

Cart Energy Patterns

Read data descriptions and connect them to graph shapes.

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 Underline each measurement that compares mass and kinetic energy. Circle each measurement that compares speed and kinetic energy, then use your marks to identify the relationship shown by each graph.

Testing a Rolling Cart

- ① Engineers at a skate park tested how a rolling cart's kinetic energy changed when its mass changed. They used the same ramp height each time, so the cart reached the same speed at the bottom. 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. On a graph, mass belongs on the horizontal axis and kinetic energy belongs on the vertical axis. The points make an upward straight pattern.
- ② Next, the team kept the cart's mass at 2 kilograms and changed its speed. At 2 meters per second, the cart had 4 joules of kinetic energy. At 4 meters per second, it had 16 joules. At 6 meters per second, it had 36 joules. A speed graph places speed on the horizontal axis and kinetic energy on the vertical axis. Its points rise in a curve, not a straight pattern. Faster motion increases kinetic energy by larger and larger amounts as speed rises.
- ③ Graph shapes help a reader compare changes. In the mass test, each added kilogram increased kinetic energy by the same amount because speed stayed constant. The graph rose in a straight pattern. In the speed test, equal increases in speed did not add equal amounts of kinetic energy. From 2 to 4 meters per second, speed doubled, while kinetic energy rose from 4 to 16 joules. That is four times as much as before. Keep mass constant when studying speed, and keep speed constant when studying mass.

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 What shape should the speed graph have, and what does that shape show about increases in kinetic energy?

- 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

A new cart moves at a constant 4 meters per second. Its kinetic energy is 8 joules at 1 kilogram, 16 joules at 2 kilograms, and 24 joules at 3 kilograms. Draw a graph with a title, labeled axes with units, and all three points, then write two sentences describing the relationship.

PART 1 • READ AND MARK

Underline each measurement that compares mass and kinetic energy. Circle each measurement that compares speed and kinetic energy, then use your marks to identify the relationship shown by each graph. 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	What shape should the speed graph have, and what does that shape show about increases in kinetic energy?	It should rise in a curve. As speed increases, kinetic energy increases by larger and larger amounts.
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 title: Kinetic Energy and Mass at Constant Speed. Horizontal axis: mass (kg); vertical axis: kinetic energy (J); points: (1, 8), (2, 16), (3, 24). As mass increases by 1 kilogram, kinetic energy increases by 8 joules. The points form an upward straight pattern because speed stays constant.

Accept a graph with mass on the horizontal axis, kinetic energy on the vertical axis, correct units, and all three plotted points. The written description should state that kinetic energy increases by equal amounts as mass increases while speed remains constant.