Writing Function Rules

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Printed: December 11, 2023 (PST)

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Last Modified: Aug 23, 2023

[Figure 1]

Alfred is getting ready to decorate the yard for Halloween. He always lights both sides of the driveway with carved jack-o-lanterns. Alfred knows that Jacob, a local farmer sells his smaller pumpkins for $2.75 each. He needs to write some type of a function rule to determine the cost of 25, 35, 45 and 50 pumpkins. How can Alfred use the information he knows to write the function rule?

In this concept, you will learn to write function rules.

Function Rule

A **functionrule** expresses the output value in terms of all operations performed on the input value. A function rule can be expressed either using words or symbols. When a function rule is written from the information given in an input/output table, the pattern represented in the table must be represented by the function rule.

Let's write a function rule for each of the following input/output tables:

Input (x)	Output (y)
2	7
3	10
4	13
5	16

First, look for a pattern between the input numbers and the output numbers.

The values of the output numbers are very close to the input number times three.

$$y = 3x$$

Next, try the function rule to see if it works.

$$\begin{aligned} y &= 3x \\ y &= 3(2) \\ y &= 6 \end{aligned}$$

$$\begin{aligned} y &= 3x \\ y &= 3(3) \\ y &= 9 \end{aligned}$$

$$\begin{aligned} y &= 3x \\ y &= 3(4) \\ y &= 12 \end{aligned}$$

$$\begin{aligned} y &= 3x \\ y &= 3(5) \\ y &= 15 \end{aligned}$$

Next, if the function rule does not give the output number, determine what value could be added or subtracted from the original function rule to give the desired output number.

Each of the given output numbers is one greater than the output values found by $y = 3x$.

Next, write a new function rule to satisfy the values given in the table.

$$y = 3x + 1$$

Next, try the new function rule to see if it works.

$$\begin{aligned} y &= 3x + 1 \\ y &= 3(2) + 1 \\ y &= 6 + 1 \\ y &= 7 \end{aligned}$$

$$\begin{aligned} y &= 3x + 1 \\ y &= 3(3) + 1 \\ y &= 9 + 1 \\ y &= 10 \end{aligned}$$

$$\begin{aligned} y &= 3x + 1 \\ y &= 3(4) + 1 \\ y &= 12 + 1 \\ y &= 13 \end{aligned}$$

$$\begin{aligned} y &= 3x + 1 \\ y &= 3(5) + 1 \\ y &= 15 + 1 \\ y &= 16 \end{aligned}$$

The function rule $y = 3x + 1$ gives the output values shown in the table when the given input values are used.

Input (x)	Output (y)
-3	-2
-1	2
1	6
3	10

First, look for a pattern between the input numbers and the output numbers.

The pattern between the values of the output numbers and the input number is not obvious. Perhaps trial and error may work to get started. Begin by doubling each of the input numbers.

$$y = 2x$$

Next, try the function rule to see if it works.

$$\begin{aligned} y &= 2x \\ y &= 2(-3) \\ y &= -6 \end{aligned}$$

$$\begin{aligned} y &= 2x \\ y &= 2(-1) \\ y &= -2 \end{aligned}$$

$$\begin{aligned} y &= 2x \\ y &= 2(1) \\ y &= 2 \end{aligned}$$

$$\begin{aligned} y &= 2x \\ y &= 2(3) \\ y &= 6 \end{aligned}$$

Next, if the function rule does not give the output number, determine what value could be added or subtracted from the original function rule to give the desired output number.

When $x = 1$ in the function rule $y = 2x$, the output number was $y = 2$. If 4 were added to this, then the value of 'y' would be 6 which is the given output number in the table.

Next, write a new function rule to satisfy the values given in the table.

$$y = 2x + 4$$

Next, try the new function rule to see if it works.

$$\begin{aligned} x &= -3 \\ y &= 2x + 4 \\ y &= 2(-3) + 4 \\ y &= -6 + 4 \\ y &= -2 \end{aligned}$$

$$\begin{aligned} x &= -1 \\ y &= 2x + 4 \\ y &= 2(-1) + 4 \\ y &= -2 + 4 \\ y &= 2 \end{aligned}$$

$$\begin{aligned} x &= 1 \\ y &= 2x + 4 \\ y &= 2(1) + 4 \\ y &= 2 + 4 \\ y &= 6 \end{aligned}$$

$$\begin{aligned} x &= 3 \\ y &= 2x+4 \\ y &= 2(3)+4 \\ y &= 6+4 \\ y &= 10 \end{aligned}$$

The function rule $y = 2x + 4$ gives the output values shown in the table when the given input values are used.

