28 FORMULAE

BBC ACTIVE

You could use a formula to work out the distance you could drive before running out of fuel. It might be good idea if you were driving somewhere remote like Death Valley in the USA. Temperatures have been known to reach 57°C (134°F) in July and there is no shade. It is still known for people to die if they break down or run out of fuel in one of the most remote areas.

Objectives

In this chapter you will:

- use formulae
- write word formulae
- substitute numbers into expressions
- use and write algebraic formulae
- find the value of a term which is not the subject of the formula
- change the subject of a formula.

Before you start

You need to know:

- the order of operations
- the difference between expressions, variables and terms.

28.1 Using word formulae

Objectives

- You can understand word formulae.
- You can substitute values into word formulae.
- You can evaluate word formulae.
- You can write a formula in words to represent a problem.

Why do this?

Word formulae can help you work out a value when you know all the other variables. For example, you can work out total pay when you know the hours worked and rate of pay.

Get Ready

Work out

1. 15 × 25p **2.** 36 × £5.90 **3.** 3.14 × 12

Key Points

- A **word formula** uses words to represent a relationship between two quantities.
- When using formulae you need to remember the order of operations, BIDMAS (see Chapter 9).
- Formulae are used when calculating:
  - area of triangles (see Section 14.3)
  - angles in polygons (see Section 7.2)
  - area of circles (see Chapter 17).
- Make sure the units of measure are consistent when calculating using formulae.

Example 1

This word formula can be used to work out the perimeter of an equilateral triangle.

Perimeter = 3 × length of side

Work out the perimeter of an equilateral triangle with sides of 9 cm.

Perimeter = 3 × 9 = 27 cm

Put 9 into the word formula for length of side.

Example 2

Suki is paid £6.50 per hour.

a Write a word formula for her weekly pay.

b Work out her pay for a week when she works 24 hours.

a Weekly pay = hourly rate × hours worked per week

A word formula must be in the form something = something else.

b Pay = £6.50 × 24
= £156

Put 24 and £6.50 into the formula. Do not forget the units.

Exercise 28A

Questions in this chapter are targeted at the grades indicated.

G

1 This word formula can be used to work out the perimeter of a regular pentagon.
Perimeter = 5 × length of side
Work out the perimeter of a regular pentagon with sides of 7 cm.

2 Gwen uses this word formula to work out her wages.
Wages = rate per hour × number of hours worked
Gwen's rate per hour is £5 and she works for 37 hours.
Work out her wages.

3 This word formula can be used to work out the area of a triangle.
Area = $\frac{1}{2}$ base × vertical height
A triangle has base 8 cm and vertical height 10 cm.
Work out the area of the triangle.

F

4 This word formula can be used to work out the perimeter of a rectangle.
Perimeter = 2 × length + 2 × width
Work out the perimeter of a rectangle with a length of 8 cm and width of 3 cm.

5 Owen uses this word formula to work out his phone bill.
Total bill = cost per minute × number of minutes + monthly charge
The cost per minute is 6p. Owen made 70 minutes of calls.
The monthly charge is £15. Work out his total bill.

6 Kirsty buys 12 stamps at 42p each.
- **a** Write a word formula for the total cost of the stamps.
- **b** Work out the cost of the stamps.

7
- **a** Write a word formula to work out the number of packets of crisps left in a machine after a number have been sold.
- **b** Use your formula to work out the number of packets left in a machine that holds 56 packets, when 27 have been sold.

8 Georgina uses this word formula to work out her take-home pay.
Take-home pay = rate per hour × number of hours worked − deductions
Georgina's rate per hour is £7. She worked for 40 hours and her deductions were £96.
Work out her take-home pay.

9 For each part write a word formula, then use it to calculate the answers.
- **a** Alex shared a bag of sweets equally between herself and her three brothers. There were 84 sweets in the bag. How many did each person have?
- **b** At a buffet lunch there were 36 slices of pizza. Every person at the lunch had 3 slices. All the slices were eaten. How many people were at the lunch?

