

## Input-Output Tables

An input-output table is a little machine: it takes an input number, applies a rule, and gives an output. The rule is always the same operation, applied to every input.

Input	Rule	Output
4	+ 3	7
6	+ 3	9
8	+ 3	11

### Key Concepts

1. Each **input** runs through the rule to become an **output**.
2. The rule is the *same* for every row of the table.
3. To find a missing *output*: apply the rule to the input.
4. To find a missing *input*: *undo* the rule on the output. ( $+n$  undoes to  $-n$ ,  $\times n$  undoes to  $\div n$ , and so on.)

### Worked Examples

① Rule: add 9. Input = 6. What is the output?

 Just apply the rule:  $6 + 9 = 15$ . The output is 15.

 **Answer:** 15

② Input: 4, 6, 8. Output: 12, 18, 24. What is the rule?

 Compare each input to its output.  $4 \rightarrow 12$ ,  $6 \rightarrow 18$ ,  $8 \rightarrow 24$ . The output is always 3 times the input ( $4 \times 3 = 12$ ,  $6 \times 3 = 18$ ,  $8 \times 3 = 24$ ). So the rule is “multiply by 3.”

 **Answer:** *Multiply by 3*

③ Rule: subtract 5. Output = 20. What was the input?

 To find the input from the output, undo the rule. “Subtract 5” is undone by “add 5.” So input =  $20 + 5 = 25$ . Check:  $25 - 5 = 20$  ✓.

 **Answer:** 25

### Practice Problems

Find the missing input, output, or rule.

1. Rule: + 6. In = 7, Out = ? \_\_\_\_\_

5. Rule:  $\times 3$ . In = ?, Out = 27 \_\_\_\_\_

2. Rule:  $\times 5$ . In = 4, Out = ? \_\_\_\_\_

6. Rule: - 15. In = ?, Out = 35 \_\_\_\_\_

3. Rule: - 8. In = 30, Out = ? \_\_\_\_\_

7. In: 2, 4, 6      Out: 10, 20, 30      Rule?

4. Rule: + 12. In = ?, Out = 25 \_\_\_\_\_

8. In: 5, 8, 11      Out: 1, 4, 7      Rule? \_\_\_\_\_
9. In: 3, 5, 7      Out: 9, 15, 21      Rule? \_\_\_\_\_
10. Rule:  $+9$ . In = 16, Out = ? \_\_\_\_\_
11. Rule:  $\times 4$ . In = ?, Out = 32 \_\_\_\_\_
12. In: 10, 20, 30      Out: 5, 10, 15      Rule? \_\_\_\_\_

### Study Tips

-  To **find the rule**, try the same operation on the first input/output pair, then verify it works on every other row.
-  Forward:  $\text{input} + \text{rule} = \text{output}$ . Backward:  $\text{output} - \text{rule} = \text{input}$ . (Use the inverse operation when going backward.)
-  Multiplication and division rules usually make the output grow or shrink fast. Addition and subtraction grow or shrink steadily.

### Word Problems

1. A vending machine gives 3 stickers for every token. Complete the table: Tokens: 2, 4, 7. Stickers: ?, ?, ?.

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

2. The rule is “subtract 4.” If the output is 16, what was the input? If the input is 25, what is the output?

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

**Answer Key — with Friendly Explanations****Practice Problems**

1.  $7 + 6 = 13$ .

 **Answer:** 13

2.  $4 \times 5 = 20$ .

 **Answer:** 20

3.  $30 - 8 = 22$ .

 **Answer:** 22

4. Undo:  $25 - 12 = 13$ .

 **Answer:** 13

5. Undo:  $27 \div 3 = 9$ .

 **Answer:** 9

6. Undo:  $35 + 15 = 50$ .

 **Answer:** 507. Each output is  $5 \times$  input. **Answer:** *Multiply by 5*8. Each output is input  $-4$ . **Answer:** *Subtract 4*9. Each output is  $3 \times$  input. **Answer:** *Multiply by 3*

10.  $16 + 9 = 25$ .

 **Answer:** 25

11. Undo:  $32 \div 4 = 8$ .

 **Answer:** 812. Each output is input  $\div 2$ . **Answer:** *Divide by 2***Word Problems**1. Rule  $\times 3$ : 6, 12, 21. **Answer:** 6, 12, 21 *stickers*

2. Input = 20 (undo); Output = 21 (apply).

 **Answer:** *Input = 20; Output = 21*

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