

Jet Ski Rental



Institute Notes

Concept(s): Distinguish between a proportional and non-proportional situation using the characteristics of a proportional relationship.

TEKS Focus: 6.3—The student solves problems involving proportional relationships.

7.3—The student solves problems involving proportional relationships.

8.3—The student identifies proportional relationships in problem situations and solves problems.

Overview: Participants will use multiple representations to determine whether the situation of a jet ski rental represents a proportional or non-proportional relationship. A table can be constructed and the ratio of $\frac{y}{x}$ can be compared to see if there is a set of equivalent ratios which lead to a constant ratio. The values in the table can be graphed to determine if they represent a line passing through the origin. The table of values can also be used to make a generalization and to write an equation. This equation can be examined to see if it is of the form $y = kx$.

Materials: 1" graph paper or centimeter grid paper
Markers
Peel-and-stick dots
Rulers
Graphing calculators

Procedure:

1. Participants will work in groups of 2 to 4 on this activity. Put a transparency of Activity 1 on the overhead and present the problem.
2. To be able to organize the data in a table to see the relationship between time and cost, participants must first decide which to use as the independent variable and which to use as the dependent variable. In other words, do we want:
 - a. The rental cost depends on the number of hours.
 - b. The number of hours depends on the rental cost.
3. Next, have participants complete the table for Activity 1 to help them solve the problem.

Also:

Grade 6

4A, 4B, 5A, 11A, 11C, 12A, 13B

Grade 7

13A, 13C, 14A, 15B

Grade 8

3A, 4A, 5A, 5B, 14A, 14C, 15A, 16B

Math Notes:

"a" makes more sense in this situation. Participants should identify the words that represent the dependent and independent variables.

(dependent variable = y = rental cost; independent variable = x = number of hours)

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4. Have participants discuss the questions in Activity 1 to determine if the situation is a proportional relationship.
5. Next, have participants graph the data on 1" graph paper using markers and peel-and-stick dots. Record the graph on Transparency 1.
6. When participants have completed their graphs, have them discuss the answers to the questions at the bottom of Transparency 1.
7. Next, ask participants how they would change this problem so that it would represent a proportional relationship. Have them rewrite the problem to show this change. Example: *"You are at Galveston for a week-long vacation. Members of your family want to rent a jet ski. It will cost \$45 per hour. How long can you rent the jet ski if your family has budgeted \$350 for the rental fee?"* Other changes might include leaving out the deposit and changing the rental fee.
8. Have some participants share what they have written by writing their revised problems on the board or on a transparency. Ask all participants to look at the problems written, determine if the new problems represent a proportional relationship, and explain how they determined this.
9. Use the original problem with the words "\$30 for a deposit plus" omitted and ask participants to complete the table for Activity 2.
10. Ask participants to compare the ratio of total cost, y , to number of hours, x , for each row of their table and state their observations. Discuss the other questions in Activity 2.
11. Have them graph the data from Activity 2 on the same graph paper as Activity 1 and compare their graphs.
12. Ask a participant to graph the new data on Transparency 2, and have all participants answer the questions on Transparency 2.

Participants should observe that the deposit makes the difference. By omitting the deposit in the original problem, the situation becomes a proportional relationship. Having participants compare and contrast situations, enables them to develop a concept.

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- Extension:**
1. Use a graphing calculator to graph the equations in Activities 1 and 2. Use the **table** feature to generate a table of values to help you answer the questions from the activities.
 2. Write a problem situation that represents a proportional relationship. Show that this problem situation is a proportional relationship by using a table and comparison of ratios, an equation, a graph and/or a diagram.
 3. Write a problem that does not represent a proportional relationship. Use multiple representations to support your case.

Assessment: Find a newspaper ad for the rental of some equipment and write a problem for this. Make a table and graph the data. Use your table and graph and explain why this situation is a proportional or non-proportional relationship.

Notes:

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Activity 1

You are at Galveston for a week-long gathering. Members of your family want to rent a jet ski. It will cost \$30.00 for a deposit plus \$45.00 per hour. How long can you rent the jet ski if your family has budgeted \$350 for the rental fee?

