

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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