Function Machines and Inverse Operations

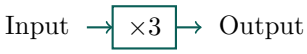
GCSE Mathematics • **Foundation Tier** • Grades 1–3 • Non-calculator

WORKED SOLUTIONS

Name: worked example Class: _____ Total: 54 / 54

Show all your working. Marks are given for correct method as well as the final answer.

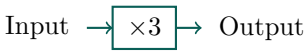
1. Work out the output when the input is 6. **[1 mark]**



$6 \times 3 = 18$

Answer: 18

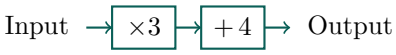
2. Work out the input when the output is 21. **[2 marks]**



work BACKWARDS with the inverse
the inverse of $\times 3$ is $\div 3$
$21 \div 3 = 7$

Answer: 7

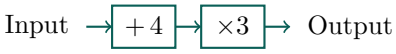
3. Work out the output when the input is 5. **[2 marks]**



$5 \times 3 = 15$
$15 + 4 = 19$

Answer: 19

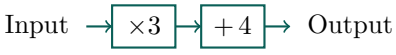
4. Work out the output when the input is 5. **[2 marks]**



$5 + 4 = 9$
$9 \times 3 = 27$
same numbers, different order, different answer

Answer: 27

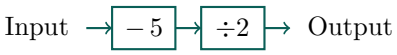
5. Work out the input when the output is 31. **[3 marks]**



go backwards, inverting each box
$31 - 4 = 27$
$27 \div 3 = 9$

Answer: 9

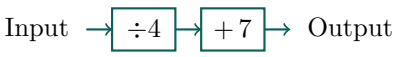
6. Work out the input when the output is 8. **[3 marks]**



backwards: × 2 then +5
8 × 2 = 16
16 + 5 = 21

Answer: 21

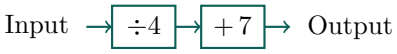
7. Work out the output when the input is 20. **[2 marks]**



20 ÷ 4 = 5
5 + 7 = 12

Answer: 12

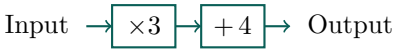
8. Work out the input when the output is 10. **[3 marks]**



10 − 7 = 3
3 × 4 = 12

Answer: 12

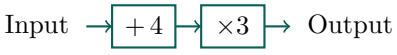
9. Write down an expression for the output when the input is x. **[2 marks]**



x × 3 = 3x
3x + 4

Answer: 3x + 4

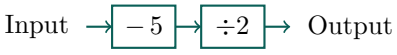
10. Write down an expression for the output when the input is x. **[2 marks]**



x + 4
then × 3, so BRACKET it
3x + 4 would be the other machine

Answer: 3(x + 4)

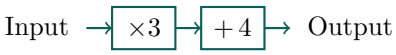
11. Write down an expression for the output when the input is n. **[2 marks]**



n − 5
then ÷ 2 → $\frac{n-5}{2}$

Answer: $\frac{n-5}{2}$

12. Write down the inverse operations, in order, for this machine. **[2 marks]**



undo the LAST box first
last in, first out

Answer: −4 then ÷3

13. Use a function machine to solve $4x + 7 = 31$. **[3 marks]**

machine: × 4 then +7
backwards: 31 − 7 = 24
24 ÷ 4 = 6

Answer: x = 6

14. Use a function machine to solve $\frac{x}{3} - 2 = 5$. **[3 marks]**

machine: ÷3 then −2
backwards: 5 + 2 = 7
7 × 3 = 21

Answer: x = 21

15. Use a function machine to solve $2(x - 3) = 14$. **[3 marks]**

machine: −3 then × 2
backwards: 14 ÷ 2 = 7
7 + 3 = 10

Answer: x = 10

16. A machine doubles a number then subtracts 9. The output is 13. Work out the input. **[3 marks]**

13 + 9 = 22
22 ÷ 2 = 11

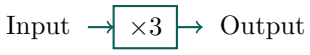
Answer: 11

17. A machine has a single box ×5. Explain why the output is always a multiple of 5 for whole-number inputs. **[2 marks]**

output = 5 × input
5 × any whole number is in the 5 times table

Answer: every output is 5 times a whole number

18. This machine is used twice: the output of the first is fed into a second identical machine.



(a) Work out the final output for an input of 4. **[2 marks]**

$4 \times 3 = 12$

$12 \times 3 = 36$

(b) Write an expression for the final output when the input is x. **[2 marks]**

$x \times 3 \times 3$

$= 9x$

Answer: 36 ; $9x$

19. A two-step machine turns 4 into 19 and 7 into 34.

(a) The first box is ×5. Work out the second box. **[3 marks]**

$4 \times 5 = 20$

20 goes to 19, so the second box is −1

check: $7 \times 5 = 35$, $35 - 1 = 34$ ✓

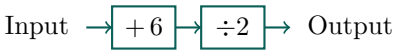
(b) Work out the output when the input is 10. **[2 marks]**

$10 \times 5 = 50$

$50 - 1 = 49$

Answer: −1 ; 49

20. A machine adds 6 then divides by 2.



(a) Write an expression for the output when the input is x. **[2 marks]**

$x + 6$

$\frac{x+6}{2}$

(b) Work out the input that gives an output equal to the input. **[3 marks]**

$\frac{x+6}{2} = x$

$x + 6 = 2x$

$6 = x$

so the input is 6

Answer: $\frac{x+6}{2}$; 6

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