Cart in Motion

Model how one external force changes motion

8.10 "Develop and use models to illustrate how individual external forces affect the motion of objects."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each force acting on the cart, then circle the words that describe how that force changes its motion. Number the three horizontal-force cases in the order they appear so you can compare their models.

A Cart, a Fan, and a Spring

1. At a science museum, a small cart rolls to the right along a level track. A model of its motion uses an arrow pointing right to show its velocity, which includes speed and direction. A different arrow shows a force acting on the cart. In these cases, a horizontal force arrow points in the direction the cart's velocity changes, not always in the direction the cart moves. Gravity pulls down, and the track pushes up. These vertical forces balance, so the cases below focus on one horizontal force at a time.

2. First, a fan blows on the cart as it moves right along a smooth stretch of track. The air pushes it right, so a rightward force arrow pairs with a rightward motion arrow that grows longer as the cart speeds up. Next, the fan is off, and the cart reaches a rough patch. Friction pushes left on the cart while it still rolls right. In that model, the motion arrow still points right but shrinks as the cart slows. The opposing force does not make the cart turn around instantly.

3. Finally, the cart rolls right into a spring bumper fixed at the end of the track. While the spring is compressed, it pushes the cart left. A model can show three moments: the cart moves right more slowly, pauses for an instant, then moves left as it rebounds. At the pause, the model labels the cart's velocity zero, even though the spring's force arrow points left. The leftward push changes the cart's velocity throughout contact. After contact ends, the spring no longer pushes, but the cart can keep rolling left.

2 ANSWER WITH EVIDENCE

Use the passage

1. On the smooth stretch, which way should the fan's force arrow point? Describe what happens to the cart's motion arrow.

2. On the rough patch, how can the force arrow point left while the motion arrow still points right? Describe the change in the motion arrow.

3. When the cart pauses against the spring bumper, what should the model show for its velocity and the spring's force?

4. Just after the cart leaves the spring bumper, which way can its motion arrow point? Explain why the arrow does not have to disappear when the spring stops pushing.

3 YOUR TURN

Your own words

Imagine looking down at a ball rolling right. Invent what could push it toward the top of your sketch. In two panels, draw and label its motion before and during the sideways push, show the force arrow during the push, and write one sentence explaining the change.

ANSWER KEY

Cart in Motion

GRADE 8 · 8.10

PART 1 · READ AND MARK

Underline each force acting on the cart, then circle the words that describe how that force changes its motion. Number the three horizontal-force cases in the order they appear so you can compare their models. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	On the smooth stretch, which way should the fan's force arrow point? Describe what happens to the cart's motion arrow.	**The force arrow points right. The rightward motion arrow grows longer as the cart speeds up.**
2	On the rough patch, how can the force arrow point left while the motion arrow still points right? Describe the change in the motion arrow.	**Friction pushes left against the cart's rightward motion. The rightward motion arrow shrinks as the cart slows.**
3	When the cart pauses against the spring bumper, what should the model show for its velocity and the spring's force?	**Label the velocity zero. The spring's force arrow still points left.**
4	Just after the cart leaves the spring bumper, which way can its motion arrow point? Explain why the arrow does not have to disappear when the spring stops pushing.	**It can point left. The cart can keep moving left after the spring's force ends.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Panel 1: The ball has a motion arrow pointing right. Panel 2: A finger pushes the ball toward the top of the sketch; the force arrow points up, and the motion arrow points diagonally up and right. The sideways push adds motion toward the top of the sketch, changing the ball's direction.

Accept any plausible source of a sideways push. The second motion arrow should include a component toward the top of the sketch, while the force arrow points that way.