Chapter 33

Problems & Exercises

1.

3×10^{-39} s

3.

1.99×10^{-16} m (0.2 fm)

4.

(a) 10^{-11} to 1, weak to EM

(b) 1 to 1

6.

(a) 2.09×10^{-5} s

(b) 4.77×10^{4} Hz

8.

78.0 cm

10.

1.40×10^{6}

12.

100 GeV

13.

67.5 MeV

15.

(a) 1×10^{14}

(b) 2×10^{17}

17.

(a) 1671 MeV

(b) $Q = 1, Q\prime = 1 + 0 + 0 = 1.\ L_\tau = -1; L\prime\tau = -1; L\mu = 0; L\prime\mu = -1 + 1 = 0$

$\tau^- \rightarrow \mu^- + v_\mu + \bar{v}_\tau$

(c) $\Rightarrow \mu^-$ antiparticle of μ^+; v_μ of $\bar{v}_\mu$; $\bar{v}_\tau$ of v_τ

19.

(a) 3.9 eV

(b) 2.9×10^{-8}

21.

(a) The uud composition is the same as for a proton.

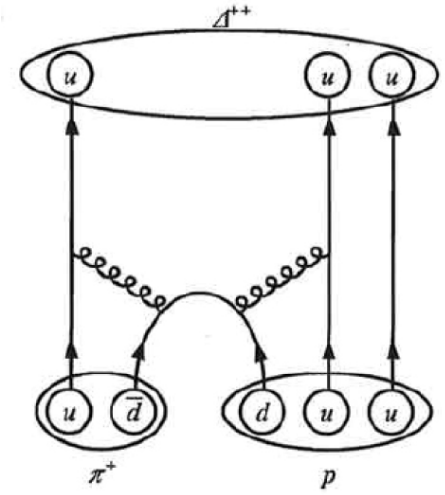
(b) 3.3×10^{-24} s

(c) Strong (short lifetime)

23.

a) $\Delta^{++}(\text{uuu});\ B = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 1$

b)



25.

(a) +1

(b) $B = 1 = 1 + 0,\ Z == 0 + (-1)$, all lepton numbers are 0 before and after

(c) (sss) $\rightarrow$ (uds) + $\left(\bar{u}s\right)$

27.

(a) $(u\bar{u} + d\bar{d}) \rightarrow (u\bar{u} + d\bar{d}) + (u\bar{u} + d\bar{d})$

(b) 277.9 MeV

(c) 547.9 MeV

29.

No. Charge $= -1$ is conserved. $L_{e_i} = 0 \neq L_{e_f} = 2$ is not conserved. $L_\mu = 1$ is conserved.

31.

(a)Yes. $Z = -1 = 0 + (-1)$, $B = 1 = 1 + 0$, all lepton family numbers are 0 before and after, spontaneous since mass greater before reaction.

(b) $\text{dds} \rightarrow \text{udd} + \bar{u}d$

33.

(a) 216

(b) There are more baryons observed because we have the 6 antiquarks and various mixtures of quarks (as for the -meson) as well.

35.

$\Omega^+ \left(\bar{s}\, \bar{s}\, \bar{s} \right)$

$B = -\frac{1}{3} - \frac{1}{3} - \frac{1}{3} = -1,$

$L_e,\, \mu,\, \tau = 0 + 0 + 0 = 0,$

$Q = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 1,$

$S = 1 + 1 + 1 = 3.$

37.

(a)803 MeV

(b) 938.8 MeV

(c) The annihilation energy of an extra electron is included in the total energy.

39.

$\bar{c}d$

41.

a)The antiproton

b) $\bar{p} \rightarrow \pi^0 + e^-$

43.

(a) 5×10^{10}

(b) 5×10^4 particles/m^2

45.

2.5×10^{-17} m

47.

(a) 33.9 MeV

(b) Muon antineutrino 29.8 MeV, muon 4.1 MeV (kinetic energy)

49.

(a) 7.2×10^5 kg

(b) 7.2×10^2 m^3

(c) 100 months

53.

(a) $2(1.67 \times 10^{-27} \text{ kg}) = 3.34 \times 10^{-27}$ kg

(b) $3.34 \times 10^{-27}(3.00 \times 10^8)^2$ joules $= 3.01 \times 10^{-10}$ joules

(c) 3.01×10^{-10} joules

(d) The proton has a positive charge, and the antiproton has a negative charge.