1. $10^6 \times 28.2 = \Delta m.931 \times 10^6$

$\Delta m = 0.03029$

$\Delta m = 0.03029$ (Take)

$m_p = 1.007276$

$m_n = 1.008005$

$(2 \times m_p + 2 \times m_n - \Delta m)$

m_α = 4.001592 A.M.U.

2. The no.of protons is ${}^{56}_{26}fe = 26$
The no. of neutrons = 56 - 26 = 30
B.E. = [26 × 1.00783 u + 30 × 1.00867 u - 55.9349u]c^2
= 492 MeV

3. Use energy conservation

$m({}^{238}P_U)C^2 = m({}^{234}U)C^2 + m({}^{4}He)C^2 + k$

k = $\left[m({}^{238}P_U) - m({}^{234}U) - m({}^{4}He)\right]c^2$
= (238.04955u - 234.04095u - 4.002603u)

$\frac{931 MeV}{u}$ = 5.58 MeV

4. [7.0160 + 1.00783 – (2x4.0026)]x931
= 17.34 MeV

5. ${}^{32}P \rightarrow {}^{32}S + {}_{-}e + \vec{v}$

$\Delta m = 2 \times 10^{-3}$ A.M.U
E= 1.862 MeV

6. ${}^{40}_{19}K \rightarrow {}^{40}_{20}Ca + {}^{e}_{-1} + \bar{v}$

E = $\Delta m(931) = 1.3034$

7. $\Delta m 931 = E$
$\therefore$ α particle energy = E - 217 Kev

8. $\Delta m = 12.018613 - 12 - 2 \times 0.0005486$
$\therefore$ E = 16.3072
E e^+ = 16.3072 - 4.43 = 11.88 MeV

9. (a) The Q - Value of β^- decay is

$Q = \left[m({}^{19}0) - m({}^{19}F)\right]C^2$
= 4.816 MeV

(b) The Q - Value of β^1 decay is

$Q = \left[m({}^{23}Al) - m({}^{25}Mg) - 2mc\right]C^2$

$= \left[24.990432u - 24.985839u - 2 \times 0.511 \frac{MeV}{C^2}\right]C^2$

= (0.004593) - (931 $^{Mev}/_{u}$) - 1.022 MeV
= 3.254 Mev

10.
The kinetic energy available for the beta particle and the antinutreno is

$Q = \left[m({}^{175}Lu) - m({}^{176}Hf)\right]C^2$

= (175.942694 u - 175.941420 u) (931 $^{MeV}/_{u}$)
= 1.182 MeV

* This energy is shared by the beta particle and the antinutreno.
So Max K.E. = 1.182 MeV when antineutrino do not get any share

11. If the product nucleus ^{198}Hg is formed is its ground state, the kinetic energy available to the e^- and antinutreno is

$Q = \left[m({}^{198}Au) - m({}^{198}Hg)\right]C^2$

As ^{198}Hg has energy 1.088 MeV more than ^{198}Hg is 9.5, K.E. actually available is

$Q = \left[m({}^{198}Au) - m({}^{198}Hg)\right]C^2 - 1.088$

= 0.2806 MeV (Max^m K.E. of the e^- emitted)

12. Rate = 300 MW = 300 x 10^6 J/s
Energy in one second = 300 x 10^6 J
Energy from one fisson = 200 x 10^6 x 1.6 x 10^{-19}s

No of fission = $\frac{3 x 1}{2 x 1.6 x 10^{-19}}$

= No of u-nucleus

Gm-moles n

$= \frac{1.5 x 10^{19}}{1.6 x 6.023 x 10^{23}} = 0.1556 x 10^{-4}$

amount = n M = 36.578 x 10^{-4} gm

$\Rightarrow 3.6578 mg = 3.7 mg$

13. Q value =

$[2(4.0026) - 8.0053]931 = -1 x 10^{-4} x 931$

$= -931 x 10^{-4} MeV x 10^3$ $= -93.1 KeV$

Q value is energy released So because q value is -ve hence energy has to be given.

14. $B\left({}_1H^2\right) = 1.1 MeV$

$B\left({}_2He^4\right)$ = 7.0 MeV

Energy release= 4(7.0) - 4(1.1)
= 28 - 4.4 = 23.6 MeV

15.

Mass of ${}^1_1H = 1.67 \times 10^{-27}$kg

Now No. of ${}^1_1H$ atom is sun

$= \frac{1.7 \times 10^{50}}{1.67 \times 10^{-27}}$ atom

No. of ${}^4_2He$ from $= \frac{1.7 \times 10^{30}}{1.67 \times 10^{-27} \times 4}$

Energy release

$= \frac{1.7 \times 10^{30}}{1.67 \times 10^{-27} \times 4} \times 26 \times 10^6 \times 1.6 \times 10^{-19}$ Joule

Time taken = $\frac{\text{Energy release}}{3.9 \times 10^{26}}$

$= \frac{1.7 \times 10^{30} \times 26^{\times 6} \times 1.6 \times 10^{-19}}{1.7 \times 10^{-27} \times 4 \times 3.9 \times 10^{26}} = \frac{8}{3} \times 10^{18}$ s

