Brake the Cart

Design, test, and improve a friction brake

P.5.6.6 "Design a system to increase the effects of friction on the motion of an object (e.g., non-slip surfaces or vehicle braking systems or flaps on aircraft wings). Use an engineering design process to define the problem, design, construct…"

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the problem Maya needs to solve. Number the parts of the passage that show what she built, how she tested it, and how she improved it.

A Brake for the Fair

1. At the school fair, a small toy cart rolled down a ramp and crossed a display table. It needed a brake that could stop it before the table's edge. The design goal was to shorten the cart's stopping distance without pushing it sideways. Friction can slow a turning wheel when a pad rubs against it. A pad that never touches the wheel cannot brake it.

2. Maya fastened a felt pad to a clothespin so squeezing the pin pressed the pad against one rear wheel. She released the cart from the same mark on the ramp each time and squeezed the pin when its front reached a tape line. The cart traveled 60 centimeters past the line before stopping. On one run, the pad slipped out of place, so she fixed it before testing again.

3. Maya replaced the felt with a rubber pad, keeping the clothespin and test marks the same. This time the cart stopped 32 centimeters past the line. The rubber pad pressed against the wheel and increased the braking effect of friction in her tests. Maya checked that the cart still rolled straight and that the pad stayed attached. She planned to repeat the tests to see if the shorter stopping distance was reliable.

2 ANSWER WITH EVIDENCE

Use the passage

1. What did Maya need her brake to do, and what did she want to avoid?

2. How did Maya's first design use friction to slow the cart?

3. What test result showed that the rubber pad was an improvement? Name one thing Maya kept the same during testing.

4. Why did Maya need more tests before using the rubber brake at the fair?

3 YOUR TURN

Your own words

A wooden block slides across a smooth desk and bumps into a pencil cup. In 5 or 6 sentences, design a removable surface to help it stop sooner. Describe what you would build, how you would test it fairly, what you would measure, and one change you could make if it does not stop soon enough.

ANSWER KEY

Brake the Cart

GRADE 5 · P.5.6.6

PART 1 · READ AND MARK

Underline the problem Maya needs to solve. Number the parts of the passage that show what she built, how she tested it, and how she improved it. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	What did Maya need her brake to do, and what did she want to avoid?	**She needed the cart to stop before the table's edge without being pushed sideways.**
2	How did Maya's first design use friction to slow the cart?	**Squeezing the clothespin pressed a felt pad against a rear wheel. The rubbing slowed the wheel.**
3	What test result showed that the rubber pad was an improvement? Name one thing Maya kept the same during testing.	**The cart stopped 32 centimeters past the line with rubber, compared with 60 centimeters with felt. Maya kept the clothespin, test marks, or release point the same.**
4	Why did Maya need more tests before using the rubber brake at the fair?	**She needed to check whether it stopped the cart sooner each time while the cart rolled straight and the pad stayed attached.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I want the wooden block to stop before it reaches the pencil cup. I would tape a piece of rough shelf liner to the desk in the block's path. I would release the block from the same place on a short ramp for each test, first without the liner and then with it. I would measure how far the block slides past the end of the ramp before stopping. If it still reaches the cup, I would try a longer piece of liner and test again.

Accept designs that increase rubbing between the sliding block and a removable surface. A fair test should keep the release conditions the same and compare stopping distances.