1. Two particles interact to produce only photons, with the original particles disappearing. The particles must have been:
   A) mesons
   B) strange particles
   C) strongly interacting
   D) leptons
   E) a particle, antiparticle pair

2. Messenger particles of the strong interaction are called:
   A) gluons
   B) photons
   C) W and Z
   D) gravitons
   E) pions

3. A particle can decay to particles with greater rest mass:
   A) only if antiparticles are produced
   B) only if photons are also produced
   C) only if neutrinos are also produced
   D) only if the original particle has kinetic energy
   E) never

4. The interaction $\pi^- + p \rightarrow \pi^- + \Sigma^+$ violates the principle of conservation of:
   A) strangeness
   B) angular momentum
   C) lepton number
   D) baryon number
   E) none of these

5. An electron participates in:
   A) the strong force only
   B) the strong and weak forces only
   C) the electromagnetic and gravitational forces only
   D) the electromagnetic, gravitational, and weak forces only
   E) the electromagnetic, gravitational, and strong forces only

6. The two basic interactions that have finite ranges are:
   A) electromagnetic and gravitational
   B) electromagnetic and strong
   C) electromagnetic and weak
   D) gravitational and weak
   E) weak and strong

7. The interaction $\pi^- + p \rightarrow K^- + \Sigma^+$ violates the principle of conservation of:
   A) angular momentum
   B) baryon number
   C) lepton number
   D) strangeness
   E) none of these
8. $\pi^+$ represents a pion (a meson), $\mu^-$ represents a muon (a lepton), $\nu_e$ represents an electron neutrino (a lepton), and $\nu_\mu$ and $p$ represents a proton a muon neutrino (a lepton). Which of the following decays might occur? 
   A) $\pi^+ \rightarrow \mu^+ + \bar{\nu}_e$  
   B) $\pi^- \rightarrow \mu^- + \nu_\mu$  
   C) $\pi^+ \rightarrow \mu^- + \nu_\mu$  
   D) $\pi^+ \rightarrow \mu^+ + \nu_e$  
   E) $\pi^+ \rightarrow \mu^+ + \bar{\nu}_e$

9. Which of the following particles has a lepton number of zero? 
   A) $p$  
   B) $e^+$  
   C) $\bar{\nu}_e$  
   D) $\mu^+$  
   E) $\nu_e$

10. All leptons interact with each other via the: 
   A) strange force  
   B) strong force  
   C) weak force  
   D) electromagnetic force  
   E) none of these

11. Which of the following particles is stable? 
   A) Neutron  
   B) Proton  
   C) Pion  
   D) Muon  
   E) Kaon

12. A baryon with strangeness –1 decays via the strong interaction into two particles, one of which is a baryon with strangeness 0. The other might be: 
   A) a baryon with strangeness 0  
   B) a baryon with strangeness +1  
   C) a meson with strangeness –1  
   D) a meson with strangeness +1  
   E) a meson with strangeness 0

13. Color is carried by: 
   A) only quarks  
   B) only leptons  
   C) only quarks and leptons  
   D) only quarks and gluons  
   E) only photons and gluons

14. A positron cannot decay into three neutrinos. Of the following conservation laws, which would be violated if it did? 
   A) Baryon number  
   B) Angular momentum  
   C) Energy  
   D) Lepton number  
   E) Linear momentum

15. A particle with spin angular momentum $\hbar/2$ is called a: 
   A) lepton  
   B) hadron  
   C) fermion  
   D) boson  
   E) electron

16. The color theory explains why quarks: 
   A) have spin  
   B) have mass  
   C) have charge that is a multiple of e/3  
   D) form particles in pairs and triplets  
   E) none of the above
Answer Key

1. E
2. A
3. E
4. A
5. D
6. E
7. E
8. B
9. A
10. C
11. B
12. C
13. D
14. D
15. C
16. D