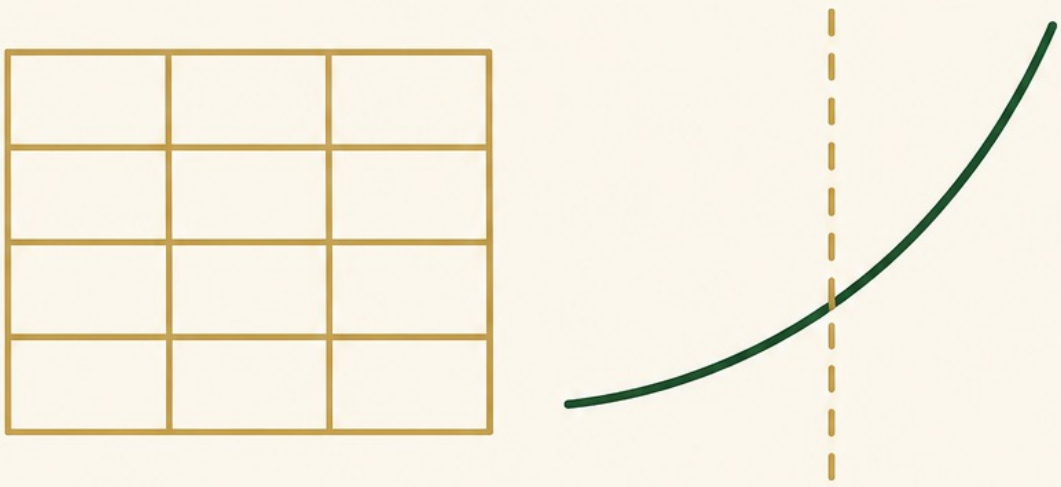
SCHOOL OF MATH

PRE-ALGEBRA · CLASS 19

Functions: Tables, Graphs, and the Vertical-Line Test



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Functions: Tables, Graphs, and the Vertical-Line Test

A function assigns exactly one output to each input. In this class you will read mapping diagrams, apply function rules, complete tables forward and backward, plot tables as points, read real-world graphs, and use the vertical-line test.

How to use this workbook

1. Study each teaching image, then answer the five practice questions on the facing page. Show your work in the blank space.
2. For tables and ordered pairs, check whether any input has two different outputs. For graphs, imagine a vertical line sliding across.
3. Plot points by reading *x* first (left or right), then *y* (down or up). Blank grids are provided where plotting is required.
4. Finish with the Homework review (R1–R8) and Homework word problems (W1–W12). Check every rule by substituting a value.

Contents

1. What is a function?
2. Inputs, outputs and function rules
3. Completing function tables
4. Identifying functions from tables
5. From tables to graphs
6. Reading function graphs
7. The vertical-line test
8. Mixed practice: function or not?
9. Homework review
10. Homework word problems

Worked answers for every question are available online at schoolofmath.us/posts/pre-algebra-class-19-functions-tables-graphs-vertical-line-test

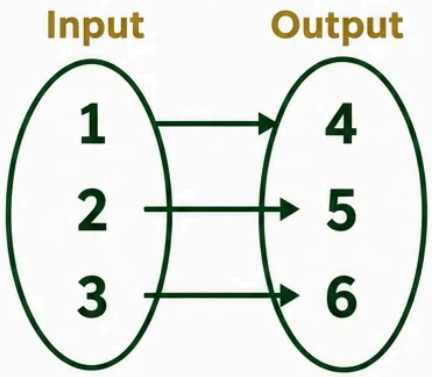
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CLASS 19 • PRE-ALGEBRA • ITEM 1

What Is a Function?

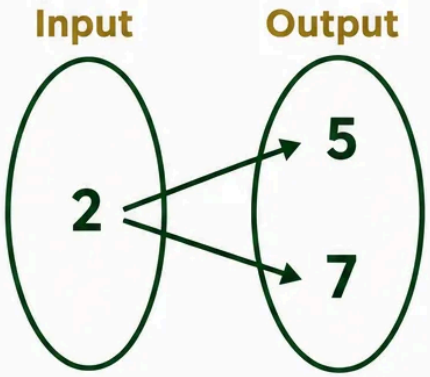
A function assigns exactly ONE output to each input.

FUNCTION



Each input has exactly one output.

NOT A FUNCTION



One input has two different outputs.

Different inputs may *share* the same output.

