DPP - Daily Practice Problems

Chapter-wise Sheets

Date : | **Start Time :** | **End Time :**

PHYSICS

CP27

SYLLABUS : Nuclei

Max. Marks : 180 **Marking Scheme :** (+4) for correct & (–1) for incorrect answer **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQs. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. The mass of a $^{7}_{3}Li$ nucleus is 0.042 u less than the sum of the masses of all its nucleons. The binding energy per nucleon of $^{7}_{3}Li$ nucleus is nearly

(a) 46 MeV (b) 5.6 MeV
(c) 3.9 MeV (d) 23 MeV

2. In the nuclear decay given below:

$$^{A}_{Z}X \longrightarrow {}^{A}_{Z+1}Y \longrightarrow {}^{A-4}_{Z-1}B^{*} \longrightarrow {}^{A-4}_{Z-1}B,$$

the particles emitted in the sequence are

(a) γ, β, α (b) β, γ, α
(c) α, β, γ (d) β, α, γ

3. If the nuclear radius of ^{27}Al is 3.6 Fermi, the approximate nuclear radius of ^{64}Cu in Fermi is :

(a) 2.4 (b) 1.2 (c) 4.8 (d) 3.6

4. Which of the following statements is true for nuclear forces?

(a) they obey the inverse square law of distance
(b) they obey the inverse third power law of distance
(c) they are short range forces
(d) they are equal in strength to electromagnetic forces.

5. A radioactive sample at any instant has its disintegration rate 5000 disintegrations per minute. After 5 minutes, the rate is 1250 disintegrations per minute. Then, the decay constant (per minute) is

(a) 0.4 ln 2 (b) 0.2 ln 2 (c) 0.1 ln 2 (d) 0.8 ln 2

6. 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 $(T_1 - T_2)$ is proportional to

(a) $(R_1T_1 - R_2T_2)$ (b) $(R_1 - R_2)$
(c) $(R_1 - R_2)/T$ (d) $(R_1 - R_2)\,T$

7. In the reaction, $^{2}_{1}H + {}^{3}_{1}H \longrightarrow {}^{4}_{2}He + {}^{1}_{0}n$, if the binding energies of $^{2}_{1}H$, $^{3}_{1}H$ and $^{4}_{2}He$ are respectively, a, b and c (in MeV), then the energy (in MeV) released in this reaction is

(a) $a + b + c$ (b) $a + b - c$
(c) $c - a - b$ (d) $c + a - b$

8. If M (A; Z), M_p and M_n denote the masses of the nucleus $^{A}_{Z}X$, proton and neutron respectively in units of u (1u = 931.5 MeV/c^2) and BE represents its bonding energy in MeV, then

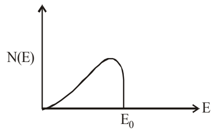
(a) $M(A, Z) = ZM_p + (A - Z)M_n - BE/c^2$
(b) $M(A, Z) = ZM_p + (A - Z)M_n + BE$
(c) $M(A, Z) = ZM_p + (A - Z)M_n - BE$
(d) $M(A, Z) = ZM_p + (A - Z)M_n + BE/c^2$

RESPONSE GRID					
	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ		

Space for Rough Work

9. How does the binding energy per nucleon vary with the increase in the number of nucleons?
(a) Increases continuously with mass number
(b) Decreases continuously with mass number
(c) First decreases and then increases with increase in mass number
(d) First increases and then decreases with increase in mass number

10. The energy spectrum of β-particles [Number N(E) as a function of β-energy E] emitted from a radioactive source is

(a)


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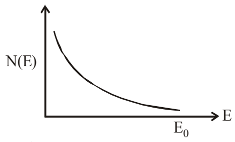

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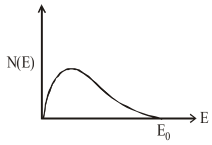

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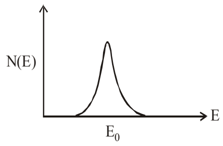

11. A radioactive nucleus undergoes a series of decay according to the scheme

$$A \xrightarrow{a} A_1 \xrightarrow{\beta} A_2 \xrightarrow{\alpha} A_3 \xrightarrow{\gamma} A_4$$

If the mass number and atomic number of 'A' are 180 and 72 respectively, then what are these numbers for A_4
(a) 172 and 69 (b) 174 and 70
(c) 176 and 69 (d) 176 and 70