Input (x)	Output (y)
2	7
3	10
4	13
5	16

The above input/output table can also be written as

x	$f(x)$
2	7
3	10
4	13
5	16

The input values are now represented by ' x ' and the output numbers ' y ' are represented by $f(x)$.

Therefore, the function rule $y = 3x + 1$ can also be written as $f(x) = 3x + 1$. This way of writing a function rule is known as **function notation**.

$$f(x) = 3x + 1$$

The above function notation can be read as:

There is a function ' f ' written in terms of the variable ' x ' such that it equals $3x + 1$ or f of x equals $3x + 1$.

If a function written in function notation form were given then to find the value of the function for the input value '3' the function notation could be written as.

If $f(x)=-3x+5$ find $f(3)$.

First, substitute '3' for the value of 'x.'

$$\begin{aligned} f(x) &= -3x+5 \\ f(3) &= -3(3)+5 \end{aligned}$$

Next, perform the multiplication to clear the parenthesis.

$$\begin{aligned} f(3) &= -3(3)+5 \\ f(3) &= -9+5 \end{aligned}$$

Then, perform the addition on the right side of the function.

$$\begin{aligned} f(3) &= -9+5 \\ f(3) &= -4 \end{aligned}$$

The answer is -4.

If $f(x)=-3x+5$ then $f(3)=-4$.

Examples

Example 1

Earlier, you were given a problem about Alfred and the pumpkins.

Alfred needs to buy small pumpkins that cost $2.75 each. Alfred needs to write a function rule to figure out the cost of 25, 35, 45 and 50 pumpkins. What function rule can Alfred write using function notation?

First, he can create a table to represent the information from the problem.

x	$f(x)$
25	
35	
45	
60	

Next, write a function rule, using function notation that can be used to complete the table.

$$f(x) = 2.75x$$

Next, use the function rule to determine the value of $f(x)$ for each of the given 'x' values.

If $f(x) = 2.75x$ find $f(25)$.

Next, substitute 25 for 'x' in the function rule.

$$\begin{aligned} f(x) &= 2.75x \\ f(25) &= 2.75(25) \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(25) &= 2.75(25) \\ f(25) &= \$68.75 \end{aligned}$$

The answer is 68.75.

Twenty-five pumpkins will cost $68.75.

If $f(x) = 2.75x$ find $f(35)$.

Next, substitute 35 for 'x' in the function rule.

$$\begin{aligned} f(x) &= 2.75x \\ f(35) &= 2.75(35) \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(35) &= 2.75(35) \\ f(35) &= \$96.25 \end{aligned}$$

The answer is 96.25.

Thirty-five pumpkins will cost $96.25.

If $f(x) = 2.75x$ find $f(45)$.

Next, substitute 45 for 'x' in the function rule.

$$\begin{aligned} f(x) &= 2.75x \\ f(45) &= 2.75(45) \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(45) &= 2.75(45) \\ f(45) &= \$123.75 \end{aligned}$$

The answer is 123.75.

Forty-five pumpkins will cost $123.75.

If $f(x) = 2.75x$ find $f(50)$.

Next, substitute 50 for 'x' in the function rule.

$$\begin{aligned} f(x) &= 2.75x \\ f(50) &= 2.75(50) \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(50) &= 2.75(50) \\ f(50) &= \$137.50 \end{aligned}$$

The answer is 137.50.

Fifty pumpkins will cost $137.50.

Example 2

For the given table, write a function rule using function notation to represent the information given in the table.

x	$f(x)$
9	8
11	10
15	14
17	16

Remember, the input numbers have been replaced with ‘ x ’ and the output numbers have been replaced with $f(x)$.

First, look at the two columns of given numbers to determine a pattern between the values.

The numbers in the second column are one less than those in the first column.

Next, write a function rule, using function notation, to represent the pattern.

$$f(x) = x - 1$$

Next, test the function rule for each of the given ‘ x ’ values.

If $f(x) = x - 1$ find $f(9)$.

Next, substitute 9 for ‘ x ’ in the function rule.

$$\begin{aligned} f(x) &= x - 1 \\ f(9) &= 9 - 1 \end{aligned}$$

Then, perform the subtraction on the right side of the function rule.

$$\begin{aligned} f(9) &= 9 - 1 \\ f(9) &= 8 \end{aligned}$$

The answer is 8.

If $f(x) = x - 1$ find $f(11)$.

Next, substitute 11 for ‘ x ’ in the function rule.

$$\begin{aligned} f(x) &= x - 1 \\ f(11) &= 11 - 1 \end{aligned}$$

Then, perform the subtraction on the right side of the function rule.

$$\begin{aligned} f(11) &= 11 - 1 \\ f(11) &= 10 \end{aligned}$$

The answer is 10.

If $f(x) = x - 1$ find $f(15)$.