Example: (1, 4), (2, 4), (3, 4) | This **IS** a function.

Your turn: Is {(1, 3), (2, 5), (1, 7)} a function? Explain.

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Q1

Is the set of ordered pairs {(2, 9), (4, 11), (6, 13)} a function? Explain.

Q2

A mapping diagram sends 5 → 1, 6 → 2 and 5 → 8. Is it a function? Why or why not?

Q3

Is {(0, 7), (3, 7), (8, 7), (10, 7)} a function? Explain what is repeated and whether it matters.

Q4

Fill in the blank so the relation is *not* a function, then explain: {(3, 2), (7, 5), (__, 9)}.

Q5

A snack machine gives one snack for each button. Button A gives chips, Button B gives pretzels, Button C gives chips. Is “button → snack” a function? Would “snack → button” be a function?

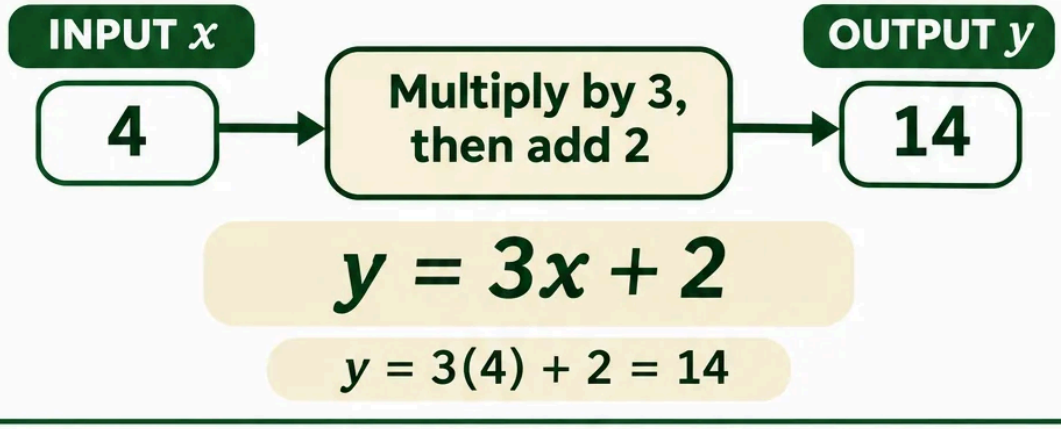
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CLASS 19 • PRE-ALGEBRA • ITEM 2

Inputs, Outputs & Function Rules

Input: the value you start with.

Output: the value the rule produces.



Same rule, different inputs

Input x	Output y
−1	−1
0	2
2	8
4	14

Apply the same rule to every input.

Find the rule

Inputs: 1, 2, 3

Outputs: 5, 6, 7

Rule: $y = x + 4$

Your turn: For $y = 2x - 3$, find the outputs when $x = 0$, 3, and 5.

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Q6

For the rule $y = 4x - 1$, find the outputs when $x = 0, 2$, and 5.

Q7

Write the rule “divide by 2, then add 5” as an equation. Then find the output when the input is 12.

Q8

Inputs 2, 3, 4 produce outputs 10, 15, 20. Find the rule and write it as an equation.

Q9

Inputs 0, 1, 2, 3 produce outputs 6, 5, 4, 3. Find the rule.

Q10

For $y = 2x + 7$, which input gives the output 25?

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CLASS 19 • PRE-ALGEBRA • ITEM 3

Completing Function Tables

Use the rule to find each missing value.

Rule: $y = 2x + 3$

Input x	Output y
−2	−1
−1	1
0	3
1	5
2	7

1. Substitute the input for x.
2. Multiply by 2.
3. Add 3.

When $x = -2$: $y = 2(-2) + 3 = -1$

Missing input? Work backward.

If $y = 11$, what is x?

$$11 = 2x + 3$$
$$8 = 2x$$
$$x = 4$$

Check: $2(4) + 3 = 11$

Your turn: Complete the table.

Rule: $y = 3x - 2$

Input x	Output y
−1	_____
0	_____
2	_____
_____	13

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Q11

Complete the table for $y = 3x - 4$ with inputs $x = -2, 0, 1, 3$.

Q12

For the rule $y = 5x + 2$, the output is 27. Find the missing input.

Q13

Complete the table for $y = -2x + 6$. One row has a missing input.

