

# Graphing Proportional Relationships

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 24

## Q Quick Review

A **proportional relationship** connects two quantities so that their ratio is always the same. You can write it as  $y = kx$ , where  $k$  is the **constant of proportionality** — the number you multiply  $x$  by to get  $y$ . To find  $k$  from a point  $(x, y)$ , just divide:  $k = \frac{y}{x}$ . When you graph  $y = kx$ , you always get a *straight line through the origin*  $(0, 0)$ , and  $k$  is the **slope** of that line — the steepness. The bigger  $k$  is, the steeper the line climbs.

◊ **Example:** A car travels 150 miles in 3 hours at a steady speed. Find the constant of proportionality and write the equation.  
 ⇒ The two quantities here are distance  $y$  and time  $x$ , and a steady speed means they are proportional. To find  $k$ , divide distance by time:  $k = \frac{150}{3} = 50$ . That 50 is the speed in miles per hour — it tells us how many miles the car covers each hour. Now we just slot  $k$  into  $y = kx$  to get  $y = 50x$ . The graph would be a straight line through the origin rising 50 for every 1 hour.

**Answer:**  $k = 50, y = 50x$

## PRACTICE

Find the constant of proportionality  $k$ , or use  $y = kx$  as needed.

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| 1. $y = kx$ through $(1, 4)$ ; $k = ?$ _____  | 11. $k = 11, x = 4$ ; $y = ?$ _____            |
| 2. $y = kx$ through $(1, 9)$ ; $k = ?$ _____  | 12. $k = \frac{2}{3}, x = 9$ ; $y = ?$ _____   |
| 3. $y = kx$ through $(2, 10)$ ; $k = ?$ _____ | 13. $k = 5, y = 35$ ; $x = ?$ _____            |
| 4. $y = kx$ through $(3, 21)$ ; $k = ?$ _____ | 14. $k = 9, y = 63$ ; $x = ?$ _____            |
| 5. $y = kx$ through $(4, 12)$ ; $k = ?$ _____ | 15. $k = 4, y = 30$ ; $x = ?$ _____            |
| 6. $y = kx$ through $(5, 40)$ ; $k = ?$ _____ | 16. Is $y = 3x$ proportional? _____            |
| 7. $y = kx$ through $(6, 9)$ ; $k = ?$ _____  | 17. Is $y = 2x + 5$ proportional? _____        |
| 8. $y = kx$ through $(8, 2)$ ; $k = ?$ _____  | 18. $y = kx$ through $(10, 4)$ ; $k = ?$ _____ |
| 9. $k = 6, x = 7$ ; $y = ?$ _____             | 19. Slope of $y = 7x$ _____                    |
| 10. $k = 2.5, x = 8$ ; $y = ?$ _____          | 20. Unit rate: \$18 for 3 lb _____             |

## ◆ Word Problems

21. A printer prints 36 pages in 4 minutes at a steady rate. Write an equation relating pages  $y$  to minutes  $x$ , and find how many pages it prints in 9 minutes. \_\_\_\_\_
22. At a market, 5 apples cost \$2. The cost is proportional to the number of apples. How much do 20 apples cost? \_\_\_\_\_
23. A cyclist rides at a constant speed and covers 24 km in 2 hours. Two graphs are compared: cyclist A has  $y = 12x$  and cyclist B covers 24 km in 2 hours. Who is faster, or are they the same? \_\_\_\_\_
24. A faucet fills a tub proportionally, putting in 7 gallons every 2 minutes. How long does it take to fill a 35-gallon tub? \_\_\_\_\_



## Answer Keys

- |                      |                         |
|----------------------|-------------------------|
| 1. $k = 4$           | 13. $x = 7$             |
| 2. $k = 9$           | 14. $x = 7$             |
| 3. $k = 5$           | 15. $x = \frac{15}{2}$  |
| 4. $k = 7$           | 16. yes                 |
| 5. $k = 3$           | 17. no                  |
| 6. $k = 8$           | 18. $k = \frac{2}{5}$   |
| 7. $k = \frac{3}{2}$ | 19. 7                   |
| 8. $k = \frac{1}{4}$ | 20. \$6 per lb          |
| 9. $y = 42$          | 21. $y = 9x$ ; 81 pages |
| 10. $y = 20$         | 22. \$8                 |
| 11. $y = 44$         | 23. the same speed      |
| 12. $y = 6$          | 24. 10 minutes          |

### Step-by-Step Explanations

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| <p>1. With <math>x = 1</math>, the value of <math>y</math> is the constant: <math>k = \frac{4}{1} = 4</math>.</p> <p>2. At <math>x = 1</math>, <math>k = \frac{9}{1} = 9</math>. The point <math>(1, k)</math> always reveals <math>k</math>.</p> <p>3. Divide <math>y</math> by <math>x</math>: <math>k = \frac{10}{2} = 5</math>.</p> <p>4. <math>k = \frac{21}{3} = 7</math>, the same ratio every time.</p> <p>5. <math>k = \frac{12}{4} = 3</math> — <math>y</math> is always three times <math>x</math>.</p> <p>6. <math>k = \frac{40}{5} = 8</math>.</p> <p>7. <math>k = \frac{9}{6} = \frac{3}{2}</math> — <math>k</math> can be a fraction.</p> <p>8. <math>k = \frac{2}{8} = \frac{1}{4}</math>, a value less than 1.</p> <p>9. Use <math>y = kx</math>: <math>y = 6 \times 7 = 42</math>.</p> <p>10. <math>y = 2.5 \times 8 = 20</math>.</p> <p>11. <math>y = 11 \times 4 = 44</math>.</p> <p>12. <math>y = \frac{2}{3} \times 9 = 6</math>.</p> <p>13. From <math>y = kx</math>, divide: <math>x = \frac{35}{5} = 7</math>.</p> | <p>14. <math>x = \frac{63}{9} = 7</math>.</p> <p>15. <math>x = \frac{30}{4} = \frac{15}{2}</math>.</p> <p>16. It has the form <math>y = kx</math> with <math>k = 3</math> and passes through <math>(0, 0)</math>, so yes.</p> <p>17. The <math>+5</math> shifts the line off the origin, so it is <i>not</i> proportional.</p> <p>18. <math>k = \frac{4}{10} = \frac{2}{5}</math>.</p> <p>19. In <math>y = kx</math>, the constant <math>k</math> is the slope, so the slope is 7.</p> <p>20. Divide cost by weight: <math>\frac{18}{3} = 6</math> dollars per pound.</p> <p>21. The rate is <math>k = \frac{36}{4} = 9</math> pages per minute, so <math>y = 9x</math>. In 9 minutes: <math>y = 9 \times 9 = 81</math> pages.</p> <p>22. The unit cost is <math>k = \frac{2}{5} = 0.40</math> dollars per apple. For 20 apples: <math>0.40 \times 20 = \\$8</math>.</p> <p>23. Cyclist B's rate is <math>\frac{24}{2} = 12</math> km/h, the same <math>k</math> as cyclist A's <math>y = 12x</math>. Equal constants mean equal speeds.</p> <p>24. The rate is <math>\frac{7}{2} = 3.5</math> gallons per minute. Time = <math>\frac{35}{3.5} = 10</math> minutes.</p> |
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