12. The activity of a radioactive sample is measured as 9750 counts per minute at $t = 0$ and as 975 counts per minute at $t = 5$ minutes. The decay constant is approximately
(a) 0.922 per minute (b) 0.691 per minute
(c) 0.461 per minute (d) 0.230 per minute

13. Actinium 231, $^{231}AC_{89}$, emit in succession two β particles, four α-particles, one β and one α plus several γ rays. What is the resultant isotope?
(a) $^{221}Au_{79}$ (b) $^{211}Au_{79}$
(c) $^{221}Pb_{82}$ (d) $^{211}Pb_{82}$

14. Fusion reactions take place at high temperature because
(a) atoms are ionised at high temperature
(b) molecules break up at high temperature
(c) nuclei break up at high temperature
(d) kinetic energy is high enough to overcome repulsion between nuclei

15. If M_O is the mass of an oxygen isotope $_8O^{17}$, M_P and M_N are the masses of a proton and a neutron respectively, the nuclear binding energy of the isotope is
(a) $(M_O - 17M_N)c^2$ (b) $(M_O - 8M_P)c^2$
(c) $(M_O - 8M_P - 9M_N)c^2$ (d) M_Oc^2

16. Which of the following nuclear reactions is not possible?
(a) $^{12}_{6}C + ^{12}_{6}C \longrightarrow ^{20}_{10}Ne + ^{4}_{2}He$
(b) $^{9}_{4}Be + ^{1}_{1}H \longrightarrow ^{6}_{3}Li + ^{4}_{2}He$
(c) $^{11}_{5}Be + ^{1}_{1}H \longrightarrow ^{9}_{4}Be + ^{4}_{2}He$
(d) $^{7}_{3}Li + ^{4}_{2}He \longrightarrow ^{1}_{1}H + ^{10}_{4}B$

17. The ratio of half-life times of two elements A and B is $\frac{T_A}{T_B}$. The ratio of respective decay constant $\frac{\lambda_A}{\lambda_B}$, is
(a) T_B / T_A (b) T_A / T_B
(c) $\frac{T_A + T_B}{T_A}$ (d) $\frac{T_A - T_B}{T_A}$

18. Two radioactive materials X_1 and X_2 have decay constants 10λ and λ respectively. If initially they have the same number of nuclei, then the ratio of the number of nuclei of X_1 to that of X_2 will be 1/e after a time
(a) $1/10\lambda$ (b) $1/11\lambda$
(c) $11/10\lambda$ (d) $1/9\lambda$

19. In a radioactive material the activity at time t_1 is R_1 and at a later time t_2, it is R_2. If the decay constant of the material is λ, then
(a) $R_1 = R_2 e^{\lambda(t_1 - t_2)}$ (b) $R_1 = R_2 e^{(t_2/t_1)}$
(c) $R_1 = R_2$ (d) $R_1 = R_2 e^{-\lambda(t_1 - t_2)}$

20. The correct relation between t_{av} = average life and $t_{1/2}$ = half life for a radioactive nuclei.
(a) $t_{av} = t_{1/2}$ (b) $t_{av} = \frac{1}{2} t_{1/2}$
(c) $0.693\ t_{av} = t_{1/2}$ (d) $t_{av} = 0.693\ t_{1/2}$

21. If the nuclear force between two protons, two neutrons and between proton and neutron is denoted by F_{pp}, F_{nn} and F_{pn} respectively, then
(a) $F_{pp} \approx F_{nn} \approx F_{pn}$ (b) $F_{pp} \neq F_{nn}$ and $F_{pp} = F_{nn}$
(c) $F_{pp} = F_{nn} = F_{pn}$ (d) $F_{pp} \neq F_{nn} \neq F_{pn}$

22. Which one is correct about fission?
(a) Approx. 0.1% mass converts into energy
(b) Most of energy of fission is in the form of heat
(c) In a fission of U^{235} about 200 eV energy is released
(d) On an average, one neutron is released per fission of U^{235}

RESPONSE GRID					
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	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ
	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	

Space for Rough Work

23. If 200 MeV energy is released in the fission of a single U^{235} nucleus, the number of fissions required per second to produce 1 kilowatt power shall be (Given $1 eV = 1.6 \times 10^{-19}$ J)
(a) 3.125×10^{13} (b) 3.125×10^{14}
(c) 3.125×10^{15} (d) 3.125×10^{16}