Number of hours	Process (Total Cost in Dollars)	Total Cost Dollars
1	$45(1) + 30$	75
2	$45(2) + 30$	120
3	$45(3) + 30$	165
4	$45(4) + 30$	210
5	$45(5) + 30$	255
x	$45(x) + 30$	y

- Study the table for patterns and state any observations.
- Compare the total cost to the number of hours for each row of the table. Is there a set of equivalent ratios?
- How can you use this information to help you determine if the jet ski rental situation is a proportional relationship?
- Write an equation that relates the total cost, y , and the number of hours, x .
- How can you determine if this jet ski rental situation is a proportional relationship by looking at the equation?

TEXTEAMS Rethinking Middle School Mathematics: Proportionality

Activity-5

Reason and Communicate:

a. Participants should see that the number of hours increases by one hour each time in the table. The total cost increases by 45 for each additional hour. And, the total cost can always be determined by multiplying the number of hours by 45 and adding on 30. Model the first two or three rows with them and stress the "Process" column. Have participants generalize in words what the cost would be to rent the jet ski for any number of hours. They should be able to articulate that the cost is "30 dollars plus 45 dollars times the number of hours". This verbalization will help them connect the symbols in the process column with the words they have just used.

b. They should write $\frac{75}{1}, \frac{120}{2}, \frac{165}{3}$,

$\frac{210}{4}, \frac{255}{5} \dots$

When they simplify each ratio, they will get $75/1, 60/1, 55/1, 105/2$, and $51/1$ for the first 5 rows of their table. These ratios are not equivalent.

c. In a proportional relationship, the ratio of $\frac{y}{x}$ is constant. All the ratios

exhibited by the y and x in the relationship must be equivalent in order for there to be a constant of proportionality. In this situation, the ratio of total cost to number of hours is not constant, so the relationship is not a proportional one.

d. They should write $y = 45x + 30$ using the pattern from their table.

e. Participants should recognize a proportional relationship from its equation, $y = kx$. Our equation is not of this form and, therefore, does not represent a proportional relationship.



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Activity 1

You are at Galveston for a week-long gathering. Members of your family want to rent a jet ski. It will cost \$30.00 for a deposit plus \$45.00 per hour. How long can you rent the jet ski if your family has budgeted \$350 for the rental fee?

Number of hours	Process (Total Cost in Dollars)	Total Cost in Dollars
1	$45(1) + 30$	75
2		
3		
4		
5		
x		

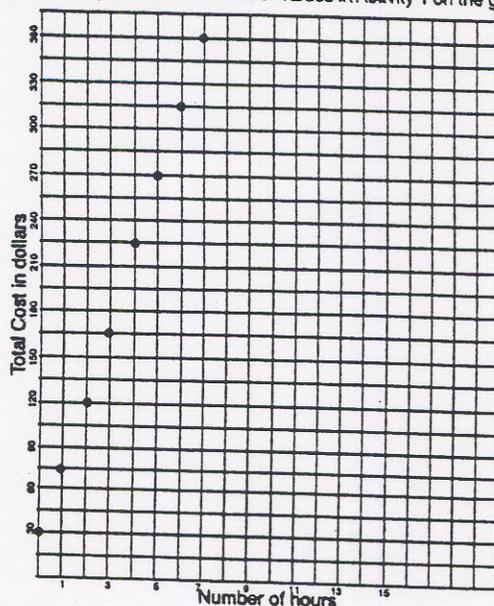
- Study the table for patterns and state any observations.
- Compare the total cost to the number of hours for each row of the table. Is there a set of equivalent ratios?
- How can you use this information to help you determine if the jet ski rental situation is a proportional relationship?
- Write an equation that relates the total cost, y , and the number of hours, x .
- How can you determine if this jet ski rental situation is a proportional relationship by looking at the equation?

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Transparency 1

Graph the ordered pairs from the table of values in Activity 1 on the grid below.



