

# Substitution/Solving/Rearranging Equations (H)

A collection of 9-1 Maths GCSE Sample and Specimen questions from AQA, OCR, Pearson-Edexcel and WJEC Eduqas.

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Total Marks:	

1. Given that  $a = 10$ ,  $b = 3$

and  $c = -5$ , find the value of each of the following expressions.

(a)  $b^2$

$$3^2 = 9$$

[1]

(b)  $\frac{ab}{c}$

$$\frac{10 \times 3}{-5} = \frac{30}{-5} = -6$$

[1]

(c)  $\frac{2bc}{a}$

$$\frac{2 \times 3 \times -5}{10} = \frac{-30}{10} = -3$$

[1]

2. Kelly is trying to work out the two values of  $w$  for which  $3w - w^3 = 2$

Her values are 1 and -1

Are her values correct?

You must show your working.

when  $w = 1$  LHS  $3 \times 1 - 1^3 = 3 - 1 = 2 \checkmark$

$$\text{LHS} = \text{RHS}$$

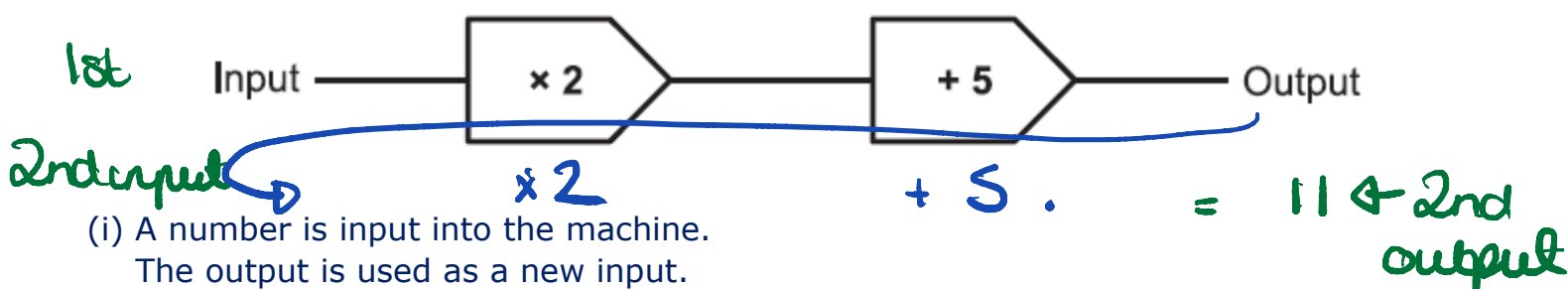
when  $w = -1$  LHS  $3 \times -1 - (-1)^3 = -3 + 1 = -2$

$$\text{LHS} \neq \text{RHS} \times$$

$\therefore$  only 1 of her values is correct

[2]

3. (a) A function is represented by the following function machine.



Work out the number that was the first input.

$$11 - 5 = 6 \quad 6 \div 2 = 3$$

$$3 - 5 = -2 \quad -2 \div 2 = -1$$

(a)(i)  $\dots -1 \dots$  [2]

(ii) A number is input into the machine.  
The output given is the same number.

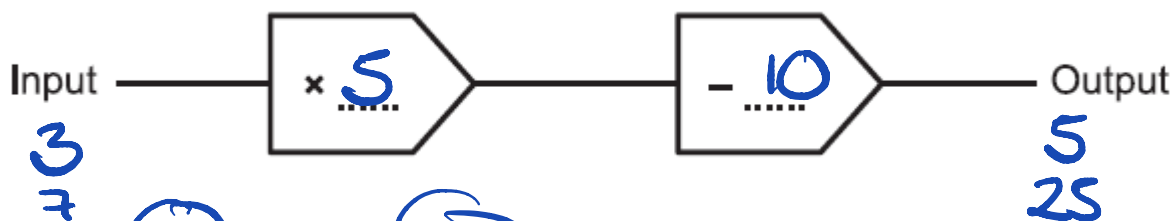
Work out the number.

$$x \rightarrow 2x + 5 \rightarrow x$$

$$2x + 5 = x$$

(ii)  $\dots x = -5 \dots$  [3]

(b) Another function machine is shown below.



If the Input is 3, the Output is 5.  
If the Input is 7, the Output is 25.

