Graphing Proportional Relationships

Name: ______________________	Date: ______________	Score: _____ / 18

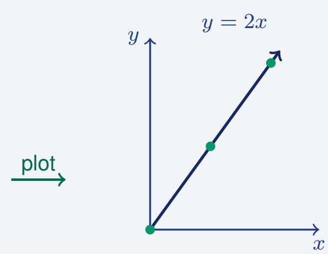
Graphs turn numbers into pictures—and for a proportional relationship, that picture is a straight line through the origin $(0,0)$! Because the equation is $y = kx$, a bigger k makes a steeper line and a smaller k makes a flatter one. Plot just a few accurate points, connect them, and you instantly have a tool for estimating, comparing, and predicting. This is where proportional thinking becomes something you can literally *see*.

Key Concepts & Quick Review

To graph $y = kx$: (1) plot $(0,0)$; (2) choose x, compute $y = kx$, plot (x, y); (3) draw a line through both points and extend with arrows.

Reading k from a graph: pick any point (x, y) on the line; $k = \frac{y}{x}$. Steeper line $\Rightarrow$ larger k. Line *must* pass through $(0,0)$.

x	y
0	0
1	2
2	4



Examples

① The equation $y = 3x$ represents the cost (dollars) of buying x notebooks. Identify three ordered pairs, state k, and describe the graph.

Think It Through: Use the equation to generate points by plugging in values of x. If $x = 0$, then $y = 0$; if $x = 1$, then $y = 3$; if $x = 2$, then $y = 6$; and if $x = 3$, then $y = 9$. So points on the graph include $(0,0)$, $(1,3)$, and $(2,6)$. The constant of proportionality is $k = 3$, which means \$3 per notebook. Because the equation is proportional, the graph is a straight line through the origin.

Answer: $k = 3$; *points:* $(0,0), (1,3), (2,6)$

② A graph of a proportional relationship passes through $(5, 8)$. Find k, write the equation, and find y when $x = 15$.

Think It Through: In a proportional relationship, $k = \frac{y}{x}$. Using the point $(5,8)$, $k = \frac{8}{5} = 1.6$. That means the equation is $y = 1.6x$. To find y when $x = 15$, substitute into the equation: $y = 1.6 \times 15 = 24$. The point tells you the rate, and the rate gives you the whole equation.

Answer: $k = 1.6$; $y = 1.6x$; $y = 24$ *when* $x = 15$

Practice Problems

Find k from the given point on a proportional graph, or find the missing coordinate.

1. The point $(2, 6)$ lies on a proportional graph. Find the constant of proportionality k. ______
2. The point $(3, 9)$ lies on a proportional graph. Find the constant of proportionality k. ______
3. The point $(4, 10)$ lies on a proportional graph. Find the constant of proportionality k. ______
4. The point $(5, 20)$ lies on a proportional graph. Find the constant of proportionality k. ______
5. The point $(6, 15)$ lies on a proportional graph. Find the constant of proportionality k. ______
6. The point $(8, 12)$ lies on a proportional graph. Find the constant of proportionality k. ______
7. In the proportional relationship $y = kx$, use $k = 3$ and $x = 7$ to find y. ______
8. In the proportional relationship $y = kx$, use $k = 2.5$ and $x = 4$ to find y. ______
9. In the proportional relationship $y = kx$, use $k = \frac{1}{2}$ and $x = 10$ to find y. ______
10. In the proportional relationship $y = kx$, use $k = 4$ and $y = 32$ to find x. ______
11. In the proportional relationship $y = kx$, use $k = 0.75$ and $y = 6$ to find x. ______
12. The point $(9, 27)$ lies on a proportional graph. Find the constant of proportionality k. ______
13. In the proportional relationship $y = kx$, use $k = 6$ and $x = 5$ to find y. ______
14. The point $(10, 4)$ lies on a proportional graph. Find the constant of proportionality k. ______
15. In the proportional relationship $y = kx$, use $k = \frac{3}{5}$ and $x = 15$ to find y. ______

Study Tips

- The graph of $y = kx$ always passes through **the origin** $(0, 0)$ — if the line misses the origin, the relationship is not proportional.
- Use **at least two points** when graphing a line: the origin plus one other computed point. A third point helps you check accuracy.
- Reading k from a graph: pick a point **on the gridline intersection** so the coordinates are exact, then divide y by x.