F

10 This word formula can be used to work out the average speed for a journey.

$$\text{Average speed} = \frac{\text{total distance travelled}}{\text{time taken}}$$

Raj travels 215 miles in 5 hours. Work out his average speed in miles per hour (mph).

11 This word formula can be used to work out the angle sum, in degrees, of a polygon.
Angle sum = (number of sides − 2) × 180
Work out the angle sum of a polygon with 7 sides.

12 This word formula can be used to work out the size, in degrees, of each exterior angle of a regular polygon.

$$\text{Exterior angle} = \frac{360}{\text{number of sides}}$$

Work out the size of each exterior angle of a regular polygon with 8 sides.

13 This word formula can be used to work out the area inside a circle.
Area = π × radius × radius
Work out the area of a circle with a radius of 4 cm.
Give your answer to the nearest whole number.

28.2 Substituting numbers into expressions

Objectives

- You can work out the value of an algebraic expression by substituting in the values of each letter or letters.
- You can substitute negative numbers into expressions.

Why do this?

You could work out pocket or birthday money if you get a certain amount of money per year depending on your age.

Get Ready

1. Use the word formula perimeter = 2 × length + 2 × width to work out the perimeter of a rectangle with:
a length 4 cm, width 2 cm **b** length 5 cm, width 3 cm **c** length 7 cm, width 5 cm.

Key Point

- You can **substitute** values into an algebraic expression in the same way as you substitute values into a word formula.

Example 3

$a = 4$ and $b = 5$

Work out the value of

a $3a - b$ **b** $3ab$ **c** $a^2 + 2b$

a $3a - b = 3 \times 4 - 5$
$= 12 - 5$
$= 7$

The numbers replace the letters so $3a = 3 \times 4$ and $b = 5$.

Remember: multiplication before subtraction.

b $3ab = 3 \times 4 \times 5 = 60$

$3ab = 3 \times a \times b$

c $a^2 + 2b = 4 \times 4 + 2 \times 5$
$= 16 + 10$
$= 26$

$a^2 = a \times a = 4 \times 4$

Exercise 28B

D

1 $p = 3$, $q = 2$, $r = 5$ and $s = 0$

Work out the value of the following expressions.

a $p + r$ **b** rs **c** $5p - 2r$
d pqr **e** $pr - pq$ **f** $6pq + 3qr$
g $4(p + 7)$ **h** $p(q + 4)$ **i** $p(r - q)$
j $r^2 + 1$ **k** $(q + 1)^2$ **l** $2p^3$
m $(p + r)^2$ **n** $(p - q)^3$

2 $p = \frac{3}{4}$, $q = \frac{1}{4}$, $r = 2$ and $s = 1$

Work out the value of the following expressions.

a $4q$ **b** $7qr$ **c** $4p - 6q$
d qrs **e** $qr - pq$ **f** $4qr - 5pq$
g $6(r - 2)$ **h** $r(r - 2)$ **i** p^2
j $3r^3 - 2$ **k** $(r - 4)^2$ **l** $6q^3$
m $(p + q)^3$

3 $p = 0.5$, $q = 2$, $r = 3$ and $s = 1.25$

Work out the value of the following expressions.

a pq **b** $6p + 4q$ **c** $7p + 8s$
d $pr + 4q$ **e** $qr + rs$ **f** $6pr - 7qs$
g $5(p + q)$ **h** $q(p + r)$ **i** $5p^2$
j $5q^2 + 7$ **k** r^3 **l** $p^2 + r^2$
m $p^3 - q^3$

Example 4

$p = 2$, $q = -3$ and $r = -5$

Work out the value of

a $p + r$ **b** $q - r$ **c** pq **d** qr

e $p(q + r)$ **f** $r^2 + 6r$ **g** $(p + q)^2$ **h** $4r^3$

a $p + r = 2 + (-5)$
$= 2 - 5$
$= -3$

Adding a negative number is the same as subtracting a positive number.

