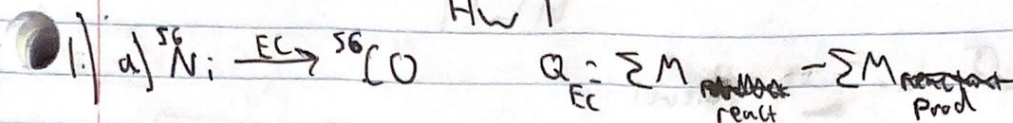


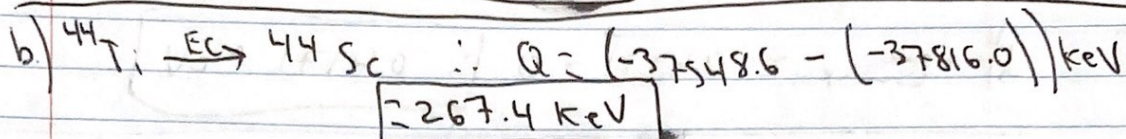
Hw 1



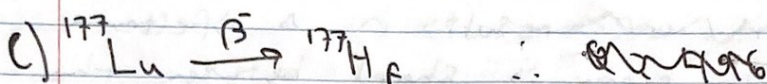
$$Q_{\text{EC}} = (-56040.5) - (-53907.6) \text{ KeV}$$

$$Q_{\text{EC}} = (-53907.6) - (-56040.5) \text{ KeV}$$

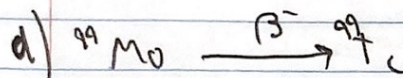
$$= 2132.9 \text{ KeV}$$



$$= 267.4 \text{ KeV}$$

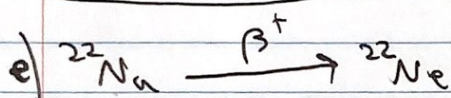


$$= 496.8 \text{ KeV}$$



$$Q = -85970.11 - (-87327.9)$$

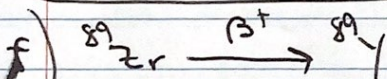
$$= 1357.79 \text{ KeV}$$



$$Q = \sum M_{\text{react}} - \sum M_{\text{prod}} - 2m_e$$

$$Q = -5181.39 - (-8024.716) - 2(511)$$

$$= 1821.326 \text{ KeV}$$



$$Q = -84878 - (-87711.2) - 2(511)$$

$$= 1811.2 \text{ KeV}$$



HW 1

2)  $E_{\beta}^{\max} = Q - E_{\text{level}}$

a)  $E_{\max} = 0.4971 - 0.32132 = 0.17578 \text{ MeV}$

b)  $E_{\max} = 0.4971 - 0.24967 = 0.24743 \text{ MeV}$

c)  $E_{\max} = 0.4971 - 0.11295 = 0.38415 \text{ MeV}$

d)  $E_{\max} = 0.4971 - 0 = 0.4971 \text{ MeV}$

3)  $\beta$  decay ~~is~~ results in a Spectrum because the energy is shared between the  $\beta$  particle and antineutrino so if the energy for the antineutrino is higher than the energy for the  $\beta$  particle would be lower and vice versa



HW1

- 4) a)  $^{22}_{Na} (\beta^+) : ^{22}_{Na} \rightarrow ^{22}_{Ne} + e^+ + \nu$   
 $^{22}_{Na} (\beta^-) : ^{22}_{Na} \rightarrow ^{22}_{Mg} + e^- + \bar{\nu}$   
 b)  $^{60}_{Co} (EC) : ^{60}_{Co} e^- \rightarrow ^{60}_{Fe} + \gamma + \nu$   
 c)  $^{127}_{Cs} (\beta^+) : ^{127}_{Cs} \rightarrow ^{127}_{Xe} + e^+ + \nu$   
 $^{127}_{Cs} (\beta^-) : ^{127}_{Cs} \rightarrow ^{127}_{Ba} + e^- + \bar{\nu}$   
 d)  $^{241}_{Am} (\alpha) : ^{241}_{Am} \rightarrow ^{237}_{Np} + ^4_2He$   
 e)  $^{252}_{Cf} (\alpha) : ^{252}_{Cf} \rightarrow ^{248}_{Cm} + ^4_2He$

