Where Energy Goes

Use measurements to track energy through a ramp test

PHS.7.4 "Conduct investigations to provide evidence of the conservation of energy as energy is converted from one form of energy to another (e.g., wind to electric, chemical to thermal, mechanical to thermal, and potential to kinetic)."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each measurement and circle each observation that helps track energy. Number the energy forms in the order they appear in the test.

The Ramp Test

1. A class tests whether energy disappears when a sliding block reaches the bottom of a ramp. The block has a mass of 0.50 kilogram, and its starting point is 1.0 meter above the bottom. Gravitational potential energy equals mass times gravitational field strength times height, so the class calculates 4.9 joules at release. A motion sensor records the block's speed just before it reaches the bottom. The class releases the block without pushing and repeats the trial five times. They keep the block, starting height, and ramp angle the same so the speed readings can be compared.

2. The sensor reports a speed of 4.0 meters per second at the bottom. Kinetic energy equals one-half times mass times speed squared, giving the moving block 4.0 joules. The difference, 0.9 joule, does not mean energy vanished. As the block slides, friction warms the contact surfaces, and a little energy leaves as sound. Students press a temperature probe against the same spot on the track before and after a series of runs; it registers a small rise. They also hear the block scrape. These observations support energy transfer, but they do not measure exactly how much energy became heat or sound.

3. To strengthen the investigation, the class could repeat the test with a smoother track. They would keep the block, starting height, and sensor position unchanged, then compare bottom speeds and track temperatures. If the smoother track gives a higher bottom speed, more of the original potential energy remains as kinetic energy at that point. A smaller temperature rise would also support the idea that less energy was transferred to the track by friction. The class would still need measurements of every relevant output to claim a complete numerical energy balance. An unexplained difference is not evidence that energy was destroyed.

2 ANSWER WITH EVIDENCE

Use the passage

1. How much gravitational potential energy does the block have at release, and what measurement is used to find it?

2. Use the measured bottom speed to calculate the block's kinetic energy. How does it compare with the starting energy?

3. What two observations support the claim that some energy changed form during the slide? What can they not tell the class?

4. In the proposed smoother-track test, what result would support the idea that less energy transfers to the track? Name one condition the class must keep the same.

3 YOUR TURN

Your own words

Design a different investigation using a hand-cranked generator connected to a resistor. Explain what you would measure to compare mechanical energy put in with electrical energy delivered, and how you would investigate an energy difference.

ANSWER KEY

Where Energy Goes

HIGH SCHOOL · PHS.7.4

PART 1 · READ AND MARK

Underline each measurement and circle each observation that helps track energy. Number the energy forms in the order they appear in the test. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How much gravitational potential energy does the block have at release, and what measurement is used to find it?	**It has 4.9 joules. The calculation uses its 0.50-kilogram mass and 1.0-meter starting height.**
2	Use the measured bottom speed to calculate the block's kinetic energy. How does it compare with the starting energy?	**One-half × 0.50 × 4.0 squared = 4.0 joules, which is 0.9 joule less than the starting energy.**
3	What two observations support the claim that some energy changed form during the slide? What can they not tell the class?	**The track's temperature rose, and the students heard scraping. These observations do not show exactly how many joules became thermal energy or sound.**
4	In the proposed smoother-track test, what result would support the idea that less energy transfers to the track? Name one condition the class must keep the same.	**A smaller track-temperature rise would support that idea. The class must keep the block, starting height, or sensor position the same.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would measure the force applied to the crank and the distance the handle travels to estimate mechanical energy put in. I would record voltage and current through the resistor over the same time to calculate electrical energy delivered. I would repeat the test and check whether the generator or resistor warms. If the electrical energy is lower, some energy may have become thermal energy or sound, and measurement error may explain part of the difference.

Accept equivalent calculations and observations. For Your Turn, look for measurable input and output energy, at least one possible additional energy transfer, and no claim that an energy difference proves energy was destroyed.