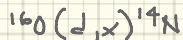
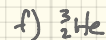
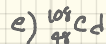
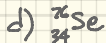
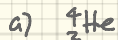


HW 13

Chapter 13

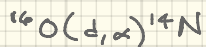
13.1



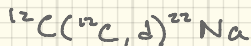
$$A = 16 + 2 \Rightarrow 18 - 14 = 4$$

$$Z = 8 + 1 \Rightarrow 9 - 7 = 2 \Rightarrow \text{He}$$

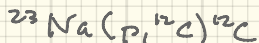
13.8



$$Q = [M({}^{16}_8\text{O}) + M({}^2_1\text{H}) - M({}^4_2\text{He}) - M({}^{14}_7\text{N})]u \cdot c^2 = 3.11 \text{ MeV} \text{ exo}$$

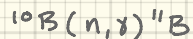


$$Q = -2.95 \text{ MeV} \text{ endo}$$



$$Q = -2.24 \text{ MeV} \text{ endo}$$

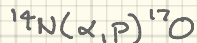
13.14



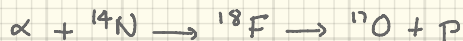
$$E_\gamma = [M(^{10}\text{B}) + M(n) - M(^{11}\text{B})]u \cdot c^2 = 11.5 \text{ MeV}$$

13.19

@ threshold



$E(\alpha) = 6.7 \text{ MeV}$



$$K_{\text{cm}}(\alpha) = \frac{M(^{14}\text{N})}{M(^{14}\text{N}) + M(\alpha)} K_{\text{lab}}(\alpha) = \frac{14}{18} (6.7) = 5.21 \text{ MeV}$$

in cm compound nucleus is at rest

$$E^* = [M(^{14}\text{N}) + M(^4\text{He}) - M(^{18}\text{F})]u \cdot c^2 = 4.41 \text{ MeV}$$

so back in lab

$$E = E^* + K_{\text{cm}} = 9.62 \text{ MeV}$$

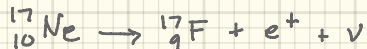
13.22 a) $T_{1/2} = 109 \text{ ms}$

need τ in order to get Γ :

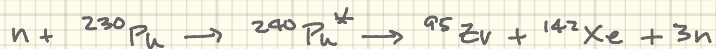
$$\tau = \frac{T_{1/2}}{\ln 2} = \frac{109 \text{ ms}}{0.67} = 157 \text{ ms}$$

$$\tau \Gamma = \frac{\hbar}{2} \Rightarrow \Gamma = \frac{\hbar}{2\tau} = \frac{6.58 \times 10^{-16} \text{ eV}\cdot\text{s}}{2(0.157 \text{ s})} = 2.1 \times 10^{-15} \text{ eV}$$

b) stable Ne is ${}^{20}_{10}\text{Ne}_{10}$. This is ${}^{17}_{10}\text{Ne}_7 \Rightarrow$ excess of protons, so good candidate for e^+ decay



13.26



$$\Delta E = [M({}^{239}\text{Pu}) + M(n) - M({}^{95}\text{Zr}) - M({}^{142}\text{Xe}) - 3M(n)]c^2$$

$$\Delta E = 183.6 \text{ MeV}$$

13.30

reactor power 1250 MWe $\rightarrow$ megawatts "electric"

each fission is 200 MeV from ${}^{235}\text{U}$

$$\begin{aligned} \text{So energy/day} \Rightarrow 1250 \text{ MW} &= (1.25 \times 10^9 \text{ J/s}) \left(\frac{86,400 \text{ s/d}}{1.6 \times 10^{13} \text{ J/MeV}} \right) \\ &= 6.74 \times 10^{26} \text{ MeV/d} \end{aligned}$$

↑

from fission, 200 MeV at a time

$$(6.74 \times 10^{26} \text{ MeV/d}) \left(\frac{1 \text{ fission}}{200 \text{ MeV}} \right) \left(\frac{0.235 \text{ kg}}{\text{mol}} \right) \left(\frac{\text{mol}}{6.02 \times 10^{23}} \right) = 1.32 \text{ kg/d}$$

13.31

for 1 kg:

$$(1 \text{ kg}) \left(\frac{6.02 \times 10^{23} \text{ atoms}}{0.235 \text{ kg}} \right) \left(\frac{200 \text{ MeV}}{\text{atom}} \right) = 5.13 \times 10^{26} \text{ MeV}$$

$$\rightarrow \text{kWh} \dots 2.3 \times 10^7 \text{ kWh}$$

from table 13.1, 1 kg coal worth $3 \times 10^7 \text{ J} \rightarrow 8.33 \text{ kWh}$

fission $\sim 10^6 \times$ coal