Cart in Motion

Trace how forces change a cart's motion

P.2.a "Evaluate the effects of balanced and unbalanced forces on an object's motion."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each horizontal force in the passage, then circle each statement that links the net force to the cart's motion.

A Cart Across the Warehouse

1. At a warehouse, Mira pushes a loaded cart across a level floor. At first, the cart is at rest. As it begins rolling to the right, her push is 70 newtons to the right, while rolling resistance acts with 20 newtons to the left. These horizontal forces do not cancel. The net horizontal force is 50 newtons to the right, so the cart speeds up to the right. The floor also pushes up on the cart while gravity pulls down. Those vertical forces balance, so the cart does not accelerate upward or downward.

2. Once the cart reaches a steady pace, Mira eases her push to 20 newtons to the right. Rolling resistance remains 20 newtons to the left. The horizontal net force is now zero, even though the cart is still moving. It continues right at a constant speed along a straight path. The upward force from the floor still balances the cart's weight, so its vertical motion does not change either. Balanced forces do not require an object to be still. They require its velocity, meaning its speed and direction, to stay the same.

3. Near a loading door, Mira stops pushing, but the cart does not stop at once. While it rolls right, rolling resistance still acts 20 newtons left. With no rightward push, the net horizontal force points left, opposite the cart's motion, and the cart slows. To slow it more quickly, Mira pulls left with 30 newtons while it is still rolling right. The pull and rolling resistance act together, giving a net force of 50 newtons left. This stronger unbalanced force changes the cart's rightward velocity more quickly; a leftward force does not mean the cart instantly moves left.

2 ANSWER WITH EVIDENCE

Use the passage

1. When Mira first pushes the cart, what is the net horizontal force, and how does it affect the cart's motion?

2. At the steady pace, why does the cart keep moving even though the horizontal forces are balanced?

3. After Mira stops pushing, which way does the net horizontal force point, and what happens to the cart?

4. Compare the cart's motion when Mira lets it coast and when she pulls left while it is still rolling right. Why does one change its motion more quickly?

3 YOUR TURN

Your own words

Create a different object-in-motion example with two phases: one with balanced forces and one with unbalanced forces. For each phase, state the object's starting motion, the directions and sizes of two horizontal forces, the net force, and what happens to its motion.

Cart in Motion

PART 1 · READ AND MARK

Underline each horizontal force in the passage, then circle each statement that links the net force to the cart's motion. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	When Mira first pushes the cart, what is the net horizontal force, and how does it affect the cart's motion?	**The net force is 50 newtons right, so the cart speeds up to the right.**
2	At the steady pace, why does the cart keep moving even though the horizontal forces are balanced?	**The forces cancel, so the net force is zero. The moving cart continues right at a constant speed.**
3	After Mira stops pushing, which way does the net horizontal force point, and what happens to the cart?	**Rolling resistance produces a net force of 20 newtons left. The cart is moving right, so it slows.**
4	Compare the cart's motion when Mira lets it coast and when she pulls left while it is still rolling right. Why does one change its motion more quickly?	**The cart slows in both cases. Pulling left makes the leftward net force 50 newtons instead of 20 newtons, so its rightward velocity decreases more quickly.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

A sled moves east at a steady speed while a rope pulls east with 40 newtons and friction acts west with 40 newtons. The net horizontal force is zero, so the sled keeps moving east at the same speed. Next, while the sled is still moving east, the pull increases to 60 newtons and friction remains 40 newtons west. The net force is 20 newtons east, so the sled speeds up east.

Accept different objects and directions if the forces, net forces, and predicted changes in motion are consistent. A zero net force means velocity stays constant, not that the object must be still.