Substitution, Solving & Rearranging Equations (F)

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. Solve.

    $3x^2 = 75$

    $x^2 = 25$

    $x = \sqrt{25}$

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

2. Solve.

    $3x + 7 = 19$

    $3x = 12$

    $x = 4$

    $x = $ ..... 4 ..... [2]

3. Here is a formula.

    $T = 5r + 3u$

    Work out the value of T when $r = 8$ and $u = 9$.

    $T = 5 \times 8 + 3 \times 9$

    $T = 40 + 27$

    $T = 67$

    ..... [2]

4. Six equations are shown below, each labelled with a letter.

A	B	C
$y = {}^-6x$	$x = \frac{1}{6}y$	$y = \frac{{}^-3}{x}$

D	E	F
$x = \frac{6}{y}$	$y = 6x$	$y = \frac{2}{x} + 2$

Choose the correct letters to make this statement true.

Equation B and equation ..... E ..... are equivalent. [1]

5. Solve.

5x = 2x + 18

$$3x = 18$$
$$x = 6$$

x = ...6.. [2]

6. (a) Solve.

(i) 2x = 18

(a)(i) x = ...9.. [1]

(ii) x + 2 = 5

(ii) x = ...3.. [1]

(iii) $\frac{x}{3} = 15$

(iii) x = ...45.. [1]

(b) (i) Find the value of t when g = 4 and h = 7.

t = 12g - 5h

$$t = 12 \times 4 - 5 \times 7$$
$$= 48 - 35$$

(b)(i) t = ...13.. [2]

(ii) Rearrange to make r the subject.

4r - p = q

$$4r = q + p$$

$$r = \frac{q + p}{4}$$

(ii) ......$\frac{q+p}{4}$.. [2]

7. Show that $3r = 2(5k^2 - 2r)$ can be rearranged to $k = \sqrt{\frac{7r}{10}}$

$$3r = 10k^2 - 4r$$
$$3r + 4r = 10k^2$$
$$7r = 10k^2$$

$$\frac{7r}{10} = k^2$$

$$k = \sqrt{\frac{7r}{10}}$$

[4]

8. Find the value of a − b when a = 3 and b = -2.

3 - -2   =5

.... [1]

9. Solve.

3a + 10 = a + 40

2a +10 = 40
2a = 30

a = 15 .... [3]

10. Here are three expressions.

$$\frac{b}{a} \qquad b - a \qquad ab$$

When a = 2 and b = - 6 which expression has the smallest value? ab

You must show your working.

$\frac{-6}{2} = -3$ -6 - 2 = -8   2 x -6 = -12

[2]

11. 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.

If w = 1,   3 x 1 - (1) = 2

If w = -1,   3 x (-1) - (-1) = -3 + 1 = -2

Therefore, only one of the values is correct

[2]

12. Solve 4x + 5 = x + 26

3x + 5 = 26
3x = 21
x = 7

x = 7 ....

[2]

13. Solve 3x − 5 = 9

3x = 14
$x = \frac{14}{3}$

$4\frac{2}{3}$

x = ...

[2]

14. $f = 5x + 2y$

   $x = 3$ and $y = -2$

   Find the value of f.

   $f = 5 \times 3 + 2 \times -2$
   $f = 15 - 4$
   $f = 11$

   .... [2]

15. $q = \dfrac{p}{r} + s$

   Make p the subject of this formula.

