

Tables, Graphs, and Rules

GUIDED SKILL SUPPORT

Overview

Three ways to write relationships for data are tables, words (descriptions), and rules (equations). The pattern in tables between input (x) and output (y) values usually establishes the rule for a relationship. If you know the rule, it may be used to generate sets of input and output values. A description of a relationship may be translated into a table of values or a general rule that describes the relationship between the input values and output values. Each of these three forms of relationships may be used to create a graph to visually represent the relationship. For additional information, see the Methods & Meanings boxes in Lessons 3.1.3, 3.1.4, 3.1.5, and 3.2.1 of

Core Connections Course 3.

Examples

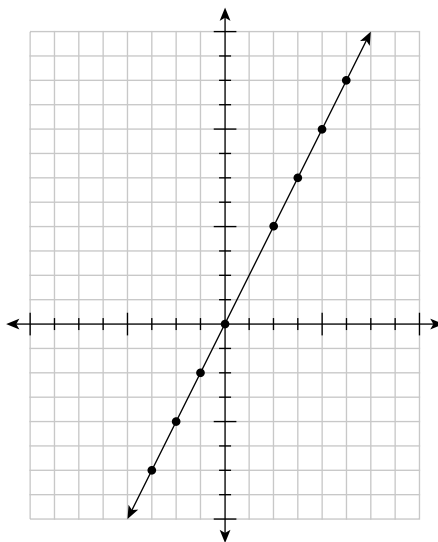
- Complete the table by determining the relationship between the input (x) values and output (y) values, write the rule for the relationship, and graph the data.

In (x)	4	-3		5	0		3	-2	x
Out (y)	8		4	10	0	-2		-4	

Begin by examining the four pairs of input and output values: 4 and 8, 5 and 10, 0 and 0, and -2 and -4. Determine what arithmetic operation(s) are applied to the input value of each pair to get the output value. The operation(s) applied to the input value must be the same in all four cases to produce each output value. In this example, the output value in each pair is twice the input value. Since this pattern works for all four points, make the conjecture that the rule is $y = 2x$, where y is the output and x is the input. See the completed table for the missing values.

In (x)	4	-3	2	5	0	-1	3	-2	x
Out (y)	8	-6	4	10	0	-2	6	-4	$y = 2x$

The rule is $y = 2x$. Finally, graph each pair of data points on an xy -coordinate system, as shown.



2. Complete the table by determining the relationship between the input (x) values and output (y) values, then write the rule for the relationship.

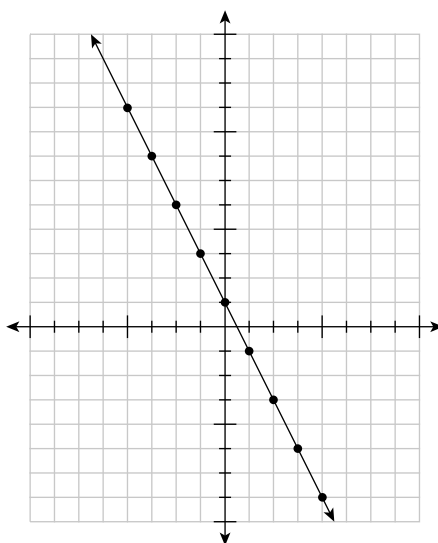
In (x)	2	-1	4	-3	0	-2	1	x
Out (y)	3	-3	7	-7	-1	-5	1	

Use the same approach as Example 1. In this table, the relationship is more complicated than simply multiplying the input value or adding (or subtracting) a number. Use a guess-and-check approach to try different patterns. For example, the first pair of values could be found by the rule $x + 1$, that is, $2 + 1 = 3$. However, that rule fails when you check it for -1 and -3: $-1 + 1 \neq -3$. From this guess, you know that the rule must be some combination of multiplying the input value and then adding or subtracting to that product. The next guess could be to start by doubling x . Try it for the first two or three input values and see how close each result is to the known output values: for 2 and 3, $2(2) = 4$; for -1 and -3, $2(-1) = -2$; and for 4 and 7, $2(4) = 8$. Notice that each result is one more than the actual output value. If you subtract 1 from each product, the result is the expected output value. Make the conjecture that the rule is $y = 2x - 1$ and test it for the other input values: for -3 and -7, $2(-3) - 1 = -7$; for 0 and -1, $2(0) - 1 = -1$; for -2 and -5, $2(-2) - 1 = -5$; and for 1 and 1, $2(1) - 1 = 1$. These all work, so the rule is $y = 2x - 1$.

