Exercise O-1

① $^{14}_{6}C$, $^{12}_{6}C$ is stable. So for decreasing

$\frac{n}{p}$ ratio, β^- will be emitted.

$$^{14}_{6}C \rightarrow ^{14}_{7}N + e^- + \nu$$

Ⓐ

$$[n \rightarrow p^+ + e^-]$$

② $$^{30}_{15}P \rightarrow ^{30}_{14}Si + \beta^+ + \nu$$

Ⓒ

$$(p^+ \rightarrow n + \beta^+)$$

③ $^{27}_{13}Al$ is stable, so $^{29}_{13}Al$ is expected to disintegrate by $_{-1}^{0}\beta$. (for decreasing n/p ratio).

Ⓑ

④ $$n \rightarrow p^+ + \beta^-$$ Ⓒ

So here increase in proton and decrease in neutron occurs.

⑤ $$^{13}_{4}Be \rightarrow ^{12}_{4}Be + n,$$

8. from above example, we can say reaction involving neutron emission will generate an isotope.

Ⓐ

⑥ S^{35} is neutron rich, So for decreasing $\frac{n}{p}$ ratio $(n \rightarrow p^{+} + e^{-})$, It will like to undergo beta emission. (B)

⑦ $${}^{238}_{92}X \longrightarrow {}^{206}_{82}Y + n_1\,{}^{4}_{2}He + n_2\,{}^{0}_{-1}e$$

$238 = 206 + 4n_1$ | $92 = 82 + 2n_1 - n_2$

$n_1 = 32/4 = 8$ | $10 = 2\times 8 - n_2$

$n_2 = 6$ (D)

⑧ $${}_{35}X^{88} \xrightarrow[p^{+} \rightarrow n + \beta^{+}]{\text{I}} {}_{34}Y^{88} \xrightarrow[\text{alpha}]{\text{II}} {}_{32}Z^{84}$$

· A − 2Z value of $Y = 88 - 2\times 34 = 20$ (C)

and for $Z = 84 - 2\times 32 = 20$

So Y and Z are isodiaphers.

⑨ $${}_{90}Th^{232} \xrightarrow{-\alpha} {}_{88}Ra^{228} \xrightarrow{-\beta} {}_{89}Ac^{228} \xrightarrow{-\beta} {}_{90}Th^{228}$$

A

$${}_{90}Th^{228} \xrightarrow{-\alpha} {}_{88}Ra^{224} \xrightarrow{-\alpha} {}_{86}Rn^{220} \xrightarrow{-\alpha} {}_{84}Po^{216}$$

B, D

$${}_{84}Po^{216} \xrightarrow{-\alpha} {}_{82}Pb^{212}$$

$${}_{84}Po^{216} \xrightarrow{-\beta} {}_{85}At^{216}$$

Ans C $\Rightarrow {}_{88}Ra^{226}$, This is not a natural decay product of ${}_{90}Th^{232}$.

(10) no of half life $= \frac{18}{3} = 6$ (Ans) = B

from $M_t = \frac{M_0}{2^n}$, $M_t = \frac{256}{2^6} = 4$ gm.

(11) no of half life $(n) = \frac{24}{4} = 6$

$N_t = \frac{N_0}{2^n}$, $N_t = \frac{N_0}{2^6}$

from relation, $A = N\lambda$ (Ans) (C)

$$\frac{A_1}{A_2} = \frac{N_1}{N_2}$$

$$\frac{200}{A_2} = \frac{N_0}{N_0/2^6}$$

$$A_2 = \frac{200}{64} = 3.125 \text{ dpm.}$$

(12) no of half life $(n) = \frac{3}{6} = \frac{1}{2}$

$$M_t \Rightarrow \frac{M_0}{2^n}$$

(Ans) (C)

$$10 \text{ mg} = \frac{M_0}{2^{1/2}}$$

$$M_0 = 10 \times \sqrt{2}$$

$$\Rightarrow 1.41 \times 10 = 14.1 \text{ mg}$$

(13) $A \xrightarrow{t_{1/2}} 50$ min

$B \xrightarrow{t_{1/2}} 10$ min

initially no of nuclides of A & B are N and 8N respectively and after some time (t), no of nuclides of A & B are $2N'$ & N' respectively

no of half life for A $= \frac{t}{50}$

and for B $= \frac{t}{10}$

for A, $N_t = \frac{N_0}{2^n}$, $2N' = \frac{N}{2^{t/50}}$ — (I)

for B, $N' = \frac{8N}{2^{t/10}}$ — (II)