Input x	Output y
−1	___
2	___
4	___
___	−4

Q14

Complete the table for $y = \frac{x}{4} + 1$ with inputs $x = 0, 4, 12$, then find the input that gives $y = 9$.

Q15

A table for $y = 6x - 5$ shows the pair (3, 12). Is the table correct? If not, fix the output.

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CLASS 19 • PRE-ALGEBRA • ITEM 4

Identifying Functions from Tables

Check the inputs: does any input have two different outputs?

FUNCTION

Input x	Output y
1	4
2	4
3	6

Each input has exactly one output.

Repeated outputs are allowed.

NOT A FUNCTION

Input x	Output y
1	4
2	5
1	7

Input 1 has two different outputs: 4 and 7.

How to check

1. Look for repeated inputs.
2. Compare their outputs.
3. Different outputs for the same input? Not a function.

An identical repeated pair does not break the rule.

(2, 5), (2, 5), (3, 6) → Function

Your turn: Function or not? Explain.

A

x	y
−1	3
0	3
1	3

B

x	y
2	1
3	4
2	6

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Q16

Function or not? Explain.

Input x	Output y
2	9
4	9
6	9
8	9

Q17

Function or not? Explain.

Input x	Output y
3	1
5	4
3	8
7	2

Q18

Function or not? Explain.

Input x	Output y
−4	6
−2	6
−4	6
0	10

Q19

Each row shows (student, locker number). Is “student → locker” a function? Is “locker → student” a function?

Student	Locker
Ana	104
Ben	117
Cal	104
Dee	120

Q20

Change one output so this table becomes a function, and explain why your change works.

Input x	Output y
1	5
2	8
1	11
4	8

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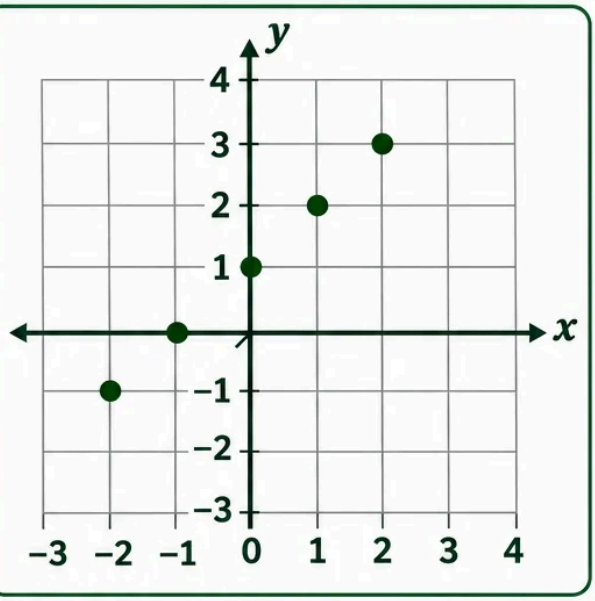
From Tables to Graphs

Each row gives an ordered pair: (x, y).

Rule: $y = x + 1$

x	y
−2	−1
−1	0
0	1
1	2
2	3

$(-2, -1), (-1, 0), (0, 1), (1, 2), (2, 3)$



Steps

1. Read x first, then y.
2. Move horizontally to x.
3. Move vertically to y and plot.

Plot only the listed points unless the problem asks for more.

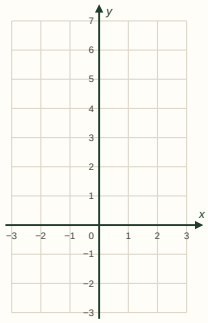
Your turn

For $y = 2x$, use $x = -1, 0, 1, 2$.

Make a table, write the ordered pairs, and plot the points.

Q21

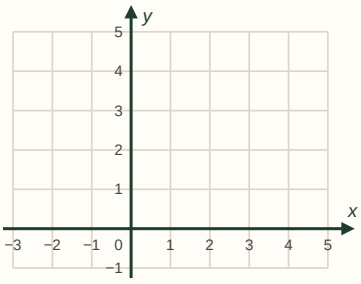
For $y = 3x$, make a table using $x = -1, 0, 1, 2$, write the ordered pairs, and plot the points.



Q22

Write the ordered pairs from this table, then plot them.

