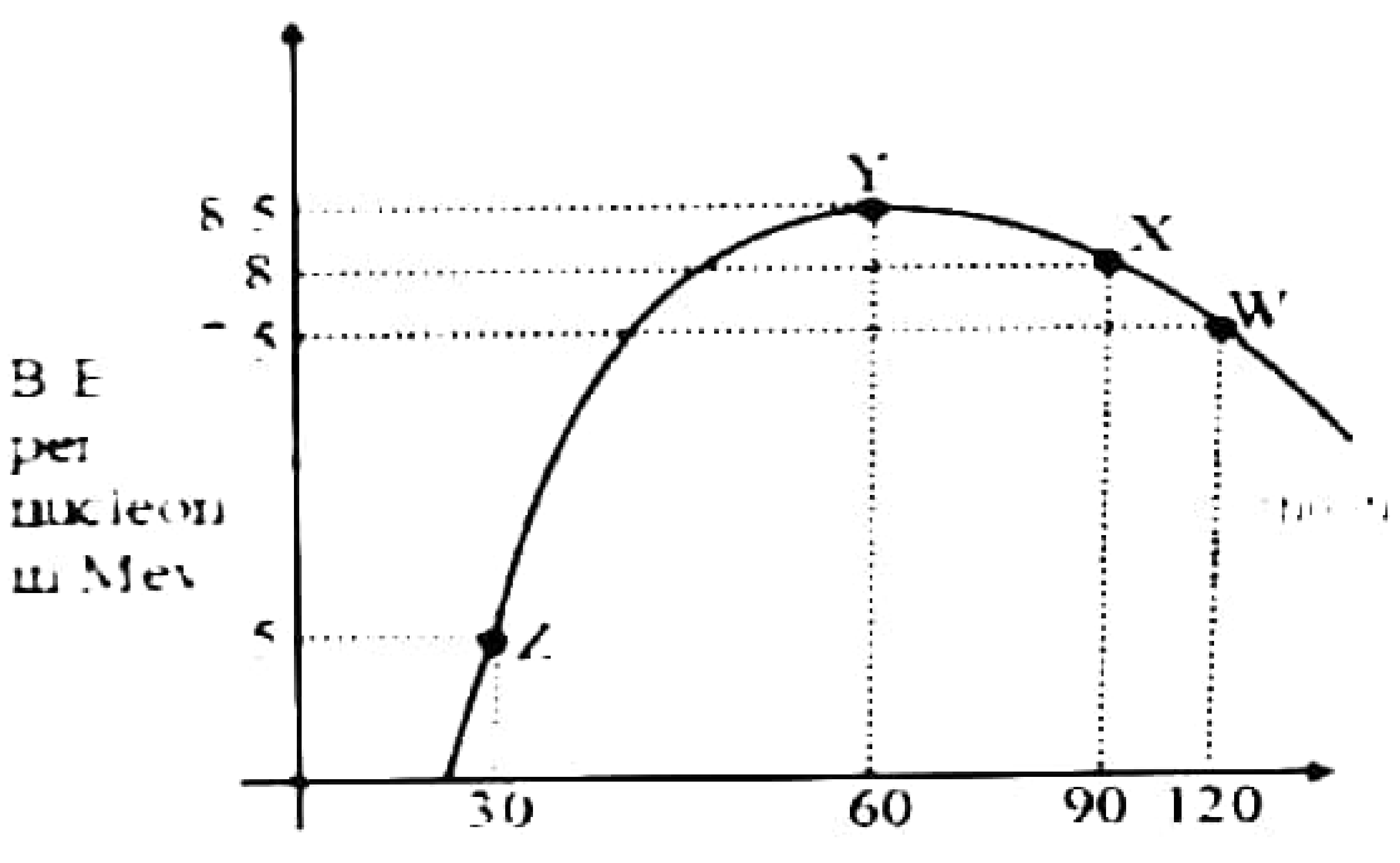
(A) $F_{pp} > F_{pn} = F_{nn}$ (B) $F_{pp} = F_{pn} = F_{nn}$

(C) $F_{pp} > F_{pn} > F_{nn}$ (D) $F_{pp} < F_{pn} = F_{nn}$

$$F_{p\text{-}n} = F_{n\text{-}n} > F_{p\text{-}p}$$

40.