   $q - s = \dfrac{p}{r}$
   $r(q-s) = p$

   ....$P = r(q-s)$............... [2]

16. Here is a number machine.

   input ⟶ ×3 ⟶ −4 ⟶ output
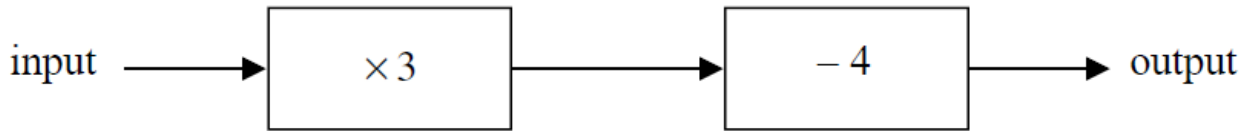
   (a) Work out the output when the input is 4

   $(4 \times 3) - 4$ 8

   .... [1]

   (b) Work out the input when the output is 11

   $(11 + 4) \div 3$ 5

   .... [2]

   (c) Show that there is a value of the input for which the input and the output have the same value.

   $3x - 4 = x$
   $2x = 4$
   $x = 2$

                                                       [2]

17. Solve $3x + 7 = 1$

   $3x = -6$

                              -2
   x = ... [2]

18. $f = 6$, $g = 5$

   Work out the value of $3f - 2g$

   $3 \times 6 - 2 \times 5$
   $18 - 10$ 8

   .... [2]

19. Solve 5p = 3p + 8

$$2p = 8$$
$$p = 4$$
.... [2]

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

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

21. (a) Alan is looking at number machine problems.
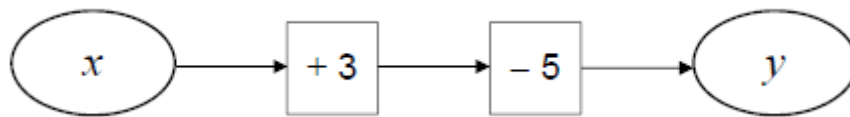
He says,

"If I know y I can work out x. I subtract 3 then I add 5."

Does this method work?

Give a reason for your answer.

Yes because you are doing the inverse of addition and subtraction.

[1]

(b)

He says,

"If I know d I can work out c. I divide by 3, then subtract 5."

Does this method work?

Give a reason for your answer.

No because you need to do the inverse of +5 first and then do the inverse of x5.

[1]

22. Solve 5w - 11 = 24

$$5w = 35$$
$$w = 7$$

[2]

[2]

23. A company has bikes for hire.

The cost, £C, to hire a bike for n days is given by the formula

$$C = 12 + \frac{27}{4}(n - 1)$$

(a) Write down the cost to hire a bike for 1 day. **C=12**

[1]

(b)

