

Constant of Proportionality (k)

Name: _____

Date: _____

Score: _____ / 18

Every proportional relationship has a magic number hiding inside it: the **constant of proportionality**, k . It tells you how many units of y you get for each 1 unit of x , so $k = \frac{y}{x}$. Once you know k , you can write the equation $y = kx$ and predict *any* value in the relationship—that is real mathematical power! The best part is that k always has a concrete meaning, like dollars per item or miles per gallon, so it connects the math to the real world.

Key Concepts & Quick Review

From a table: $k = \frac{y}{x}$ (same for every row). **From an equation:** $y = kx \Rightarrow k$ is the coefficient of x .

Given k , find y : multiply $k \times x$. **Given k , find x :** divide $y \div k$. Larger k means a steeper graph.

| x | y |
|-----|-----|
| 2 | 6 |
| 4 | 12 |

$y \div x \rightarrow$ $k = 6 \div 2 = 3$
 $y = 3x$

k tells how much y there is for each 1 unit of x .

Examples

① A table shows: (2, 7), (4, 14), (6, 21), (8, 28). Find k and write the equation.

Think It Through: To find the constant of proportionality, divide y by x in the table. Each pair gives the same value: $\frac{7}{2} = 3.5$, $\frac{14}{4} = 3.5$, $\frac{21}{6} = 3.5$, and $\frac{28}{8} = 3.5$. Since the ratio is always 3.5, that is the constant k . A proportional relationship with constant k is written as $y = kx$, so the equation is $y = 3.5x$.

Answer: $k = 3.5$; $y = 3.5x$

② A car's fuel economy is proportional: it uses 2.5 gal for every 50 mi driven. Find k (miles per gallon), write the equation for total miles y given gallons x , and find how far the car travels on 11 gal.

Think It Through: The constant of proportionality here is miles per gallon, so divide miles by gallons: $\frac{50}{2.5} = 20$. That means the car travels 20 mi for each gallon of gas. Using $y = kx$, the equation becomes $y = 20x$, where x is gallons and y is miles. For 11 gal, substitute $x = 11$ and get $y = 20 \times 11 = 220$ miles. The units help you decide which quantity goes on top when finding k .

Answer: $k = 20$ mpg; 220 mi on 11 gal

Practice Problems

Find the constant of proportionality k , or use the given k to find the missing value.



1. In the proportional relationship $y = kx$, _____ use $y = 12$ and $x = 3$ to find k .
2. In the proportional relationship $y = kx$, _____ use $y = 35$ and $x = 5$ to find k .
3. In the proportional relationship $y = kx$, _____ use $y = 48$ and $x = 8$ to find k .
4. In the proportional relationship $y = kx$, _____ use $y = 2.4$ and $x = 4$ to find k .
5. In the proportional relationship $y = kx$, _____ use $y = \frac{3}{2}$ and $x = 3$ to find k .
6. In the proportional relationship $y = kx$, _____ use $y = 9$ and $x = 6$ to find k .
7. In the proportional relationship $y = kx$, _____ use $k = 4$ and $x = 7$ to find y .
8. In the proportional relationship $y = kx$, _____ use $k = 2.5$ and $x = 6$ to find y .
9. In the proportional relationship $y = kx$, _____ use $k = \frac{1}{3}$ and $x = 9$ to find y .
10. In the proportional relationship $y = kx$, _____ use $k = 5$ and $y = 40$ to find x .
11. In the proportional relationship $y = kx$, _____ use $k = 0.6$ and $y = 4.8$ to find x .
12. In the proportional relationship $y = kx$, _____ use $k = \frac{3}{4}$ and $y = 9$ to find x .
13. In the proportional relationship $y = kx$, _____ use $y = 7.2$ and $x = 9$ to find k .
14. In the proportional relationship $y = kx$, _____ use $y = 100$ and $x = 25$ to find k .
15. In the proportional relationship $y = kx$, _____ use $k = 1.5$ and $x = 10$ to find y .

