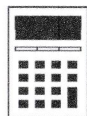


GCSE MATHEMATICS

Number Machines



AQA These questions have been taken or modified from previous AQA GCSE Mathematics Papers.

Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Answer **all** questions.
- You must answer the questions in the spaces provided.
- If your calculator does not have a π button, take the value of π to be 3.14 unless another value is given in the question.

Information

- The marks for questions are shown in brackets.
- The quality of your written communication is specifically assessed in questions that are indicated with an asterisk (*).

Advice

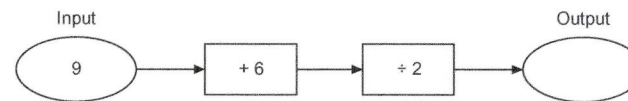
- Read each question carefully before you start to answer it.
- In all calculations, show clearly how you work out your answer.
- Use the number of marks for the question as a guide to the amount of time you need to spend.
- Look at previous parts of the question, e.g. a), b), c) i) as there may be information there you need to answer later parts.
- Check your answer is realistic and appropriate.
- For calculator decimal numbers always write your full calculator display in the working out area and then, if you need to, round the answer on the answer line.

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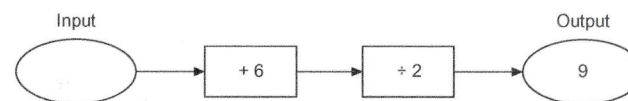
1 (a) Here is a number machine.



Work out the output when the input is 9.

Answer *7.5 or $\frac{15}{2}$* (1 mark)

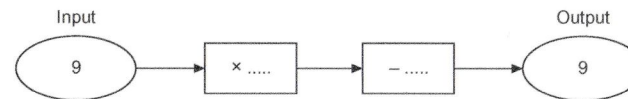
1 (b) Here is the same number machine.



Work out the input when the output is 9.

Answer *12* (1 mark)

1 (c) Here is a different number machine.



Complete possible operations for this number machine.

Some possibilities

.....

9 x 1 - 0 = 9

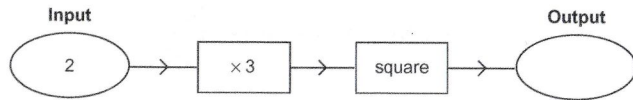
9 x 2 - 9 = 9

9 x 3 - 18 = 9

.....

..... (1 mark)

2 (a) Here is a number machine.



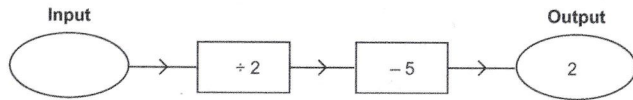
Work out the output when the input is 2

[1 mark]

Answer

36

2 (b) Here is another number machine.



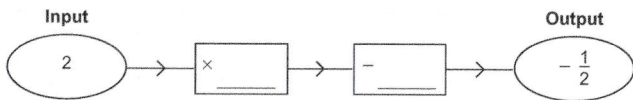
Work out the input when the output is 2

[2 marks]

Answer

14

2 (c) Here is another number machine.



Fill in possible values for the operations when the input is 2 and the output is $-\frac{1}{2}$

[1 mark]

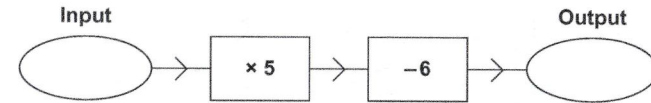
Examples

$$2 \times 1 - 2.5 = -\frac{1}{2}$$

$$2 \times 0 - \frac{1}{2} = -\frac{1}{2}$$

...

3 Here is a number machine.



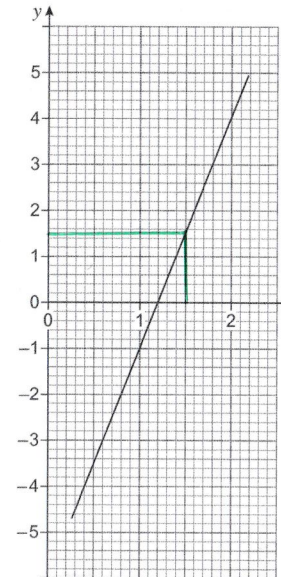
3 (a) What is the output when the input is -3?