$$12 + \frac{27}{4} \times 6$$

52.50

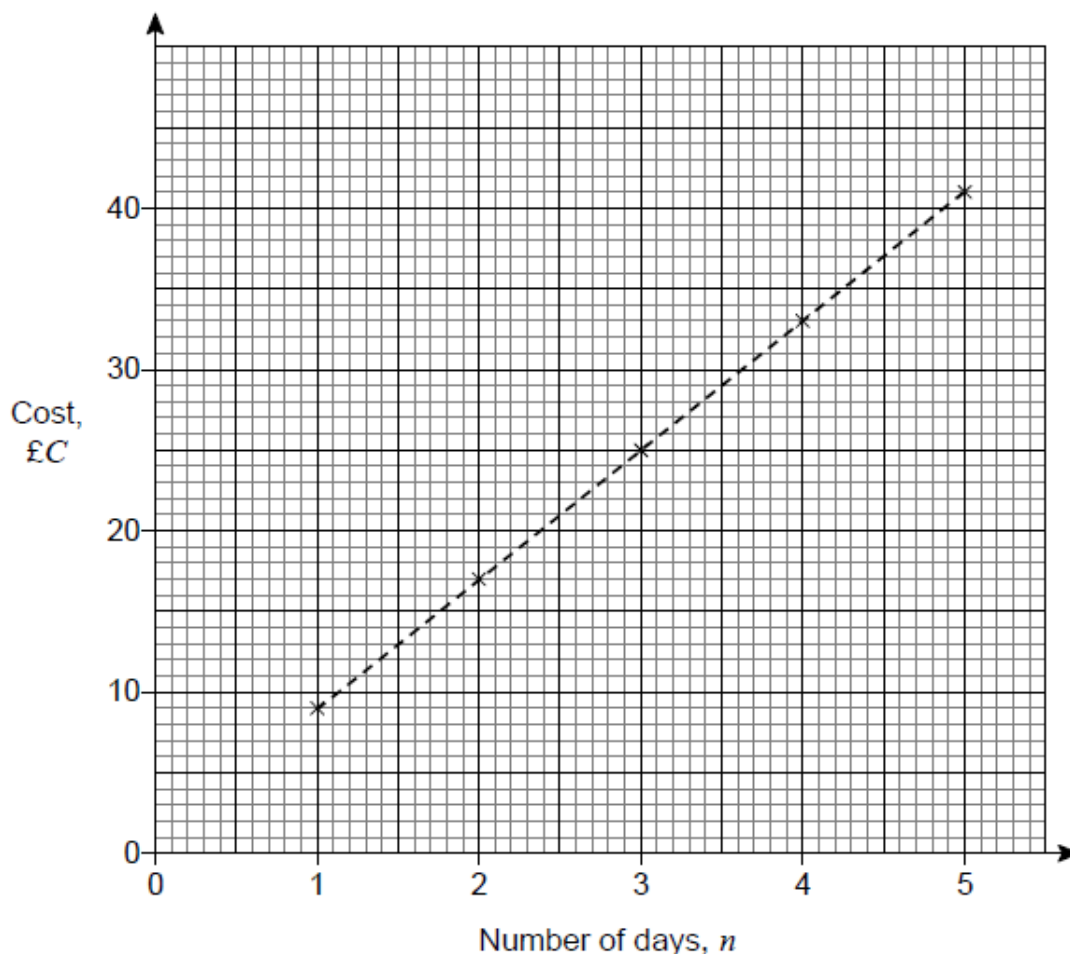| Special offer |
| :---: |
| Hire a bike for £9 per day |

$\rightarrow 7 \times 9 = 63$

Is it cheaper to hire a bike for 7 days using the special offer?

You must show your working.

No, it is £10.50 cheaper to use the normal formula.

[2]

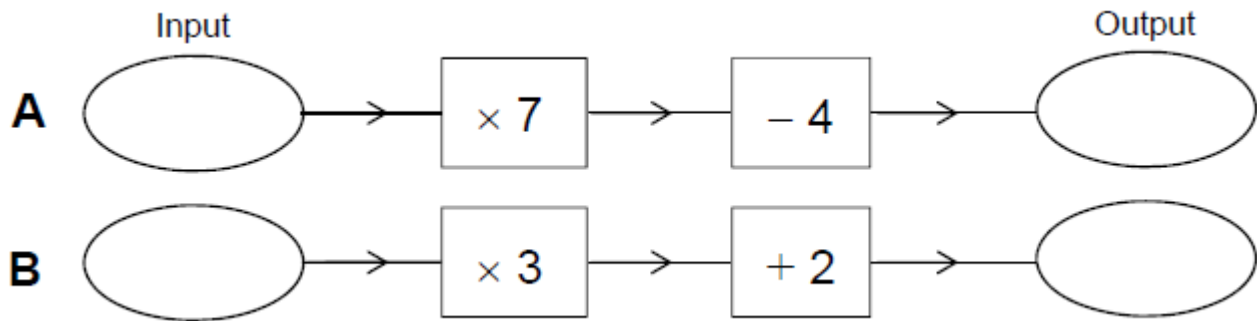(c) The graph shows the cost to hire a bike for one to five days at a different company.

The cost, £C, to hire a bike for n days using this company is given by the formula

$$C = a + b(n - 1)$$

Work out the values of a and b.

a = __9__   b = __8__   [3]

24. Here are two number machines, A and B. **Simultaneous equations**

Both machines have the same input.

Work out the input that makes the output of A three times the output of B.

