

# Relations and Functions

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 26

## Quick Review

A **relation** is just any set of ordered pairs  $(x, y)$ . A **function** is a special kind of relation where every input goes to *exactly one* output — no input can give two different answers. **Vertical Line Test** on a graph: if any vertical line crosses the graph more than once, it fails the function test (because that one  $x$  would have two  $y$ -values). The **domain** is the set of all input ( $x$ ) values; the **range** is the set of all output ( $y$ ) values. Functions can be shown as ordered pairs, tables, mapping diagrams, graphs, or equations like  $y = 2x + 1$ .

## PRACTICE

State whether each relation is a function. Give domain/range when asked.

- |                                                        |       |                                             |       |
|--------------------------------------------------------|-------|---------------------------------------------|-------|
| 1. $\{(1, 3), (2, 5), (3, 7)\}$                        | _____ | 11. Domain of $\{(-2, 4), (0, 0), (2, 4)\}$ | _____ |
| 2. $\{(4, 1), (4, 2), (5, 3)\}$                        | _____ | 12. $\{(3, 9), (5, 9), (3, 8)\}$            | _____ |
| 3. $\{(-1, 6), (0, 6), (1, 6)\}$                       | _____ | 13. $\{(1, 1), (2, 4), (3, 9), (4, 16)\}$   | _____ |
| 4. Domain of $\{(2, 3), (3, 4), (4, 5), (5, 6)\}$      | _____ | 14. Range of $\{(1, 5), (2, 10), (3, 15)\}$ | _____ |
| 5. $\{(0, 0), (1, 1), (1, -1)\}$                       | _____ | 15. $y = 2x + 3$                            | _____ |
| 6. Range of $\{(7, 2), (8, 4), (9, 6)\}$               | _____ | 16. $\{(a, 1), (b, 1), (c, 1), (d, 1)\}$    | _____ |
| 7. Table $x : 1, 2, 3, 4; y : 5, 5, 5, 5$              | _____ | 17. $\{(0, 1), (0, 2), (0, 3)\}$            | _____ |
| 8. $a \rightarrow 1, b \rightarrow 2, c \rightarrow 1$ | _____ | 18. Horizontal line $y = 4$                 | _____ |
| 9. Graph passes vertical line test                     | _____ | 19. Vertical line $x = 2$                   | _____ |
| 10. Vertical line crosses graph in 3 points            | _____ | 20. $y = x^2$                               | _____ |

## VISUAL PRACTICE

Use the graph, table, chart, or diagram to answer the question.

21. Does the mapping represent a function?

```

    2 ↘ 3
      ↘ 5
    4 ↘ 7
    
```

Answer: \_\_\_\_\_

22. Does the mapping represent a function?

```

    1 → 4
    2 ↘ 5
    3 ↘ 5
    
```

Answer: \_\_\_\_\_

## Word Problems

23. A vending machine assigns each button (A1, A2, A3, B1) to a snack: A1 → chips, A2 → pretzels, A3 → chips, B1 → cookies. Is this a function? List the domain and range. \_\_\_\_\_
24. A teacher records test scores: Ana → 88, Ben → 92, Carla → 88, Dana → 95, Eli → 100. Is this a function? \_\_\_\_\_
25. A weather station records daily high temperatures in a table: Monday → 75°, Tuesday → 80°, and Monday → 78°. Explain whether this relation is a function of the day. \_\_\_\_\_
26. A pizza shop has a menu: small → \$8, medium → \$12, large → \$16. The size determines the price. Is price a function of size? Is size a function of price? \_\_\_\_\_



## Answer Keys

- |                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>1. function</p> <p>2. not a function</p> <p>3. function</p> <p>4. {2, 3, 4, 5}</p> <p>5. not a function</p> <p>6. {2, 4, 6}</p> <p>7. function</p> <p>8. function</p> <p>9. function</p> <p>10. not a function</p> <p>11. {-2, 0, 2}</p> <p>12. not a function</p> <p>13. function</p> | <p>14. {5, 10, 15}</p> <p>15. function</p> <p>16. function</p> <p>17. not a function</p> <p>18. function</p> <p>19. not a function</p> <p>20. function</p> <p>21. no</p> <p>22. yes</p> <p>23. Yes, function</p> <p>24. Yes, function</p> <p>25. No, not a function</p> <p>26. Both yes</p> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Step-by-Step Tutor Notes

