

Substitution

Solutions

For AQA GCSE Mathematics (8300) • Foundation tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (4 marks)

- (a) Work out the value of $5a$ when $a = 7$

$5a$ means $5 \times a$.

$$5 \times 7 = 35$$

Answer: 35

Tip: $5a$ means $5 \times a$. Replacing a with 7 gives 5×7 , not 57.

- (b) Work out the value of $b - 9$ when $b = 4$

Replace b with 4:

$$4 - 9 = -5$$

Answer: -5

- (c) Work out the value of $\frac{c}{3}$ when $c = 18$

$\frac{c}{3}$ means $c \div 3$.

$$18 \div 3 = 6$$

Answer: 6

- (d) Work out the value of d^2 when $d = 6$

d^2 means $d \times d$.

$$6 \times 6 = 36$$

Answer: 36

2 (2 marks)

Work out the value of $4p + 3q$ when $p = 6$ and $q = -5$

$$4p = 4 \times 6 = 24$$

$$3q = 3 \times (-5) = -15$$

$$\text{Add: } 24 + (-15) = 24 - 15 = 9$$

Answer: 9

Tip: Put negative numbers in brackets when you substitute: $3 \times (-5)$. Adding a negative is the same as subtracting.

Marks: 1 mark for 24 and -15 seen. 1 mark for 9.

3 (1 mark)

Circle the expression that has the largest value when $x = -3$

Options: $x + 8$, x^2 , $5x$, $10 - x$

Work out each one with $x = -3$:

$$x + 8 = -3 + 8 = 5$$

$$x^2 = (-3) \times (-3) = 9$$

$$5x = 5 \times (-3) = -15$$

$$10 - x = 10 - (-3) = 10 + 3 = 13$$

The largest value is 13.

Answer: $10 - x$

Tip: Take care with the signs. $10 - (-3)$ is $10 + 3 = 13$, not 7.

4 (5 marks)

$$R = \frac{m}{4} + 3n$$

- (a) Work out the value of R when $m = 20$ and $n = 3$

Replace m with 20 and n with 3:

$$R = \frac{20}{4} + 3 \times 3$$

$$\frac{20}{4} = 5 \text{ and } 3 \times 3 = 9$$

$$R = 5 + 9 = 14$$

Answer: $R = 14$

Tip: $3n$ means $3 \times n$. With $n = 3$ this is $3 \times 3 = 9$, not 33.

Marks: 1 mark for $\frac{20}{4} + 3 \times 3$ or for 5 and 9. 1 mark for 14.

- (b) Work out the value of n when $R = -3$ and $m = 12$

Put the values you know into the formula:

$$-3 = \frac{12}{4} + 3n$$

$$\frac{12}{4} = 3, \text{ so } -3 = 3 + 3n$$

Subtract 3 from both sides: $3n = -6$

Divide both sides by 3: $n = -2$

Answer: $n = -2$

Tip: Substitute the numbers first, then solve the equation. $-3 - 3$ is -6 , not 0.

Marks: 1 mark for $-3 = \frac{12}{4} + 3n$ or $-3 = 3 + 3n$. 1 mark for $3n = -6$. 1 mark for -2 .

5 (2 marks)

Work out the value of $x^2 + 7x$ when $x = -4$

$$x^2 = (-4)^2 = (-4) \times (-4) = 16$$

$$7x = 7 \times (-4) = -28$$

$$\text{Add: } 16 + (-28) = -12$$

Answer: -12

Tip: A negative number squared is positive: $(-4)^2 = 16$. On a calculator, type the brackets: $(-4)^2$. Typing -4^2 gives -16 .

Marks: 1 mark for 16 and -28 . 1 mark for -12 .

6 (2 marks)

$$m = 5 \text{ and } n = -2$$

Circle the expression that gives the lowest value.

You must show your working.

Options: $m + n$, n^2 , mn , $\frac{m}{n}$

$$m + n = 5 + (-2) = 3$$

$$n^2 = (-2) \times (-2) = 4$$

$$mn = 5 \times (-2) = -10$$

$$\frac{m}{n} = 5 \div (-2) = -2.5$$

The smallest is -10 , because -10 is less than -2.5 .

Answer: mn

Tip: -10 is smaller than -2.5 . With negative numbers, the one further from zero is smaller.

Marks: 1 mark for at least three correct values. 1 mark for mn .

7 (4 marks)

The cost, C pounds, of hiring a bike for h hours is given by

$$C = 12 + 5h$$

- (a) Work out the cost of hiring a bike for 6 hours.

Replace h with 6:

$$C = 12 + 5 \times 6$$

Multiply first: $5 \times 6 = 30$

Then add: $C = 12 + 30 = 42$

Answer: £42

Tip: Multiply before you add. $12 + 5 \times 6$ is not 17×6 .

Marks: 1 mark for $12 + 5 \times 6$. 1 mark for 42.

