Writing Equations for Proportional Relationships

Name: _____	Date: _____	Score: _____ / 18

This is where all of Chapter 3 comes together in one neat package: the equation $y = kx$. It says that y is always a constant multiple of x, and that multiplier is k—the constant of proportionality you already know how to find. Pull k from a table, a graph, or a word problem, write the equation, and you can predict *any* missing value. Think of $y = kx$ as the bridge that turns a pattern you notice into algebra you can use!

Key Concepts & Quick Review

From a table: $k = \frac{y}{x}$, then write $y = kx$. **From a graph:** read any point (x, y); $k = \frac{y}{x}$; write $y = kx$.

From a description: identify the two quantities and the constant rate. Let $x =$ independent quantity, $y =$ dependent quantity, $k =$ rate. Then $y = kx$. Use the equation to predict any value.

Examples

① A table shows hours worked (x) and pay (y): $(1, \$12.50)$, $(3, \$37.50)$, $(5, \$62.50)$. Write an equation and find pay for 8 hours.

Think It Through: Find the constant of proportionality by dividing pay by hours. Using any point, $k = \frac{12.50}{1} = 12.50$. That means the pay equation is $y = 12.5x$. Once the equation is written, substitute $x = 8$: $y = 12.5 \times 8 = 100$. So the pay for 8 hours is \$100. The equation is a shortcut that lets you find any value in the pattern.

Answer: $y = 12.5x$; $\$100$ *for* 8 *hours*

② A recipe uses $\frac{2}{3}$ cup of olive oil per serving. Write an equation for the total oil y needed for x servings. How much oil is needed for 15 servings? For $\frac{3}{2}$ servings?

Think It Through: The recipe uses $\frac{2}{3}$ cup for each serving, so the constant of proportionality is $k = \frac{2}{3}$. That means the equation is $y = \frac{2}{3}x$, where x is servings and y is cups of oil. For 15 servings, $y = \frac{2}{3} \times 15 = 10$ cups. For $\frac{3}{2}$ servings, $y = \frac{2}{3} \times \frac{3}{2} = 1$ cup. The same equation works whether the number of servings is a whole number or a fraction.

Answer: $y = \frac{2}{3}x$; 10 *cups for* 15 *serv.*; 1 *cup for* $\frac{3}{2}$ *serv.*

Practice Problems

Write the equation $y = kx$ using the given information, or evaluate the equation for the given value.

1. Write the equation $y = kx$ when $k = 4$, _____ then find y for $x = 6$.

2. Write the equation $y = kx$ when $k = 7$, _____ then find y for $x = 9$.

3. Write the equation $y = kx$ when $k = 2.5$, _____ then find y for $x = 8$.

4. Write the equation $y = kx$ when $k = \frac{1}{4}$, _____ then find y for $x = 20$.

5. Use $y = kx$ with $k = 3$ and $y = 24$ to find x. _____
6. Use $y = kx$ with $k = 6$ and $y = 42$ to find x. _____
7. Use $y = kx$ with $k = 0.5$ and $y = 3.5$ to find x. _____
8. Use $y = kx$ with $k = \frac{3}{5}$ and $y = 12$ to find x. _____
9. The point $(2, 10)$ lies on $y = kx$. Find k and write the equation. _____
10. The point $(4, 6)$ lies on $y = kx$. Find k and write the equation. _____
11. The point $(5, \frac{5}{3})$ lies on $y = kx$. Find k and write the equation. _____
12. The point $(9, 27)$ lies on $y = kx$. Find k and write the equation. _____
13. Use the equation $y = 8x$ to find y when $x = 3.5$. _____
14. Use the equation $y = \frac{2}{3}x$ to find y when $x = 9$. _____
15. Use the equation $y = 1.2x$ to find y when $x = 15$. _____

Study Tips

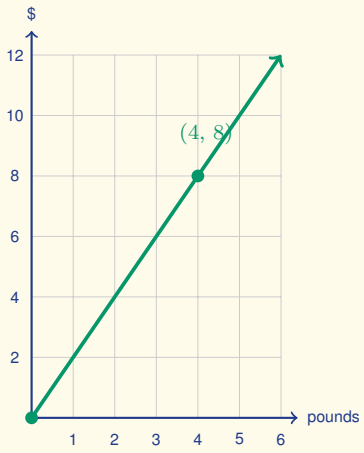
- The equation $y = kx$ is the **algebraic form** of a proportional relationship. Every table, graph, and word problem in this chapter leads to exactly this form.
- Always define your **variables with units** before writing the equation: "Let $x =$ hours, $y =$ miles, $k = 55\ mph$," then $y = 55x$.
- Use the equation to **work backwards**: if you know y and k, solve $x = \frac{y}{k}$ — this is just a proportion in disguise.

Word Problems

16. A printing press produces $1{,}800$ pages in $\frac{3}{4}$ of an hour. Let x be the time in hours and y the total pages printed. Find k, write the equation, and determine how many pages are printed in a 7.5-hour shift. How many minutes does it take to print 600 pages? _____

17. Three friends each run at a constant speed. Amir runs $2\ mi$ in $\frac{1}{4}$ hour. Bea runs $9\ mi$ in $\frac{3}{4}$ hour. Carlos's equation is $y = 11x$ where y is miles and x is hours. Write equations for Amir and Bea, identify who is fastest and who is slowest, and find how far each person runs in 2 hours. _____

18. This graph shows the cost in dollars of buying x pounds of trail mix. Use the highlighted lattice point to write the equation that models the relationship in the form $y = kx$, and use it to find the cost of 9 pounds of trail mix.


$
12
10
8
6
4
2
(4, 8)
pounds
1
2
3
4
5
6

Answer Keys

1) 24
2) 63
3) 20
4) 5
5) 8
6) 7
7) 7
8) 20
9) 5
10) 1.5
11) $\frac{1}{3}$
12) 3
13) 28
14) 6
15) 18
16) $k = 2400$ pages/hr; $y = 2400x$; $18{,}000$ pages; $15\ min$
17) Amir: $y = 8x$; Bea: $y = 12x$; Bea fastest; Amir slowest; 16, 24, and $22\ mi$
18) $k = 2$; $y = 2x$; $18

Step-by-Step Explanations

Tutoring notes not found for this topic.

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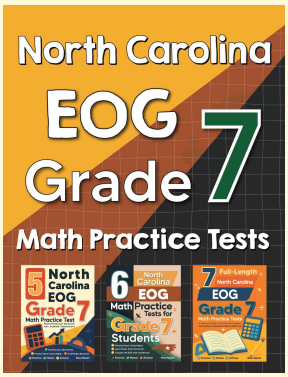

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