3. Complete the table shown for $y = -2x + 1$, then graph each of the points in the table.

In (x)	-4	-3	-2	-1	0	1	2	3	4	x
Out (y)										$y = -2x + 1$

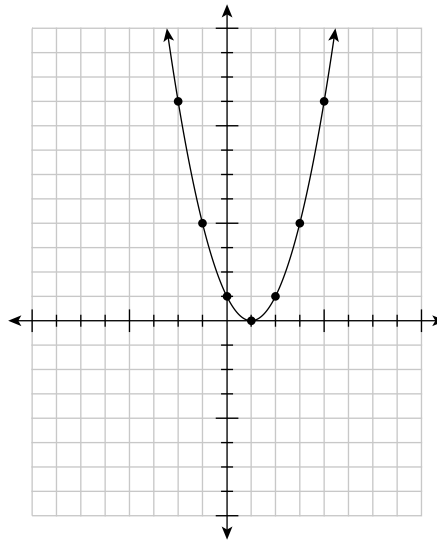
Replace x with each input value, multiply by -2 , then add 1. The results are ordered pairs: $(-4, 9)$, $(-3, 7)$, $(-2, 5)$, $(-1, 3)$, $(0, 1)$, $(1, -1)$, $(2, -3)$, $(3, -5)$, and $(4, -7)$. Plot these points on the graph (see Four-Quadrant Graphing if you need help with the fundamentals of graphing).



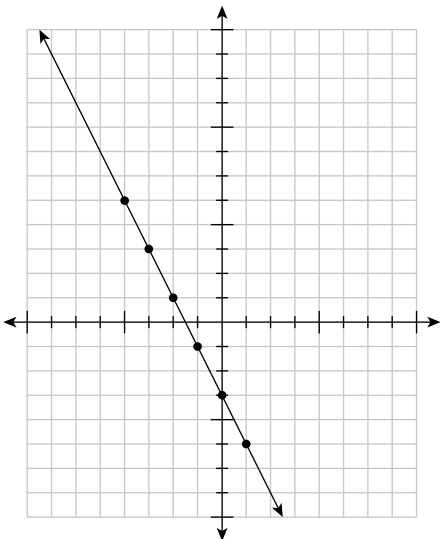
4. Complete the table shown for $y = x^2 - 2x + 1$, then graph each of the points in the table.

In (x)	-2	-1	0	1	2	3	4	x
Out (y)								$y = x^2 - 2x + 1$

Replace x in the equation with each input value. Square the value, multiply the value by -2 , then add both of these results and 1 to get the output (y) value for each input (x) value. The results are ordered pairs: $(-2, 9)$, $(-1, 4)$, $(0, 1)$, $(1, 0)$, $(2, 1)$, $(3, 4)$, and $(4, 9)$.



5. Make an $x \rightarrow y$ table for the graph shown, then write a rule for the table.



Working left to right on the graph, read the coordinates of each point and record them in the table.

In (x)	-4	-3	-2	-1	0	1	x
Out (y)	5	3	1	-1	-3	-5	$y = -2x - 3$

Guess and check by multiplying the input value, then adding or subtracting numbers to get the output value. For example, you could start by multiplying the input value by 2: $2(-4) = -8$, $3(-4) = -12$, $2(-3) = -6$, etc. The results are not close to the correct output value. The product is also the opposite sign (+ -) of what you want. Your next choice could be to multiply by -2 : $-2(-4) = 8$, $-2(-3) = 6$, $-2(-2) = 4$. Each result is 3 more than the expected output value, so make the conjecture that the rule is $y = -2x - 3$. Test it for the remaining points: $-2(-1) - 3 = -1$, $-2(0) - 3 = -3$, and $-2(1) - 3 = -5$. The rule is $y = -2x - 3$.

Practice

Complete each table. Then write a rule relating x and y .

1.

In (x)	10	5	20		-7	3	x
Out (y)	14	9		-4	-3		

2.

In (x)	22	5	11		-9	12	x
Out (y)	19	2		-8	-12		

3.

In (x)	10	0	15		-7	6	x
Out (y)	25	-5		-8		13	

4.

In (x)	10	-3	4		-5	15	x
Out (y)	-30	9	-12	-1			

5.

In (x)	4	-6		2	-12		x
Out (y)	7	-3	6		-9	1	

6.