Next, substitute 15 for ‘ x ’ in the function rule.

$$\begin{aligned} f(x) &= x - 1 \\ f(15) &= 15 - 1 \end{aligned}$$

Then, perform the subtraction on the right side of the function rule.

$$\begin{aligned} f(15) &= 15 - 1 \\ f(15) &= 14 \end{aligned}$$

The answer is 14.

If $f(x) = x - 1$ find $f(17)$.

Next, substitute 17 for ‘ x ’ in the function rule.

$$\begin{aligned} f(x) &= x - 1 \\ f(17) &= 17 - 1 \end{aligned}$$

Then, perform the subtraction on the right side of the function rule.

$$\begin{aligned} f(17) &= 17-1 \\ f(17) &= 16 \end{aligned}$$

The answer is 16.

All of the $f(x)$ values calculated using the function rule match the $f(x)$ values given in the table.

The function rule $f(x)=x-1$ represents the information given in the table.

Example 3

Write a function rule using function notation to represent the information given in the following table.

x	$f(x)$
12	6
9	4.5
7	3.5
4	2

First, look at the two columns of given numbers to determine a pattern between the values.

The numbers in the second column are one-half the numbers in the first column.

Next, write a function rule, using function notation, to represent the pattern.

$$f(x)=\frac{1}{2}x$$

Next, test the function rule for each of the given 'x' values.

If $f(x)=\frac{1}{2}x$ find $f(12)$.

Next, substitute 12 for 'x' in the function rule.

$$\begin{aligned} f(x) &= \tfrac{1}{2}x \\ f(12) &= \tfrac{1}{2}(12) \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(12) &= \tfrac{1}{2}(12) \\ f(12) &= 6 \end{aligned}$$

The answer is 6.

If $f(x)=\frac{1}{2}x$ find $f(9)$.

Next, substitute 9 for 'x' in the function rule.

$$\begin{aligned} f(x) &= \tfrac{1}{2}x \\ f(9) &= \tfrac{1}{2}(9) \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(9) &= \tfrac{1}{2}(9) \\ f(9) &= 4.5 \end{aligned}$$

The answer is 4.5.

If $f(x)=\frac{1}{2}x$ find $f(7)$.

Next, substitute 7 for 'x' in the function rule.

$$\begin{aligned} f(x) &= \tfrac{1}{2}x \\ f(7) &= \tfrac{1}{2}(7) \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(7) &= \tfrac{1}{2}(7) \\ f(7) &= 3.5 \end{aligned}$$

The answer is 3.5.

If $f(x) = \dfrac{1}{2}x$ find $f(4)$.

Next, substitute 4 for 'x' in the function rule.

$$\begin{aligned} f(x) &= \tfrac{1}{2}x \\ f(4) &= \tfrac{1}{2}(4) \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(4) &= \tfrac{1}{2}(4) \\ f(4) &= 2 \end{aligned}$$

The answer is 2.

All of the $f(x)$ values calculated using the function rule match the $f(x)$ values given in the table.

The function rule $f(x) = \dfrac{1}{2}x$ represents the information given in the table.

Example 4

Write a function rule using function notation to represent the information given in the following table.

x	$f(x)$
9	-27
11	-33
15	-45
16	-48

First, look at the two columns of given numbers to determine a pattern between the values.

The numbers in the second column are negative three times the numbers in the first column.

Next, write a function rule, using function notation, to represent the pattern.

$$f(x) = -3x$$

Next, test the function rule for each of the given 'x' values.

If $f(x) = -3x$ find $f(9)$.

Next, substitute 9 for 'x' in the function rule.

$$\begin{aligned} f(x) &= -3x \\ f(9) &= -3(9) \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(9) &= -3(9) \\ f(9) &= -27 \end{aligned}$$

The answer is -27.

If $f(x) = -3x$ find $f(11)$.

Next, substitute 11 for 'x' in the function rule.

$$\begin{aligned} f(x) &= -3x \\ f(11) &= -3(11) \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(11) &= -3(11) \\ f(11) &= -33 \end{aligned}$$

The answer is -33.

If $f(x) = -3x$ find $f(15)$.

Next, substitute 15 for 'x' in the function rule.

$$\begin{aligned} f(x) &= -3x \\ f(15) &= -3(15) \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(15) &= -3(15) \\ f(15) &= -45 \end{aligned}$$

The answer is -45.

If $f(x) = -3x$ find $f(16)$.

Next, substitute 16 for 'x' in the function rule.

$$\begin{aligned} f(x) &= -3x \\ f(16) &= -3(16) \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(16) &= -3(16) \\ f(16) &= -48 \end{aligned}$$

The answer is -48.

All of the $f(x)$ values calculated using the function rule match the $f(x)$ values given in the table.

