Graphing Proportional Relationships

Proportional Graphs: Build Useful Models

Name _____ **Date** _____ **Score** _____ / 6

QUICK REVIEW

In a proportional model, $y = kx$ links two quantities with no starting amount. Label what x and y measure: k carries output units per input unit. A continuous process may use a ray for $x \geq 0$; whole-item counts need discrete points. For a rate of $\$2$ per item, $(3, 6)$ means three items cost $\$6$.

Worked example

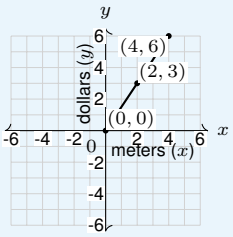
Ribbon costs $\$1.50$ per meter. Graph cost y against length x for $0 \leq x \leq 4$ and find the cost of 4 meters.

1. The starting cost is 0 and the rate is 1.50 dollars per meter. The proportional model is therefore $y = 1.5x$.

2. Calculate $y(0) = 0$, $y(2) = 3$, and $y(4) = 6$. Plot $(0, 0), (2, 3), (4, 6)$ and join the specified segment.

3. Label x in meters and y in dollars. The endpoint $(4, 6)$ shows that 4 meters cost exactly $\$6$.

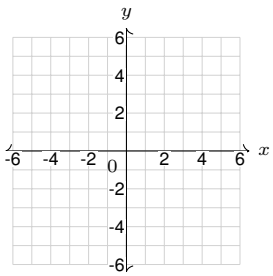
Answer: $y = 1.5x$; $\$6$.



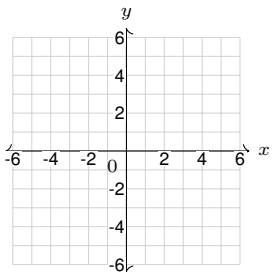
Practice Problems

Show your thinking.

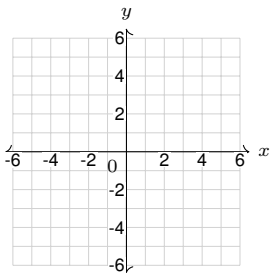
1. A pump fills 2 liters per minute from empty. Graph $0 \leq x \leq 3$, with minutes x and liters y. Find the amount after 3 minutes.



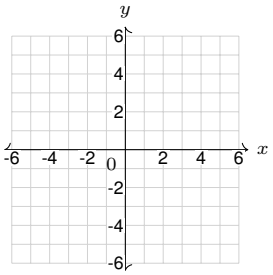
2. A recipe uses 2 cups of flour per 3 batches. Graph flour y versus batches x for whole batches 0 through 6. How much for 6?



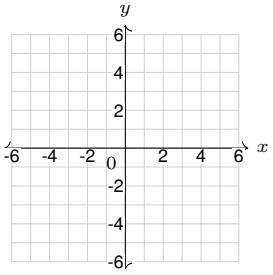
3. A map uses 1 grid unit of map distance y for 2 kilometers of actual distance x. Graph $0 \leq x \leq 6$; locate 4 kilometers.



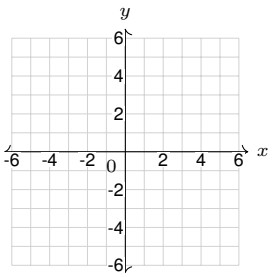
4. Design a constant-speed trip starting at distance 0, reaching 6 kilometers by hour 3. Graph distance y versus hours x on $0 \leq x \leq 3$.



5. A sensor reports change $y = -\frac{3}{2}x$ degrees after x hours. Graph $0 \leq x \leq 4$ and explain the sign of the change at hour 4.



6. Pens cost $\$1$ each; stickers cost $\$0.50$ each. Graph both costs for whole-item counts 0 through 6. Compare costs for 4 items.



Answer Key

1. $y = 2x$; 6 liters.
2. $y = \frac{2}{3}x$; 4 cups; discrete points.
3. $y = \frac{1}{2}x$; $(4, 2)$.
4. $y = 2x$, segment from $(0, 0)$ to $(3, 6)$.
5. $y(4) = -6$: a decrease of 6 degrees.
6. Pens $y = x$: \$4; stickers $y = \frac{1}{2}x$: \$2.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Empty means $y = 0$ at $x = 0$. With rate 2 liters per minute, write the proportional model $y = 2x$.

2. Calculate $y(1) = 2$ and $y(3) = 6$. Plot $(0, 0), (1, 2), (3, 6)$, then draw the segment for $0 \le x \le 3$.

3. Label minutes on the horizontal axis and liters on the vertical axis. The endpoint represents 6 liters after 3 minutes.

Problem 2

1. The rate is $k = 2/3$ cup per batch, so $y = \frac{2}{3}x$. At $x = 3, 6$, the amounts are $2, 4$ cups.

2. Plot $(0, 0), (1, \frac{2}{3}), (2, \frac{4}{3}), (3, 2), (4, \frac{8}{3}), (5, \frac{10}{3}), (6, 4)$. Use separate points because only whole batches are requested.

3. Label the axes batches and cups. Since $\frac{2}{3}(6) = 4$, six batches require exactly 4 cups; do not round fractional coordinates.

Problem 3

1. The output is map distance, so the ratio is $k = 1/2$, not 2. Write $y = \frac{1}{2}x$ for the given scale.

2. Calculate $y(0) = 0$, $y(4) = 2$, and $y(6) = 3$. Plot these points and draw the segment for the stated distance interval.

3. Label x as actual kilometers and y as map units. The point $(4, 2)$ means 4 actual kilometers occupy 2 map units.

Problem 4

1. The required speed is total distance divided by total time: $k = 6/3 = 2$ kilometers per hour. Starting distance is 0.

2. Write $y = 2x$ and compute the midpoint sample $y(1) = 2$. Plot $(0, 0), (1, 2), (3, 6)$ on the provided plane.

3. Join the points only over $0 \le x \le 3$. The model reaches $(3, 6)$ exactly, so it satisfies both endpoint conditions.

Problem 5

1. At $x = 0, 2, 4$, calculate $y = 0, -3, -6$. The negative rate means the reported change becomes more negative as time increases.

2. Plot $(0, 0), (2, -3), (4, -6)$ and draw the segment for $0 \le x \le 4$. Label hours and temperature change in degrees.

3. Substitution gives $-\frac{3}{2}(4) = -6$. The sensor reports a decrease of 6 degrees, not an absolute temperature of -6 degrees.

Problem 6

1. Both costs start at 0. Write $y = x$ for pens and $y = \frac{1}{2}x$ for stickers, using item count as x.

2. Plot each model at integer inputs $0, 1, 2, 3, 4, 5, 6$. Keep the points discrete and label the two sets to distinguish the prices.

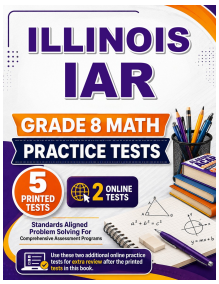
3. At $x = 4$, pen cost is $1(4) = 4$ and sticker cost is $0.5(4) = 2$. Pens cost \$2 more for four items.

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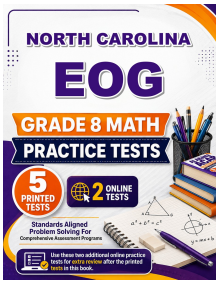
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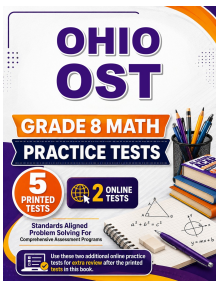
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