Answer

-21

(1 mark)

3 (b) Here is a graph of $y = 5x - 6$



Find the input value for the number machine that gives the same output value. You **must** show clearly how you obtain your answer.

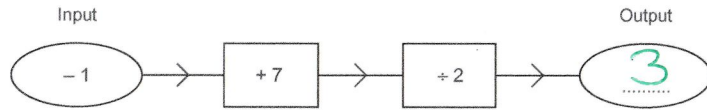
$$1.5 \times 5 - 6 = 1.5$$

Answer

1.5

(2 marks)

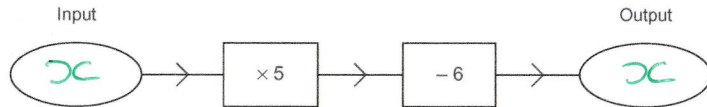
4 (a) Here is a number machine.



Calculate the output when the input is -1

(1 mark)

4 (b) Here is a different number machine.



The output is equal to the input.

Work out the input.

$$5x - 6 = x$$

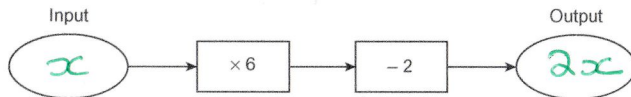
$$4x = 6$$

$$x = \frac{3}{2}$$

$$1.5$$

Answer (3 marks)

5 Here is a number machine.



The output is twice the input.

Work out the input.

$$(x \times 6) - 2 = 2x$$

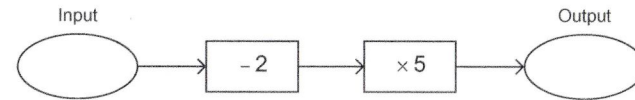
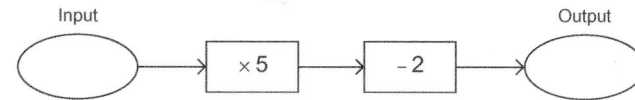
$$6x - 2 = 2x$$

$$4x = 2$$

$$x = 0.5 \text{ or } \frac{1}{2}$$

Answer (3 marks)

6 Here are two number machines.



When the inputs are equal,

show that the **difference** between the outputs is always 8

[3 marks]

First $x \times 5 - 2 = 5x - 2$

Second $(x - 2) \times 5 = 5x - 10$

Difference between -10 and -2. So whatever number your input is (x), the difference is always 8.

7 Here are three number machines.

7 (a) Fill in an algebraic expression for the output.

[1 mark]



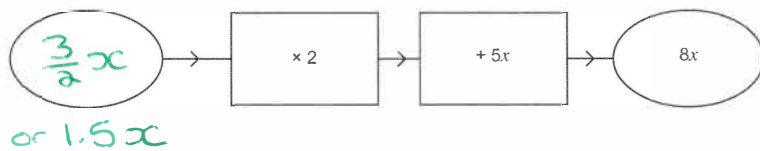
7 (b) Fill in an algebraic expression for the input.

[1 mark]

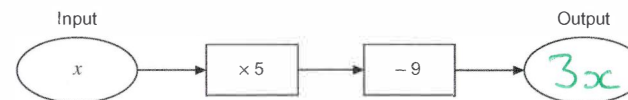


7 (c) Fill in an algebraic expression for the input.

[2 marks]



8 Here is a number machine.



The output is three times the input.

Work out the input x .

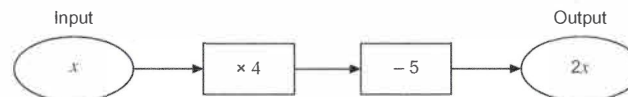
$$5x - 9 = 3x$$

$$2x = 9$$

$$x = 9/2 \text{ or } 4.5$$

$x = 9/2 \text{ or } 4.5$ (4 marks)

9 Here is a number machine.



Work out the value of x .

