

Name: _____

The Standard Model and Collisions

- 1) A lambda particle consists of an up, a down, and a strange quark.
A lambda particle can be classified as a
A) photon B) meson C) baryon D) lepton
- 2) The strong force is the force of
A) repulsion between nucleons C) repulsion between protons
B) attraction between nucleons D) attraction between protons and electrons
- 3) What are the sign and charge, in coulombs, of an antiproton?
- 4) The force that holds protons and neutrons together is known as the
A) electrostatic force B) magnetic force C) gravitational force D) strong force
- 5) Which combination of quarks would produce a neutral baryon?
A) uud B) $\bar{u}dd$ C) udd D) $\bar{u}\bar{u}d$
- 6) A lithium atom consists of 3 protons, 4 neutrons, and 3 electrons. This atom contains a total of
A) 21 quarks and 3 leptons C) 14 quarks and 3 leptons
B) 9 quarks and 7 leptons D) 12 quarks and 6 leptons
- 7) Protons and neutrons are composed of smaller particles called
A) quarks B) alpha particles C) bosons D) baryons
- 8) Which combination of quarks could produce a neutral baryon?
A) cdu B) cts C) cdt D) cdb
- 9) What type of nuclear force holds the protons and neutrons in an atom together?
A) a strong force that acts over a short range C) a weak force that acts over a short range
B) a weak force that acts over a long range D) a strong force that acts over a long range
- 10) According to the *Standard Model of Particle Physics*, a meson is composed of
A) a quark and an antiquark C) a lepton and an antilepton
B) a quark and a muon neutrino D) three quarks
- 11) A meson may *not* have a charge of
A) $0e$ B) $-1e$ C) $+2e$ D) $+1e$
- 12) The tau neutrino, the muon neutrino, and the electron neutrino are *all*
A) hadrons B) mesons C) leptons D) baryons

- 13) When an electron and its antiparticle (positron) combine, they annihilate each other and become energy in the form of gamma rays.

The positron has the same mass as the electron. Calculate how many joules of energy are released when they annihilate. [Show all work, including the equation and substitution with units.]

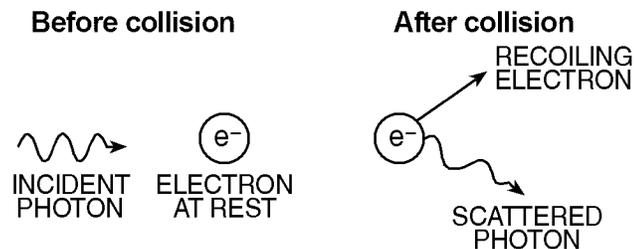
- 14) According to the Standard Model, a proton is constructed of two up quarks and one down quark (uud) and a neutron is constructed of one up quark and two down quarks (udd). During beta decay, a neutron decays into a proton, an electron, and an electron antineutrino. During this process there is a conversion of a

- A) lepton to another lepton
 B) u quark to a d quark
 C) d quark to a meson
 D) baryon to another baryon

- 15) Which statement is true of the strong nuclear force?

- A) It repels neutral charges.
 B) It acts over very great distances.
 C) It is much weaker than gravitational forces.
 D) It holds protons and neutrons together.

- 16) The diagram below shows the collision of an incident photon having a frequency of 2.00×10^{19} hertz with an electron initially at rest.



- (a) Calculate the initial energy of the photon. [Show all calculations, including the equation and substitution with units.]

- (b) What is the total energy of the two-particle system after the collision?

- 17) A top quark has an approximate charge of

- A) $+1.07 \times 10^{-19} \text{ C}$
 B) $+2.40 \times 10^{-19} \text{ C}$
 C) $-1.07 \times 10^{-19} \text{ C}$
 D) $-2.40 \times 10^{-19} \text{ C}$

- 18) Protons and neutrons are examples of

- A) quarks
 B) mesons
 C) baryons
 D) positrons