- (b) Kim pays £37 to hire a bike.
For how many hours does she hire the bike?

Now $C = 37$:

$$37 = 12 + 5h$$

Subtract 12 from both sides: $5h = 25$

Divide both sides by 5: $h = 5$

Answer: 5 hours

Marks: 1 mark for $37 - 12$ or $5h = 25$. 1 mark for 5.

8 (2 marks)

- (a) Work out the value of $2a^2$ when $a = 3$

$2a^2$ means $2 \times a^2$.

Square first: $3^2 = 9$

Then multiply by 2: $2 \times 9 = 18$

Answer: 18

Tip: Only the a is squared, not the 2. $2a^2$ is $2 \times 9 = 18$, not $6^2 = 36$.

(b) Tom says,

‘When $a = -3$, the value of $2a^2$ is -18 ’

Explain why Tom is wrong.

$$(-3)^2 = (-3) \times (-3) = 9$$

A negative number squared is positive.

So $2a^2 = 2 \times 9 = 18$, not -18 .

Answer: $(-3)^2 = +9$, so $2a^2 = 18$

9 (4 marks)

$$v = u + at$$

(a) Work out v when $u = 5$, $a = 3$ and $t = 4$

at means $a \times t$.

$$v = 5 + 3 \times 4$$

$$v = 5 + 12 = 17$$

Answer: $v = 17$

Marks: 1 mark for $5 + 3 \times 4$. 1 mark for 17.

(b) Work out v when $u = 20$, $a = -2$ and $t = 6$

$$v = 20 + (-2) \times 6$$

$$(-2) \times 6 = -12$$

$$v = 20 - 12 = 8$$

Answer: $v = 8$

Marks: 1 mark for $20 + (-2) \times 6$. 1 mark for 8.

10 (2 marks)

$$x = -2$$

Tick **one** box for each row.

	True	False
$x^2 = 4$	✓	
$3x = 6$		✓
$x - 5 = -7$	✓	
$-x^2 = 4$		✓

$$x^2 = (-2)^2 = 4, \text{ so True.}$$

$$3x = 3 \times (-2) = -6, \text{ so False.}$$

$$x - 5 = -2 - 5 = -7, \text{ so True.}$$

$-x^2$ means square first, then make it negative.

$$-x^2 = -(4) = -4, \text{ so False.}$$

Tip: $-x^2$ and $(-x)^2$ are different. In $-x^2$ you square x first, then put the minus sign in front.

Marks: 2 marks for all four correct. 1 mark for two or three correct.

11 (2 marks)

The perimeter of a rectangle is given by the formula $P = 2(l + w)$

Work out the value of P when $l = 8.5$ and $w = 3.5$

Work out the bracket first: $8.5 + 3.5 = 12$

Then multiply by 2: $P = 2 \times 12 = 24$

Answer: $P = 24$

Marks: 1 mark for $2(8.5 + 3.5)$. 1 mark for 24.

12 (2 marks)

$$s = ut + \frac{1}{2}at^2$$

Work out the value of s when $u = 2$, $t = 5$ and $a = 4$

$$ut = 2 \times 5 = 10$$

$$t^2 = 5^2 = 25$$

$$\frac{1}{2}at^2 = \frac{1}{2} \times 4 \times 25 = 50$$

$$s = 10 + 50 = 60$$

Answer: $s = 60$

Tip: Only t is squared. Work out $t^2 = 25$ first, then multiply by $\frac{1}{2}$ and by a .

Marks: 1 mark for 10 or 50. 1 mark for 60.

13 (4 marks)

The formula to change a temperature in degrees Celsius, C , to degrees Fahrenheit, F , is

$$F = \frac{9C}{5} + 32$$

(a) Work out F when $C = 25$

$$9C = 9 \times 25 = 225$$

$$\text{Divide by 5: } 225 \div 5 = 45$$

Add 32: $F = 45 + 32 = 77$

Answer: $F = 77$

Marks: 1 mark for $\frac{9 \times 25}{5}$ or 45. 1 mark for 77.

(b) Work out F when $C = -10$

$$9C = 9 \times (-10) = -90$$

$$\text{Divide by 5: } -90 \div 5 = -18$$

$$\text{Add 32: } F = -18 + 32 = 14$$

Answer: $F = 14$

Marks: 1 mark for -18 . 1 mark for 14.

14 (2 marks)

$$a = 3 \quad b = -2 \quad c = 5$$

Work out the value of $a^2 - bc$

$$a^2 = 3^2 = 9$$

$$bc = (-2) \times 5 = -10$$

$$a^2 - bc = 9 - (-10)$$

Subtracting a negative is the same as adding: $9 + 10 = 19$

Answer: 19

Tip: Work out bc first, then subtract it. Subtracting -10 means adding 10.

Marks: 1 mark for 9 and -10 . 1 mark for 19.
