DPP
DAILY PRACTICE PROBLEMS

Class : XIIth | **Solutions** | **Subject : PHYSICS**
Date : | | **DPP No. : 1**

Topic :- NUCLEI

1 **(a)**

Remaining amount

$= 16 \times \left(\frac{1}{2}\right)^{32/2} = 16 \times \left(\frac{1}{2}\right)^{16} = \left(\frac{1}{2}\right)^{12} < 1mg$

3 **(a)**

Half-life of a radioactive element

$T = \frac{0.693}{\lambda}$ or $T \propto \frac{1}{\lambda}$

$\therefore \quad \frac{\lambda_A}{\lambda_B} = \frac{T_B}{T_A}$

4 **(b)**

${}_7N^{14} + {}_2He^4 \rightarrow {}_8O^{17} + {}_1H^1$

5 **(a)**

$N_{t_1} = N_0 e^{-\lambda t_1}$

$N_{t_2} = N_0 e^{-\lambda t_2}$

$\therefore \; N_{t_1} - N_{t_2} = N_0 (e^{-\lambda_{t2}} - e^{-\lambda_{t2}})$

7 **(a)**

Mass defect

$\Delta m =$ Total mass of $\alpha -$ particles $-$ mass of ^{12}C nucleus

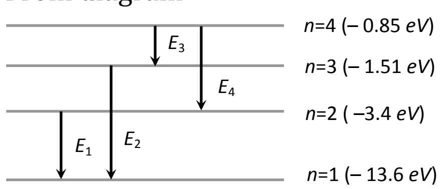
$= 3 \times 4.002603 - 12$

$= 12.007809 - 12$

$= 0.007809$ unit

8 **(b)**

From diagram



$E_1 = -13.6 - (-3.4) = -10.2eV$

$E_2 = -13.6 - (-1.51) = -12.09eV$
$E_3 = -1.51 - (-0.85) = -0.66eV$
$E_4 = -3.4 - (-0.85) = (-2.55)eV$
E_3 is least, *i.e.*, frequency is lowest

9 **(a)**

1amu (or 1 u)=$1.6605402 \times 10^{-27}$ kg

$= 1.6 \times 10^{-24}$ g

Moreover 1 amu is equivalent to 931 MeV

0r 1.6×10^{-24} g is equivalent to 931 MeV

$\therefore$ 1g is equivalent to $\frac{931}{1.6 \times 10^{-24}}$ MeV

and 10^{-3} g is equivalent to $\frac{931}{1.6 \times 10^{-24}} \times 10^{-3}$MeV

$= 5.6 \times 10^{23}$ MeV

10 **(d)**

$\Delta m = 0.3g$

$= 0.3 \times 10^{-3}$ kg $= 3 \times 10^{-4}$ kg

Energy liberated , $E = \Delta mc^2$

$= 3 \times 10^{-4} \times (3 \times 10^8)^2$

$= 3 \times 10^{-4} \times 9 \times 10^{16}$

$= 27 \times 10^{12}$ J $= \dfrac{27 \times 10^{12}}{3.6 \times 10^6}$ kWh

$= 7.5 \times 10^6$ kWh

11 **(c)**

$$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{4^2}\right) = \frac{3R}{16} \Rightarrow \lambda = \frac{16}{3R} = \frac{16}{3} \times 10^{-5} cm$$

Frequency $n = \frac{c}{\lambda} = \frac{3 \times 10^{10}}{\frac{16}{3} \times 10^{-5}} = \frac{9}{16} \times 10^{15} Hz$

12 **(d)**

$V = (12.1 - 5.1) volt$
$V_{stopping} = 7V$

13 **(b)**

${}_{88}A^{196} \rightarrow {}_{78}B^{164}$

Number of α − particles $= \frac{196 - 164}{4} = 8$

$${}_{88}A^{196} \xrightarrow{-8\alpha} {}_{72}X^{164} \rightarrow {}_{78}B^{164}$$

$\therefore$ Number of β − particles $= 78 - 72 = 6$

14 **(c)**

$$\frac{hc}{\lambda} = E = eV$$

$$\Rightarrow \lambda = \frac{hc}{eV} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{1.6 \times 10^{-19} \times 4.9} = 2525 \text{ Å}$$

15 **(b)**

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

Remaining part $= N_0 - \frac{3}{4}N_0$

$= \frac{1}{4}N_0$

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

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

n=2

Time = Half year × Number of half year= 3 × 2 = 6days

16 **(a)**

The total mass of the initial particles

m_i = 1.007825 +7.016004

= 8.023829 u

and the total mass of final particles

m_f = 2 × 4.002603 =8.005206 u

Difference between initial and final mass of particles

$\Delta m = m_i - m_f$ = 8.023829 - 8.005206

= 0.018623 u

The Q-value is given by

$Q = (\Delta m)c^2$

= 0.018623 × 931.5 =17.35 MeV

17 **(c)**

1 week = 7 days = 7 × 24hr ≃ 14 half lives

Number of atoms left $= \frac{N_0}{(2)^{14}}$, Activity $= N\lambda$

∴ Activity left is $\frac{1}{(2)^{14}}$ times the initial

$\Rightarrow \frac{1}{(2)^{14}} \times 1 curie = \frac{1}{16384} \times 1$ curie ≅61 × 10^{-6} curie

$\approx 60\mu\ curie$

18 **(a)**

Mean life $= \frac{\text{Half life}}{0.6931} = \frac{10}{0.6931} = 14.4\ hours$

19 **(a)**

If R is activity of radioactive substance after n half lives,

then $R = R_0\left(\frac{1}{2}\right)^n$

$\frac{R_0}{16} = R_0\left(\frac{1}{2}\right)^n \therefore n = 4$

$t = n\,T = 4 \times 100 = 400$ µs

20 **(b)**

Here $T_{1/2} = 20\ minutes$, we know $\frac{N}{N_0} = \left(\frac{1}{2}\right)^{t/T_{1/2}}$

For 20% decay $\frac{N}{N_0} = \frac{80}{100} = \left(\frac{1}{2}\right)^{t_1/20}$ ...(i)

For 80% decay $\frac{N}{N_0} = \frac{20}{100} = \left(\frac{1}{2}\right)^{t_2/20}$ ...(ii)

Dividing (ii) by (i)

$$\frac{1}{4} = \left(\frac{1}{2}\right)^{\frac{(t_2 - t_1)}{20}}$$

On solving we get $t_2 - t_1 = 40\ min$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	A	C	A	B	A	B	A	B	A	D
Q.	11	12	13	14	15	16	17	18	19	20
A.	C	D	B	C	B	A	C	A	A	B