Conceptual Questions

5.1 Forces

1 . What properties do forces have that allow us to classify them as vectors?

5.2 Newton's First Law

2 . Taking a frame attached to Earth as inertial, which of the following objects cannot have inertial frames attached to them, and which are inertial reference frames?

(a) A car moving at constant velocity

(b) A car that is accelerating

(c) An elevator in free fall

(d) A space capsule orbiting Earth

(e) An elevator descending uniformly

3 . A woman was transporting an open box of cupcakes to a school party. The car in front of her stopped suddenly; she applied her brakes immediately. She was wearing her seat belt and suffered no physical harm (just a great deal of embarrassment), but the cupcakes flew into the dashboard and became “smushcakes.” Explain what happened.

5.3 Newton's Second Law

4 . Why can we neglect forces such as those holding a body together when we apply Newton’s second law?

5 . A rock is thrown straight up. At the top of the trajectory, the velocity is momentarily zero. Does this imply that the force acting on the object is zero? Explain your answer.

5.4 Mass and Weight

6 . What is the relationship between weight and mass? Which is an intrinsic, unchanging property of a body?

7 . How much does a 70-kg astronaut weight in space, far from any celestial body? What is her mass at this location?

8 . Which of the following statements is accurate?

(a) Mass and weight are the same thing expressed in different units.

(b) If an object has no weight, it must have no mass.

(c) If the weight of an object varies, so must the mass.

(d) Mass and inertia are different concepts.

(e) Weight is always proportional to mass.

9 . When you stand on Earth, your feet push against it with a force equal to your weight. Why doesn't Earth accelerate away from you?

10 . How would you give the value of $g\rightarrow$ in vector form?

5.5 Newton's Third Law

11 . Identify the action and reaction forces in the following situations: (a) Earth attracts the Moon, (b) a boy kicks a football, (c) a rocket accelerates upward, (d) a car accelerates forward, (e) a high jumper leaps, and (f) a bullet is shot from a gun.

12 . Suppose that you are holding a cup of coffee in your hand. Identify all forces on the cup and the reaction to each force.

13 . (a) Why does an ordinary rifle recoil (kick backward) when fired? (b) The barrel of a recoilless rifle is open at both ends. Describe how Newton's third law applies when one is fired. (c) Can you safely stand close behind one when it is fired?

5.6 Common Forces

14 . A table is placed on a rug. Then a book is placed on the table. What does the floor exert a normal force on?

15 . A particle is moving to the right. (a) Can the force on it be acting to the left? If yes, what would happen? (b) Can that force be acting downward? If yes, why?

5.7 Drawing Free-Body Diagrams

16 . In completing the solution for a problem involving forces, what do we do after constructing the free-body diagram? That is, what do we apply?

17 . If a book is located on a table, how many forces should be shown in a free-body diagram of the book? Describe them.

18 . If the book in the previous question is in free fall, how many forces should be shown in a free-body diagram of the book? Describe them.