Lines Tell Stories

Model rates and starting values with linear equations.

8.PAR.4 · Show and explain the connections between proportional and non-proportional relationships, lines, and linear equations; create and interpret graphical mathematical models and use the graphical, mathematical model to explain real phenomena represented in the graph.

Name _____ Date _____

Spot the Starting Value

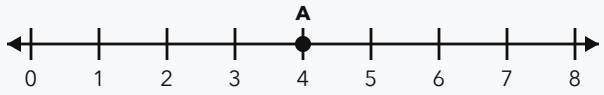
A proportional relationship has the form y = kx, so its line passes through (0, 0). A non-proportional linear relationship has the form y = mx + b, where b is not 0. The slope is the rate of change, and b is the starting value.

Worked example

Point A marks x on the number line. For y = 7x, find y. Is the relationship proportional?

1. Point A is at x = 4.
2. Substitute: y = 7(4).
3. Multiply: y = 28.
4. The equation has the form y = kx.

y = 28; proportional



1. Practice

For y = 6x, state whether the relationship is proportional. Then give the slope.

2. Practice

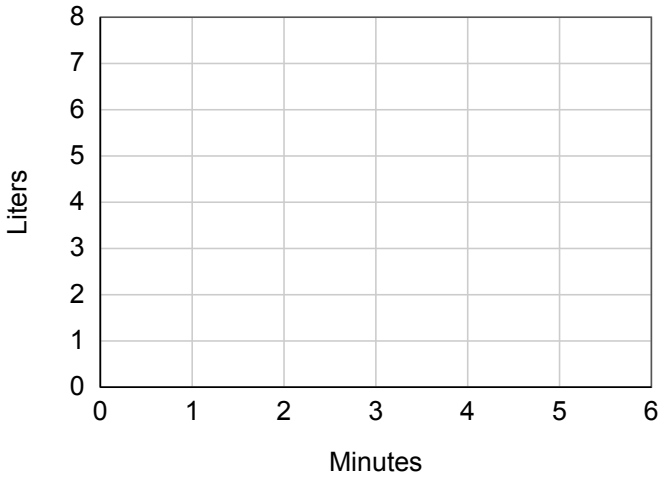
For y = 2x + 9, state whether the relationship is proportional. Then give the y-intercept.

3. Practice

A line passes through (3, 12) and (5, 20). Write its equation. Is it proportional?

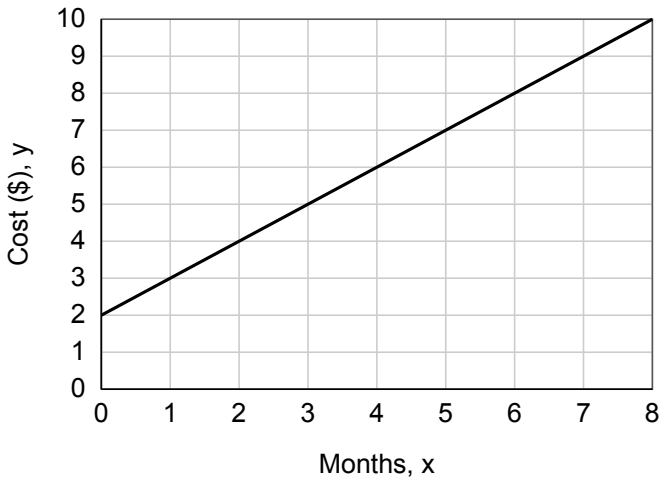
4. Practice

A tank begins with 1 liter and fills at 1 liter per minute. Let x be minutes and y be liters. Write the equation. Graph it for 0 to 6 minutes, including fractional minutes. Explain the starting value and rate. Is it proportional?



5. Apply

The graph shows a music app's total cost, y, after x months. What is the signup fee? What is the cost after 6 months? Is the relationship proportional?



6. Apply

In a game, you earn 3 coins for each level you finish. Write an equation for coins y after x levels. How many coins do you earn after 8 levels? Explain why the relationship is proportional.

7. Challenge

A temperature is -2 degrees at hour 0 and rises 2 degrees each hour. Write an equation for temperature y after x hours. Is this relationship proportional? Explain why it has the same slope as y = 2x but is different.

What to accept

Accept equivalent correct equations. A proportional linear relationship passes through the origin; a nonzero starting value makes these linear relationships non-proportional.

1. Practice

Proportional; slope = 6

2. Practice

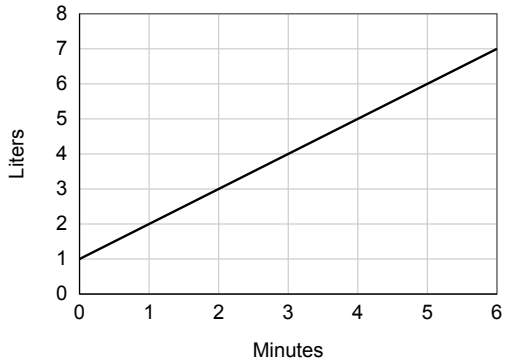
Non-proportional; y-intercept = 9

3. Practice

y = 4x; proportional

4. Practice

y = x + 1; segment from (0,1) to (6,7). Start: 1 L; rate: 1 L/min. Not proportional because it misses (0,0).



5. Apply

Signup fee: $2; cost after 6 months: $8; non-proportional

The y-intercept is 2, so the signup fee is $2. At x = 6, the graph gives y = 8, and the line does not pass through the origin.

6. Apply

y = 3x; 24 coins; it starts at 0 coins and has a constant rate of 3 coins per level

Multiply the number of levels by 3, so y = 3x. The equation has no added starting value and passes through (0, 0).

7. Challenge

y = 2x - 2; non-proportional; both lines have slope 2, but y = 2x - 2 starts at -2 and does not pass through (0, 0)