Input x	Output y
−2	4
0	3
2	2
4	1

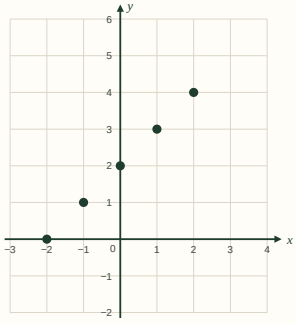


Q23

A student plotted the pair (3, −2) by moving 3 units down and 2 units left. What went wrong, and where should the point be?

Q24

Use the graph to write the table of values and the rule that produced it.



Q25

For $y = 2x - 1$, a classmate plotted only (0, −1) and (2, 3) and says the table is finished. The table asked for $x = 0, 1, 2, 3$. Complete the table and list the missing points.

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CLASS 19 • PRE-ALGEBRA • ITEM 6

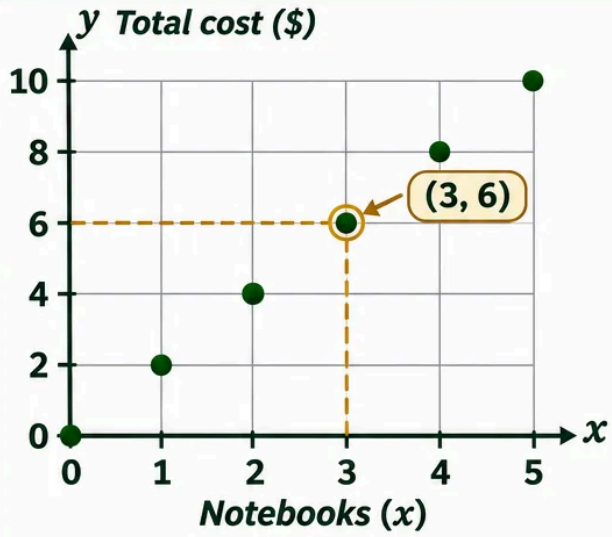
Reading Function Graphs

Start with the input on the x-axis. Read the output on the y-axis.

Buying notebooks

Each notebook costs $2.





Steps

1. Find $x = 3$ on the horizontal axis.
2. Move up to the plotted point.
3. Read $y = 6$ on the vertical axis.

Interpretation | The point (3, 6) means 3 notebooks cost $6.

An ordered pair gives both the input and the output.

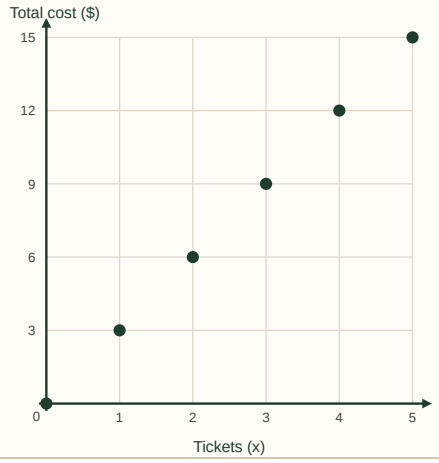
Your turn: Use the graph

1. What is the cost of 4 notebooks? _____
2. How many notebooks can you buy for $10? _____
3. What does the point (2, 4) mean? _____

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Q26

Use the raffle-ticket graph. What is the total cost of 4 tickets?



Q27

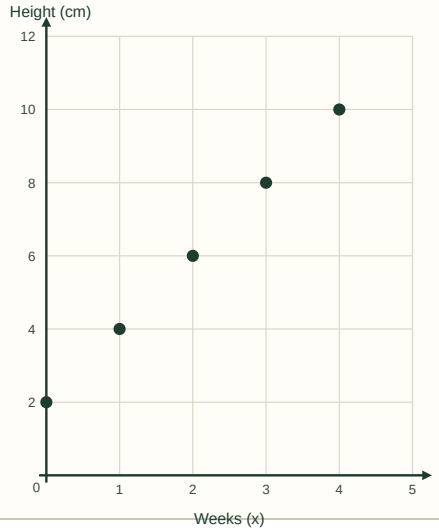
Use the raffle-ticket graph above. How many tickets can you buy with \$9? What rule connects tickets x and cost y?

Q28

Use the raffle-ticket graph above. What does the point (5, 15) mean? Is total cost a function of the number of tickets? Explain.

Q29

Use the plant graph. How tall was the plant at week 3, and how tall was it when it was first measured?



Q30

Use the plant graph above. In which week was the plant 6 cm tall? How much did it grow each week, and what rule gives the height y after x weeks?