16. E = 2 x 0.5 = 1MeV

$$\frac{E}{2}=\frac{hc}{\lambda}=\frac{1.24\times10^{-12}MeVm}{\lambda}$$

$$\lambda=2.48\times10^{-12}m \;=2.48\times10^{-12}\,m$$

17.
$$2\,{}^{2}H_1 \rightarrow \;{}_2He^4+23.6\,MeV$$
$$\downarrow \qquad\qquad \downarrow$$
$$1.1\times2\times2.2 \qquad E-4.4 \qquad\qquad E = 28\ MeV$$

18. $\pi^+ \rightarrow \mu^+ +$ neutrino

$100 \rightarrow 100MeV$

$$50=\frac{1}{2}mv^2+\frac{hc}{\lambda} \qquad mv=\frac{h}{\lambda}$$

$$50=\frac{1}{2}100\frac{v^2}{c^2}+100\frac{v}{c}$$

$$x^2+2x-1=0 \qquad x=0.41\Rightarrow\frac{v}{c}=0.41$$

$$\frac{1}{2}mv^2=\frac{1}{2}\frac{100x10^6 0.41\times c^2}{C^2}=9\times10^6\,eV$$

19. Δm = (2.0141) -4.0024
= 0.0258 u
Q = 0.0258 x 931
= 24 Me

20. $A=A_0e^{-\lambda t}$ $\qquad$ $500 = 600e^{-\lambda t}$

$$\lambda=\frac{Ln6/5}{t}=\frac{Ln(5/6)}{40\ min}$$

Half life $t_{1/2}=\frac{\ln2}{\lambda}=\frac{\ln2}{\ln6/5}\times40=152\,min$

21. $$\lambda=\frac{\ln^2}{4.5\times10^9}$$

No of U^{238} atoms = N_u $\qquad$ No of Pb^{206} atoms = N_{pb}

$N_u = N_{pb}$ $\qquad$ $N_u = N_o e^{-\lambda t}$

$e^{-\lambda t} = 1-e^{-\lambda t}$ $\qquad$ $\lambda t = \ln2$

$t = 4.5 \times 10^9 y$

22.

From $N=N_0\left[1-e^{-\lambda t}\right]$

$$1\times10^5=N_0\left[1-e^{-\lambda 36}\right] \qquad \text{....... (1)}$$

$$1.11\times10^5=N_0\left[1-e^{-108\lambda}\right] \qquad \text{....... (2)}$$

From eq. (1) & (2)

$$\lambda=\frac{2.27}{36}=0.0630 \qquad t_{1/2}=\frac{0.693}{0.0638}=10.89\ Sec.$$

23. $${}^{40}_{19}K\rightarrow{}^{40}_{18}Ar+{}_{+1}e^0+\nu$$

$$\lambda=\frac{0.693}{1.4\times10^9} \qquad N=N_0e^{-\lambda t}$$

$$1=8e^{-\lambda t} \qquad \lambda t=\ln(8)\Rightarrow\frac{2.079\times1.4\times10^9}{0.693}=t$$

$t = 4.2 \times 10^9$ years.

24. Given $R=Ril^{-\lambda t}$
No of atom disasocile in twis t
= 80%

$$\Rightarrow \frac{80N_0}{100}=N_0\left[1-e^{-\lambda t}\right] \qquad 4=5-5e^{-\lambda t}$$

$$\Rightarrow 5e^{-\lambda t}=1\Rightarrow\ln5=\lambda t$$

$$t=\frac{\ln5}{\lambda}=\left(\frac{\ln5}{\ln2}\right)\tau$$

25.

$t_{1/2}$ = 8 days $\qquad$ $A_0 = 20\,\mu ci$

$A=A_0e^{-\lambda t}$

26. Since the number o ^{206}Pb atoms equals the no. of ^{238}U atoms, half of the original ^{238}U atom have decayed. It takes one half life to decay half of the active mudei, Thus the sample is 4.5×10^9y old

27.

$$t=\frac{1}{\lambda}\ln\left(1+\frac{N_D}{N_c}\right) \qquad t_1=\frac{1}{\lambda}\ln\left(1+\frac{1}{9}\right)$$

$$t_2=\frac{1}{\lambda}\ln(1+9) \qquad t_1-t_2=24\,min$$

28. $$t=\frac{1}{\lambda}\ln\left(1+\frac{N_{pb}}{N_u}\right)$$

$$t=\frac{4.47\times10^9}{\ln2}\left(1+\frac{\frac{0.6\times10^3}{286}}{\frac{2\times10^3}{238}}\right)$$

$$=\frac{4.47\times10^9}{\ln2}\ln(1.34660)$$

$= 1.92 \times 10^9$ years

29. $\xrightarrow{\alpha} A \xrightarrow{\lambda} B$ $\qquad$ t = 0

$$N=N_oe^{-\lambda t}+\frac{R}{\lambda}(1-e^{-\lambda t})$$

$$N=\frac{1}{\lambda}\left[\alpha(1-e^{-\lambda t})+\lambda N_oe^{-\lambda/2}\right]$$

$$\alpha=2N_ox$$

$$N_{\lambda/2}=\frac{1}{\lambda}\left[2N_o\lambda\left(\frac{1}{2}\right)+\frac{\lambda N_o}{2}\right]$$

$$=\frac{3N_o}{2}$$

$$N_\infty=\frac{1}{\lambda}\left[2N_o\lambda(1-0)+\lambda N_o\,x\,0\right]=2N_o$$