Binding energy per nucleon vs mass number curve for nuclei is shown in the figure. W, X, Y and Z are four nuclei as indicated on the curve. The process that would release energy is–



(A) Y → 2 Z ✗ (B) W → Y + Z ✗

(C) W → 2Y (D) X → Y + Z ✗

41.

For pair production i.e. for the production of electron and positron incident photon must have minimum frequency of the order of –

(A) 10^{18}/sec (B*) 10^{21}/sec (C) 10^{25}/sec (D) 10^{30}/sec

$E = 1.02\,MeV = h\nu$

$1.02\times10^{6}\times1.6\times10^{-19} = 6.6\times10^{-34}\,\nu$

$\nu = 2.47\times10^{21}$/sec

$\approx 10^{21}$/sec

42.

If radius of the $^{27}_{13}Al$ nucleus is estimated to be 3.6 Fermi, then the radius of $^{125}_{52}Te$ nucleus be nearly -

(A) 4 Fermi (B) 5 Fermi (C*) 6 Fermi (D) 8 Fermi

$r \propto (A)^{1/3}$

$\frac{r_1}{r_2} = \left(\frac{A_1}{A_2}\right)^{1/3}$

$\frac{3.6\,\text{fermi}}{r_2} = \left(\frac{27}{125}\right)^{1/3} = \frac{3}{5}$

$r_2 = 6\,\text{fermi}$

43.

In pair annihilation electron and positron combined to form photon. In this process -

(A) Heavy nucleus is required for the process to occur

(B) Two photons are formed which move in same direction

(C) Two photons are formed which move in opposite direction

(D) Linear momentum is not conserved

44.

If there is a mass defect of 0.1% in nuclear fission, then the energy released in the fission of 1 kg mass would be -

(A) 2.5×10^5 kWH (B) 2.5×10^7 kWH

(C) 2.5×10^9 kWH (D) 2.4×10^{-7} kWH

$\Delta m = 0.1\%\ 1kg$

$\Delta m = 10^{-3} kg$

$E = \Delta m \times c^2$

$= 10^{-3} \times 9 \times 10^{16}$

$= 9 \times 10^{+13}$ J

$= \frac{9 \times 10^{13}}{10^3 \times 3600}$ kwh $= 2.5 \times 10^7$ kWh

45.

Thermal neutron means :

(A) neutron being heated ✗

(B) the energy of these neutrons is equal to the energy of neutrons in a heated atom. ✗

(C) these neutrons have energy of neutron in a neutron gas at normal temperature ✓

(D) such neutrons gather energy released in the fission process

$$K = \frac{3}{2} kT$$

46.

The critical mass of fissionable material is -

(A) 1 kg equivalent

(B) Minimum mass needed for chain reaction ✓

(C) The rest mass equivalent to 10^{29} joules

(D) 7.5 kg

47.

Calculate the binding energy of the deuteron which consists of a proton and a neutron, given that the atomic mass of the duteron is 2.014102 u –

(Take mass of proton and neutron as 1.007825 amu 1.008665 amu)

(A) 0.002388 MeV (B) 2.014102 MeV

(C) 2.016490 MeV (D) 2.224 MeV ✓

Sol

$$_1H^2 \equiv p + n$$

$$m_p + m_n = 1.007825 + 1.008665 = 2.016490 \text{ amu}$$

$$\Delta m = 2.016490 - 2.014102 = 0.002388 \text{ amu}$$

$$B.E = 0.002388 \times 931.5 \text{ MeV}$$

$$= 2.224 \text{ MeV}$$

48.

The half life period of a radioactive element X is same as the mean life time of another radioactive element Y. Initially both of them have the same number of atoms. Then -

(A) X & Y have the same decay rate initially

(B) X & Y decay at the same rate always

(C) ✓ Y will decay at a faster rate than X

(D) X will decay at a faster rate than Y

Sol

$(t_{1/2})_x = \tau_y$

$\frac{0.7}{\lambda_x} = \frac{1}{\lambda_y}$

$\lambda_x = 0.7\lambda_y$

$\lambda_x < \lambda_y$

N_0 = same.