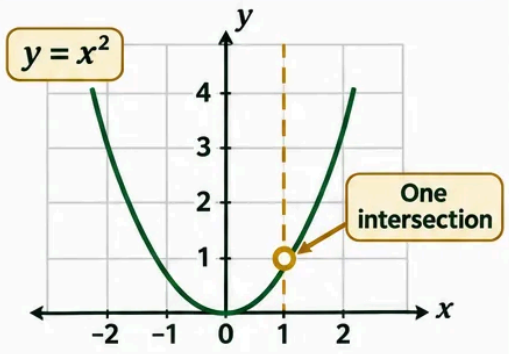
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CLASS 19 • PRE-ALGEBRA • ITEM 7

The Vertical-Line Test

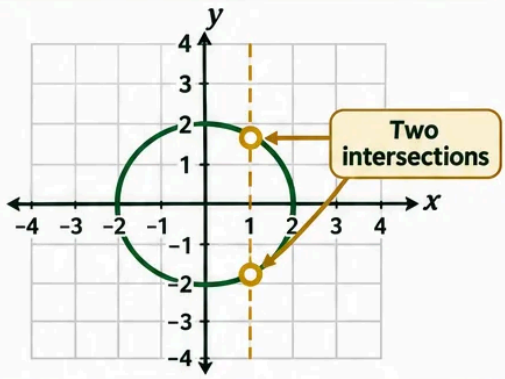
A graph represents y as a function of x if every vertical line meets it at most once.

PASSES: FUNCTION



Each x has only one y.

FAILS: NOT A FUNCTION



The same x has two different y-values.

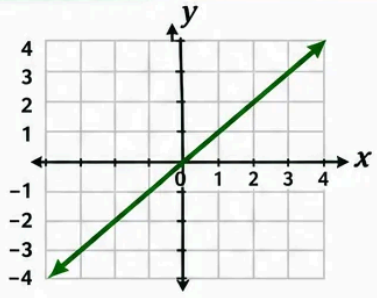
How to test

1. Imagine sliding a vertical line across the graph.
2. Count the intersections at each position.
3. If any vertical line meets it twice or more, it fails.

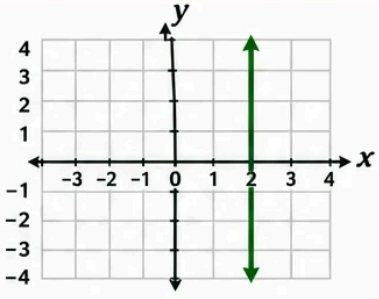
Vertical lines test inputs. Horizontal lines do not test whether y is a function of x.

Your turn: Pass or fail?

A



B

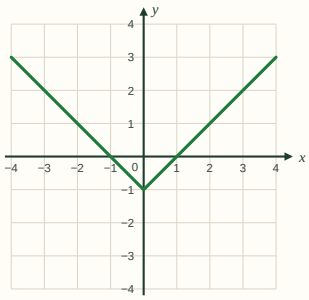


Explain your choices using vertical lines.

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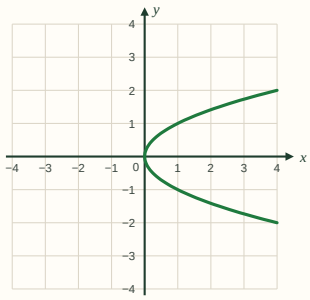
Q31

Pass or fail? Explain using vertical lines.



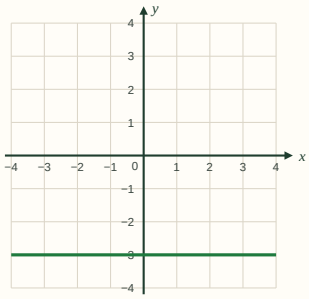
Q32

Pass or fail? Explain using vertical lines.



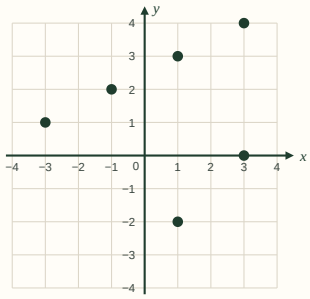
Q33

Pass or fail? Explain using vertical lines.



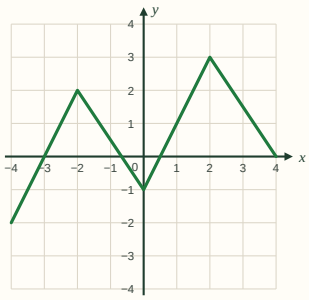
Q34

Pass or fail? Explain using vertical lines.



