Name _____ Date _____

Newton's Three Laws of Motion: Inertia, Acceleration and Action-Reaction Pairs

Directions: Answer each question. Many of them test a popular idea about forces and motion. In number questions, type only the number; the unit is shown next to the box.

1. After a player strikes a hockey puck, it slides across the ice and gradually comes to a stop. What causes the puck to slow down?

A. Moving objects naturally slow down on their own, even when no force acts on them.

B. The puck eventually runs out of inertia.

C. The force from the stick is gradually used up as the puck travels.

D. Friction from the ice and resistance from the air act against its motion.

2. A bus is traveling forward when the driver suddenly brakes, and the standing passengers lurch forward. What explains the passengers' motion?

A. The bus pushes everyone inside it forward as it stops.

B. The bus slows down, but the passengers' bodies continue moving forward until the floor and handrails slow them as well.

C. The brakes apply a forward push to the passengers.

D. The passengers' weight suddenly increases.

3. An astronaut on the Moon pushes a 90-kilogram cart across smooth, level ground, where friction can be ignored, and there the cart weighs only about one-sixth as much as it does on Earth. Compared with doing the same thing on smooth, level ground on Earth, how much force does it take to give the cart the same acceleration?

A. About one-sixth as much force, because the cart weighs one-sixth as much

B. No force at all, because the Moon's weak gravity lets the cart float

C. About six times as much force, because the Moon's gravity is weaker

D. The same force, because the cart's mass, and so its inertia, has not changed

4. Net force = mass × acceleration. A 1,200-kilogram car speeds up at 3 m/s^2. What is the net force on the car? Type your answer without a comma.

_____ N

5. Mass = net force ÷ acceleration. When the net force on a loaded sled is 150 N, the sled speeds up at 2 m/s^2. What is the mass of the sled?

_____ kg

6. Two solid steel balls, one with a mass of 1 kilogram and one with a mass of 5 kilograms, are dropped at the same moment from the same height, and air resistance can be ignored. Which statement is true?

A. The 5-kilogram ball lands first, because it has more inertia.

B. The 5-kilogram ball lands first, because heavier objects fall faster.

C. They land at the same time, because gravity pulls 5 times harder on the bigger ball, but that ball also has 5 times the mass to speed up.

D. The 1-kilogram ball lands first, because it is easier to move.

7. A bug strikes the windshield of a moving car and splatters. Compare the force the bug exerts on the windshield with the force the windshield exerts on the bug.

A. There is no force on the windshield, because the car does not seem to slow down.

B. The windshield pushes much harder, because the car is much bigger.

C. The forces are equal in size and opposite in direction, but the bug's motion changes far more because its mass is so small.

D. The windshield's force comes first, and the bug's force comes a moment later.

8. Lena says: "When a horse pulls a cart forward, the cart pulls back on the horse with an equal force. Those forces cancel, so the horse and cart can never get moving." What is wrong with her reasoning?

A. The cart actually pulls back with a smaller force than the horse pulls forward.

B. The forces cancel only while the cart is standing still.

C. Nothing is wrong; a horse and cart can move only if something else pushes them.

D. The two forces act on different objects, so they cannot cancel; the cart speeds up if the horse's pull on it is greater than the friction holding it back.

9. A rocket traveling far out in space, where there is no air, fires its engine and speeds up. What actually pushes the rocket forward?

A. The engine pushes hot gas out the back, and the gas pushes the rocket forward with an equal force.

B. The empty space around the rocket pulls it forward.

C. The flame pushes against the air behind the rocket.

D. Nothing; a rocket cannot really speed up where there is no air to push against.

10. Two ice skaters stand face to face on smooth ice, where friction can be ignored, and push off each other. Skater A has a mass of 40 kg, skater B has a mass of 80 kg, and while they push, skater A pushes on skater B with a force of 120 N. Acceleration = net force ÷ mass. What is skater A's acceleration while they push?

_____ m/s^2