$7x-4=3y$
$3x+2=y$

②−①

$7x-3y=4 \to$ ①
$3x-y=-2$
$9x-3y=-6 \to$ ②

$2x = -10$
$x = -5$

[4]

25. Solve 4(x + 5) = 15

$4x + 20 = 15$
$4x = -5$ $x = \frac{-5}{4} = -1\frac{1}{4}$

[3]

26. Work out the value of 5x + 9y when x = 7 and y = −2

$5 \times 7 + 9 \times -2$
$35 - 18$
17

[2]

27. Solve 4x - 5 = 17

$4x = 22$
$x = \frac{22}{4}$ $x = 5\frac{1}{2}$

[2]

28. Here is a formula.

$$V = \frac{1}{2} x^2 h$$

Work out the value of V when $x = 11$ and $h = 6$

$$V = \frac{1}{2} \times 11^2 \times 6 \qquad V = 363$$

[2]

29. Solve 12x = 3

Circle your answer.

[1]

x = -9   x = $\frac{1}{4}$ x = 4   x = 36

30. You are given that a = 3 and b = 5

Tick whether each statement is true or false.

Give a reason for each answer.

Statement	True	False	Reason
$ab = 35$		✓	$3 \times 5 = 15$
$2b^2 = 100$		✓	$2 \times 5^2 = 50$

[2]

31. (a) Solve $4x = 16$ $x = 4$

[1]

(b) Solve $\frac{y}{5} = 4$ $y = 20$

[1]

(c) Solve $5a - 8 = 17$ $5a = 25$

$a = 5$

[2]

32. Using the formula below, find the value of k when $p = 50$ and $q = 10$.

You must show all your working.

$$2q = p - 10k$$

$2 \times 10 = 50 - 10K$

$20 = 50 - 10K$

$10K = 50 - 20$

$K = 3$

[3]

33. (a) Solve $4c + 5 = 11$

$4c = 6$

$C = 1.5$

$c = $ .....1.5.......... [2]

(b) Solve $5(e + 7) = 20$

$5e + 35 = 20$

$5e = -15$

$e = -3$

$e = $ .....-3......... [2]

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

$w - 11 = 3t$

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

[2]

35. (a) Solve $f + 2f + f = 20$

$4f = 20$

$f = 5$

$f = $ ....5...... [1]

(b) Solve $18 - m = 6$

$18 = 6 + m$

$12 = m$

$m = $ ...12....... [1]

36. Complete this table of values.

n	$3n + 2$
12	38
15	47

[3]

37. Solve   x – 7 = 56

Circle your answer.

[1]

x = 8   x = 49   x = 56   (x = 63)

38. Here is a number machine.
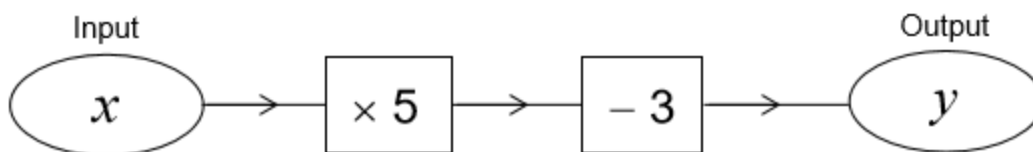
Input
x → ×5 → – 3 → Output y

a) Work out the output when the input is 12

5×12 –3 =57

[1]

b) Work out the input when the output is 27

(27+3)÷5 =6

[2]

c) Write y as an expression in terms of x.

y=5x–3

[1]

39. Work out the value of $4(2x + 3y)$ when $x = 8$ and $y = -3$

$4(2 \times 8 + 3 \times -3)$
$4(16 - 9)$

$4 \times 7 = 28$

[2]

40. 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.

a) How much tax do you pay if you earn £20 000?

$T = 0.2(20000 - 10600)$
$T = 0.2 \times 9400$

$T = 1880$

[2]

b) What is the most you can earn without paying tax?

10600

[1]

c) Alison pays £5200 tax.