24. In any fission process, the ratio of

$$\frac{\text{mass of fission products}}{\text{mass of parent nucleus}} \text{ is}$$

(a) equal to 1
(b) greater than 1
(c) less than 1
(d) depends on the mass of the parent nucleus

25. In an α-decay the kinetic energy of α-particle is 48 MeV and Q-value of the reaction is 50 MeV. The mass number of the mother nucleus is X. Find value of X/25.
(Assume that daughter nucleus is in ground state)
(a) 2 (b) 4 (c) 6 (d) 8

26. A sample of radioactive element has a mass of 10gm at an instant t=0. The approximate mass of this element in the sample after two mean lives is
(a) 6.30 gm (b) 1.35 gm
(c) 2.50 gm (d) 3.70 gm

27. Consider a radioactive material of half-life 1.0 minute. If one of the nuclei decays now, the next one will decay
(a) after 1 minute
(b) after $\dfrac{1}{\log_e 2}$ minute
(c) after $\dfrac{1}{N}$ minute, where N is the number of nuclei present at that moment
(d) after any time

28. The mass of α-particle is
(a) less than the sum of masses of two protons and two neutrons
(b) equal to mass of four protons
(c) equal to mass of four neutrons
(d) equal to sum of masses of two protons and two neutron

29. The decay constants of a radioactive substance for α and β emission are λ_α and λ_β respectively. If the substance emits α and β simultaneously, then the average half life of the material will be

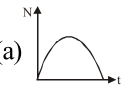
(a) $\dfrac{2T_\alpha T_\beta}{T_\alpha + T_\beta}$ (b) $T_\alpha + T_\beta$

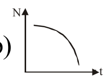
(c) $\dfrac{T_\alpha T_\beta}{T_\alpha + T_\beta}$ (d) $\dfrac{1}{2}\left(T_\alpha + T_\beta\right)$

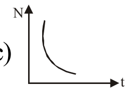
30. If the end A of a wire is irradiated with α-rays and the other end B is irradiated with β-rays. Then
(a) a current will flow from A to B
(b) a current will flow from B to A
(c) there will be no current in the wire
(d) a current will flow from each end to the mid-point of the wire

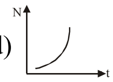
31. A radioactive nucleus of mass M emits a photon of frequency ν and the nucleus recoils. The recoil energy will be
(a) $Mc^2 - h\nu$ (b) $h^2\nu^2 / 2Mc^2$
(c) zero (d) $h\nu$

32. Radioactive element decays to form a stable nuclide. The rate of decay of reactant is correctly depicted by

(a) 

(b) 

(c) 

(d) 

33. A nucleus of mass $M + \Delta m$ is at rest and decays into two daughter nuclei of equal mass $\dfrac{M}{2}$ each. Speed of light is c. The speed of daughter nuclei is

(a) $c\dfrac{\Delta m}{M + \Delta m}$ (b) $c\sqrt{\dfrac{2\Delta m}{M}}$ (c) $c\sqrt{\dfrac{\Delta m}{M}}$ (d) $c\sqrt{\dfrac{\Delta m}{M + \Delta m}}$

34. Atomic weight of Boron is 10.81 and it has two isotopes ${}_5B^{10}$ and ${}_5B^{11}$. Then the ratio ${}_5B^{10} : {}_5B^{11}$ in nature would be
(a) 19 : 81 (b) 10 : 11 (c) 15 : 16 (d) 81 : 19

35. A nucleus ruptures into two nuclear parts, which have their velocity ratio equal to 2:1. What will be the ratio of their nuclear size (nuclear radius)?
(a) $2^{1/3} : 1$ (b) $1 : 2^{1/3}$ (c) $3^{1/2} : 1$ (d) $1 : 3^{1/2}$

36. A nucleus of uranium decays at rest into nuclei of thorium and helium. Then :
(a) the helium nucleus has less momentum than the thorium nucleus.
(b) the helium nucleus has more momentum than the thorium nucleus.
(c) the helium nucleus has less kinetic energy than the thorium nucleus.
(d) the helium nucleus has more kinetic energy than the thorium nucleus.