Use this information to fill in the two boxes.

difference of 4  $\rightarrow$  difference of 20

so must be a multiple of 5

[3]

4. Make  $a$  the subject of  $a + 3 = \frac{2a+7}{r}$

$$(a+3)r = 2a+7$$

$$ar + 3r = 2a+7$$

$$ar - 2a = 7 - 3r$$

$$a(r-2) = 7 - 3r$$

$$a = \frac{7-3r}{r-2}$$

[3]

5. Solve.

$$\frac{3x^2}{3} = \frac{75}{3}$$

$$x^2 = 25$$

$$x = \sqrt{25}$$

$$x = \dots 5 \text{ or } -5 \dots [2]$$

6. Show that  $k = \frac{4+3j}{5-j}$  can be rearranged to  $j = \frac{5k-4}{3+k}$

$$(5-j)k = 4+3j$$

$$5k - jk = 4+3j$$

$$5k - 4 = 3j + jk$$

$$j(3+k) = 5k-4$$

$$j = \frac{5k-4}{3+k} \text{ QED}$$

[4]

7. Solve.

$$4x - 7 = 8 - 2x + 2x$$

$$6x - 7 = 8$$

$$\frac{6x}{6} = \frac{15}{6}$$

$$x = \dots 2.5 \dots [3]$$

8. Rearrange this formula to make x the subject.

$$y = \sqrt{4x-3}$$

$$y^2 = 4x-3$$

$$y^2+3 = 4x$$

$$x = \frac{y^2+3}{4}$$

[3]

9. Make t the subject of the formula  $w = 3t + 11$

$$3t = w - 11$$

$$t = \frac{w-11}{3}$$

[2]

10. Steve is asked to solve the equation  $5(x + 2) = 47$

Here is his working.

$$\begin{aligned} 5(x + 2) &= 47 \\ 5x + 2 &= 47 \\ 5x &= 45 \\ x &= 94 \end{aligned}$$

$$\begin{aligned} 5x + 10 &= 47 \\ 5x &= 37 \end{aligned}$$

Steve's answer is wrong.

a) What mistake did he make?

he didn't expand the bracket correctly  $5 \times 2 = 10$  [1]

Liz is asked to solve the equation  $3x^2 + 8 = 83$

Here is her working.

$$\begin{aligned} 3x^2 + 8 &= 83 \\ 3x^2 &= 75 \\ x^2 &= 25 \\ x &= 5 \end{aligned}$$

$$\begin{aligned} 3x^2 + 8 &= 83 \\ -8 &-8 \\ 3x^2 &= 75 \\ \frac{3x^2}{3} &= \frac{75}{3} \\ x^2 &= 25 \\ x &= \sqrt{25} \\ &= \pm 5 \end{aligned}$$

b) Explain what is wrong with Liz's answer.

She hasn't included the negative solution

[1]

11. Make  $t$  the subject of the formula  $y = \frac{t^3}{3} - 2a$

$$3y = t^3 - 6a$$

$$3y + 6a = t^3$$

$$3(y + 2a)$$

$$t = \sqrt[3]{3(y + 2a)}$$

[2]

$$12. m = \sqrt{\frac{k^3 + 1}{4}}$$

Make  $k$  the subject of the formula.

$$m^2 = \frac{k^3 + 1}{4}$$

$$4m^2 = k^3 + 1$$

$$4m^2 - 1 = k^3$$

$$k = \sqrt[3]{4m^2 - 1}$$

$$k = \sqrt[3]{4m^2 - 1}$$

[3]

13. Rearrange  $y = \frac{4-3x}{x-5}$  to make  $x$  the subject

$$\begin{aligned} y(x-5) &= 4-3x \\ yx-5y &= 4-3x \\ yx+3x &= 4+5y \\ x(y+3) &= 4+5y \end{aligned}$$

$$x = \frac{4+5y}{y+3}$$

[4]

14. This formula works out the tax you pay.

$$T = 0.2(E - 10\,600)$$

T is the tax you pay in pounds.

E is the amount you earn in pounds.

Alison pays £5200 tax.