$\left|\frac{dN}{dt}\right| = \lambda N$

$\propto \lambda$

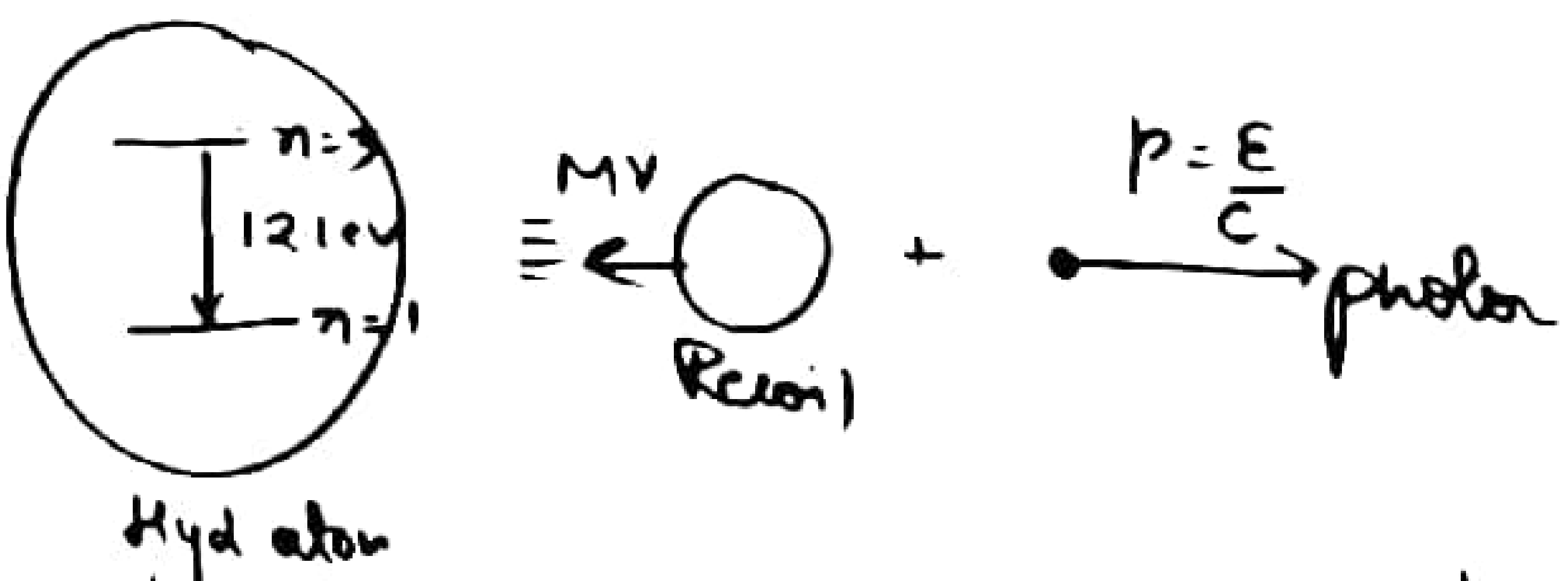
$\left|\frac{dN}{dt}\right|_x < \left|\frac{dN}{dt}\right|_y$

49.

An electron in H-atom makes a transition from n = 3 to n = 1. The recoil momentum of H-atom will be-

(A) ✓ 6.45×10^{-27} N s (B) 6.8×10^{-27} N s

(C) 6.45×10^{-24} N s (D) 6.8×10^{-24} N s



$P_{Hyd\ atom} = P_{photon} = \frac{E}{c} = \frac{12.1\,eV}{3\times10^8} = \frac{12.1\times1.6\times10^{-19}}{3\times10^8} = 6.4\times10^{-27}$ N-s

50.

The orbital velocity of electron in the ground state of hydrogen is v. If the electron is excited to energy state – 0.54 eV, its orbital velocity will be -

(A) v (B) $\frac{v}{3}$ (C) ✓ $\frac{v}{5}$ (D) $\frac{v}{7}$

Sol Ground state = v

$v' \propto \frac{Z}{n} \Rightarrow v' = \frac{v}{n} = \frac{v}{5}$