

22. (a) From Eq. 38-47,

$$\begin{aligned} Q &= -\Delta m c^2 = (m_{\Lambda^0} - m_p - m_{\pi^-})c^2 \\ &= 1115.6 \text{ MeV} - 938.3 \text{ MeV} - 139.6 \text{ MeV} = 37.7 \text{ MeV} . \end{aligned}$$

(b) We use the formula obtained in problem 11 (where it should be emphasized that E is used to mean the rest energy, not the total energy):

$$\begin{aligned} K_p &= \frac{1}{2E_\Lambda} \left[(E_\Lambda - E_p)^2 - E_\pi^2 \right] \\ &= \frac{(1115.6 \text{ MeV} - 938.3 \text{ MeV})^2 - (139.6 \text{ MeV})^2}{2(1115.6 \text{ MeV})} = 5.35 \text{ MeV} . \end{aligned}$$

(c) By conservation of energy,

$$K_{\pi^-} = Q - K_p = 37.7 \text{ MeV} - 5.35 \text{ MeV} = 32.4 \text{ MeV} .$$