Physics 30 – Lesson 36
Radioactivity

/ 56

1)

/2 ${}^{16}_{8}O$ - 8 protons, 8 electrons, 8 neutrons

${}^{120}_{50}Sn$ - 50 protons, 50 electrons, 70 neutrons

2)

/1 ${}^{34}_{15}\mathrm{P} \rightarrow {}^{0}_{-1}e + {}^{34}_{16}S + \bar{\nu}$

3)

/8
a) ${}^{4}_{2}He$ *e*) ${}^{0}_{-1}e + \bar{\nu}$

b) ${}^{4}_{2}He$ *f*) ${}^{0}_{+1}e + \nu$

c) ${}^{0}_{+1}e + \nu$ *g*) ${}^{0}_{-1}e + \bar{\nu}$

d) ${}^{4}_{2}He$ *h*) ${}^{4}_{2}He$

4)

/5 *a*) α b) α c) α d) β e) β

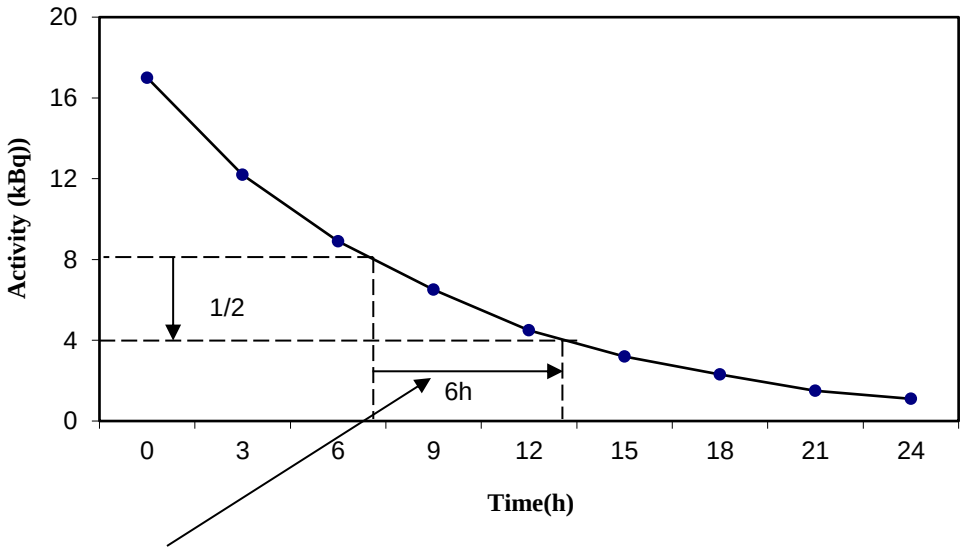
5)

a) $n = \dfrac{t}{t_{1/2}} = \dfrac{40}{20} = 2 \quad N = N_0\left(\tfrac{1}{2}\right)^n = 320g\left(\tfrac{1}{2}\right)^2 = \boxed{80g}$

/9 b) $n = \dfrac{t}{t_{1/2}} = \dfrac{80}{20} = 4 \quad N = N_0\left(\tfrac{1}{2}\right)^n = 320g\left(\tfrac{1}{2}\right)^4 = \boxed{20g}$

c) $n = \dfrac{t}{t_{1/2}} = \dfrac{5\times 24}{20} = 6 \quad N = N_0\left(\tfrac{1}{2}\right)^n = 320g\left(\tfrac{1}{2}\right)^6 = \boxed{5.0g}$

6)