In (x)	3	0		-12	16	9	x
Out (y)	3	-3	13		29		

7.

In (x)	2	0	-4		-13		x
Out (y)	-5	1		-20	40	-17	

8.

In (x)	9	-6		0	3	-3	x
Out (y)	3	-2	4		1		

9.

In (x)	-3	-2	-1	0	1	2	x
Out (y)	-7	-4	-1	2	5	8	

10.

In (x)	-6	-4	-2	0	2	4	x
Out (y)	1	2	3	4	5	6	

11.

In (x)	-2	-1	0	1	2	3	x
Out (y)	5	2	1	2	5	10	

Complete a table for each rule, then graph and connect the points. For each rule, start with a table like the one shown, with input values from -3 to 3.

In (x)	-3	-2	-1	0	1	2	3
Out (y)							

12. $y = 3x - 2$

13. $y = \frac{1}{2}x + 1$

14. $y = -x + 2$

15. $y = x^2 - 6$

Answers

1.

In (x)	10	5	20	-8	-7	3	x
Out (y)	14	9	24	-4	-3	7	$y = x + 4$

2.

In (x)	22	5	11	-5	-9	12	x
Out (y)	19	2	8	-8	-12	9	$y = x - 3$

3.

In (x)	10	0	15	-1	-7	6	x
Out (y)	25	-5	40	-8	-26	13	$y = 3x - 5$

4.

In (x)	10	-3	4	$\frac{1}{3}$	-5	15	x
Out (y)	-30	9	-12	-1	15	-45	$y = -3x$

5.

In (x)	4	-6	3	2	-12	-2	x
Out (y)	7	-3	6	5	-9	1	$y = x + 3$

6.

In (x)	3	0	8	-12	16	9	x
Out (y)	3	-3	13	-27	29	15	$y = 2x - 3$

7.

In (x)	2	0	-4	7	-13	6	x
Out (y)	-5	1	13	-20	40	-17	$y = -3x + 1$

8.

In (x)	9	-6	12	0	3	-3	x
Out (y)	3	-2	4	0	1	-1	$y = \frac{x}{3}$

9.

In (x)	-3	-2	-1	0	1	2	x
Out (y)	-7	-4	-1	2	5	8	$y = 3x + 2$

10.

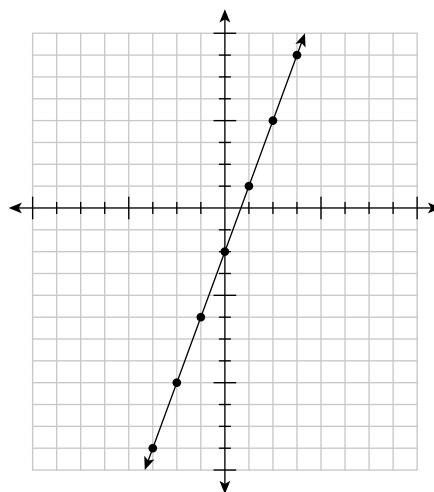
In (x)	-6	-4	-2	0	2	4	x
Out (y)	1	2	3	4	5	6	$y = \frac{1}{2}x + 4$

11.

In (x)	-2	-1	0	1	2	3	x
Out (y)	5	2	1	2	5	10	$y = \frac{1}{2}x + 4$

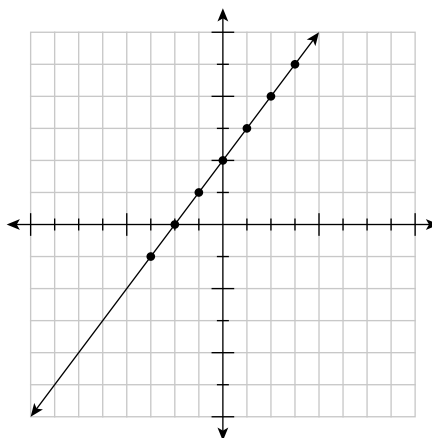
12.

In (x)	-3	-2	-1	0	1	2	3
Out (y)	-11	-8	-5	-2	1	4	7



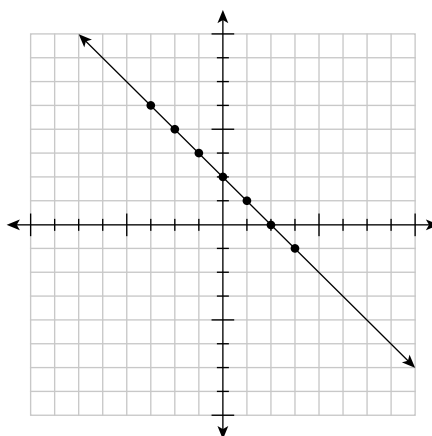
13.