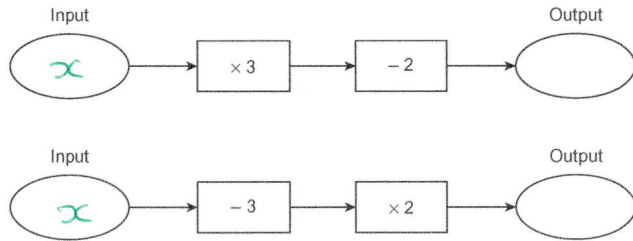
[3 marks]

$$4x - 5 = 2x$$

$$2x = 5 \quad x = 5/2 \text{ or } 2.5$$

$x = 5/2 \text{ or } 2.5$

10 Here are two number machines.



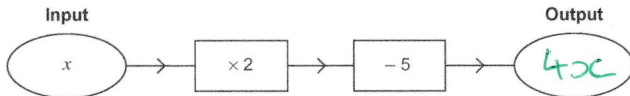
The same number is put into each machine.
The two outputs are equal.

What number is put in?

First $3x - 2$ $3x - 2 = 2x - 6$
 Second $2x - 6$ $x = -4$

Answer -4 (4 marks)

11 Here is a number machine.



The output is four times the input.

Use algebra to work out the value of x .
You **must** show your working.

[4 marks]

$2x - 5 = 4x$
 $-5 = 2x$
 $x = -5/2$ or -2.5
 $x = -5/2$ or -2.5

12 The two sets of instructions give identical outcomes.

Complete the tables to show this.

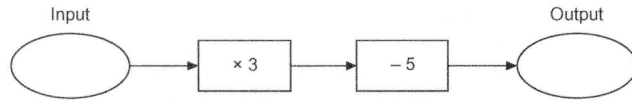
First set	
Instruction	Expression
Start with x	x
Double it	$2x$
Double again	$4x$
Add 6	$4x + 6$
Outcome	$4x + 6$

Second set	
Instruction	Expression
Start with x	x
Add 4	$x + 4$
Multiply by 4	$4x + 16$
Subtract 10	$4x + 6$
Outcome	$4x + 6$

(3 marks)

*13

Here is a number machine.



When the input is a the output is b .

When the input is $a + b$ the output is 64

Work out the values of a and b .
Do **not** use trial and improvement.
You **must** show your working.

[4 marks]

$$3a - 5 = b$$

$$3a + 3b - 5 = 64$$

$$3a + 3b = 69$$

$$- 3a - b = 5$$

$$4b = 64 \quad b = 16$$

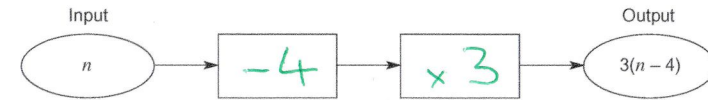
$$3a - 5 = 16$$

$$3a = 21 \quad a = 7$$

$a = 7 \quad b = 16$

14

Here is a number machine.



14 (a) Write an operation in each box to make the number machine work.

(2 marks)

14 (b) Work out the value of n when the input and output are equal.

$$n = 3(n - 4)$$

$$n = 3n - 12$$

$$2n = 12$$

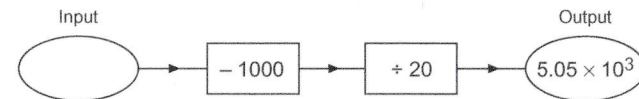
Answer $n = 6$ (2 marks)

15 (a) Work out $(6.45 \times 10^6) \times (2.5 \times 10^{-4})$

Write your answer in standard form.

$$\text{Answer } 1.6125 \times 10^3 \quad (2 \text{ marks})$$

15 (b) Here is a number machine.



Work out the **input** when the output is 5.05×10^3

Write your answer in standard form.

$$\text{Answer } 1.02 \times 10^5 \quad (3 \text{ marks})$$