/8 half life = 6 hours

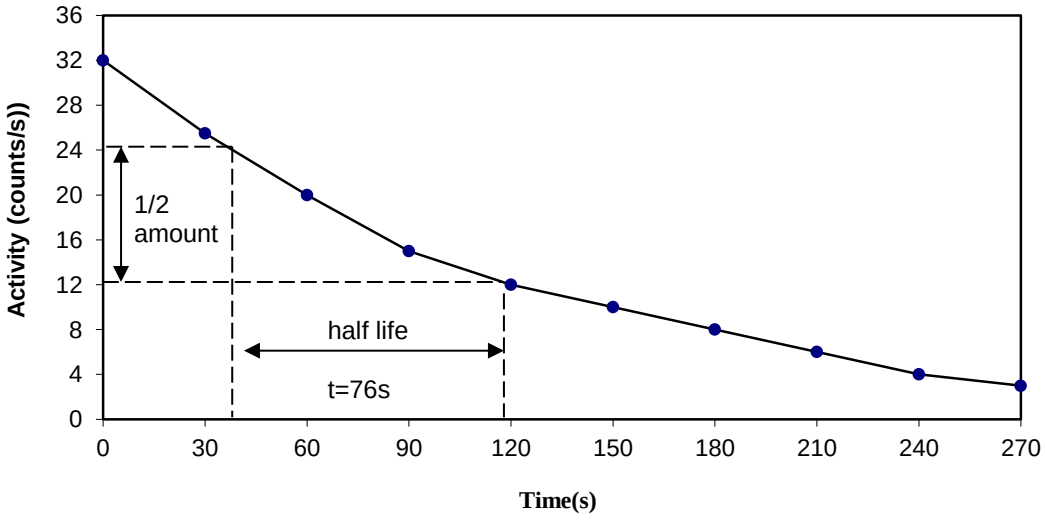
$n = \frac{t}{t_{1/2}} = \frac{7}{6}$ $\quad$ $n = \frac{t}{t_{1/2}} = \frac{19}{6}$ $\quad$ $n = \frac{t}{t_{1/2}} = \frac{26}{6}$

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

$N = 17.0\left(\frac{1}{2}\right)^{\frac{7}{6}}$ $\quad$ $N = 17.0\left(\frac{1}{2}\right)^{\frac{19}{6}}$ $\quad$ $N = 17.0\left(\frac{1}{2}\right)^{\frac{26}{6}}$

$\boxed{N = 7.6kBq}$ $\quad$ $\boxed{N = 1.9kBq}$ $\quad$ $\boxed{N = 0.84kBq}$

7)



/6

$\boxed{t_{half} \sim 76s}$

8) /3

$N_0 = 140g$

$N = 17.5$

$n = ?$

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

$17.5 = 140\left(\frac{1}{2}\right)^n$

$\left(\frac{1}{2}\right)^n = \frac{17.5}{140}$

$\left(\frac{1}{2}\right)^n = \frac{1}{8}$

since $2^3 = 8$ $\quad n = 3.0$ half lives

time = 3.0 x 25 days = $\boxed{75.0 \text{ days}}$

9) /3

$N_0 = 10$

$N = 2.5$

$n = ?$

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

$2.5 = 10\left(\frac{1}{2}\right)^n$

$\left(\frac{1}{2}\right)^n = \frac{2.5}{10}$

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

since $2^2 = 4$ $\quad n = 2.0$ half lives

time = 2.0 x 4 days = $\boxed{8.0 \text{ days}}$

10) /4

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

$\frac{1}{8} = \left(\frac{1}{2}\right)^n$

$n = 3$

$t_{1/2} = \frac{t}{n} = \frac{9.0days}{3}$

$t_{1/2} = \boxed{3.0days}$

11) /2

$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{96}_{40}Zr + {}^{137}_{52}Te + 3\,{}^{1}_{0}n$

12) /5

$^{228}_{90}Th \rightarrow {}^{4}_{2}He + {}^{224}_{88}Ra$

$228.028715u \quad 4.002603u \quad 224.020186u$

$\Delta m = \sum m_{\text{products}} - \sum m_{\text{reactants}}$

$\Delta m = (4.002603u + 224.020186u) - 228.028715u$

$\Delta m = -0.005926u$

$E = \Delta mc^2$

$E = \left(-0.005926u \times 1.660540 \times 10^{-27}\ \frac{kg}{u}\right)(3.00 \times 10^8\ {}^{m}\!/_{s})^2$

$E = -8.856324 \times 10^{-13}\,J$

$\boxed{E = -5.53520MeV}$