Work out the amount she earns.

$5200 = 0.2(E - 10600)$

$26000 = E - 10600$

$E = 36600$

[3]

41. Solve $x^2 = 30.25$

$x = \sqrt{30.25}$
$x = 5.5$ or -5.5

[2]

42. Solve $\frac{2x}{5} + 1 = 13$

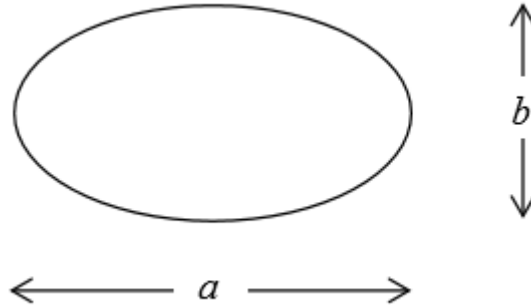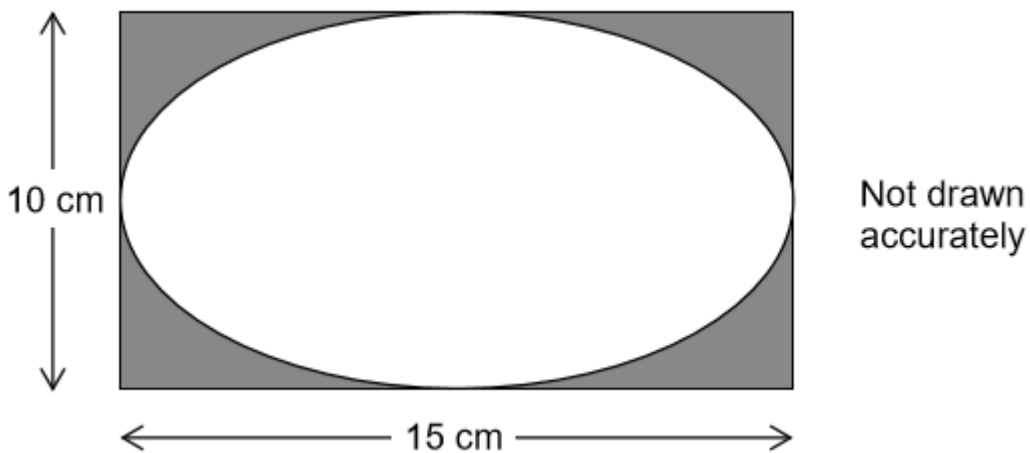$\frac{2x}{5} = 12$ $2x = 60$ $x = 30$

[3]

43. 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.

10 cm

15 cm

Not drawn accurately

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

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

[3]

$$\frac{\text{Ellipse}}{\text{Rectangle}} \times 100$$

$$\frac{0.25 \times \pi \times 10 \times 15}{10 \times 15} \times 100$$

$$= 78.5\%$$

CREDITS AND NOTES

Q	Awarding Body	Q	Awarding Body	Q	Awarding Body	Q	Awarding Body
1	OCR	15	Pearson Edexcel	29	AQA	43	AQA
2	OCR	16	Pearson Edexcel	30	AQA		
3	OCR	17	Pearson Edexcel	31	WJEC Eduqas		
4	OCR	18	Pearson Edexcel	32	WJEC Eduqas		
5	OCR	19	Pearson Edexcel	33	Pearson Edexcel		
6	OCR	20	Pearson Edexcel	34	Pearson Edexcel		
7	OCR	21	AQA	35	Pearson Edexcel		
8	OCR	22	AQA	36	Pearson Edexcel		
9	OCR	23	AQA	37	AQA		
10	AQA	24	AQA	38	AQA		
11	AQA	25	AQA	39	AQA		
12	Pearson Edexcel	26	AQA	40	AQA		
13	Pearson Edexcel	27	AQA	41	AQA		
14	Pearson Edexcel	28	AQA	42	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/gcsemaths

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