The function rule $f(x) = -3x$ represents the information given in the table.

Example 5

x	$f(x)$
1	4
2	7
3	10
4	13

First, look at the two columns of given numbers to determine a pattern between the values.

The numbers in the second column are one greater than three times the values in the first column.

Next, write a function rule, using function notation, to represent the pattern.

$$f(x) = 3x + 1$$

Next, test the function rule for each of the given 'x' values.

If $f(x) = 3x + 1$ find $f(1)$.

Next, substitute 1 for 'x' in the function rule.

$$\begin{aligned} f(x) &= 3x + 1 \\ f(1) &= 3(1) + 1 \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(1) &= 3(1) + 1 \\ f(1) &= 4 \end{aligned}$$

The answer is 4.

If $f(x) = 3x + 1$ find $f(2)$.

Next, substitute 2 for 'x' in the function rule.

$$\begin{aligned} f(x) &= 3x+1 \\ f(2) &= 3(2)+1 \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(2) &= 3(2)+1 \\ f(2) &= 7 \end{aligned}$$

The answer is 7.

If $f(x)=3x+1$ find $f(3)$.

Next, substitute 3 for ‘ x ’ in the function rule.

$$\begin{aligned} f(x) &= 3x+1 \\ f(3) &= 3(3)+1 \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(3) &= 3(3)+1 \\ f(3) &= 10 \end{aligned}$$

The answer is 10.

If $f(x)=3x+1$ find $f(4)$.

Next, substitute 4 for ‘ x ’ in the function rule.

$$\begin{aligned} f(x) &= 3x+1 \\ f(4) &= 3(4)+1 \end{aligned}$$

Then, perform the multiplication on the right side of the function rule.

$$\begin{aligned} f(4) &= 3(4)+1 \\ f(4) &= 13 \end{aligned}$$

The answer is 13.

All of the $f(x)$ values calculated using the function rule match the $f(x)$ values given in the table.

The function rule $f(x) = 3x + 1$ represents the information given in the table.

Review

1. Write a function rule for the following data.

x	$f(x)$
9	11
11	9
15	5
16	4

2. Write a function rule for the following data.

x	$f(x)$
-2	-6
0	-4
2	-2
4	0

3. Write a function rule for the following data.

x	$f(x)$
0	0
1	2
4	8
5	10

4. Write a function rule for the following data.

x	$f(x)$
1	0
2	2
4	6
8	14

5. Write a function rule for the following data.

x	$f(x)$
2	1
4	2
8	4
10	5
18	9

6. Write a function rule for the following data.

x	$f(x)$
6	2
9	3
15	5
21	7
30	10

7. Write a function rule for the following data.

x	$f(x)$
2	3
9	10
15	16
21	22
30	31

8. Write a function rule for the following data.

x	$f(x)$
3	-6
9	-18
15	-30
20	-40
24	-48

Solve the following problem.

9. Sandwiches cost $3.45 each. Write a function rule for the cost, c, for a number of sandwiches, s.

10. Now, find the cost of 3 sandwiches.

11. Find the cost of 6 sandwiches.

12. Find the cost of 9 sandwiches.

13. Find the cost of 2 sandwiches.

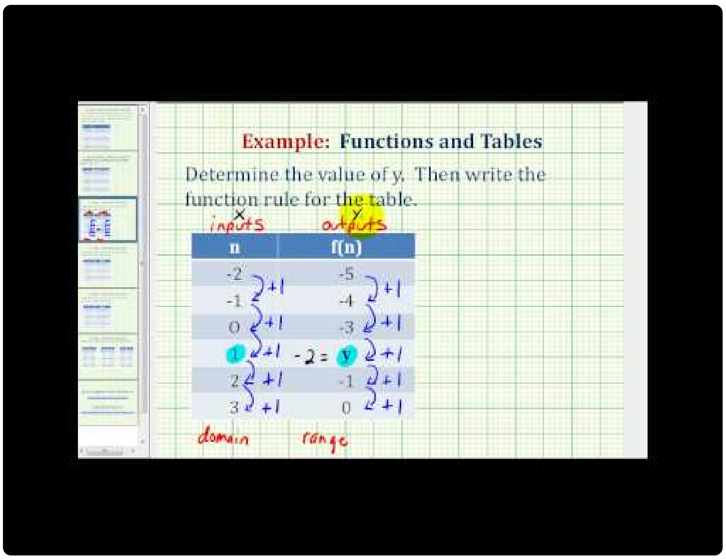
14. Find the cost of 8 sandwiches.

15. Find the cost of a dozen sandwiches.

Review (Answers)

To see the review answers, return to the Table of Contents and select ‘Other Versions’ or ‘Resources’.

Resources



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