- What is the cost of rental at 0 hours? What does this mean?
- What does the ordered pair (6,300) on the graph mean in words?
- How many hours can your family rent the jet ski if they have budgeted \$350? Explain.
- Use your graph to determine the cost to rent the ski for 13 hours over a 2-day period?
- Is it reasonable to pay \$400 for renting the jet ski for 8 hours on one day? Explain your reasoning.
- Does this graph represent a proportional relationship? Why or why not?

TEXTEAMS Rethinking Middle School Mathematics: Proportionality

Transparency-PM

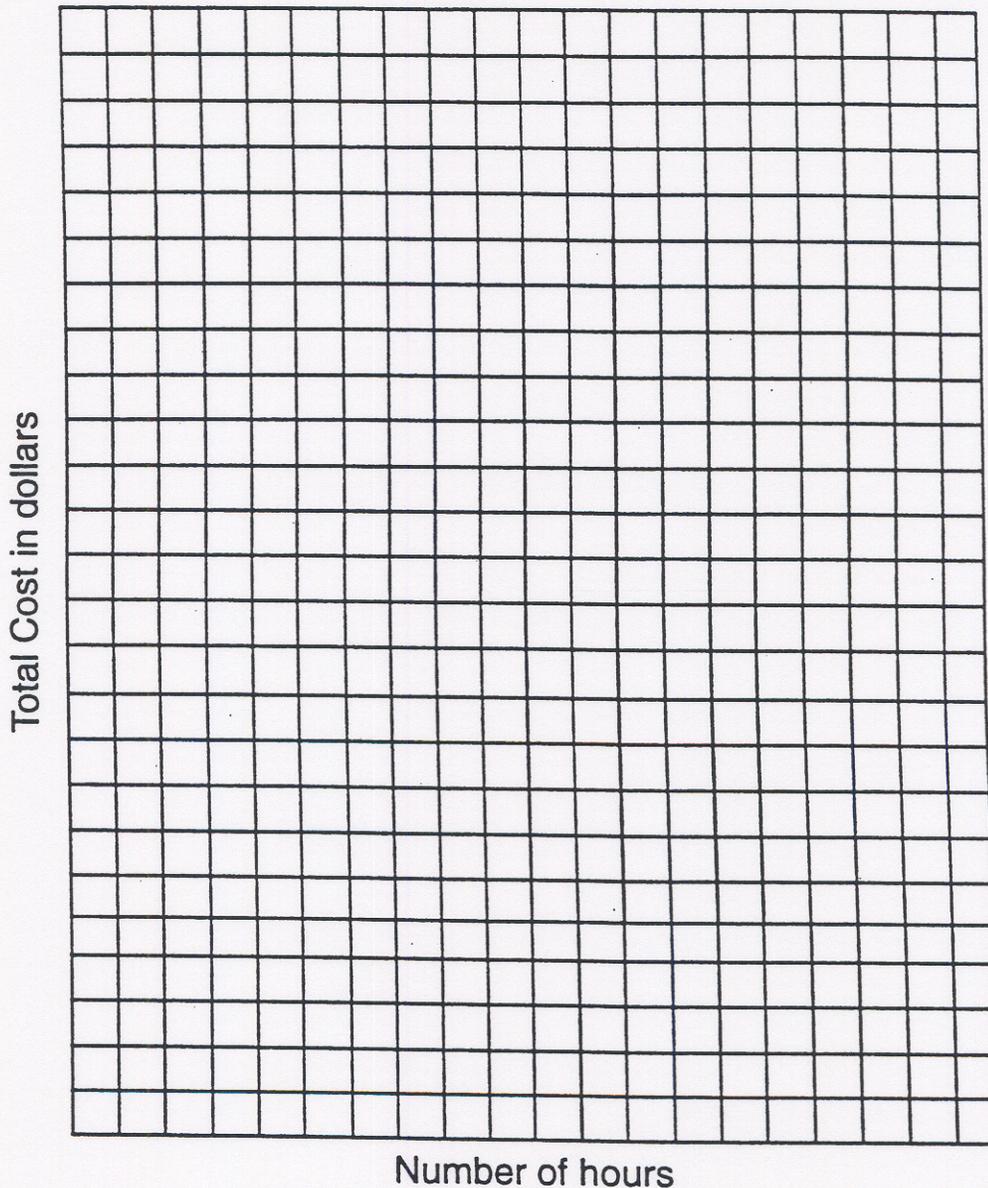
Answers and Math Notes:

- Because of the deposit, it will cost \$30 to rent the jet ski before ever riding it.
- It will cost \$300 to rent the jet ski for 6 hours.
- They can rent the jet skis for 7 hours at a cost of \$345 and stay within their budget.
- Extend the line if you need to in order to find the cost when the number of hours is 13 on the x-axis. The ordered pair is (13, 615).
- The cost of rental for 8 hours should be \$390. If I locate 8 hours along the x-axis on my graph and find the corresponding y-value, it should be 390 instead of 400.
- No. The graph does not pass through the origin.

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Transparency 1

Graph the ordered pairs from the table of values in Activity 1 on the grid below.



- What is the cost of rental at 0 hours? What does this mean?
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- How many hours can your family rent the jet ski if they have budgeted \$350? Explain.
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- Does this graph represent a proportional relationship? Why or why not?

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Activity 2



You are at Galveston for a week-long vacation. Members of your family want to rent a jet ski. It will cost \$45.00 per hour. How long can you rent the jet ski if your family has budgeted \$350 for the rental fee?

Number of hours	Process (Total Cost in Dollars)	Total Cost Dollars
1	45 (1)	45
2	45 (2)	90
3	45 (3)	135
4	45 (4)	180
5	45 (5)	225
x	45 (x)	y

- Compare the ratio of Total Cost, y , to Number of Hours, x , for each row of this table and state your observations.
- How can you use this information to help you determine if this is a proportional relationship?
- Write an equation using the "process column" in your table.
- How can you recognize a proportional relationship from an equation?
- How many hours can you rent the jet ski on a budget of \$350? Explain.

TEXTEAMS Rethinking Middle School Mathematics: Proportionality

Activity-9

Answers and Math Notes:

a. The ratio $\frac{y}{x}$ for any number of hours

is equivalent to $\frac{45}{1}$.

b. By observing a set of equivalent ratios for $\frac{y}{x}$, one can conclude that

there is a constant ratio $\frac{45}{1}$.

This constant ratio is the constant of proportionality in a proportional relationship.

c. $y = 45x$

d. If the equation is of the form $y = kx$, it represents a proportional relationship.

e. $7\frac{7}{9}$ hours

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Activity 2

You are at Galveston for a week-long vacation. Members of your family want to rent a jet ski. It will cost \$45.00 per hour. How long can you rent the jet ski if your family has budgeted \$350 for the rental fee?

Number of hours	Process (Total Cost in Dollars)	Total Cost Dollars
1	45 (1)	45
2		
3		
4		
5		
x		

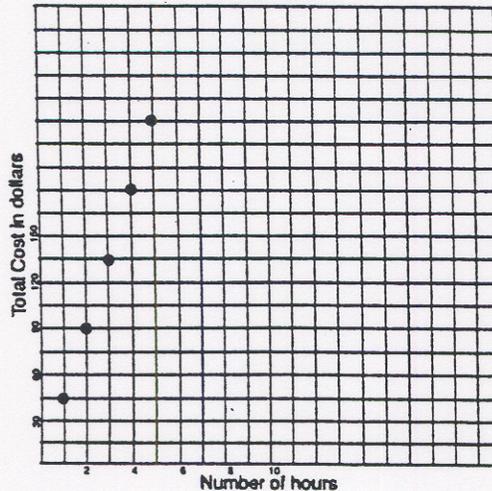
- Compare the ratio of Total Cost, y , to Number of Hours, x , for each row of this table and state your observations.
- How can you use this information to help you determine if this is a proportional relationship?
- Write an equation using the “process column” in your table.
- How can you recognize a proportional relationship from an equation?
- How many hours can you rent the jet ski on a budget of \$350? Explain.

