

- 1) Inside the nucleus, the weakest of the four fundamental forces is
 - A) the electromagnetic force.
 - B) the strong nuclear force.
 - C) the gravitational force.
 - D) the weak nuclear force.
- 2) Inside the nucleus, the strongest of the four fundamental forces is
 - A) the gravitational force.
 - B) the weak nuclear force.
 - C) the electromagnetic force.
 - D) the strong nuclear force.
- 3) Which of the following statements about hadrons are correct? (There may be more than one correct choice.)
 - A) Protons and neutrons are hadrons, but the electron is not.
 - B) All hadrons are composed of quarks.
 - C) All hadrons interact by the strong nuclear force.
 - D) Hadrons are composed of leptons.
 - E) Electrons, protons, and neutrons are commonly-occurring hadrons.
- 4) Leptons can interact by which of the following forces?
 - A) strong nuclear force, weak nuclear force, electromagnetic force
 - B) weak nuclear force, electromagnetic force, gravitation
 - C) strong nuclear force, electromagnetic force, gravitation
 - D) strong nuclear force, weak nuclear force
 - E) strong nuclear force, weak nuclear force, electromagnetic force, gravitation
- 5) Which of the following particles are leptons? (There may be more than one correct choice.)
 - A) photons
 - B) neutrons
 - C) electrons
 - D) protons
 - E) quarks
- 6) Elementary particles that experience the weak nuclear force but not the strong nuclear force are called
 - A) baryons.
 - B) hadrons.
 - C) bosons.
 - D) mesons.
 - E) leptons.
- 7) What combination of quarks produces a proton and what are the electric charges on these quarks, expressed in terms of e ?
- 8) What combination of quarks produces a neutron and what are the electric charges on these quarks, expressed in terms of e ?
- 9) The proton is made up of which one of the following quark combinations (up, down, strange, charm, top, bottom)?
 - A) uud
 - B) udd
 - C) ttb
 - D) ddu
 - E) bst
- 10) The neutron is made up of which one of the following quark combinations (up, down, strange, charm, top, bottom)?
 - A) bst
 - B) udd
 - C) uud
 - D) ddu
 - E) ttb
- 11) Which of the following particles are *not* made up of quarks? (There could be more than one correct choice.)
 - A) alpha particle
 - B) proton
 - C) neutron
 - D) electron
 - E) positron

- 12) Which of the following particles (or groups of particles) are made up of quarks?
- A) protons, neutrons, and electrons
 - B) protons and neutrons
 - C) photons
 - D) electrons and neutrinos
 - E) All particles except for photons are made up of quarks.
- 13) What are the possible charges of a quark (not an antiquark)?
- A) $-e, 0, e$
 - B) $-1/3 e, +2/3 e$
 - C) $-2/3 e, +1/3 e$
 - D) $-2/3 e, -1/3 e, +1/3 e, +2/3 e$
 - E) $-1/3 e, +1/3 e$
- 14) How many quarks are in a deuteron, ${}^2_1\text{H}$?
- A) 3
 - B) 9
 - C) 2
 - D) 4
 - E) 6
- 15) How many quarks are in a tritium isotope, ${}^3_1\text{H}$?
- A) 2
 - B) 3
 - C) 4
 - D) 9
 - E) 6
- 16) How does the range of an exchange force depend on the mass of the exchange particle?
- A) The range is shorter for a massive exchange particle than for a light exchange particle.
 - B) The range does not depend on the mass of the exchange particle.
 - C) The range is longer for a massive exchange particle than for a light exchange particle.
- 17) 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)
- 18) 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)

Answer Key

Testname: CH32_ELEM_PARTICALS

- 1) C
- 2) D
- 3) A, B, C
- 4) B
- 5) C
- 6) E
- 7) uud, with charges $+2/3 e$, $+2/3 e$, and $-1/3 e$
- 8) udd, with charges $+2/3 e$, $-1/3 e$, and $-1/3 e$
- 9) A
- 10) B
- 11) D, E
- 12) B
- 13) B
- 14) E
- 15) D
- 16) A
- 17) $4 \times 10^{-25} \text{ kg}$
- 18) $1.5 \times 10^{-15} \text{ m}$