

1. Which object requires direct contact to exert a force?

- (A) a planet
- (B) a spring**
- (C) a magnet
- (D) a lightning bolt

The correct answer is B. A spring requires direct contact with it in order for the spring to exert a force. Masses are surrounded by gravitational fields, magnets by magnetic fields, and electrical charges by electrical fields. Each one of these exerts a force when their fields interact with the same field surrounding another object, even though the two objects do not actually touch.

2. The weight of an object on earth is a measure of _____?

- (A) the gravitational force surrounding the object
- (B) the mass of the object being weighed
- (C) the gravity exerted by the earth
- (D) the force exerted on the object by the earth**

The correct answer is D. Every mass is surrounded by a gravitational field. When that gravitational field senses another gravitational field surrounding some other mass, both gravitational fields cause the two masses to accelerate toward each other. The acceleration of a mass in the gravitational field of another mass occurs because a gravitational force was created when the two masses entered each other's gravitational field. Mathematically, a gravitational force is mass times acceleration: $F = ma$.

3. Which statement about gravity is untrue?

- (A) The force of gravity always pulls objects downward.**
- (B) A single object produces no force of gravity.
- (C) A gravitational field extends in all directions.
- (D) The force of gravity only pulls, never pushes.

The correct answer is A. The force of gravity pulls two objects toward each other, so you are being pulled toward the earth and the earth is being pulled toward you. Because the earth is always beneath you, gravity appears to be pulling you downward.

4. Your mass on earth _____.

- (A) decreases the further you go into outer space
- (B) has a weaker gravitational field around itself in outer space
- (C) remains the same value in outer space**
- (D) is maximal over the equator where the earth has a slight bulge

The correct answer is C. Mass never changes. What changes is the strength of the gravitational field of the other mass. Since doubling the distance from the other mass decreases the strength of the gravitational field to one-fourth, your weight decreases to one-fourth its value each time you double your distance from the surface of the earth.

5. Which statement is untrue?

- (A) A moving mass is surrounded by a gravitational field.
- (B) A moving electrical charge is surrounded by an electrical field.**
- (C) A moving magnet is surrounded by a magnetic field.
- (D) A stationary electrical field is surrounded by an electrical field.

The correct answer is B. When an electrical charge starts moving, it creates a magnetic field that circles the moving electrical charge perpendicular to the path of movement.

6. Which statement is true?

- (A) Weight is properly measured in kilograms.
- (B) Mass is properly measured in grams.**
- (C) In the American system, pounds are a measure of mass.
- (D) In the American system, a slug is a measure of weight.

Answer B is correct. In the metric system, mass is measured in grams, micrograms, milligrams, and kilograms. Force is measured in newtons. In the American system, mass is measured in slugs and force is measured in pounds. Weight is a measure of force, not mass.

7. Which statement about magnetic fields is untrue?

- (A) The north and south magnetic poles of the earth are close to, but not right underneath, the north and south poles of the earth.
- (B) The instrument that detects the earth's magnetic field is a compass.
- (C) You can't have a north pole without a south pole, or a south pole without a north pole.
- (D) Magnetic field lines extend out in all directions.**

The correct answer is D. The reason a magnetic field does not extend out in all directions like a gravitational field or an electrical field is that a north pole never exists without a south pole, and vice-versa, a south pole never exists without a north pole. The magnetic field lines leaving a north and south pole always curve toward the opposite magnetic pole, so magnetic field lines never point outward in all directions.