5)  $A = 150 \text{ MBq}$   
 $A_0 = 200 \text{ MBq}$   
 $t = 5 \text{ days}$

$$A = A_0 e^{-\lambda t}$$

$$\lambda = \frac{-\ln\left(\frac{A}{A_0}\right)}{t}$$

$$\lambda = \frac{-\ln\left(\frac{150 \text{ MBq}}{200 \text{ MBq}}\right)}{5 \text{ days}}$$

$$\lambda = 0.057536414 \text{ days}^{-1}$$

~~$$\lambda = 12.0471042 \text{ days}^{-1}$$~~

~~$$t_{1/2} = \frac{\ln(2)}{\lambda}$$~~

$$t_{1/2} = \frac{\ln(2)}{\lambda} = 12.0471042 \text{ days}$$



6) a)  $^{239}\text{Pu} \rightarrow ^{235}\text{U} + ^4\text{He}$  HW 1

$$\therefore Q_\alpha = \sum M_{\text{react}} - \sum M_{\text{prod}}$$

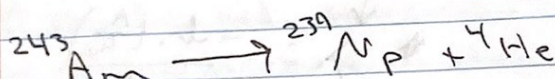
$$= \underbrace{48588.2}_{\text{Pu}} - \underbrace{40918.8}_{\text{U}} - \underbrace{2424.91587}_{\text{He}}$$

$$= 5244.484 \text{ KeV}$$

$$T_\alpha = (Q - E_{\text{level}}) \left( \frac{A_{D_1}}{A_{D_1} + A_{D_2}} \right) = (5244.484 - 0) \left( \frac{235}{235+4} \right)$$

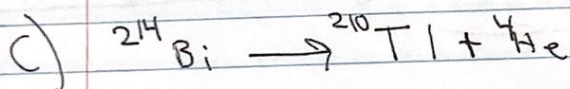
$$= 5156.710337 \text{ KeV}$$

used values  
from iaea  
for b



$$Q = 57175 - 49311 - 2424.916 = 5439.084 \text{ KeV}$$

$$T_\alpha = 5439.084 \left( \frac{239}{243} \right) = 5349.552 \text{ KeV}$$



$$Q = -1201 - (-9247) - 2424.916 = 5621.084 \text{ KeV}$$

$$T_\alpha = 5621.084 \left( \frac{210}{214} \right) = 5516.017 \text{ KeV}$$



7)  $^{187}\text{Po}$  can ~~not~~ undergo both  $\alpha$  and  $\beta$  decay. HLW 1

~~because~~

$I+$  can undergo  $\alpha$  decay because it is heavy and unstable and it can undergo  $\beta$  decay because  $A > Z$ .

And the chart of nuclides says 88%  $\beta$  and 12%  $\alpha$

8)  $N_0 = 2.5 \text{ mol}$   $N = N_0 \exp(-\lambda t)$   
 $t_{1/2} = 43 \text{ days}$   
 $\lambda = \frac{\ln(2)}{t_{1/2}} = 0.01612 \text{ days}^{-1}$

$$N_{43} = 2.5 \exp(-0.01612 \cdot 43) = 1.25 \text{ mol}$$

$$N_{6m} = 2.5 \exp(-0.01612 \cdot 6 \cdot 30.5) = 0.130861638 \text{ mol}$$

$$N_{1y} = 2.5 \exp(-0.01612 \cdot 1 \cdot 12 \cdot 30.5) = 6.849907 \times 10^{-3} \text{ mol}$$



HW 1

a)

$$A_0 = 47 \text{ Bq}$$

$$t_{1/2} = 4 \text{ days}$$

$$\lambda = \frac{\ln 2}{t_{1/2}} = 0.173286795 \frac{1}{\text{days}}$$

$$A = A_0 \exp(-\lambda \cdot t)$$

u)

$$2 \text{ days before: } t = -2$$

~~ACMA~~

$$A = 47 \exp(-0.173286795 \cdot -2)$$

$$= 66.46803743 \text{ Bq}$$

b)

$$2 \text{ days after: } t = +2$$

$$\therefore A = 47 \exp(-0.173286795 \cdot 2)$$

$$= 33.23401872 \text{ Bq}$$



Josh Whitehead  
Nucl 3100  
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10) HW 1  
 $A = 3.5 \mu\text{Ci} = 3.5 \times 10^{-6} \text{ Ci} = 3.5 \times 10^{-6} \text{ Ci} \cdot \frac{3.7 \times 10^{10} \text{ Bq}}{1 \text{ Ci}}$

$$A = 129500 \text{ Bq} = 129500 \text{ dps}$$

$$\lambda = \frac{\ln(2)}{t_{1/2}} = \frac{\ln(2)}{1.41352 \times 10^{17} \text{ sec}} = 4.90369 \times 10^{-18} \frac{1}{\text{sec}}$$

using  $A = \lambda N \rightarrow N = \frac{A}{\lambda}$

$$= \frac{129500 \frac{\text{atom}}{\text{sec}}}{4.90369 \times 10^{-18} \frac{1}{\text{sec}}} = 2.64087 \times 10^{22} \text{ atom}$$

$$\Rightarrow 2.64087 \times 10^{22} \text{ atom} \cdot \frac{1 \text{ mol}}{6.022 \times 10^{23}}$$

$$= 0.043853666 \text{ mol } ^{235}\text{U}$$