b $q - r = -3 - (-5)$
$= -3 + 5$
$= 2$

Subtracting a negative number is the same as adding a positive number.

c $pq = 2 \times -3$
$= -6$

When you multiply two numbers which have different signs the answer is negative. Remember: 2 means +2.

d $qr = -3 \times -5$
$= 15$

When you multiply two numbers which have the same sign the answer is positive.

e $p(q + r) = 2 \times (-3 + -5)$
$= 2(-8)$
$= -16$

A bracket means times.
Work out the value of the bracket first.

f $r^2 + 6r = (-5)^2 + 6 \times -5$
$= (-5 \times -5) - 30$
$= 25 - 30$
$= -5$

Square and multiply before adding.

g $(p + q)^2 = (2 + (-3))^2$
$= (2 - 3)^2$
$= (-1)^2$
$= -1 \times -1$
$= 1$

Work out the value of the bracket first.

Square.

h $4r^3 = 4 \times (-5)^3$
$= 4 \times (-5 \times -5 \times -5)$
$= 4 \times -125$
$= -500$

$(-5)^3$ means cube of -5.
Cube before you multiply.

Exercise 28C

In this exercise $a = -5$, $b = 6$, $c = -2$, $d = \frac{1}{2}$ and $e = 1$.
Work out the value of the following expressions.

1	$a + b$	2	$a - b$	3	$b - a$	4	$a - c$
5	$b - c$	6	$a + b + c$	7	$3a + 7$	8	$4a + 3b$
9	$2b + 5c$	10	$2a - 5c$	11	$3b - 2a$	12	ab
13	acd	14	$3bc$	15	$bd - 1$	16	$ab - bc$
17	$2ab + 3ac$	18	$3ac - 2bc$	19	$abcd$	20	$3d(a + 1)$
21	$b(c - a)$	22	$c(a + b)$				
23	$5(c - 1)$	24	$a(b + c)$	25	a^2	26	$3c^2d$
27	$4a^2 - 3$	28	$5c^2 + 3c$	29	$2a^2 - 3a$	30	$(a + 1)^2$
31	$(c + 3)^2$	32	$(a + b)^2$	33	$(a + c)^2$	34	$(c - a)^2$
35	$2b^3$	36	$3a^3$	37	$6c^3$	38	$2(b + c)^2$
39	$a^2 - b^2$	40	$(a - c)^3$	41	$(e - d)^2$	42	$(c - 5d)^2$

E

D

C

28.3 Using algebraic formulae

Objective

- You can substitute number values for the letters in a formula to work out a quantity.

Why do this?

If you are given an algebraic formula to work out your pay, you need to know how to use it!

Get Ready

$a = -5$, $b = 6$, $c = \frac{1}{2}$
Work out

1. $a + (b \times c)$
2. abc
3. $\dfrac{(a + b)}{c}$

Key Point

- An **algebraic formula** uses letters to show a relationship between quantities, e.g. $A = lw$.
  The letter that appears on its own on one side of the $=$ sign and does not appear on the other side is called the **subject** of the formula.
  In the formula above, A is the subject of the formula.

Example 5 The formula for the perimeter of this isosceles triangle is $P = 2a + b$.
Work out the value of P when $a = 8$ and $b = 5$.

$P = 2 \times 8 + 5 = 16 + 5 = 21$

Put $a = 8$ and $b = 5$ into the formula to find P.

A03

Example 6 Harry's pay is worked out using the formula $P = hr + b$
where P = pay
h = hours worked
r = rate of pay
b = bonus.
Work out Harry's pay when $h = 35$, $r = £10$ and $b = £45$.

$P = hr + b$
$P = 35 \times 10 + 45$
$P = 350 + 45$
$P = £395$

Substitute $h = 35$, $r = 10$ and $b = 45$.

