Instruction Coach™

7

Mathematics

Dr. Jerry Kaplan
Senior Mathematics Consultant

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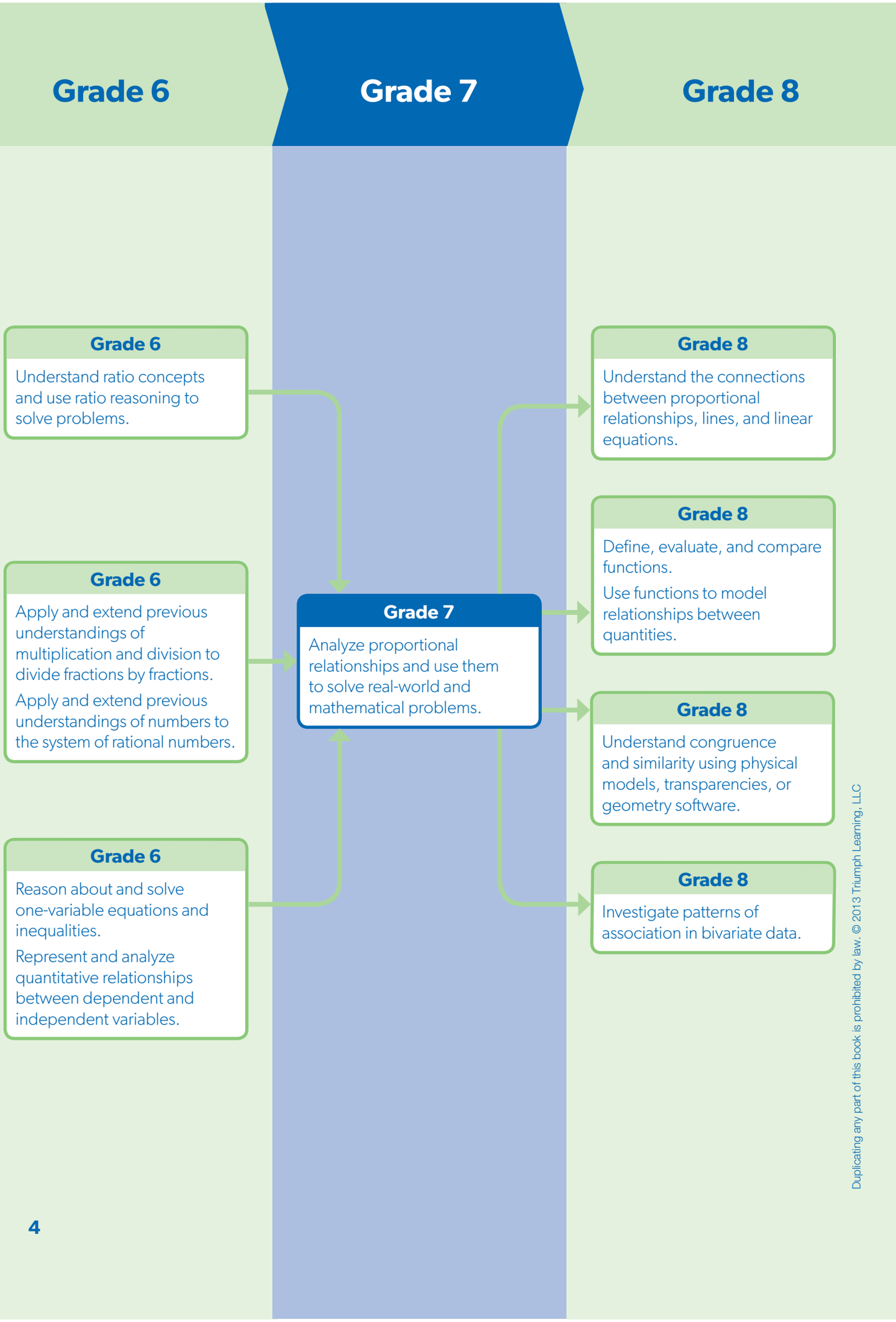

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LESSON 2

Identifying Proportional Relationships

UNDERSTAND A **proportion** states that two ratios are equivalent. In a proportional relationship, when one quantity increases, the other quantity also increases. The ratio of the two quantities remains constant. This constant ratio is called the **constant of proportionality**, k.

You can use tables, graphs, or equations to determine if relationships are directly proportional.

- Test pairs of values in a table to see if they are equivalent ratios.
- Graph pairs of values to see if they form a straight line that passes through the **origin**.
- Test pairs of values to see if they are related by the equation $y = kx$, where k is the constant of proportionality.

If the above are true, the quantities are in a directly proportional relationship.

Show that the quantities in the table below are in a directly proportional relationship. Identify the constant of proportionality, which is also Tina's hourly wage.

Tina's Earnings

Hours Worked (x)	1	2	3	4	5	6
Total Earnings in \$ (y)	12	24	36	48	60	72

1

Write pairs of values as ratios. Simplify them.

