Extended Response

23.1 The Four Fundamental Forces 69.

If the strong attractive force is the greatest of the four fundamental forces, are all masses fated to combine together at some point in the future? Explain.

a. No, the strong attractive force acts only at incredibly small distances. As a result, only masses close enough to be within its range will combine.
b. No, the strong attractive force acts only at large distances. As a result, only masses far enough apart will combine.
c. Yes, the strong attractive force acts at any distance. As a result, all masses are fated to combine together at some point in the future.
d. Yes, the strong attractive force acts at large distances. As a result, all masses are fated tocombine together at some point in the future.

70.

How does the discussion of carrier particles relate to the concept of relativity?

a. Calculations of mass and energy during their transfer are relativistic, because carrier particles travel more slowly than the speed of sound.
b. Calculations of mass and energy during their transfer are relativistic, because carrier particles travel at or near the speed of light.
c. Calculations of mass and energy during their transfer are relativistic, because carrier particles travel at or near the speed of sound.
d. Calculations of mass and energy during their transfer are relativistic, because carrier particles travel faster than the speed of light.

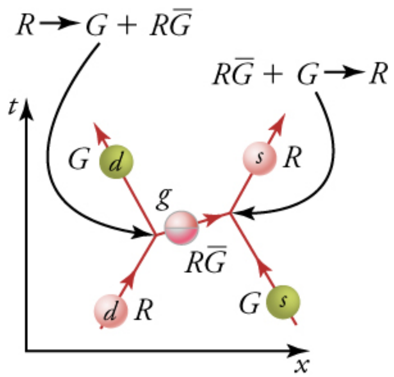
71.

Why are synchrotrons constructed to be very large?

a. By using a large radius, high particle velocities can be achieved using a large centripetal force created by large electromagnets.
b. By using a large radius, high particle velocities can be achieved without a large centripetal force created by large electromagnets.
c. By using a large radius, the velocities of particles can be reduced without a large centripetal force created by large electromagnets.
d. By using a large radius, the acceleration of particles can be decreased without a large centripetal force created by large electromagnets.

23.2 Quarks 72.

In this image, how does the emission of the gluon cause the down quark to change from a red color to a green color?



a. The emitted red gluon is made up of a green and a red color. As a result, the down quark changes from a red color to a green color.
b. The emitted red gluon is made up of an anti-green and an anti-red color. As a result, the down quark changes from a red color to a green color.
c. The emitted red gluon is made up of a green and an anti-red color. As a result, the down quark changes from a red color to a green color.
d. The emitted red gluon is made up of an anti-green and a red color. As a result, the down quark changes from a red color to a green color.

73.

Neutrinos are much more difficult for scientists to find when compared to other hadrons and leptons. Why is this?

a. Neutrinos are hadrons, and they lack charge.
b. Neutrinos are not hadrons, and they lack charge.
c. Neutrinos are hadrons, and they have positive charge.
d. Neutrinos are not hadrons, and they have a positive charge.

74.

What happens to the masses of a particle and its antiparticle when the two annihilate at low energies?

a. The masses of the particle and antiparticle are transformed into energy in the form of photons.
b. The masses of the particle and antiparticle are converted into kinetic energy of the particle and antiparticle respectively.
c. The mass of the antiparticle is converted into kinetic energy of the particle.
d. The mass of the particle is converted into radiation energy of the antiparticle.

75.

When a star erupts in a supernova explosion, huge numbers of electron neutrinos are formed in nuclear reactions. Such neutrinos from the 1987A supernova in the relatively nearby Magellanic Cloud were observed within hours of the initial brightening, indicating that they traveled to earth at approximately the speed of light. Explain how this data can be used to set an upper limit on the mass of the neutrino.

a. If the velocity of the neutrino is known, then the upper limit on mass of the neutrino can be set.
b. If only the kinetic energy of the neutrino is known, then the upper limit on mass of the neutrino can be set.
c. If either the velocity or the kinetic energy is known, then the upper limit on the mass of the neutrino can be set.
d. If both the kinetic energy and the velocity of the neutrino are known, then the upper limit on the mass of the neutrino can be set.

76.

The term *force carrier particle* is shorthand for the scientific term *vector gauge boson*. From that perspective, can the Higgs boson truly be considered a *force carrier particle*?

a. No, the mass quality provided by the Higgs boson is a scalar quantity.
b. Yes, the mass quality provided by the Higgs boson results in a change of particle's direction.

23.3 The Unification of Forces 77.

If a Grand Unified Theory is proven and the four forces are unified, it will still be correct to say that the orbit of the Moon is determined by the gravitational force. Explain why.

a. Gravity will not be a property of the unified force.
b. Gravity will be one property of the unified force.
c. Apart from gravity, no other force depends on the mass of the object.
d. Apart from gravity, no other force can make an object move in a fixed orbit.

78.

As the universe expanded and temperatures dropped, the strong nuclear force separated from the electroweak force. Is it likely that under cooler conditions, the force of electricity will separate from the force of magnetism?

a. No, the electric force relies on the magnetic force and vice versa.
b. Yes, the electric and magnetic forces can be separated from each other.

79.

Two pool balls collide head-on and stop. Their original kinetic energy is converted to heat and sound. Given that this is not possible for particles, what happens to their converted energy?

a. The kinetic energy is converted into relativistic potential energy, governed by the equation E = \lambda mch.
b. The kinetic energy is converted into relativistic mass, governed by the equation E = \lambda m^{2}c.
c. The kinetic energy is converted into relativistic potential energy, governed by the equation E = \lambda mgh.
d. Their kinetic energy is converted into relativistic mass, governed by the equation E = \lambda mc^{2}.