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Transparency 2

Graph the ordered pairs from the table of values in Activity 2 on the grid below.



- What does the ordered pair $(0, 0)$ mean in words in this problem?
- What is the cost to rent the jet ski for 7 hours?
- How many hours could your family rent the ski with no deposit on a budget of \$350?
- Did the deposit make any difference in the number of hours you could rent the jet ski on a budget of \$350? Explain.
- Does this graph represent a proportional relationship? Why or why not?

TEXTEAMS Rethinking Middle School Mathematics: Proportionality

Transparency-11

Reason and Communicate:

a. There is no deposit required to rent the jet ski.

b. \$315

c. 7 hours

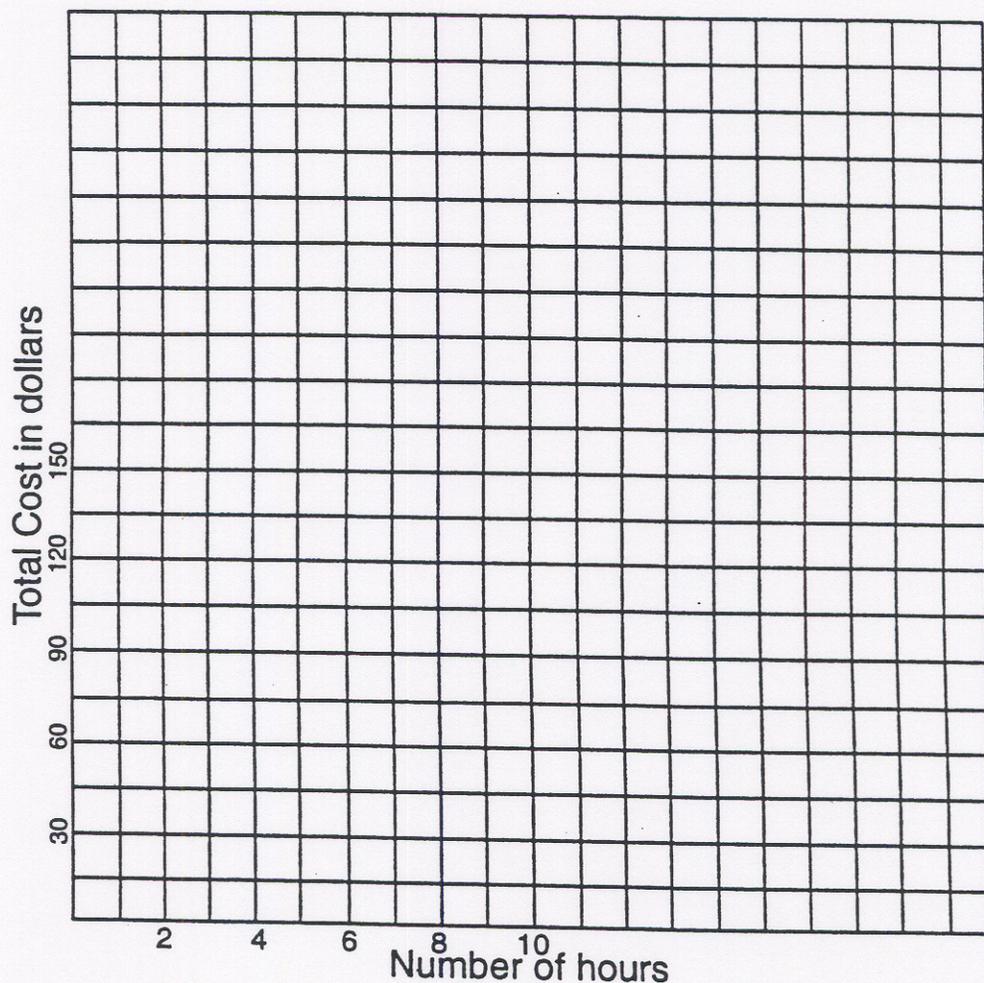
d. The number of hours is the same because the deposit of \$30 is less than \$45.

e. The graph of the new data is a line that passes through the origin. This new situation can be determined to be a proportional relationship from its graph. The original graph passed through the point $(0, 30)$ instead of the origin because of the \$30 deposit.