1. Use the clue in the question first, then let the arithmetic finish the job. Each input appears once. Yes, function. So the answer is function.
2. This is a good place to slow down, check the notation, and simplify cleanly.  $x = 4$  maps to both 1 and 2. Same input, different outputs — not a function. So the answer is not a function.
3. All three inputs are different. The outputs being the same (6 every time) is fine — only repeating *inputs* break a function.
4. Use the clue in the question first, then let the arithmetic finish the job. Domain is the set of  $x$ -values, listed once each. So the answer is {2, 3, 4, 5}.
5.  $x = 1$  goes to both 1 and  $-1$ . Two outputs for one input — not a function.
6. Take it one clear step at a time and keep the original question in mind. Range is the set of  $y$ -values. So the answer is {2, 4, 6}.
7. Take it one clear step at a time and keep the original question in mind. Each  $x$  appears once. Outputs all being 5 is allowed — it's a constant function. So the answer is function.
8. Three different inputs, each going to one output. Two inputs sharing the same output ( $a$  and  $c$  both to 1) is fine.
9. Use the clue in the question first, then let the arithmetic finish the job. Vertical line test passing means every  $x$  has one  $y$ . That's the function definition. So the answer is function.
10. Three crossings means that one  $x$ -value has three different  $y$ -values. Definitely not a function.
11. Start with the definition the problem is testing, then apply it directly. List the  $x$ -values. (The repeating  $y = 4$  is fine.) So the answer is {-2, 0, 2}.
12. Take it one clear step at a time and keep the original question in mind.  $x = 3$  has two outputs: 9 and 8. Not a function. So the answer is not a function.
13. These are the squares:  $1^2, 2^2, 3^2, 4^2$ . Each input gives exactly one output. Function.
14. Start with the definition the problem is testing, then apply it directly. Range = outputs =  $y$ -values. So the answer is {5, 10, 15}.
15. Every linear equation  $y = mx + b$  is a function — one  $x$  gives one  $y$  via the rule.
16. Four different inputs, each giving the same output of 1. That's allowed — just one output per input.
17. Start with the definition the problem is testing, then apply it directly.  $x = 0$  goes to three different  $y$ -values. Same input shouldn't have multiple outputs. So the answer is not a function.
18. Focus on the main idea of the problem, then simplify carefully. For every  $x$ ,  $y = 4$ . One output per input. Function (a constant function). So the answer is function.
19. For  $x = 2$ ,  $y$  can be any value — infinitely many outputs for one input. Not a function.
20. Each  $x$  squared gives exactly one  $y$ . Function. (Note: different  $x$ -values can give the same  $y$ , like  $2^2 = 4$  and  $(-2)^2 = 4$  — that's allowed.)
21. The input 2 has two outputs, 3 and 5, so this relation is not a function.
22. Use the labels on the display first; they tell you which count or total belongs in the answer. Each input has exactly one arrow going out, so it is a function. This gives yes.
23. Each button (input) produces exactly one snack (output). Domain = {A1, A2, A3, B1}, Range = {chips, pretzels, cookies}. A1 and A3 both giving chips is fine — same output for different inputs is allowed in a function.
24. Each student has exactly one score. Domain = {Ana, Ben, Carla, Dana, Eli}. Range = {88, 92, 95, 100}. Ana and Carla sharing the score 88 is fine.
25. Monday appears twice with two different temperatures ( $75^\circ$  and  $78^\circ$ ). That violates the function rule — one input must give exactly one output. (This usually means the data has an error or needs a time-of-day label.)
26. Each size maps to exactly one price (function). Each price maps to exactly one size (also a function, since prices are all different). Both directions work here.



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