Exercise 28D

F

1 $y = 2x + 3$ is the equation of a straight line.
Work out the value of y when
a $x = 4$ **b** $x = 6$ **c** $x = 10$ **d** $x = 7.5$

E

2 The formula for the area of a parallelogram is $A = bh$.
Work out the value of A when
a $b = 7$ and $h = 3$ **b** $b = 9$ and $h = 7$
c $b = 6$ and $h = 3.7$ **d** $b = 8.4$ and $h = 4.5$

3 The formula for the circumference of a circle is $C = \pi d$.
Work out, to the nearest whole number, the value of C when
a $d = 2$ **b** $d = 5$ **c** $d = 3.7$ **d** $d = 9.3$

4 Euler's formula for the number of edges of a solid is $E = F + V - 2$, where E is the number of edges, F is the number of faces and V is the number of vertices.
Work out the value of E when
a $F = 6$ and $V = 8$ **b** $F = 16$ and $V = 19$

5 The formula $F = 1.8C + 32$ can be used to convert a temperature from degrees Celsius to degrees Fahrenheit. Work out the value of F when
a $C = 10$ **b** $C = 100$ **c** $C = -30$ **d** $C = 0$

D

6 The formula for the volume of a cuboid is $V = lwh$.
Work out the value of V when

a $l = 5$, $w = 4$ and $h = 2$ **b** $l = 8$, $w = 5$ and $h = 3.5$
c $l = 10$, $w = 6$ and $h = 4$ **d** $l = 9.3$, $w = 4.2$ and $h = 5.1$

7 The formula $v = u + at$ can be used to work out velocity.
Velocity means speed in a particular direction.
Work out the value of v when

a $u = 8$, $a = 4$ and $t = 3$ **b** $u = 0$, $a = 10$ and $t = 2$
c $u = 7$, $a = 2.6$ and $t = 5$ **d** $u = 12$, $a = 10$ and $t = 4.7$

8 The formula $T = 15(W + 1)$ can be used to work out the time needed to cook a turkey.
Work out the value of T when

a $W = 5$ **b** $W = 8$ **c** $W = 12$ **d** $W = 18$

9 The formula for the volume of a cuboid is $V = l^2h$. Work out the value of V when

a $l = 2$ and $h = 5$ **b** $l = 7$ and $h = 9.8$ **c** $l = 2.5$ and $h = 4.3$

28.4 Writing an algebraic formula to represent a problem

Objective

- You can form a simple formula including squares, cubes and roots.

Why do this?

You could write a formula to work out the total cost of your holiday including air fares, hotel costs and entertainment costs, then you could alter any one of these to find how it affects the total cost.

Get Ready

Use the formula $C = \pi d$ to work out C when

1. $d = 3$ **2.** $d = 8$ **3.** $d = 10$

Key Point

- You can use information given in words to write an algebraic formula to solve a problem.

Example 7

Florence's pay is worked out using the formula
pay = number of hours work × rate per hour + commission.

a Write this as an algebraic formula.
b Work out Florence's pay when she works 30 hours at £7.50 per hour and gets a commission of £20.

a $P = nr + c$

Use letter for pay = P, number of hours worked = n, rate per hour = r and commission = c.

b $P = nr + c$
$P = 30 \times 7.50 + 20$
$P = 225 + 20$
$P = £245$

Substitute $n = 30$, $r = £7.50$ and $c = 20$.

Exercise 28E

E

1 Write a formula for the perimeter P of this regular hexagon, with side l.
Work out the value of P when

a $l = 3$ **b** $l = 7$
c $l = 29$ **d** $l = 8.6$

2 Write a formula for the perimeter of this isosceles triangle.
Work out the perimeter when

a $a = 6$ and $b = 4$ **b** $a = 12$ and $b = 7$
c $a = 5.3$ and $b = 3.4$ **d** $a = 4.7$ and $b = 8.5$

3 **a** Write an algebraic formula for the price of a number of pens that cost 70p each.
b Use your formula to work out the cost of:
i 4 pens **ii** 6 pens **iii** 12 pens.