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Transparency 2

Graph the ordered pairs from the table of values in Activity 2 on the grid below.



- What does the ordered pair $(0, 0)$ mean in words in this problem?
- What is the cost to rent the jet ski for 7 hours?
- How many hours could your family rent the ski with no deposit on a budget of \$350?
- Did the deposit make any difference in the number of hours you could rent the jet ski on a budget of \$350? Explain.
- Does this graph represent a proportional relationship? Why or why not?

Unit II: Reflect and Apply

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- How is a proportional relationship different from a non-proportional relationship?
- Which of the following describe proportional relationships? Why? How do you know the others are not proportional relationships?

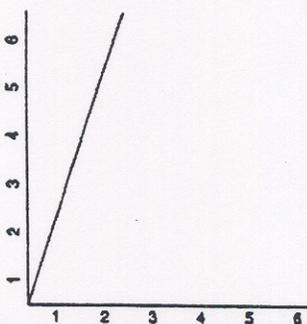
a.

x	y
3	5
4	6
5	7
6	8
7	8
x	

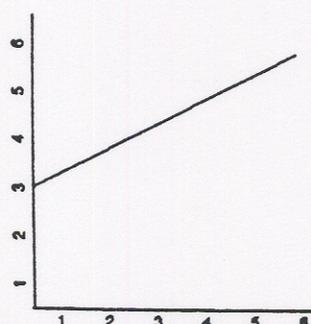
b.

x	y
3	2.25
4	3
5	3.75
6	4.50
7	5.25
x	

c.



d.



TEXTEAMS Rethinking Middle School Mathematics: Proportionality

Activity-67

Answers:

1. In a proportional relationship between x and y :

- the ratio $\frac{y}{x}$ is constant

- the graph of (x, y) is a straight line through the origin
- the constant $\frac{y}{x}$ is the constant of proportionality, k ,

and the equation of the line is $y = kx$

In a non proportional relationship:

- the ratio $\frac{y}{x}$ is not constant

- the graph is not a straight line through the origin

2. a. non-proportional, because $\frac{5}{3} \neq \frac{6}{4}$.

b. proportional, $\frac{y}{x} = \frac{3}{4}$ for all (x, y)

c. proportional, the graph is a straight line through the origin

d. non-proportional, the graph does not contain the origin

Unit II: Reflect and Apply

1. How is a proportional relationship different from a non-proportional relationship?
2. Which of the following describe proportional relationships? Why? How do you know the others are *not* proportional relationships?

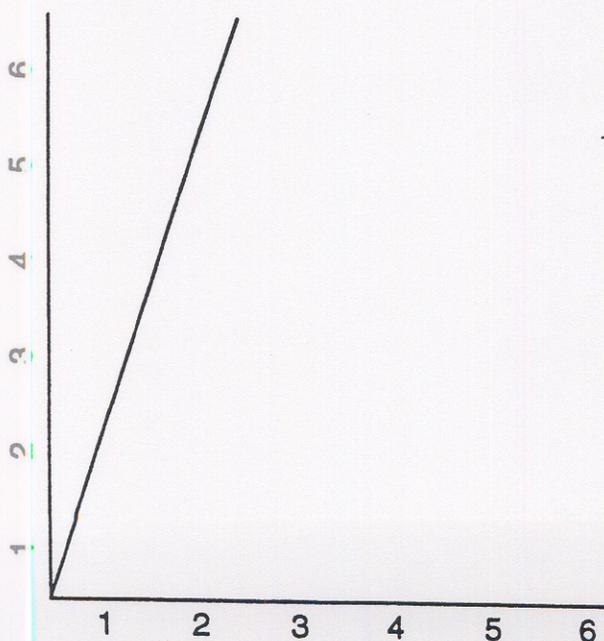
a.

x	y
3	5
4	6
5	7
6	8
7	8
x	

b.

x	y
3	2.25
4	3
5	3.75
6	4.50
7	5.25
x	

c.



d.

