Cart Energy Patterns

Construct two graphs and compare the effects of mass and speed.

MS-PS3-1 "Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Mark the mass-energy data and the speed-energy data differently. Use them to construct graphs and explain what changes when one variable is held constant.

Testing a Rolling Cart

1. Engineers tested carts in a controlled classroom model. In the first test, every cart had the same measured speed. A 1-kilogram cart had 10 joules of kinetic energy, a 2-kilogram cart had 20 joules, and a 3-kilogram cart had 30 joules. Compare mass with kinetic energy while keeping speed constant.

2. In the second test, the team kept the cart mass at 2 kilograms. At 2 meters per second, kinetic energy was 4 joules. At 4 meters per second, it was 16 joules. At 6 meters per second, it was 36 joules. Compare speed with kinetic energy while keeping mass constant.

3. A useful graph names its variables and units, uses equal spacing for equal changes on each axis, and plots the measured pairs. The horizontal and vertical axes may use different scales. Look for whether equal changes in the horizontal variable produce equal changes in energy. These simplified data are for classroom analysis.

2 ANSWER WITH EVIDENCE

Use the passage

1. For the mass test graph, what belongs on the horizontal axis and what belongs on the vertical axis? Include units.

2. Write the three ordered pairs, mass first and kinetic energy second, for the mass test.

3. For the speed test, compare the energy increases from 2 to 4 m/s and from 4 to 6 m/s. Are equal speed increases associated with equal energy increases?

4. Compare the cart moving at 2 meters per second with the cart moving at 4 meters per second. How does its kinetic energy change?

3 YOUR TURN

Your own words

Create two graphs, with titles, labeled axes and units, sensible equal-interval scales and all three points. Graph A: mass 1, 2, 3 kg with energy 8, 16, 24 J at constant speed 4 m/s. Graph B: use the second test speed-energy data, keeping mass at 2 kg. Describe and compare the patterns. Explain which variable stays constant in each graph.

ANSWER KEY

Cart Energy Patterns

GRADES 6-8 · MS-PS3-1

PART 1 · READ AND MARK

Mark the mass-energy data and the speed-energy data differently. Use them to construct graphs and explain what changes when one variable is held constant. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	For the mass test graph, what belongs on the horizontal axis and what belongs on the vertical axis? Include units.	**Horizontal axis: mass in kilograms. Vertical axis: kinetic energy in joules.**
2	Write the three ordered pairs, mass first and kinetic energy second, for the mass test.	**(1 kg, 10 J), (2 kg, 20 J), (3 kg, 30 J)**
3	For the speed test, compare the energy increases from 2 to 4 m/s and from 4 to 6 m/s. Are equal speed increases associated with equal energy increases?	**Energy rises by 12 J, then 20 J. Equal increases of 2 m/s give unequal, increasing energy gains.**
4	Compare the cart moving at 2 meters per second with the cart moving at 4 meters per second. How does its kinetic energy change?	**Its kinetic energy increases from 4 J to 16 J, so it becomes four times as large.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Graph A: mass (kg) on x, energy (J) on y; (1,8), (2,16), (3,24), a straight increasing pattern at constant speed 4 m/s. Graph B: speed (m/s) on x, energy (J) on y; (2,4), (4,16), (6,36), rising by progressively larger amounts at constant mass 2 kg. Doubling mass doubles energy at fixed speed; doubling speed from 2 to 4 m/s quadruples energy at fixed mass. Three points support these observed patterns; the speed data do not form a straight-line relationship.

Require both student-constructed graphical displays. Check independent equal-interval scales, axis labels and units, all plotted points and the held-constant variable. Accept points or a reasonable smooth trend; do not require calculation of an energy formula. Do not accept a written claim about graph shape in place of construction.