4 Write a formula for the volume of this cube.
Work out the volume when

a $s = 2$ cm **b** $s = 4.5$ cm

5 Write a formula for the surface area of the cube in question 4.
Work out the surface area when

a $s = 2$ cm **b** $s = 4.5$ cm

D

6 Write a formula for the length of the side of a square given the area.
Work out the length of the side when the area is

a 4 cm^2 **b** 1.44 cm^2

28.5 Finding the value of a term which is not the subject of a formula

Objective

- You can work out a value in a formula when it is not the subject of the formula.

Get Ready

Solve these equations.

1. $2x + 4 = 10$ **2.** $24 = 2a - 8$ **3.** $6x = 30$

Key Point

- To find out the value of a term which is not the subject of a formula, put the given values into the formula and then solve the resulting equation.

Example 8

$P = 2a + b$

Work out the value of a when $P = 25$ and $b = 7$.

$25 = 2a + 7$ ← Solve this equation.

$2a = 18$ ← Subtract 7 from both sides.

$a = 9$ ← Divide both sides by 2.

ResultsPlus
Examiner's Tip

Substitute the value of the term back into the formula to check your answer.

Exercise 28F

1 $P = 6l$

Work out the value of l when

a $P = 24$ **b** $P = 54$ **c** $P = 138$ **d** $P = 35.4$

2 $A = bh$

a Work out the value of h when

i $A = 45$ and $b = 5$ **ii** $A = 54$ and $b = 3$

b Work out the value of b when

i $A = 35$ and $h = 7$ **ii** $A = 120$ and $h = 8$

3 $E = F + V - 2$

a Work out the value of F when

i $E = 9$ and $V = 5$ **ii** $E = 21$ and $V = 9$

b Work out the value of V when

i $E = 15$ and $F = 10$ **ii** $E = 30$ and $F = 12$

4 $y = 2x + 3$

Work out the value of x when

a $y = 15$ **b** $y = 27$ **c** $y = -10$ **d** $y = -3$

5 $P = 2a + b$

a Work out the value of b when

i $P = 15$ and $a = 6$ **ii** $P = 23$ and $a = 4.5$

b Work out the value of a when

i $P = 11$ and $b = 5$ **ii** $P = 19$ and $b = 8$

6 $y = 4x - 5$

Work out the value of x when

a $y = 3$ **b** $y = -31$ **c** $y = 75$ **d** $y = -6$

F E D

D

7 $V = hwl$

Work out the value of h when

a $V = 24$, $l = 3$ and $w = 2$ b $V = 60$, $l = 6$ and $w = 2$ c $V = 80$, $l = 4$ and $w = 5$

8 $v = u + at$

a Work out the value of u when

i $v = 19$, $a = 7$ and $t = 2$ ii $v = 25$, $a = 6$ and $t = 3$

b Work out the value of a when $v = 17$, $u = 5$ and $t = 2$.

c Work out the value of t when $v = 31$, $u = 3$ and $a = 7$.

9 $y = \frac{x}{5}$

Work out the value of x when

a $y = 4$ b $y = 17$ c $y = 7.4$ d $y = 0$

10 $t = \frac{d}{s}$

Work out the value of d when

a $t = 3$ and $s = 5$ b $t = 9$ and $s = -8$ c $t = 7.5$ and $s = 6$ d $t = 5.6$ and $s = -10.4$

28.6 Changing the subject of a formula

Objective

- You can rearrange a formula to make a different variable the subject of the formula.

Why do this?

If you wanted to find out the distance that you had left to travel but the subject of the formula was time, you could rearrange it to find out the distance.

Get Ready

Solve these equations.

1. $4 = 5 + 3x$ **2.** $18 = 2(x + 4)$ **3.** $24 = \frac{1}{3} \times 8x$

Key Point

- You can change the subject of a formula by carrying out the same operations on both sides of the equals sign.