Q35

Pass or fail? Explain using vertical lines. Then explain why a horizontal line crossing it several times does not matter.



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CLASS 19 • PRE-ALGEBRA • ITEM 8

Mixed Practice: Function or Not?

Decide whether each relation is a function. Explain why.

A. Table

x	y
−2	5
0	5
2	5

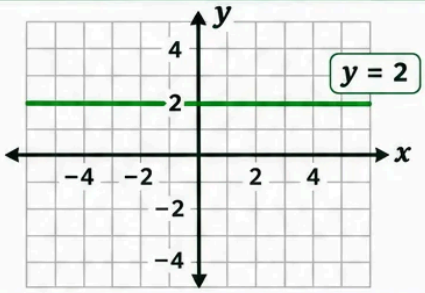
Function? _____
Reason: _____

B. Ordered pairs

(1, 2), (3, 4), (1, 6)

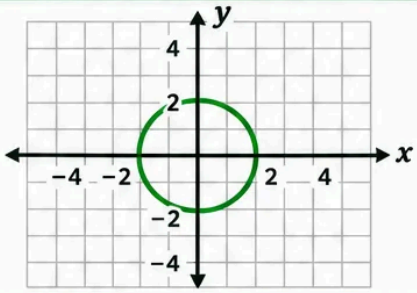
Function? _____
Reason: _____

C. Graph



Function? _____
Reason: _____

D. Graph



Function? _____
Reason: _____

Tables and pairs: check repeated inputs. | ***Graphs:*** use vertical lines.

Challenge: Change one value

Change one output so this relation becomes a function:

(2, 3), (4, 5), (2, 7)

My change: _____

A function gives each input exactly one output.

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Q36

Table. Function or not? Explain.

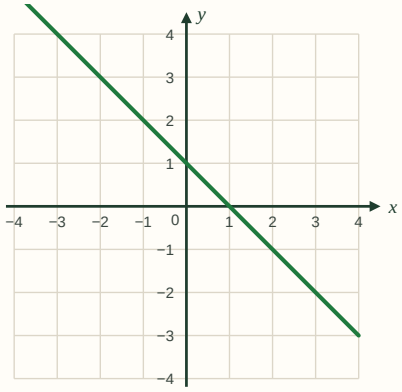
Input x	Output y
3	1
5	1
7	1
9	1

Q37

Ordered pairs. Function or not? Explain: (4, 2), (6, 3), (4, 8), (9, 3).

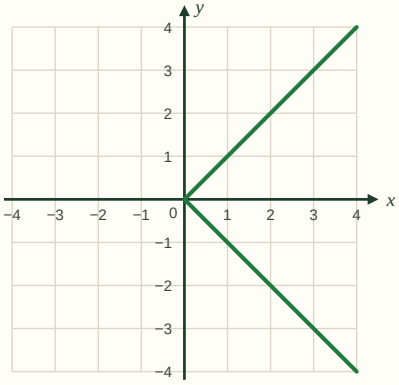
Q38

Graph. Function or not? Explain.



Q39

Graph. Function or not? Explain.



Q40

Challenge. Change one output so the relation becomes a function: (3, 1), (5, 2), (3, 6). Then describe a different single change that would also work.

R1

Is {(0, 2), (1, 2), (2, 2), (3, 2)} a function? Then decide whether a mapping diagram sending 5 → 1 and 5 → 3 is a function.

R2

For $y = 6x - 5$, find the outputs for $x = 1, 3, 10$. Then write the rule in words.

R3

Complete the table for $y = 5x + 1$, including the missing input.

Input x	Output y
−2	___
0	___
3	___
___	26

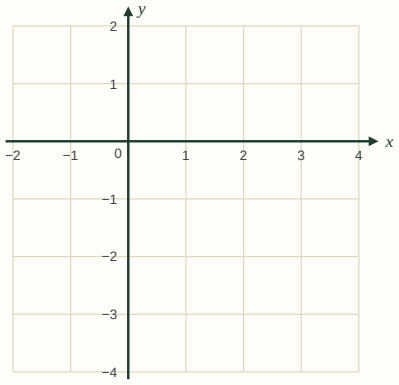
R4

Function or not? Explain.

