

**Problem 14.2** In discussing weak decays proceeding through  $W$  or  $Z$  bosons, we have focused primarily on the fundamental transitions among quarks and leptons. However, such decays often involve hadrons that contain spectator quarks, in addition to the partons that participate in the weak interaction (see Fig. 14.3). For example, Fig. 14.5 shows a diagram for the decay of a  $K^0$  into a  $\pi^+\pi^-\pi^0$  pair. Using similar quark-line diagrams, draw processes for the following decays: (a)  $K^+ \rightarrow \pi^+ + \pi^0$ , (b)  $n \rightarrow p + e^- + \bar{\nu}_e$ , (c)  $\pi^+ \rightarrow \mu^+ + \nu_\mu$ , (d)  $K^0 \rightarrow \pi^- + e^+ + \nu_e$ .

See Figs. 14.1–14.4 that provide the diagrams for decays 14.2(a)–(d), respectively.

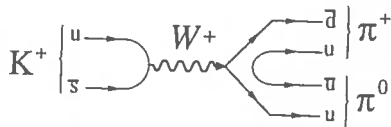


Fig. 14.1. Decay 14.2a.

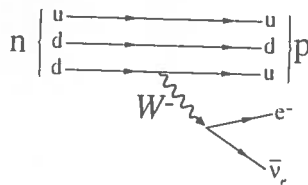


Fig. 14.2. Decay 14.2b.

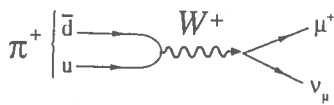


Fig. 14.3. Decay 14.2c.

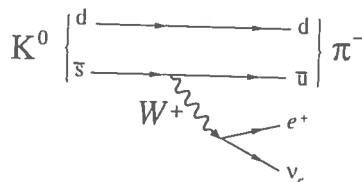


Fig. 14.4. Decay 14.2d.