Example 9 Make t the subject of the formula $v = u + at$.

$v = u + at$

$v - u = at$ ← Subtract u from both sides.

$t = \frac{v - u}{a}$ ← Divide both sides by a.

Example 10 Make l the subject of the formula $P = 2(l + b)$.

$P = 2(l + b)$

$P = 2l + 2b$ ← Multiply out the brackets.

$2l = P - 2b$ ← Subtract $2b$ from both sides.

$l = \frac{P}{2} - b$ ← Divide both sides by 2.

Alternatively, you can divide both sides by 2
$\frac{P}{2} = l + b$
and then subtract b from both sides
$l = \frac{P}{2} - b$

Example 11 Make h the subject of the formula $V = \frac{1}{3}Ah$.

$V = \frac{1}{3}Ah$

$3V = Ah$ ← Multiply both sides by 3.

$h = \frac{3V}{A}$ ← Divide both sides by A.

$h = \frac{V}{\frac{1}{3}A}$ is also correct but it is best not to have a fraction within another fraction.

Exercise 28G

Rearrange each formula to make the letter in square brackets the subject.

D

C

1	$P = 5d$	$[d]$	2	$P = IV$	$[I]$	3	$A = lw$	$[w]$
4	$C = \pi d$	$[d]$	5	$V = lwh$	$[h]$	6	$A = \pi rl$	$[r]$
7	$y = 4x - 3$	$[x]$	8	$t = 3n + 5$	$[n]$	9	$P = 2x + y$	$[y]$
10	$y = mx + c$	$[m]$	11	$v = u - gt$	$[u]$	12	$v = u - gt$	$[t]$
13	$A = \frac{1}{2}bh$	$[b]$	14	$I = \frac{PRT}{100}$	$[T]$	15	$T = \frac{D}{V}$	$[V]$
16	$\frac{PV}{T} = k$	$[V]$	17	$\frac{PV}{T} = k$	$[T]$	18	$I = m(v - u)$	$[v]$
19	$A = \frac{1}{2}(a + b)h$	$[b]$	20	$y = \frac{1}{3}x - 2$	$[x]$	21	$y = 2(x - 1)$	$[x]$
22	$x = 3(y + 2)$	$[y]$	23	$H = 17 - \frac{A}{2}$	$[A]$	24	$3x - 2y = 6$	$[x]$
25	$3x - 2y = 6$	$[y]$	26	$P = 6(q - 7) - 5(q - 6)$	$[q]$	27	$4y^2 - 2x = 6(x - 8y)$	$[x]$

Chapter review

- A **word formula** uses words to represent a relationship between two quantities.
- When using formulae you need to remember the order of operations, BIDMAS.
- Formulae are used when calculating:
  - area of triangles (see Section 14.3)
  - angles in polygons (see Section 7.2)
  - area of circles (see Chapter 17).
- Make sure the units of measure are consistent when calculating using formulae.
- You can **substitute** values into an algebraic expression in the same way as you substitute values into a word formula.
- An **algebraic formula** uses letters to show a relationship between quantities, e.g. $A = lw$.
  The letter that appears on its own on one side of the $=$ sign and does not appear on the other side is called the **subject** of the formula. In the formula above, A is the subject.
- You can use information given in words to write an algebraic formula to solve a problem.
- To find out the value of a term which is not the subject of a formula, put the given values into the formula and then solve the resulting equation.
- You can change the subject of a formula by carrying out the same operations on both sides of the equals sign.

Review exercise

F AO3

1 Nathan is three years younger than Ben.

a Write down an expression for Nathan's age.

Daniel is twice as old as Ben.

b Write down an expression for Daniel's age. *Nov 2008*

AO3

2 Amy, Bryony and Christina each collect bracelet charms.

Bryony has twice as many charms as Amy.

a Write down an expression for the number of charms that Bryony has.

Christina has 7 charms less than Amy.

b Write down an expression for the number of charms that Christina has.

