

Robot Motion Clues

Trace how balanced and unbalanced forces affect a warehouse robot.

7.7.D "analyze the effect of balanced and unbalanced forces on the state of motion of an object using Newton's First Law of Motion."

NAME _____

DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB In Investigations 1-4 only, underline the words that tell whether forces are balanced or unbalanced, including any statement that no horizontal force acts. Circle the words that tell the robot's motion result.

A Robot on the Warehouse Floor

- ① Newton's First Law explains why motion does not change without an unbalanced force. An object at rest stays at rest, and a moving object continues in a straight line at constant speed, when the net force is zero. Balanced forces are equal in size and opposite in direction, so they cancel. Unbalanced forces do not cancel. They create a net force, which changes an object's velocity by starting, stopping, speeding up, slowing down, or changing direction. Friction, pushes, pulls, and gravity can all contribute to the net force.
- ② At the warehouse, a robot waits on a level floor. In Investigation 1, its motors are off. Gravity pulls down, while the floor pushes up with an equal force. No horizontal force acts on the robot. The vertical forces are balanced, and there is no unbalanced horizontal force, so the robot remains at rest. In Investigation 2, the motors push the robot forward harder than friction pushes backward. The forces are unbalanced, producing a forward net force. The robot speeds up forward from rest.
- ③ In Investigation 3, the robot is rolling forward at a steady speed after its motors stop. Friction is the only horizontal force, and it points backward. This unbalanced force makes the robot slow down until it stops. In Investigation 4, the robot rolls straight ahead at steady speed while a side guide pushes left. The guide's leftward force is unbalanced, so the robot changes direction toward the left. A force is needed to change motion, not to keep steady motion going.

2 ANSWER WITH EVIDENCE Use the passage

- 1 Why does the robot remain at rest in Investigation 1? Include both the vertical and horizontal forces in your answer.

- 2 In Investigation 2, which force is greater, and how does that difference affect the robot's motion?

- 3 What is the direction of the unbalanced force in Investigation 3, and what motion change does it cause?

- 4 Compare Investigations 2 and 4. How does each unbalanced force change the robot's velocity?

3 YOUR TURN Your own words

Create a two-sentence motion situation for a different object. Name the object, describe the forces and whether they are balanced or unbalanced, then predict how its motion will stay the same or change.

PART 1 • READ AND MARK

In Investigations 1-4 only, underline the words that tell whether forces are balanced or unbalanced, including any statement that no horizontal force acts. Circle the words that tell the robot's motion result. Accept any marking that follows this job and points at the right text.

PART 2 • ANSWERS

#	QUESTION	ANSWER
1	Why does the robot remain at rest in Investigation 1? Include both the vertical and horizontal forces in your answer.	Gravity downward and the floor's upward push are balanced, so there is no vertical acceleration. No horizontal force acts on the robot, so there is no unbalanced horizontal force to start it moving.
2	In Investigation 2, which force is greater, and how does that difference affect the robot's motion?	The motors' forward push is greater than friction's backward push. The forward net force makes the robot speed up forward from rest.
3	What is the direction of the unbalanced force in Investigation 3, and what motion change does it cause?	The unbalanced force is backward because friction points backward. It makes the forward-moving robot slow down until it stops.
4	Compare Investigations 2 and 4. How does each unbalanced force change the robot's velocity?	In Investigation 2, a forward unbalanced force makes the robot speed up forward. In Investigation 4, a leftward unbalanced force changes the robot's direction toward the left.

PART 3 • YOUR TURN (SAMPLE ANSWER)

A skateboard rolls east at a steady speed because the horizontal forces are balanced. A rider pushes west, creating an unbalanced westward force, so the skateboard slows down.

Accept equivalent descriptions that correctly identify a zero net force for unchanged motion or an unbalanced net force for a change in speed or direction. For the open response, require a plausible force description, balanced or unbalanced classification, and a matching motion prediction.