Input x	Output y
2	7
4	7
6	9
2	11

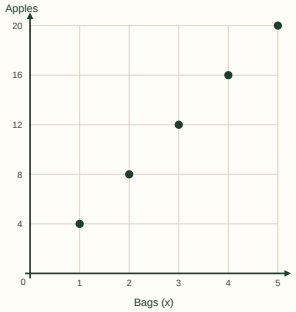
R5

For $y = x - 2$, make a table with $x = -1, 0, 1, 2, 3$, write the ordered pairs, and plot the points.



R6

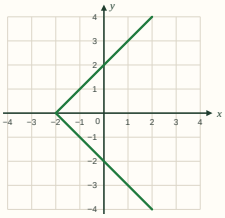
Use the graph. How many apples are in 3 bags? How many bags hold 20 apples? What does the point (4, 16) mean?



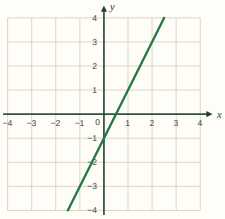
R7

Pass or fail? Decide for each graph and explain using vertical lines.

A



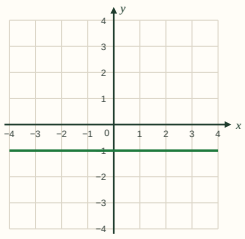
B



R8

Decide whether each relation is a function and explain: (a) the table below; (b) the pairs (−1, 0), (0, 0), (−1, 4); (c) the graph below.

Input x	Output y
1	5
2	6
3	7



W1

A taxi charges a $3 pickup fee plus $2 per mile. Write a rule for the total cost y of a ride of x miles, then find the cost of a 6-mile ride.

W2

Priya earns $12 per hour. Write the rule for her earnings y after x hours and complete a table for 3, 5 and 8 hours.

W3

Maya is 3 years older than her brother. Let x be the brother's age and y Maya's age. Write the rule, complete the table for brother ages 5, 8 and 12, and find the brother's age when Maya is 20.

W4

A gym charges a $20 joining fee plus $15 per month. Write the rule for the total cost y after x months. Find the cost of 6 months, and find how many months cost $125 in total.

W5

In a school, each student is assigned exactly one homeroom teacher, and each teacher has about 25 students. Is “student → homeroom teacher” a function? Is “homeroom teacher → student” a function? Explain.

W6

A florist's price list shows the cost of a bouquet by the number of roses: 6 roses cost $18, 12 roses cost $36, and 6 roses cost $21 on holidays. Is “number of roses → price” a function? Explain, and tell what extra information would make it one.

W7

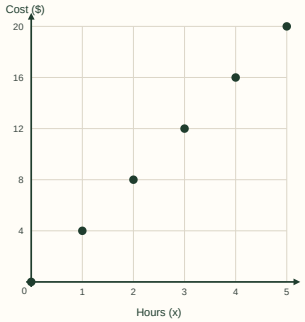
A weather station records the temperature every three hours.

Time (hour)	Temperature (°F)
6	50
9	58
12	66
15	70
18	66

Is temperature a function of time? At what times was it 66 °F? Is time a function of temperature?

W8

A bike shop charges $4 per hour. Use the graph to find the cost of 3 hours, the number of hours $20 buys, and the rule connecting hours and cost.

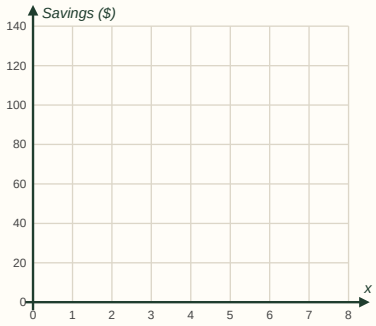


W9

The perimeter of a square is four times its side length. Write the rule for perimeter P in terms of side s, complete a table for $s = 2, 5, 9$, and find the side of a square whose perimeter is 48.

W10

Jordan has $40 saved and adds $10 each week. Write the rule for savings y after x weeks, make a table for weeks 0 to 4, plot the points, and find how many weeks it takes to reach $120.



W11

A class survey records height and the number of students with that height: 60 in → 3 students, 62 in → 5 students, 64 in → 3 students. Is “height → number of students” a function? Is “number of students → height” a function? Explain in context.

W12

Challenge. A drone's altitude is recorded every two seconds and graphed. Is altitude a function of time? Is time a function of altitude? Explain both answers using the graph.

