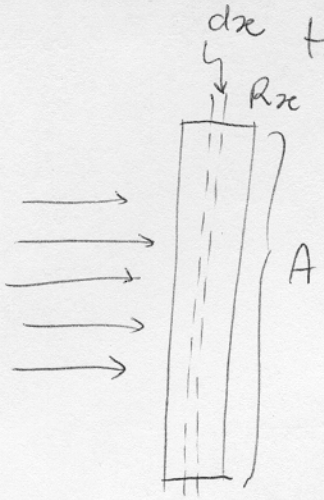
HW #13

43-17



rate at which collisions occur in dx

$$dR_x = -R_x \frac{A'}{A} = -R_x \frac{n\sigma dx \cancel{A}}{\cancel{A}}$$

rate of emerging particles

R_x is decreasing

$$\int_{R_0}^{R_x} \frac{dR_x}{R_x} = -n\sigma \int_0^t dx$$

$$\ln\left(\frac{R_x}{R_0}\right) = -n\sigma t \Rightarrow R_x = R_0 e^{-n\sigma t}$$

rate at which particles will emerge from the target

43-70

(a) $\Delta m = 2m_{^{12}_{6}C} - m_{^{24}_{12}Mg} = 2 \times 12.00000\,u - 23.985042\,u =$

$= 13.9$ MeV

(b) $2KE = |U| = \frac{1}{4\pi\epsilon_0}\frac{6^2e^2}{d} = \frac{1}{4\pi \times 8.85\times10^{-12}}\frac{36\times(1.6)^2\times10^{-38}}{6\times10^{-15}} =$

$= 1.38\times10^{-12}\,J = 8.625\times10^{6}\,eV = 8.625$ MeV

$KE = \frac{8.625}{2}$ MeV $= 4.31$ MeV

(c)

$KE = \frac{3}{2}k_BT$

$T = \frac{2}{3}\frac{KE}{k_B} = \frac{2}{3}\frac{0.69\times10^{-12}}{1.38\times10^{-23}} = 3.3\times10^{10}\,K$

44.43 $\frac{mv^2}{R} = evB \quad B = \frac{p}{eR} = \frac{pc}{eRc} = \frac{E}{eRc}$

$$B = \frac{7\times10^{12}\times1.6\times10^{-19}}{1.6\times10^{-19}\times4.25\times10^{3}\times3\times10^{8}} = 5.5T$$

44.20 $\Xi^0 \rightarrow \Sigma^+ + \pi^-$ violates energy

$\Omega^- \rightarrow \Sigma^0 + \pi^- + \nu$ violates lepton number

$\Sigma^0 \rightarrow \Lambda^0 + \gamma + \gamma$ OR

44.27 $\Xi^- \rightarrow \Lambda^0 + \pi^-$

$$Q = \left[m_{\Xi} - (m_{\Lambda_0} + m_{\pi^-})\right]c^2 = 66\,MeV$$

$$Q = K_{\Lambda_0} + K_{\pi^-} \qquad P_{\Lambda_0} = P_{\pi^-} = P$$

$$Q = 66\,MeV = \sqrt{(pc)^2 + (1115.7\,MeV)^2} - (1115.7\,MeV) + \sqrt{(pc)^2 + (139.6\,MeV)^2} - (139.6\,MeV)$$

$$pc = 139\,MeV$$

$$K_{\Lambda_0} = \sqrt{(139) + (1115.7)^2} - 1115.7 = 8.6\,MeV$$

$$K_{\pi^-} = \sqrt{(139)^2 + (139.6)^2} - 139.6 = 57.4\,MeV$$

44.36 $\frac{l_{sun}}{l_{star}} = \frac{d_{star}^2}{d_{sun}^2}$

$$d_{star} = d_{sun}\sqrt{\frac{l_{sun}}{l_{star}}}$$

$$= 150\times10^{9}\sqrt{10^{11}} = 4.74\times10^{16}\,m$$