37. If radius of the ${}^{27}_{12}Al$ nucleus is taken to be R_{Al}, then the radius of ${}^{125}_{53}Te$ nucleus is nearly:

(a) $\dfrac{5}{3}R_{Al}$ (b) $\dfrac{3}{5}R_{Al}$ (c) $\left(\dfrac{13}{53}\right)^{1/3} R_{Al}$ (d) $\left(\dfrac{53}{13}\right)^{1/3} R_{Al}$

RESPONSE GRID					
	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ
	28. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ	31. ⓐⓑⓒⓓ
	32. ⓐⓑⓒⓓ	33. ⓐⓑⓒⓓ	34. ⓐⓑⓒⓓ	35. ⓐⓑⓒⓓ	36. ⓐⓑⓒⓓ
	37. ⓐⓑⓒⓓ				

Space for Rough Work

38. M_n and M_p represent mass of neutron and proton respectively. If an element having atomic mass M has N-neutron and Z-proton, then the correct relation will be

(a) $M < [NM_n + ZM_p]$ (b) $M > [NM_n + ZM_p]$

(c) $M = [NM_n + ZM_p]$ (d) $M = N[M_n + M_p]$

39. After 300 days, the activity of a radioactive sample is 5000 dps (disintegrations per sec). The activity becomes 2500 dps after another 150 days. The initial activity of the sample in dps is

(a) 20,000 (b) 10,000

(c) 7,000 (d) 25,000

40. Order of magnitude of density of uranium nucleus is ($m_p = 1.67 \times 10^{-27}$ kg)

(a) $10^{20}\ \mathrm{kg/m^3}$ (b) $10^{17}\ \mathrm{kg/m^3}$

(c) $10^{14}\ \mathrm{kg/m^3}$ (d) $10^{11}\ \mathrm{kg/m^3}$

41. The electrons cannot exist inside the nucleus because

(a) de-Broglie wavelength associated with electron in β-decay is much less than the size of nucleus

(b) de-Broglie wavelength associated with electron in β-decay is much greater than the size of nucleus

(c) de-Broglie wavelength associated with electron in β-decay is equal to the size of nucleus

(d) negative charge cannot exist in the nucleus

42. If the total binding energies of ${}^{2}_{1}\mathrm{H}$, ${}^{4}_{2}\mathrm{He}$, ${}^{56}_{26}\mathrm{Fe}$ & ${}^{235}_{92}\mathrm{U}$ nuclei are 2.22, 28.3, 492 and 1786 MeV respectively, identify the most stable nucleus of the following.

(a) ${}^{56}_{26}\mathrm{Fe}$ (b) ${}^{2}_{1}\mathrm{H}$

(c) ${}^{235}_{92}\mathrm{U}$ (d) ${}^{4}_{2}\mathrm{He}$

43. At a specific instant emission of radioactive compound is deflected in a magnetic field. The compound cannot emit

(a) electrons (b) protons

(c) He^{2+} (d) neutrons

44. A nuclear reaction is given by

${}_{Z}X^{A} \rightarrow {}_{Z+1}Y^{A} + {}_{-1}e^{0} + \bar{\nu}$, represents

(a) fission (b) β-decay

(c) ∝-decay (d) fusion

45. Radioactive material 'A' has decay constant '8 λ' and material 'B' has decay constant 'λ'. Initially they have same number of nuclei. After what time, the ratio of number of nuclei of material 'B' to that 'A' will be $\frac{1}{e}$?

(a) $\frac{1}{7\lambda}$ (b) $\frac{1}{8\lambda}$ (c) $\frac{1}{9\lambda}$ (d) $\frac{1}{\lambda}$

RESPONSE GRID					
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	43. ⓐⓑⓒⓓ	44. ⓐⓑⓒⓓ	45. ⓐⓑⓒⓓ		

DAILY PRACTICE PROBLEM DPP CHAPTERWISE CP27 - PHYSICS			
Total Questions	45	Total Marks	180
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	50	Qualifying Score	70
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS

PHYSICS SOLUTIONS

DPP/CP27

1. **(b)** B.E. $= 0.042 \times 931 \simeq 42$ MeV

Number of nucleons in ${}^{7}_{3}Li$ is 7.