I ÷ II

$$2 = \frac{2^{t/10}}{8 \times 2^{t/50}}$$

$$16 = 2^{t/10 - t/50}$$

$$2^4 = 2^{\frac{40t}{500}}$$

$$4 = \frac{40t}{500}$$

$$t = \frac{4 \times 50\cancel{0}}{4\cancel{0}} = 50 \text{ min.}$$

Ans (C)

Q (14) $A = N\lambda$ & $\lambda = \frac{\ln 2}{t_{1/2}}$

$$\frac{A_1}{N_1} = \frac{A_2}{N_2}$$

given initial activity is 56 dpm and after 69.3 min it was found 28 dpm.

$$\frac{56}{N_1} = \frac{28}{N_2} \quad \Big| \quad \frac{N_1}{N_2} = \frac{56}{28}$$

$$\boxed{\frac{N_1}{N_2} = \frac{2}{1}}$$

final no of atom is just half, so time 69.3 is $t_{1/2}$.

$$A = N\lambda$$

$$10 = N \times \frac{\ln 2}{t_{1/2}} \quad \Big\| \quad 10 = N \times \frac{0.693}{69.3}$$

$$\boxed{N = 10^3}$$

Ans (B)

Q (15) $A = N\lambda$

$$R_1 = N_1 \times \frac{\ln 2}{T}, \quad R_2 = N_2 \times \frac{\ln 2}{T}$$

$$N_1 = \frac{R_1 T}{\ln 2}, \quad N_2 = \frac{R_2 \times T}{\ln 2}$$

$$N_1 - N_2 \Rightarrow \frac{T}{0.693}(R_1 - R_2)$$ Ans D

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Q 16 $\quad {}^{238}U \longrightarrow {}^{206}Pb$

at time t $\quad x$ mol $\quad 0.2x$ mol $\quad \frac{n_{Pb}}{n_U} = \frac{0.2}{1}$

So at initially
at $t=0$, $\quad 1.2x$ mol $\quad 0$ mol.

$$\lambda = \frac{1}{t} \ln \frac{N_0}{N_t}$$

Ans D

$$\lambda = \frac{1}{t} \ln \frac{1.2x}{x}$$

$$t = \frac{1}{\lambda} \ln \frac{6}{5}$$

Q 17 $\quad A = N\lambda$

$$\frac{A_1}{A_2} = \frac{N_1}{N_2} \quad \Big| \quad \frac{7.6}{15.2} = \frac{N_1}{N_2}$$

$$\frac{N_1}{N_2} = \frac{1}{2}, \quad N_2 = 2N_1$$

$$t = \frac{1}{\lambda} \ln \frac{N_0}{N_t}$$

$$t = \frac{t_{1/2}}{\ln 2} \ln \frac{2N}{N}$$

Ans A

$\boxed{t = t_{1/2}}$ $\quad \boxed{t = 5760}$

(18) $^{63}_{29}Cu\,(p, ---)\,^{62}_{29}Cu$

$^{63}_{29}Cu + p \rightarrow {}^{64}_{30}Zn$

$^{64}_{30}Zn \longrightarrow {}^{62}_{29}Cu + \boxed{^{2}_{1}H}$ Ans (A)

(19) $^{238}_{92}M \longrightarrow {}^{x}_{y}N + 2\,^{4}_{2}He$

$^{x}_{y}N \longrightarrow {}^{A}_{B}L + 2\,^{0}\beta^{+}$

$238 = x + 2 \times 4$ | $x = 230$

$92 = y + 4$ | $y = 88$

$x = A + 2 \times 0$ | $y = B + 2 \times 1$

$230 = A$ | $88 = B + 2$

$B = 86$ Ans B

$^{230}_{86}L \rightarrow$ no of neutron $= 230 - 86$

$\Rightarrow 144$

(20) $^{235}_{92}U + n \longrightarrow {}^{139}_{54}Xe + {}^{94}_{38}Sr + xn$

$235 + 1 = 139 + 94 + n$ | $\boxed{n = 3}$

Ans = D