AO3

3 Adam, Brandon and Charlie each buy some stamps.

Brandon buys three times as many stamps as Adam.

a Write down an expression for the number of stamps Brandon buys.

Charlie buys 5 more stamps than Adam.

b Write down an expression for the number of stamps Charlie buys.

E

4 You can use this rule to work out the cost, in pounds, of hiring a carpet cleaner.

> Multiply the number of days' hire by 6
> Add 4 to your answer

Jill hires the carpet cleaner for 3 days.

a Work out the cost.

Carlos hires the carpet cleaner. The cost is £52.

AO3

b Work out for how many days Carlos hires the carpet cleaner. *June 2009*

E

5 Navjeet uses this rule to work out his pay.

Pay = Number of hours worked × rate of pay per hour

This week Navjeet worked for 10 hours.
His rate of pay per hour was £4.50.

a Use this rule to work out his pay.

Last week Navjeet's pay was £66.
He worked for 12 hours.

b Work out Navjeet's rate of pay per hour last week. *June 2006* A03

6 This word formula can be used to work out the total cost, in pounds, of running a car.

$$\text{Total cost} = \text{fixed costs} + \frac{\text{number of miles travelled}}{6}$$

a Flora's fixed costs were £500 and she travelled 9000 miles. Work out her total cost.

b Harry's total cost was £2700 and he travelled 12 000 miles. Work out his fixed costs.

c Ali's total cost was £1600 and his fixed costs were £400. Work out the number of miles he travelled.

7 To calculate the cost of printing leaflets for a school fair, the printer uses the formula:
$C = 40 + 0.05n$
where C is the cost in pounds and n is the number of leaflets printed.

a How much would it cost to print 200 leaflets?

b Can you suggest what 40 and 0.05 represent?

D

8 If $a = 1$, $b = 2$ and $c = -3$, find the value of

a $\dfrac{c - ab}{c + ab}$ **b** $3(a + b)^2 - 2(b - c)^2$

9 $a = 4$, $b = \frac{1}{4}$, $c = -3$

Work out

a $\dfrac{5a}{b} + 7$ **b** $6a + \dfrac{2c}{3}$ **c** $3a - 6b + c$ **d** $a(a - 8b)$

10 The formula $v = u - gt$ can be used to work out velocity.

a Work out the value of v when $u = 45$, $g = 10$ and $t = 3$.

b Work out the value of u when $v = 8$, $g = 10$ and $t = 2$.

11

a Write a formula for the area of a square of side l.

b Work out the area when $l = 9$.

D

12

a Write a formula for the perimeter of a rectangle.

b Work out the perimeter when

i $l = 9$ and $w = 4$

ii $l = 6.7$ and $w = 3.4$

13 The cost, C in £, of buying t trees and b bushes together with delivery is given by the formula

$$C = 10t + 6b + 15.$$

Greg has £315 to spend and needs 35 bushes.

How many trees can he afford?

14 $s = ut + \frac{1}{2}at^2$ is a formula for working out the distance, s, moved by an object.

Work out s when

a $u = 4.2$, $a = 10$ and $t = 3$

b $u = 5$, $a = -10$ and $t = 5.7$

c $u = -3$, $a = -32$ and $t = 6$

15 $A = \frac{1}{2}bh$ is the formula for working out the area of a triangle. Work out the area of a triangle when

a $b = 30$ cm and $h = 20$ cm

b $b = 15$ cm and $h = 26$ cm

c $b = 7.3$ cm and $h = 2.9$ cm

d $b = 2.3$ cm and $h = 1.3$ cm

16 $v = u + at$ is a formula for finding the speed of an object.

Find v when

a $u = 6$, $a = 10$ and $t = 5$

b $u = 8$, $a = -10$ and $t = 6$

c $u = 20$, $a = -32$ and $t = 4\frac{1}{2}$

17 $p = 2$

Work out the value of $5p^2$.

