PX-7
(Practice Exercises Set 7)

1) A new particle is found that has a mass of 1430 MeV/c^2, responds to the strong force, has a spin quantum number of 3/2 and a strangeness of 0. Which classifications below apply to this particle? More than one choice may apply, so indicate all that are appropriate.

Baryon Boson Fermion Hadron Lepton Meson Messenger

2) Consider the following proposed reactions. For each reaction, list all conservation laws that are definitely violated, state whether the reaction can occur, and if it can occur, by what interaction.

a) $p \rightarrow n + e^+ + \nu_e$

b) $p \rightarrow n + e^+ + \gamma$

c) $\Sigma^- \rightarrow n + m^- + \bar{n}_m$

d) $\Sigma^- \rightarrow \pi^- + n$

e) $\pi^0 + \Xi^- \rightarrow \Sigma^- + \mu^+ + \overline{K^0}$

f) $\Delta^+ \rightarrow n + \mu^+ + \bar{\nu}_\mu$

3) Fill in the missing particle that will complete the following reactions consistent with all conservation laws.

a) $\Lambda + K^0 \rightarrow \pi^- +$ _____

b) $p + e^- \rightarrow n +$ _____

4) Give the quark content for the following particles.

a) Σ^+

b) n

c) K^0

d) Ω^-

e) Θ^+ *pentaquark*, with $Q = 1$, $B = 1$, and $S = 1$

PX-8
(Practice Exercises Set 8)

1) A proton and an anti-electron neutrino interact to form a neutron and a positron (anti-electron). You may have heard that the neutrino is difficult to detect; but since protons, neutrons, and positrons are easy to detect, observing protons (for example in the hydrogen atoms in water) and looking for the production of a neutron and a positron at close to the same time is an indicator of the existence of the anti-electron neutrino.

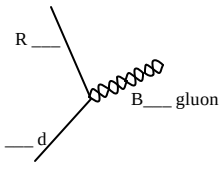
$$p + \nabla_e \rightarrow n + e^+$$

a) Does this reaction proceed via the strong interaction, the electromagnetic interaction, or the weak interaction?

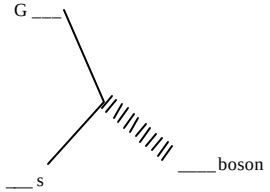
b) Draw the Feynman reaction diagram for this process.

2) Complete the following vertex diagrams by filling in all blanks with appropriate colors, flavors, or messenger names.

a)



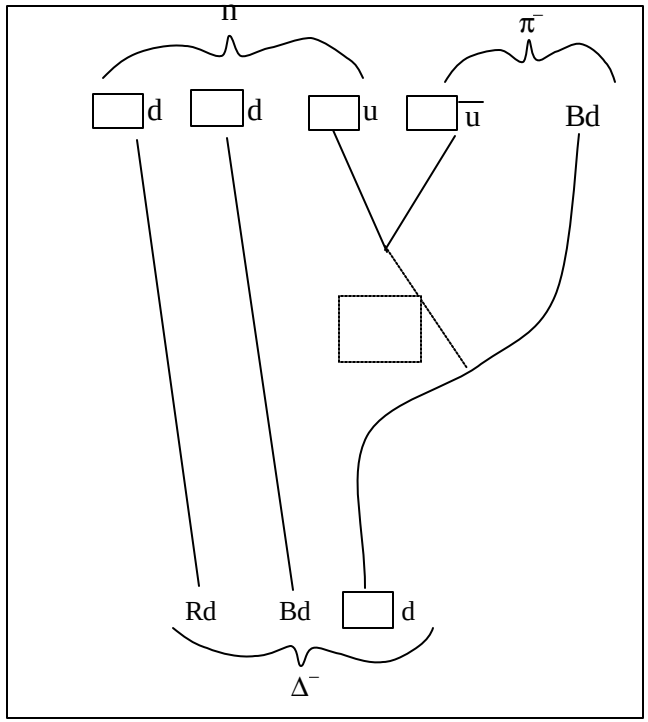
b)



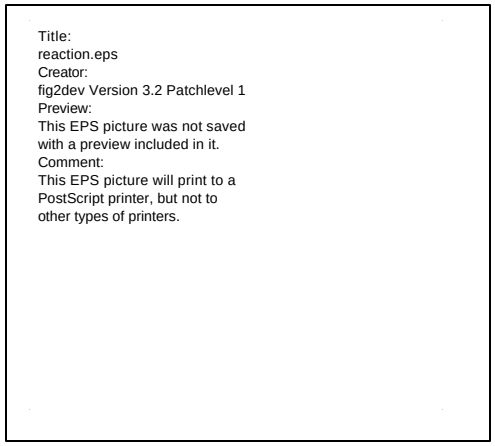
3) Consider the following decay, which proceeds by the strong interaction.

$$\Delta^- \rightarrow n + p^-$$

Complete the reaction diagram below. Specifically, fill in each blank box, giving all the unlabelled colors, and give a complete description of the messenger particle (type of messenger and colors and/or charge, if appropriate).



4) Given the following Feynman diagram for a strong interaction



(a) Identify the particles 1 - 4

(1) _____

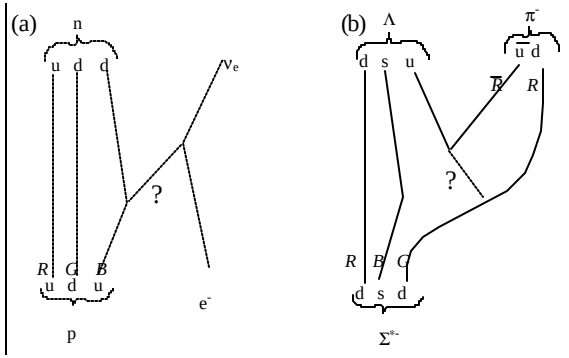
(2) _____

(3) _____

(4) _____

(b) Assign a consistent set of colors to each elementary particle, including the messenger (there is more than one possible correct answer).

5) For each of the following reaction diagrams, identify the messenger particle and state the type of interaction involved (strong, weak, E&M or gravitational). Denote the <u>colors</u> and/or <u>charges</u> for each messenger, where appropriate (write "NA" if it has no color or no charge).



(a) Messenger particle = _____,

type of interaction = _____,

Color = _____,

Charge = _____

(b) Messenger particle = _____,

type of interaction = _____,

Color = _____,

Charge = _____