$\frac{1}{12}$ is in simplest form. $\frac{2}{24} = \frac{2 \div 2}{24 \div 2} = \frac{1}{12}$ $\frac{3}{36} = \frac{3 \div 3}{36 \div 3} = \frac{1}{12}$

$\frac{4}{48} = \frac{4 \div 4}{48 \div 4} = \frac{1}{12}$ $\frac{5}{60} = \frac{5 \div 5}{60 \div 5} = \frac{1}{12}$ $\frac{6}{72} = \frac{6 \div 6}{72 \div 6} = \frac{1}{12}$

The quantities are in a proportional relationship because each simplifies to $\frac{1}{12}$.

You can write this proportion: $\frac{1}{12} = \frac{2}{24} = \frac{3}{36} = \frac{4}{48} = \frac{5}{60} = \frac{6}{72}$.

2

Determine the constant of proportionality, which is also Tina's hourly wage.

Her wage will be in dollars per hour. So, write and simplify ratios comparing $\frac{\text{dollars}}{\text{hours}}$.

Each ratio in the table is equivalent, so you can use any ratio to determine the constant:

$\frac{\$12}{1\text{ h}} = \$12$ per hour or $\frac{\$24}{2\text{ h}} = \frac{\$12}{1\text{ h}} = \$12$ per hour

Since the denominator of each ratio is 1 hour, the constant of proportionality is also a unit rate.

▶ The quantities in the table are equivalent ratios, so this shows a proportional relationship. The constant of proportionality is 12, so Tina's hourly wage is \$12 per hour.

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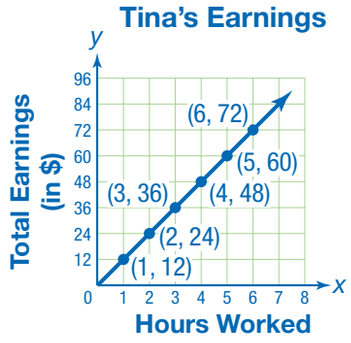
Connect

Use the table of data on the preceding page to create a graph. Explain how the graph shows that the quantities are in a proportional relationship. Then use the graph to identify the constant of proportionality.

1 Plot and label the ordered pairs from the table on a coordinate grid.

Connect the points.



2 Analyze the graph.

The points on the graph form a straight line that passes through the origin, (0, 0).

So, the graph shows a directly proportional relationship.

3 Use the graph to find the constant of proportionality, k.

The graph of a directly proportional relationship passes through the point $(1, k)$, where k is the constant of proportionality. This point also shows the unit rate.

Since the graph passes through $(1, 12)$, $k = 12$.

▶ The graph shows a proportional relationship because the points form a straight line that passes through (0, 0). The constant of proportionality, k, is 12.

TRY

The relationship between the quantities in the table on the preceding page can be represented by the equation $y = 12x$. Show that this equation relates all six pairs of values. Then explain how the equation can be used to identify the constant of proportionality.

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Practice

State whether or not each table shows a proportional relationship. If it does, identify the constant of proportionality.

1.

x	*y*
1	9
2	18
3	27
4	36
5	45

2.

x	*y*
1	10
2	20
3	40
4	80
5	160

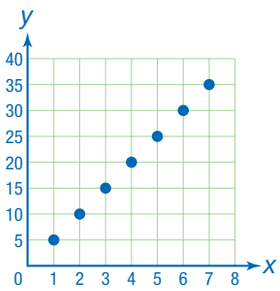
3.

x	*y*
1	15
2	30
3	45
4	60
5	75

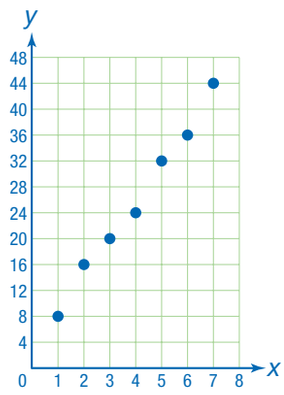
HINT: Is *every* pair of values in the table an equivalent ratio?

State whether or not the plotted points could show a proportional relationship. If they could, identify the constant of proportionality.

4.



5.



State whether or not each equation represents a proportional relationship. If it does, identify the constant of proportionality.

6. $y = x - 2$

7. $y = 7x$

8. $y = \frac{1}{5}x$

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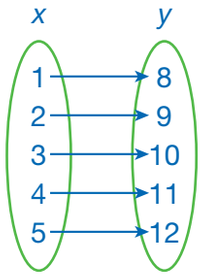
State whether or not each phrase represents a proportional relationship. Explain how you determined your answer, and if proportional, identify the constant of proportionality.

9. The value of y is equal to three times the value of x.

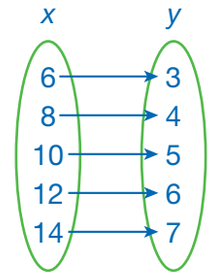
10. The value of y is equal to the sum of x and nine.

Each mapping diagram shows a relationship between x-values and y-values. State whether or not each diagram represents a proportional relationship. Explain how you determined your answer, and if proportional, identify the constant of proportionality.

11.



12.



Solve.

13. WRITE MATH Zivia is given the ordered pair (4, 16) from a table. She decides that the quantities in the table form a proportional relationship with a constant of proportionality of 4. Write whether Zivia has enough information to draw her conclusion.

14. EXPLAIN The formula for the circumference of a circle is $C = \pi d$, where C is the circumference and d is the diameter of the circle. Is this an example of a proportional relationship? If so, identify the constant of proportionality. Explain your reasoning.

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