$\therefore$ B.E./ nucleon $= \dfrac{42}{7} = 6$ MeV $\simeq 5.6$ MeV

2. **(d)** ${}^{A}_{Z}X \longrightarrow {}^{A}_{Z+1}Y : \beta,\ {}^{A}_{Z+1}Y \longrightarrow {}^{A-4}_{Z-1}B^{*} : \alpha$

${}^{A-4}_{Z-1}B^{*} \longrightarrow {}^{A-4}_{Z-1}B : \gamma$

(β, α, γ) ($\because \beta = {}^{0}_{-1}e$, $\alpha = {}^{4}_{2}He$, mass number and charge number of a nucleus remains unchanged during γ decay)

3. **(c)** The radius of the nuclears is directly proportional to cube root of atomic number i.e. $R \propto A^{1/3}$

$\Rightarrow$ $R = R_0 A^{1/3}$, where R_0 is a constant of proportionality

$$\frac{R_2}{R_1} = \left(\frac{A_2}{A_1}\right)^{1/3} \left(\frac{64}{27}\right)^{1/3} = \frac{4}{3}$$

where R_1 = the radius of ${}^{27}Al$, and A_1 = Atomic mass number of Al

R_2 = the radius of ${}^{64}Cu$ and A_2 = Atomic mass number of C4

$$R_2 = 3.6 \times \frac{4}{3} = 4.8\text{m}$$

4. **(c)** Nuclear forces are short range attractive forces which balance the repulsive forces between the protons inside the nucleus.

5. **(a)** $\lambda = \dfrac{1}{t}\log_e \dfrac{A_o}{A} = \dfrac{1}{5}\log_e \dfrac{5000}{1250}$

$= \dfrac{2}{5}\log_e 2 = 0.4 \log_e 2$

6. **(d)** Radioactivity at T_1, $R_1 = \lambda N_1$

Radioactivity at T_2, $R_2 = \lambda N_2$

$\therefore$ Number of atoms decayed in time

$(T_1 - T_2) = (N_1 - N_2)$

$$= \frac{(R_1 - R_2)}{\lambda} = \frac{(R_1 - R_2)T}{0.693} \propto (R_1 - R_2)T$$

7. **(c)** ${}^{2}_{1}H$ and ${}^{3}_{1}H$ requires a and b amount of energies for their nucleons to be separated.

${}^{4}_{2}He$ releases c amount of energy in its formation i.e., in assembling the nucleons as nucleus.

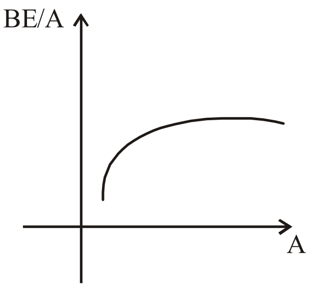
Hence, Energy released $= c - (a + b) = c - a - b$

8. **(a)** Mass defect $= ZM_p + (A - Z)M_n - M(A,Z)$

or, $\dfrac{\text{B.E.}}{c^2} = ZM_p + (A-Z)M_n - M(A,Z)$

$\therefore M(A, Z) = ZM_p + (A-Z)M_n - \dfrac{\text{B.E.}}{c^2}$

9. **(d)**



From the graph of BE/A versus mass number A it is clear that, BE/A first increases and then decreases with increase in mass number.

10. **(c)** The range of energy of β-particles is from zero to some maximum value.

11. **(a)** ${}_{72}A^{180} \xrightarrow{\alpha} {}_{70}A_1^{176} \xrightarrow{\beta} {}_{71}A_2^{176}$

$\xrightarrow{\alpha} {}_{69}A_3^{172} \xrightarrow{\gamma} {}_{69}A_4^{172}$

12. **(c)** $\dfrac{dN}{dt} = KN$

$9750 = KN_0$ .... (1)

$975 = KN$ ..... (2)

Dividing (1) by (2)

$\dfrac{N}{N_0} = \dfrac{1}{10}$

$K = \dfrac{2.303}{t}\log\dfrac{N_0}{N} = \dfrac{2.303}{5}\log 10$

$= 0.4606 = 0.461$ per minute

13. **(d)**

14. **(d)** Extremely high temps needed for fusion make K.E. large enough to overcome repulsion between nuclei.

15. **(c)** Binding energy

$= [ZM_P + (A - Z)M_N - M]c^2$

$= [8M_P + (17 - 8)M_N - M]c^2$

$= [8M_P + 9M_N - M]c^2$

$= [8M_P + 9M_N - M_o]c^2$

16. **(c)** In this reaction mass is not conserved.

