Writing Equations for Proportional Relationships

Apply the skill to decisions and designs

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

Name the input and output, find $k = y/x$, then write $y = kx$. For 3 bags holding 12 kg, $k = 12/3 = 4$ kg per bag and $m = 4b$; 5 bags hold 20 kg.

Worked example

6 identical pens cost 9 dollars. Write cost C in terms of pen count p.

1. $k = 9/6 = 3/2$ dollars per pen.
2. Cost equals unit price times count, so $C = \frac{3}{2}p$.
3. Check: $\frac{3}{2}(6) = 9$ dollars.
Answer: $C = \frac{3}{2}p$.

Practice Problems

Show your thinking.

1. 2 pitchers hold 7 L at a constant rate. Let x count pitchers and y measure L. Write the equation and find how many pitchers correspond to exactly 14 L.

2. 3 tickets cost 18 dollars at a constant rate. Let x count tickets and y measure dollars. Write the equation and find how many tickets correspond to exactly 30 dollars. Relate the coefficient in your equation to both table rows.

input	output
3	18
6	36

3. 4 banners need 18 m of ribbon at a constant rate. Let x count banners and y measure m of ribbon. Write the equation and find how many banners correspond to exactly 27 m of ribbon. State the units of the constant and explain what it measures.

4. 5 bags hold $\frac{55}{4}$ kg of feed at a constant rate. Let x count bags and y measure kg of feed. Write the equation and find how many bags correspond to exactly $\frac{77}{4}$ kg of feed. How many bags hold twice as much feed as 7 bags?

5. 6 packs hold 24 kg of paper at a constant rate. Let x count packs and y measure kg of paper. Write the equation and find how many packs correspond to exactly 32 kg of paper. Write the rule with input and output interchanged.

6. 8 batches use 26 L of paint at a constant rate. Let x count batches and y measure L of paint. Write the equation and find how many batches correspond to exactly $\frac{65}{2}$ L of paint. Does adding 1 to the right side preserve proportionality? Explain using zero input.

7. Fabric order: plan A uses the proportional pair $(4, 14)$; plan B costs 4 per unit. Write both cost equations and compare totals for 4 units.

8. Juice cartons: 6 units cost $15.00 proportionally. Write the cost equation and find the most whole units affordable with $20.00.

9. Tile packs: write an inverse equation for input x in terms of output y, using the proportional pair $(5, 35)$. Check the given output.

10. Paint batches: a student proposes $y = \frac{3}{2}x + 1$ for the pair $(8, 12)$. Repair the equation and test zero input.

Answer Key

1. $y = \frac{7}{2}x$; 4 pitchers.
2. $y = 6x$; 5 tickets.
3. $y = \frac{9}{2}x$; 6 banners. Input: banners; output: meters of ribbon; rate $\frac{9}{2}$ m per banner.
4. $y = \frac{11}{4}x$; 7 bags. The doubled amount needs 14 bags.
5. $y = 4x$; 8 packs. Reverse rule $x = \frac{1}{4}y$.
6. $y = \frac{13}{4}x$; 10 batches. No; zero input would produce 1, not 0.
7. $C_A = \frac{7}{2}x$, $C_B = 4x$; A costs $2.00 less.
8. $C = \frac{5}{2}x$; at most 8 units.
9. $x = \frac{1}{7}y$.
10. $y = \frac{3}{2}x$; at zero input the output is 0.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Divide by the pitcher count: $7 \div 2 = \frac{7}{2}$ L per pitcher.
2. The constant multiplies the input: $y = \frac{7}{2}x$.
3. Divide the target by the rate: $14 \div (\frac{7}{2}) = 4$ pitchers.

Problem 2

1. Divide by the ticket count: $18 \div 3 = 6$ dollars per ticket.
2. The constant multiplies the input: $y = 6x$.
3. Divide the target by the rate: $30 \div (6) = 5$ tickets.
4. Both table ratios are $18/3 = 36/6 = 6$.

Problem 3

1. Divide by the banner count: $18 \div 4 = \frac{9}{2}$ m of ribbon per banner.
2. The constant multiplies the input: $y = \frac{9}{2}x$.
3. Divide the target by the rate: $27 \div (\frac{9}{2}) = 6$ banners.
4. Since the input counts banners and the output measures meters, the rate is meters per banner.

Problem 4

1. Divide by the bag count: $\frac{55}{4} \div 5 = \frac{11}{4}$ kg of feed per bag.
2. The constant multiplies the input: $y = \frac{11}{4}x$.
3. Divide the target by the rate: $\frac{77}{4} \div (\frac{11}{4}) = 7$ bags.
4. Seven bags hold $\frac{77}{4}$ kg; twice that is $\frac{77}{2}$ kg. Divide: $\frac{77}{2} \div (\frac{11}{4}) = 14$ bags.

Problem 5

1. Divide by the pack count: $24 \div 6 = 4$ kg of paper per pack.
2. The constant multiplies the input: $y = 4x$.
3. Divide the target by the rate: $32 \div (4) = 8$ packs.
4. Divide by 4: $x = y/4 = \frac{1}{4}y$.

Problem 6

1. Divide by the batch count: $26 \div 8 = \frac{13}{4}$ L of paint per batch.
2. The constant multiplies the input: $y = \frac{13}{4}x$.
3. Divide the target by the rate: $\frac{65}{2} \div (\frac{13}{4}) = 10$ batches.
4. $\frac{13}{4}(0) + 1 = 1 \neq 0$.

Problem 7

1. Coefficient $k = 14/4 = \frac{7}{2}$.
2. The proportional equation is $y = \frac{7}{2}x$.
3. Totals for 4 units: A 14, B 16 dollars. B minus A $= 16 - 14 = 2$ dollars, positive, so A costs less.

Problem 8

1. Coefficient $k = 15/6 = \frac{5}{2}$.
2. The proportional equation is $y = \frac{5}{2}x$.
3. Budget divided by rate $= 20 \div (\frac{5}{2}) = 8$. One more costs $\frac{45}{2} > 20$ dollars.

Problem 9

1. Coefficient $k = 35/5 = 7$.
2. The proportional equation is $y = 7x$.
3. Divide by the coefficient: $x = y/(7) = \frac{1}{7}y$. Check $\frac{1}{7}(35) = 5$.

Problem 10

1. Coefficient $k = 12/8 = \frac{3}{2}$.
2. The proportional equation is $y = \frac{3}{2}x$.
3. The proposed rule gives $12 + 1 = 13$ at input 8, not 12. Removing 1 also gives $\frac{3}{2}(0) = 0$.

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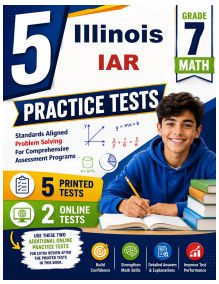

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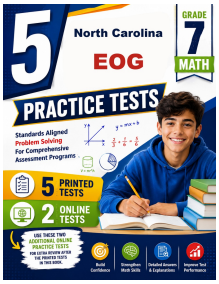

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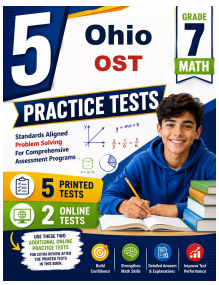

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