

DPP

DAILY PRACTICE PROBLEMS

Class : XIIth

Date :

Solutions

Subject : PHYSICS

DPP No. : 1

Topic :- NUCLEI

1

(a)

Remaining amount

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

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(a)

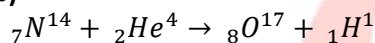
Half-life of a radioactive element

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

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

4

(b)



5

(a)

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

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

$$\therefore N_{t_1} - N_{t_2} = N_0 (e^{-\lambda t_1} - e^{-\lambda t_2})$$

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(a)

Mass defect

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

$$= 3 \times 4.002603 - 12$$

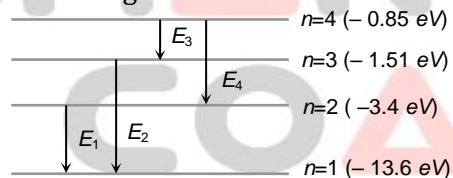
$$= 12.007809 - 12$$

$$= 0.007809 \text{ unit}$$

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

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(a)

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

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

Moreover 1 amu is equivalent to 931 MeV

Or $1.6 \times 10^{-24} \text{ g}$ is equivalent to 931 MeV

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



and 10^{-3} g is equivalent to $\frac{931}{1.6 \times 10^{-24}} \times 10^{-3}$ MeV
 $= 5.6 \times 10^{23}$ MeV

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(d)

$$\Delta m = 0.3g$$

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

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

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

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

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

$$= 7.5 \times 10^6 \text{ kWh}$$

11

(c)

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

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

12

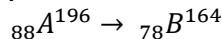
(d)

$$V = (12.1 - 5.1) \text{ volt}$$

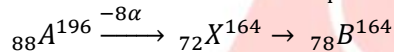
$$V_{\text{stopping}} = 7V$$

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(b)



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



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

14

(c)

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

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

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(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 \times Number of half year = $3 \times 2 = 6$ days

16

(a)

The total mass of the initial particles

$$m_i = 1.007825 + 7.016004$$

$$= 8.023829 \text{ u}$$

and the total mass of final particles

$$m_f = 2 \times 4.002603 = 8.005206 \text{ u}$$

Difference between initial and final mass of particles

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

$$= 0.018623 \text{ u}$$

The Q -value is given by

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

$$= 0.018623 \times 931.5 = 17.35 \text{ MeV}$$

17

(c)

1 week = 7 days = $7 \times 24 \text{ hr} \approx 14$ half lives

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

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

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

$\approx 60 \mu \text{ curie}$

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(a)

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

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(a)

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

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

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

$$t = nT = 4 \times 100 = 400 \mu\text{s}$$

20

(b)

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

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

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

Dividing (ii) by (i)

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

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

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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



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