17. **(a)** $T_{1/2} = \dfrac{\ln 2}{\lambda} \therefore \lambda = \dfrac{\ln 2}{T_{1/2}}$

$\Rightarrow \lambda_A = \dfrac{\ln 2}{T_A}, \lambda_B = \dfrac{\ln 2}{T_B} \Rightarrow \dfrac{\lambda_A}{\lambda_B} = \dfrac{T_B}{T_A}.$

18. **(d)** $N_1 = N_0 e^{-10\lambda t}$, $N_2 = N_0 e^{-\lambda t}$

$\frac{N_1}{N_2} = e^{-9\lambda t} = e^{-1}$; $9\lambda t = 1 \Rightarrow t = \frac{1}{9\lambda}$

19. **(d)** Let at time t_1 & t_2, number of particles be N_1 & N_2. So,

$R_1 = \frac{dN_1}{dt} = -\lambda N_1$; $R_2 = \frac{dN_2}{dt} = -\lambda N_2$

$\frac{R_1}{R_2} = \frac{\lambda N_1}{\lambda N_2} = \frac{N_1}{N_1 e^{-\lambda(t_2-t_1)}} = e^{\lambda(t_2-t_1)}$

$R_1 = R_2 e^{\lambda(t_2-t_1)} = R_2 e^{-\lambda(t_1-t_2)}$

20. **(c)** Average life of the nuclei is

$t_{av} = \frac{1}{\lambda}$ ....(i)

Half life of the nuclei

$t_{1/2} = \frac{0.693}{\lambda}$ ....(ii)

from (i) and (ii)

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

21. **(d)** Nuclear force is not the same between any two nucleons.

22. **(a)**

23. **(a)** $P = n\left(\frac{E}{t}\right) \Rightarrow 1000 = \frac{n \times 200 \times 10^6 \times 1.6 \times 10^{-19}}{t}$

$\Rightarrow \frac{n}{t} = 3.125 \times 10^{13}$.

24. **(c)** Binding energy per nucleon for fission products is higher relative to Binding energy per nucleon for parent nucleus, i.e., more masses are lost and are obtained as kinetic energy of fission products. So, the given ratio <1.

25. **(b)** We have $K_\alpha = \frac{m_y}{m_y + m_\alpha}.Q$

$\Rightarrow K_\alpha = \frac{A-4}{A}.Q \Rightarrow 48 = \frac{A-4}{A}.50 \Rightarrow A = 100$

26. **(b)** Using the relation for mean life.

Given : $t = 2\tau = 2\left(\frac{1}{\lambda}\right)$ $\left(\therefore \tau = \frac{1}{\lambda}\right)$

Then from $M = M_0 e^{-\lambda t} = 10 e^{-\lambda \times \frac{2}{\lambda}}$

$= 10\left(\frac{1}{e}\right)^2 = 1.35g$

27. **(d)** Because radioactivity is a spontaneous phenomenon.

28. **(a)** α-particle = $_2He^4$. It contains 2 p and 2 n. As some mass is converted into B.E., therefore, mass of α particle is slightly less than the sum of the masses of 2 *p* and 2 *n*.

29. **(c)** $T_{av} = \frac{T_\alpha T_\beta}{T_\alpha + T_\beta}$

If α and *B* are emitted simultaneously.

30. **(a)** Due to irradiation of α-rays on end A will make it (positive) and irradiation of β-rays on end B will make it (negative) hence current will flow from A to B (or from positive to negative).

31. **(b)** Momentum

$Mu = \frac{E}{c} = \frac{h\nu}{c}$

Recoil energy

$\frac{1}{2}Mu^2 = \frac{1}{2}\frac{M^2u^2}{M} = \frac{1}{2M}\left(\frac{h\nu}{c}\right)^2$