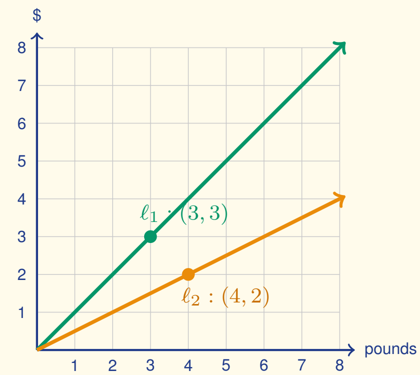
Word Problems

16. A graph of a delivery driver's earnings passes through the origin and through the point $(4, \$50)$. Find k (earnings per hour), write the equation, and use it to find earnings after a 10-hour shift and after a 40-hour work week. ______

17. Two cyclists ride at constant speeds. Cyclist A's graph passes through $(2, 30)$ and Cyclist B's graph passes through $(3, 39)$. Find k (speed in miles per hour) for each cyclist, write both equations, and determine how far

apart they would be after 5 hours if they start at the same point and ride in the same direction. ________

18. This graph shows two proportional relationships, ℓ_1 and ℓ_2, that represent the costs of two different fruits per pound. Use the highlighted lattice points to find the constant of proportionality for each line, write each equation in the form $y = kx$, and identify which fruit is the more expensive per pound.



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Answer Keys

1) 3
2) 3
3) 2.5
4) 4
5) 2.5
6) 1.5
7) 21
8) 10
9) 5
10) 8
11) 8
12) 3
13) 30
14) 0.4
15) 9
16) $k = \$12.50$/hr; $y = 12.5x$; \$125 for 10 hr; \$500 for 40 hr
17) A: $15\,mph$; B: $13\,mph$; $10\,mi$ apart
18) ℓ_1: \$1/lb; ℓ_2: \$0.50/lb; ℓ_1 is more expensive

Step-by-Step Explanations

Strategy: For Exponents and Powers of Rational Numbers, read an exponent as repeated multiplication, not as multiplication by the exponent, and keep parentheses in mind when the base is fractional or negative. A strong explanation names the repeated factor and keeps the base intact.

Practice 1: $3^4 =$ **Answer:** 81

In the opening example, expand the power mentally as repeated multiplication, keeping the base exactly as written.

Practice 15: $\left(\frac{5}{6}\right)^2 =$ **Answer:** $\frac{25}{36}$

For the end-of-set item, expand the power mentally as repeated multiplication, keeping the base exactly as written.

Word-problem notes:

16. Answer: After 8 hours: 256; after 10 hours: $1{,}024$.
$2^8 = 256$ cells after 8 hours. $2^{10} = 1{,}024$ cells after 10 hours.

17. Answer: 3rd bounce: $\left(\frac{3}{4}\right)^3 = \frac{27}{64}\,m$; 4th bounce: $\left(\frac{3}{4}\right)^4 = \frac{81}{256}\,m$.
After n bounces the height is $\left(\frac{3}{4}\right)^n\ m$. $\left(\frac{3}{4}\right)^3 = \frac{27}{64} \approx 0.42\,m$. $\left(\frac{3}{4}\right)^4 = \frac{81}{256} \approx 0.32\,m$.

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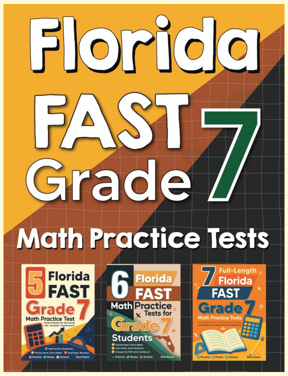

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