Work out the amount she earns.

$$5200 = 0.2(E - 10,600)$$

$$26000 = E - 10,600$$

$$E = 36,600$$

[3]

15. Solve  $x^2 = 30.25$

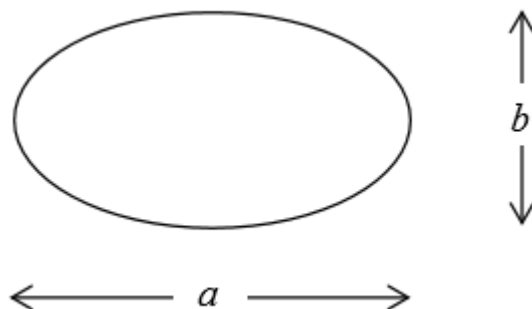
$$x = \sqrt{30.25}$$

$$x = 5.5 \text{ or } -5.5$$

[2]

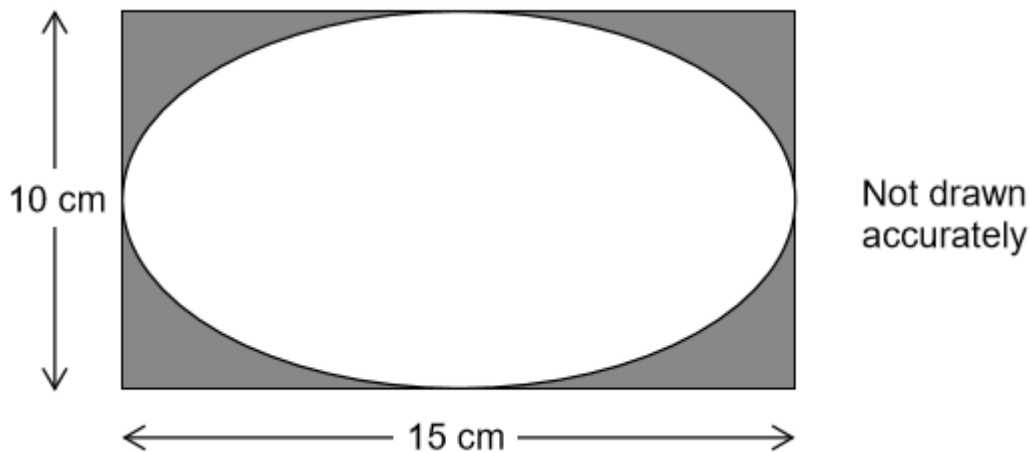
16. The area of an ellipse, width  $a$  and height  $b$ , is given by

$$\frac{\pi ab}{4}$$



A rectangular photograph measures 15 cm by 10 cm

It is put into a frame as shown.



The part of the photograph that can be seen is an ellipse.

Work out the percentage of the photograph that can be seen.

$$\frac{\text{Ellipse}}{\text{Rectangle}} \times 100 = \frac{0.25\pi \times 10 \times 15}{150} = 78.5\%$$

[3]

17. Rearrange  $c = \frac{4-d}{d+3}$  to make  $d$  the subject.

$$c(d+3) = 4-d$$

$$cd + 3c = 4-d$$

$$cd + d = 4-3c$$

$$d(c+1) = 4-3c$$

$$d = \frac{4-3c}{c+1}$$

[4]

## CREDITS AND NOTES

Q	Awarding Body	Q	Awarding Body	Q	Awarding Body
1	WJEC Eduqas	9	Pearson Edexcel	17	AQA
2	AQA	10	Pearson Edexcel		
3	OCR	11	Pearson Edexcel		
4	Pearson Edexcel	12	Pearson Edexcel		
5	OCR	13	AQA		
6	OCR	14	AQA		
7	OCR	15	AQA		
8	OCR	16	AQA		

### Notes:

These questions have been retyped from the original sample/specimen assessment materials and whilst every effort has been made to ensure there are no errors, any that do appear are mine and not the exam board's (similarly any errors I have corrected from the originals are also my corrections and not theirs!).

Please also note that the layout in terms of fonts, answer lines and space given to each question does not reflect the actual papers to save space.

These questions have been collated by me as the basis for a GCSE working party set up by the GLOW maths hub - if you want to get involved please get in touch. The objective is to provide support to fellow teachers and to give you a flavour of how different topics "could" be examined. They should not be used to form a decision as to which board to use. There is no guarantee that a topic will or won't appear in the "live" papers from a specific exam board or that examination of a topic will be as shown in these questions.



### Links:

AQA <http://www.aqa.org.uk/subjects/mathematics/gcse/mathematics-8300>

OCR <http://ocr.org.uk/qcsemaths>

Pearson Edexcel <http://qualifications.pearson.com/en/qualifications/edexcel-gcses/mathematics-2015.html>

WJEC Eduqas <http://www.eduqas.co.uk/qualifications/mathematics/gcse/>

### Contents:

This version contains questions from:

AQA – Sample Assessment Material, Practice set 1 and Practice set 2

OCR – Sample Assessment Material and Practice set 1

Pearson Edexcel – Sample Assessment Material, Specimen set 1 and Specimen set 2

WJEC Eduqas – Sample Assessment Material