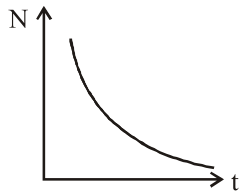
$= \frac{h^2\nu^2}{2Mc^2}$

32. **(c)** No. of nuclide at time t is given by $N = N_o e^{-\lambda t}$

Where N_o = initial nuclide

This equation is equivalent to $y = ae^{-kx}$

Thus correct graph is



33. **(b)** By conservation of energy,

$(M + \Delta m)c^2 = \frac{2.M}{2}c^2 + \frac{1}{2}.\frac{2M}{2}v^2$,

where v is the speed of the daughter nuclei

$\Rightarrow \Delta mc^2 = \frac{M}{2}v^2$ $\therefore v = c\sqrt{\frac{2\Delta m}{M}}$

34. **(a)** Suppose that,

The number of ^{10}B type atoms = x

and the number of ^{11}B type atoms = y

Weight of ^{10}B type atoms = $10x$

Weight of ^{11}B type atoms = $11y$

Total number of atoms = $x + y$

$\therefore$ Atomic weight = $\frac{10x + 11y}{x + y} = 10.81$

$\Rightarrow$ $10x + 11y = 10.81x + 10.81y$

$\Rightarrow$ $0.81x = 0.19y \Rightarrow \frac{x}{y} = \frac{19}{81}$

35. **(b)** Applying law of conservation of momentum,

$m_1v_1 = m_2v_2$

$\frac{v_1}{v_2} = \frac{m_2}{m_1}$

As $m = \frac{4}{3}\pi r^3 \rho$ $\Rightarrow m \propto r^3$

Hence, $\frac{m_2}{m_1} = \frac{r_2^3}{r_1^3}$

$\therefore \frac{v_1}{v_2} = \frac{r_2^3}{r_1^3} \quad \Rightarrow \quad \frac{r_2}{r_1} = \left(\frac{1}{2}\right)^{\frac{1}{3}}$

36. (d) In an explosion a body breaks up into two pieces of unequal masses both part will have numerically equal momentum and lighter part will have more velocity.

$U \to Th + He$

$KE_{Th} = \frac{P^2}{2m_{Th}}, KE_{He} = \frac{P^2}{2m_{He}}$

since m_{He} is less so KE_{He} will be more.

37. (a) As we know, $R = R_0 (A)^{1/3}$

where A = mass number

$R_{Al} = R_0 (27)^{1/3} = 3R_0$

$R_{Te} = R_0 (125)^{1/3} = 5R_0 = \frac{5}{3} R_{Al}$

38. (a) Given : Mass of neutron = M_n

Mass of proton = M_p; Atomic mass of the element = M; Number of neutrons in the element = N and number of protons in the element = Z. We know that the atomic mass (M) of any stable nucleus is always less than the sum of the masses of the constituent particles.

Therefore, $M < [NM_n + ZM_p]$.

X is a neutrino, when β-particle is emitted.

39. (a) Activity decreases

5000 dps to 2500 dps in 150 days

$\therefore$ Half life period $T_{1/2} = 150$ days

$\therefore$ 300 days $= 2T_{1/2}$

Therefore, initial activity $= 5000 \times 2T_{1/2} = 5000 \times 2 \times 2 = 20000$ dps

40. (b) The order of density of uranium nucleus is 10^{17} kg/m^2.

41. (b)

42. (a) $B.E_H = \frac{2.22}{2} = 1.11$

$B.E_{He} = \frac{28.3}{4} = 7.08$

$B.E_{Fe} = \frac{492}{56} = 8.78$ = maximum

$B.E_U = \frac{1786}{235} = 7.6$

${}^{56}_{26}Fe$ is most stable as it has maximum binding energy per nucleon.

43. (d) Neutrons can't be deflected by a magnetic field.

44. (b) ${}_{-1}e^0$ is known as β-particle & $\bar{\nu}$ is known as antineutrino. Since in this reaction $\bar{\nu}$ is emitted with ${}_{-1}e^0$ (β-particle or electron), so it is known as β-decay.

45. (a) Given, $\lambda_A = 8\lambda, \lambda_B = \lambda$

$N_B = \frac{N_A}{e}$

$\Rightarrow \quad N_o e^{-\lambda_B t} = N_o \frac{e^{-\lambda_A t}}{e}$

$e^{-\lambda t} = e^{-8\lambda t} e^{-1}$

$e^{-\lambda t} = e^{-8\lambda t - 1}$

Comparing both side powers

$-\lambda t = -8\lambda t - 1$

$-1 = 7\lambda t$

$t = -\frac{1}{7\lambda}$

The best possible answer is $t = \frac{1}{7\lambda}$