***Physics: Principle and Applications*, 7e (Giancoli)**
Chapter 32 Elementary Particles

32.1 Conceptual Questions

1) Inside the nucleus, the weakest of the four fundamental forces is
A) the weak nuclear force.
B) the electromagnetic force.
C) the gravitational force.
D) the strong nuclear force.
Answer: C
Var: 1

2) Inside the nucleus, the strongest of the four fundamental forces is
A) the weak nuclear force.
B) the electromagnetic force.
C) the gravitational force.
D) the strong nuclear force.
Answer: D
Var: 1

3) Which of the following statements about hadrons are correct? (There may be more than one correct choice.)
A) Hadrons are composed of leptons.
B) All hadrons are composed of quarks.
C) All hadrons interact by the strong nuclear force.
D) Electrons, protons, and neutrons are commonly-occurring hadrons.
E) Protons and neutrons are hadrons, but the electron is not.
Answer: B, C, E
Var: 1

4) Leptons can interact by which of the following forces?
A) strong nuclear force, weak nuclear force, electromagnetic force, gravitation
B) strong nuclear force, weak nuclear force, electromagnetic force
C) weak nuclear force, electromagnetic force, gravitation
D) strong nuclear force, weak nuclear force
E) strong nuclear force, electromagnetic force, gravitation
Answer: C
Var: 1

5) Which of the following particles are leptons? (There may be more than one correct choice.)
A) protons
B) neutrons
C) electrons
D) photons
E) quarks
Answer: C
Var: 1

6) Elementary particles that experience the weak nuclear force but not the strong nuclear force are called
A) leptons.
B) hadrons.
C) mesons.
D) bosons.
E) baryons.
Answer: A
Var: 1

7) What combination of quarks produces a proton and what are the electric charges on these quarks, expressed in terms of *e*?
Answer: uud, with charges +2/3 *e*, +2/3 *e*, and -1/3 *e*
Var: 1

8) What combination of quarks produces a neutron and what are the electric charges on these quarks, expressed in terms of *e*?
Answer: udd, with charges +2/3 *e*, -1/3 *e*, and -1/3 *e*
Var: 1

9) The proton is made up of which one of the following quark combinations (up, down, strange, charm, top, bottom)?
A) uud
B) ddu
C) udd
D) ttb
E) bst
Answer: A
Var: 1

10) The neutron is made up of which one of the following quark combinations (up, down, strange, charm, top, bottom)?
A) uud
B) ddu
C) udd
D) ttb
E) bst
Answer: C
Var: 1

11) Which of the following particles are *not* made up of quarks? (There could be more than one correct choice.)
A) alpha particle
B) electron
C) proton
D) positron
E) neutron
Answer: B, D
Var: 1

12) Which of the following particles (or groups of particles) are made up of quarks?
A) protons, neutrons, and electrons
B) electrons and neutrinos
C) photons
D) protons and neutrons
E) All particles except for photons are made up of quarks.
Answer: D
Var: 1

13) What are the possible charges of a quark (not an antiquark)?
A) -*e*, 0, *e*
B) -2/3 *e*, -1/3 *e*, +1/3 *e*, +2/3 *e*
C) -2/3 *e*, +1/3 *e*
D) -1/3 *e*, +2/3 *e*
E) -1/3 *e*, +1/3 *e*
Answer: D
Var: 1

14) How many quarks are in a deuteron, ${}_{1}^{2}\mathrm{H}$?

A) 2
B) 3
C) 4
D) 6
E) 9
Answer: D
Var: 1

15) How many quarks are in a tritium isotope, ${}^{3}_{1}\mathrm{H}$?

A) 2
B) 3
C) 4
D) 6
E) 9
Answer: E
Var: 1

16) How does the range of an exchange force depend on the mass of the exchange particle?
A) The range is longer for a massive exchange particle than for a light exchange particle.
B) The range is shorter for a massive exchange particle than for a light exchange particle.
C) The range does not depend on the mass of the exchange particle.
Answer: B
Var: 1

32.2 Problems

1) If a new force were discovered with a range on the order of 10^{-18} m, predict the approximate mass of the exchange particle. ($c = 3.00 \times 10^{8}$ m/s, $h = 6.626 \times 10^{-34}$ J · s)
Answer: 4×10^{-25} kg
Var: 1

2) The π^0 meson has a mass of 264 times that of an electron. What is the approximate range of the force mediated by this particle? ($m_{\text{electron}} = 9.11 \times 10^{-31}$ kg, $c = 3.00 \times 10^{8}$ m/s, $h = 6.626 \times 10^{-34}$ J · s)
A) 1.5×10^{-10} m
B) 1.5×10^{-12} m
C) 1.5×10^{-14} m
D) 1.5×10^{-15} m
Answer: D
Var: 1

3) Calculate an estimate of the range of a hypothetical force with the proton as the virtual exchange particle. ($c = 3.00 \times 10^{8}$ m/s, $h = 6.626 \times 10^{-34}$ J · s, $m_{\text{proton}} = 1.67 \times 10^{-27}$ kg)
A) 6.7×10^{-25} m
B) 2.1×10^{-16} m
C) 1.5×10^{-15} m
D) 6.0×10^{-8} m
Answer: B
Var: 1