Critical Thinking Items

4.1 Force 12.

Only two forces are acting on an object: force A to the left and force B to the right. If force B is greater than force A, in which direction will the object move, given that the object starts from rest?

a. To the right
b. To the left
c. Upward
d. The object does not move

13.

In a free-body diagram, the arrows representing tension and weight have the same length but point away from one another. What does this indicate?

a. They are equal in magnitude and act in the same direction.
b. They are equal in magnitude and act in opposite directions.
c. They are unequal in magnitude and act in the same direction.
d. They are unequal in magnitude and act in opposite directions.

14.

An object is at rest. Two forces, X and Y, are acting on it. Force X has a magnitude of x and acts in the downward direction. What is the magnitude and direction of Y, given that the object starts from rest?

a. The magnitude is x and points in the upward direction.
b. The magnitude is $2x$ and points in the upward direction.
c. The magnitude is x and points in the downward direction.
d. The magnitude is $2x$ and points in the downward direction.

15.

Three forces, A, B, and C, are acting on the same object with magnitudes *a, b*, and *c*, respectively. Force A acts to the right, force B acts to the left, and force C acts downward. What is a necessary condition for the object to move straight down?

a. The magnitude of force A must be greater than the magnitude of force B, so a > b.
b. The magnitude of force A must be equal to the magnitude of force B, so a = b.
c. The magnitude of force A must be greater than the magnitude of force C, so A > C.
d. The magnitude of force C must be greater than the magnitude of forces A or B, so A < C > B.

4.2 Newton's First Law of Motion: Inertia 16.

Two people push a cart on a horizontal surface by applying forces F_1 and F_2 in the same direction. Is the magnitude of the net force acting on the cart, F_{net}, equal to, greater than, or less than $F_1 + F_2$? Why?

a. $F_{net} < F_1 + F_2$ because the net force will not include the frictional force.
b. $F_{net} = F_1 + F_2$ because the net force will not include the frictional force
c. $F_{net} < F_1 + F_2$ because the net force will include the component of frictional force
d. $F_{net} = F_1 + F_2$ because the net force will include the frictional force

17.

True or False: A book placed on a balance scale is balanced by a standard 1-kg iron weight placed on the opposite side of the balance. If these objects are taken to the moon and a similar exercise is performed, the balance is still level because gravity is uniform on the moon's surface as it is on Earth's surface.

a. True
b. False

4.3 Newton's Second Law of Motion 18.

From the equation for Newton's second law, we see that F_{net} is directly proportional to **a** and that the constant of proportionality is ***m***. What does this mean in a practical sense?

a. An increase in applied force will cause an increase in acceleration if the mass is constant.
b. An increase in applied force will cause a decrease in acceleration if the mass is constant.
c. An increase in applied force will cause an increase in acceleration, even if the mass varies.
d. An increase in applied force will cause an increase in acceleration and mass.

4.4 Newton's Third Law of Motion 19.

True or False: A person accelerates while walking on the ground by exerting force. The ground in turn exerts force F_2 on the person. F_1 and F_2 are equal in magnitude but act in opposite directions. The person is able to walk because the two forces act on the different systems and the net force acting on the person is nonzero.

a. True
b. False

20.

A helicopter pushes air down, which, in turn, pushes the helicopter up. Which force affects the helicopter's motion? Why?

a. Air pushing upward affects the helicopter's motion because it is an internal force that acts on the helicopter.
b. Air pushing upward affects the helicopter's motion because it is an external force that acts on the helicopter.
c. The downward force applied by the blades of the helicopter affects its motion because it is an internal force that acts on the helicopter.
d. The downward force applied by the blades of the helicopter affects its motion because it is an external force that acts on the helicopter.