In (x)	-3	-2	-1	0	1	2	3
Out (y)	-0.5	0	0.5	1	1.5	2	2.5



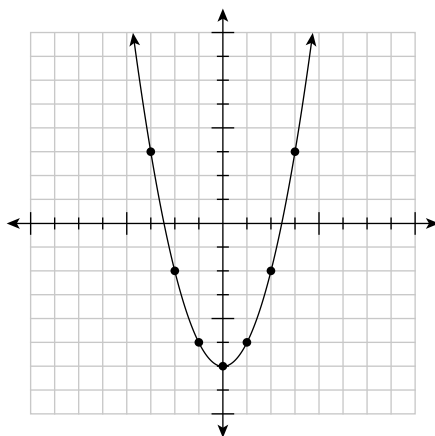
14.

In (x)	-3	-2	-1	0	1	2	3
Out (y)	5	4	3	2	1	0	-1



15.

In (x)	-3	-2	-1	0	1	2	3
Out (y)	3	-2	-5	-6	-5	-2	3



Distributive Property

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Overview

The Distributive Property shows how to express sums and products in two ways: $a(b + c) = ab + ac$. This can also be written $(b + c)a = ab + ac$.

Factored form

$$a(b + c)$$

Distributed form

$$a(b) + a(c)$$

Simplified form

$$ab + ac$$

To rewrite: Multiply each term on the inside of the parentheses by the term on the outside. Combine terms if possible.

For additional information, see the Methods & Meanings box in Lesson 3.2.5 of *Core Connections Course 3*.

Examples

$$\begin{aligned} 1. \quad & 2(47) \\ & = 2(40 + 7) \\ & = (2 \cdot 40) + (2 \cdot 7) \\ & = 80 + 14 + 94 \end{aligned}$$

$$\begin{aligned} 2. \quad & 3(x + 4) \\ & = (3 \cdot x) + (3 \cdot 4) \\ & = 3x + 12 \end{aligned}$$

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

Practice

$$1. \quad 6(9 + 4)$$

$$2. \quad 4(9 + 8)$$

$$3. \quad 7(8 + 6)$$

$$4. \quad 5(7 + 4)$$

$$5. \quad 3(27) = 3(20 + 7)$$

$$6. \quad 6(46) = 6(40 + 6)$$

$$7. \quad 8(43)$$

$$8. \quad 6(78)$$

$$9. \quad 3(x + 6)$$

$$10. \quad 5(x + 7)$$

$$11. \quad 8(x - 4)$$

$$12. \quad 6(x - 10)$$

$$13. \quad (8 + x)4$$

$$14. \quad (2 + x)5$$

$$15. \quad -7(x + 1)$$

$$16. \quad -4(y + 3)$$

$$17. \quad -3(y - 5)$$

$$18. \quad -5(b - 4)$$

$$19. \quad -(x + 6)$$

$$20. \quad -(x + 7)$$

$$21. \quad -(x - 4)$$

$$22. \quad -(-x - 3)$$

$$23. \quad x(x + 3)$$

$$24. \quad 4x(x + 2)$$

$$25. \quad -x(5x - 7)$$

$$26. \quad -x(2x - 6)$$

Answers

1. $(6 \cdot 9) + (6 \cdot 4) = 54 + 24 = 78$

2. $(4 \cdot 9) + (4 \cdot 8) = 36 + 32 = 68$

3. $56 + 42 = 98$

4. $35 + 20 = 55$

5. $60 + 21 = 81$

6. $240 + 36 = 276$

7. $320 + 24 = 344$

8. $420 + 48 = 468$

9. $3x + 18$

10. $5x + 35$

11. $8x - 32$

12. $6x - 60$

13. $4x + 32$

14. $5x + 10$

15. $-7x - 7$

16. $-4y - 12$

17. $-3y + 15$

18. $-5b + 20$

19. $-x - 6$

20. $-x - 7$

21. $-x + 4$

22. $x + 3$

23. $x^2 + 3x$

24. $4x^2 + 8x$

25. $-5x^2 + 7x$

26. $-2x^2 + 6x$