Study Tips

-  k is always $\frac{y}{x}$ — **dependent over independent**. Put the output quantity on top.
-  On a graph, k is the **slope** of the line through the origin. A steeper line means a larger k .
-  The unit of k tells you the **real-world rate**: if x is hours and y is miles, then k is miles per hour.

Word Problems

16. A baker uses $\frac{3}{2}$ cups of sugar for every 2 dozen cookies baked. Find k (cups per dozen), write the equation, and determine how many cups of sugar are needed to bake 10 dozen cookies. _____
17. Two painters work at proportional rates. Painter A completes $\frac{3}{4}$ of a room per hour. Painter B completes 45 square feet per hour, and each room is 90 sq ft. Find k for each painter in rooms per hour and determine who paints faster. _____
18. This graph shows distance versus time for a runner. Read the marked lattice point off the graph, find the constant of proportionality k (the runner's speed), state the equation $y = kx$, and use it to predict the distance after 7 hours.







Answer Keys

- | | |
|---|---|
| <p>1) 4</p> <p>2) 7</p> <p>3) 6</p> <p>4) 0.6</p> <p>5) $\frac{1}{2}$</p> <p>6) 1.5</p> <p>7) 28</p> <p>8) 15</p> <p>9) 3</p> <p>10) 8</p> | <p>11) 8</p> <p>12) 12</p> <p>13) 0.8</p> <p>14) 4</p> <p>15) 15</p> <p>16) $k = \frac{3}{4}$ cup/dozen; $y = \frac{3}{4}x$; 7.5 cups</p> <p>17) Painter A: 0.75 room/hr; Painter B: 0.5 room/hr; Painter A</p> <p>18) Point (2, 5); $k = 2.5$ mph; $y = 2.5x$; 17.5 mi</p> |
|---|---|

Step-by-Step Explanations

Strategy: For Solving Real-World Problems with Rational Numbers, sort the quantities by what they mean before choosing operations. A labeled setup helps students see which numbers are being combined and why.

Practice 1: $\frac{3}{4} \times (-8) + \frac{1}{2} =$ **Answer:** $-\frac{11}{2}$

For the first worked item, choose the rule named by the topic, substitute carefully, and simplify one line at a time.

Practice 15: $-1\frac{2}{3} \div \frac{5}{9} + (-0.2) =$ **Answer:** $-\frac{16}{5}$

Near the end of this topic, choose the rule named by the topic, substitute carefully, and simplify one line at a time.

Word-problem notes:

16. Answer: Week 2 loss: $-\$168.20$; week 3: $\$630.75$; total: $\$883.05$; overall profit.

Week 1 is a profit of $\$420.50$. Week 2 is a loss equal to $\frac{2}{5}$ of that, so compute $420.50 \times \frac{2}{5} = 168.20$ and record it as $-\$168.20$. Week 3 is $1\frac{1}{2} = \frac{3}{2}$ times week 1, so $420.50 \times \frac{3}{2} = 630.75$. Now combine the three weeks: $420.50 - 168.20 + 630.75 = 883.05$. Because the total is positive, the business made an overall profit of $\$883.05$. The signs tell the story of profit versus loss.

17. Answer: 8 intervals; change = $8 \times (-\frac{3}{8}) = -3^\circ\text{C}$; final = -6.5°C ; yes, still above -8°C .

First count how many quarter-minute intervals fit into 2 min : $2 \div \frac{1}{4} = 8$. Each interval changes the temperature by $-\frac{3}{8}^\circ\text{C}$, so the total change is $8 \times (-\frac{3}{8}) = -3^\circ\text{C}$. Add that change to the starting temperature: $-3.5 + (-3) = -6.5^\circ\text{C}$. Finally, compare -6.5°C to the lower limit of -8°C . Since $-6.5 > -8$, the reaction is still within bounds. This last comparison step matters just as much as the arithmetic.



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