**911.**

**Problem 45.22P (HRW)**

*We consider the decay* $\lambda^0 \rightarrow \mathrm{p} + \pi^-$ *with the* $\lambda^0$ *at rest*. (a) *We have to calculate the disintegration energy*; (b) *find the kinetic energy of the proton*; *and* (c) *the kinetic energy of the pion*.

**Solution:**

We recall that the needed rest mass energies are

$E_{\lambda^0} = 1116$ MeV, $E_{\mathrm{p}} = 938$ MeV and $E_{\pi^-} = 140$ MeV.

(a)

The disintegration energy of the decay $\lambda^0 \rightarrow \mathrm{p} + \pi^-$ will therefore be

$$Q_{\lambda^0 \rightarrow \mathrm{p}+\pi^-} = (1116 - 938 - 140) \text{ MeV}$$
$$= 38 \text{ MeV}.$$

(b)

From the preceding problem that is **910** we recall that the kinetic energy of the proton in terms of the rest mass energies of $\lambda^0$, p and $\pi^-$ is given by the expression

$$K_{\mathrm{p}} = \frac{1}{2E_{\lambda^0}}\left[\left(E_{\lambda^0} - E_{\mathrm{p}}\right)^2 - E_{\pi^-}^2\right].$$

Therefore, the kinetic energy of the proton will be

$$K_{\mathrm{p}} = \frac{1}{2\times 1116}\left[(1116 - 938)^2 - 140^2\right] \text{ MeV}$$
$$= 5.41 \text{ MeV},$$

and

(c)

$$K_{\pi^-} = \frac{1}{2\times 1116}\left[(1116 - 140)^2 - 938^2\right] \text{ MeV}$$
$$= 32.59 \text{ MeV}.$$