Stop That Marble

Investigate motion, friction, and a safer stopping path

P.5.6 "Students will demonstrate an understanding of the factors that affect the motion of an object through a study of Newton's Laws of Motion. Obtain and communicate information describing gravity's effect on an object..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline two places that explain how a force changes the marble's motion, and circle both stopping distances. Number Mina's first stopping design 1 and her improvement 2.

A Marble Near the Edge

1. At the school science fair, Mina releases a marble from the top of a short ramp. Gravity pulls it downward. Its potential energy from being raised changes into kinetic energy, the energy of motion. The marble leaves the ramp and rolls across a level path. Mina marks its position every second and sees that the gaps between marks get smaller. The marble is slowing down.

2. Mina tests two paths after the ramp. One is smooth plastic; the other is a rough cloth mat. She uses the same marble and release height each time and lets go without pushing. On plastic, the marble rolls 80 centimeters before stopping. On cloth, it rolls 25 centimeters. Friction is a contact force that acts against the marble's motion where it touches the path.

3. Mina wants the marble to stop before it reaches the table's edge. She first places the cloth mat near the edge, but the marble stops too close to it. She moves the mat closer to the ramp and tests again. Now the marble stops farther from the edge. While it rolls, an unbalanced friction force slows it. Once it is still, balanced forces keep it still on the level path.

2 ANSWER WITH EVIDENCE

Use the passage

1. The gaps between Mina's position marks get smaller. What does this show about the marble's speed? Predict how far it will move in the next second compared with the last second.

2. Why does the marble roll down the ramp without a push? Name the force and describe the energy change.

3. Mina needs the marble to stop in less than 30 centimeters after leaving the ramp. Which path should she use? Support your choice with a measurement and explain the force involved.

4. Why did moving the same cloth mat closer to the ramp help Mina keep the marble away from the table's edge?

3 YOUR TURN

Your own words

A toy car rolls from a ramp onto a level desk. Design a way to increase friction so it stops before the desk's edge, and explain how you would measure whether your design works. Tell how you would improve it if the car still rolls too far.

Stop That Marble

PART 1 · READ AND MARK

Underline two places that explain how a force changes the marble's motion, and circle both stopping distances. Number Mina's first stopping design 1 and her improvement 2. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	The gaps between Mina's position marks get smaller. What does this show about the marble's speed? Predict how far it will move in the next second compared with the last second.	**The marble is slowing down. It will move a shorter distance in the next second, or it may stop.**
2	Why does the marble roll down the ramp without a push? Name the force and describe the energy change.	**Gravity pulls the marble downward. Its potential energy changes into kinetic energy as it rolls.**
3	Mina needs the marble to stop in less than 30 centimeters after leaving the ramp. Which path should she use? Support your choice with a measurement and explain the force involved.	**She should use the cloth mat because the marble stops after 25 centimeters on it. Friction between the marble and cloth slows the marble.**
4	Why did moving the same cloth mat closer to the ramp help Mina keep the marble away from the table's edge?	**The marble reached the mat sooner, so friction began slowing it farther from the edge.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would attach a small rubber pad under the toy car so it rubs against the desk as the car rolls. I would release the car from the same place on the ramp with and without the pad, then measure how far it rolls on the desk each time. I would put a box at the edge to catch the car during testing. If the car still rolls too far, I would lower the pad so it presses harder against the desk and test again.

Accept designs that add a surface or part that creates friction, include a measurable stopping distance under a fair test, and propose a change to test if the car rolls too far. For question 1, accept that the marble may stop during the next second.