

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

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| <ol style="list-style-type: none"> 1. $k = 4$ 2. $k = 9$ 3. $k = 5$ 4. $k = 7$ 5. $k = 3$ 6. $k = 8$ 7. $k = \frac{3}{2}$ 8. $k = \frac{1}{4}$ 9. $y = 42$ 10. $y = 20$ 11. $y = 44$ 12. $y = 6$ | <ol style="list-style-type: none"> 13. $x = 7$ 14. $x = 7$ 15. $x = \frac{15}{2}$ 16. yes 17. no 18. $k = \frac{2}{5}$ 19. 7 20. \$6 per lb 21. $y = 9x$; 81 pages 22. \$8 23. the same speed 24. 10 minutes |
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Step-by-Step Explanations

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| <ol style="list-style-type: none"> 1. With $x = 1$, the value of y is the constant: $k = \frac{4}{1} = 4$. 2. At $x = 1$, $k = \frac{9}{1} = 9$. The point $(1, k)$ always reveals k. 3. Divide y by x: $k = \frac{10}{2} = 5$. 4. $k = \frac{21}{3} = 7$, the same ratio every time. 5. $k = \frac{12}{4} = 3$ — y is always three times x. 6. $k = \frac{40}{5} = 8$. 7. $k = \frac{9}{6} = \frac{3}{2}$ — k can be a fraction. 8. $k = \frac{2}{8} = \frac{1}{4}$, a value less than 1. 9. Use $y = kx$: $y = 6 \times 7 = 42$. 10. $y = 2.5 \times 8 = 20$. 11. $y = 11 \times 4 = 44$. 12. $y = \frac{2}{3} \times 9 = 6$. 13. From $y = kx$, divide: $x = \frac{35}{5} = 7$. | <ol style="list-style-type: none"> 14. $x = \frac{63}{9} = 7$. 15. $x = \frac{30}{4} = \frac{15}{2}$. 16. It has the form $y = kx$ with $k = 3$ and passes through $(0, 0)$, so yes. 17. The $+5$ shifts the line off the origin, so it is <i>not</i> proportional. 18. $k = \frac{4}{10} = \frac{2}{5}$. 19. In $y = kx$, the constant k is the slope, so the slope is 7. 20. Divide cost by weight: $\frac{18}{3} = 6$ dollars per pound. 21. The rate is $k = \frac{36}{4} = 9$ pages per minute, so $y = 9x$. In 9 minutes: $y = 9 \times 9 = 81$ pages. 22. The unit cost is $k = \frac{2}{5} = 0.40$ dollars per apple. For 20 apples: $0.40 \times 20 = \\$8$. 23. Cyclist B's rate is $\frac{24}{2} = 12$ km/h, the same k as cyclist A's $y = 12x$. Equal constants mean equal speeds. 24. The rate is $\frac{7}{2} = 3.5$ gallons per minute. Time = $\frac{35}{3.5} = 10$ minutes. |
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