18 $v = u + 10t$

Work out the value of v when

a $u = 10$ and $t = 7$

b $u = -2.5$ and $t = 3.2$

19 **a** Work out the value of $2a + ay$ when $a = 5$ and $y = -3$.

b Work out the value of $5t^2 - 7$ when $t = 4$.

D

20 Tom the plumber charges £35 for each hour he works at a job, plus £50.
The amount Tom charges, in pounds, can be worked out using this rule.

> Multiply the number of hours he works by 35
> Add 50 to your answer

Tom charged a customer £260 for a job.

a How many hours did Tom work?

Tom works h hours at a job.
He charges P pounds.

b Write down a formula for P in terms of h.

June 2007

ResultsPlus
Exam Question Report

86% of students did very well on part **a** of this question.

AO3

21 The cost of hiring a car can be worked out using this rule.

> Cost = £90 + 50p per mile

Bill hires a car and drives 80 miles.

a Work out the cost.

The cost of hiring a car is C pounds.

b Write the formula for C.

Nov 2007

22 The formula used to convert temperatures in Fahrenheit, F, into Celsius, C, is given by:

$$C = \frac{5(F - 32)}{9}$$

a Find C when $F = 77$.

b Use the formula to find the freezing point of water in Fahrenheit.

A newspaper headline read 'Phew, what a scorcher! Temperature soars into the 100s.'

c What temperature unit are they saying? What is its equivalent in the other unit?

23 There are many factors that determine how long it would take to climb a mountain.

a Name as many as you can.

In 1892 a Scottish mountaineer named William Naismith devised a rule which stated that you must allow 1 hour for every 5 km you walk forward, plus $\frac{1}{2}$ hour for every 300 metres of ascent.
Estimate, using Naismith's rule, how long it would take to

b walk 10 km with 900 m of ascent

c walk 20 km with 300 m of ascent

d walk 12 km with 1000 m of ascent

e walk 18 km with 450 m of ascent.

C

24 The formula $d = \frac{a + b}{3}$ can be used to work out the distance apart two bushes should be planted.

a Work out the value of d when $a = 50$ and $b = 43$.

b Work out the value of b when $d = 29$ and $a = 59$.

25 $F = 1.8C + 32$ is a formula which links temperatures in degrees Fahrenheit (F) with temperatures in degrees Celsius (C).

a Use the formula to convert:

i 20°C **ii** 45°C **iii** 70°C into °F.

b Use the formula to convert:

i 212°F **ii** 122°F **iii** 77°F into °C.

C

26 The width of a rectangle is x centimetres.
The length of the rectangle is $(x + 4)$ centimetres.

a Find an expression, in terms of x, for the perimeter of the rectangle.
Give your expression in its simplest form.

The perimeter of the rectangle is 54 centimetres.

b Work out the length of the rectangle.

27 The diagram shows a trapezium.
All the lengths are in centimetres.
The perimeter of the trapezium is P cm.
Find a formula, in terms of a and b, for P.
Give your answer in its simplest form.

Diagram **NOT** accurately drawn

28 $V = \frac{1}{3}\pi r^2 h$ is the formula for finding the volume of a cone.
Work out the volume of a cone with:

a $r = 5$ cm and $h = 10$ cm

b $r = 7$ cm and $h = 15$ cm

c $r = 4.6$ cm and $h = 9.2$ cm

29 **a** $S = 2p + 3q$
Work out the value of S when $p = -4$ and $q = 5$.

b $T = 2m + 20$
Work out the value of m when $T = 30$.

30 Make b the subject of the formula $P = 2a + 2b$.

In questions 31–35 rearrange the formula to make the letter in square brackets the subject.

31 $P = 2x + y$ $[x]$

32 $s = \dfrac{a + b + c}{2}$ $[a]$

33 $T = \dfrac{D}{V}$ $[D]$

34 $A = \frac{1}{2}(a + b)h$ $[h]$

35 $y = \dfrac{5 - x}{2}$ $[x]$