

FORMULAE

Text

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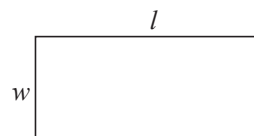
Formulae

1 Using Formulae

In formulae, letters are used to represent numbers. For example, the formula

$$A = lw$$

can be used to find the area of a rectangle. Here A is the area, l the length and w the width. In this formula, lw means $l \times w$. Formulae are usually written in this way, without multiplication signs.



The perimeter of the rectangle would be given by the formula

$$P = 2l + 2w$$

Here again there are no multiplication signs, and $2l$ means $2 \times l$ and $2w$ means $2 \times w$.



Worked Example 1

The perimeter of a rectangle can be found using the formula

$$P = 2l + 2w$$

Find the perimeter if $l = 8$ and $w = 4$.



Solution

The letters l and w should be replaced by the numbers 8 and 4.

This gives

$$\begin{aligned} P &= 2 \times 8 + 2 \times 4 \\ &= 16 + 8 \\ &= 24 \end{aligned}$$



Worked Example 2

The final speed of a car is v and can be calculated using the formula

$$v = u + at$$

where u is the initial speed, a is the acceleration and t is the time taken.

Find v if the acceleration is 2 m s^{-2} , the time taken is 10 seconds and the initial speed is 4 m s^{-1} .



Solution

The acceleration is 2 m s^{-2} so $a = 2$. The initial speed is 4 m s^{-1} so $u = 4$.

The time taken is 10 s so $t = 10$.

Using the formula

$$v = u + at$$

gives

$$\begin{aligned} v &= 4 + 2 \times 10 \\ &= 4 + 20 \\ &= 24 \text{ m s}^{-1} \end{aligned}$$



Exercises

1. The area of a rectangle is found using the formula $A = lw$ and the perimeter using $P = 2l + 2w$. Find the area and perimeter if:

- (a) $l = 4$ and $w = 2$ (b) $l = 10$ and $w = 3$
 (c) $l = 11$ and $w = 2$ (d) $l = 5$ and $w = 4$

2. The formula $v = u + at$ is used to find the final speed.

Find v if:

- (a) $u = 6$, $a = 2$ and $t = 5$ (b) $u = 0$, $a = 4$ and $t = 3$
 (c) $u = 3$, $a = 1$ and $t = 12$ (d) $u = 12$, $a = 2$ and $t = 4$

3. Use the formula $F = ma$ to find F if:

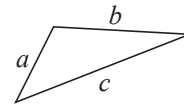
- (a) $m = 10$ and $a = 3$ (b) $m = 200$ and $a = 2$

4. The perimeter of a triangle is found using the formula

$$P = a + b + c$$

Find P if:

- (a) $a = 10$, $b = 12$ and $c = 8$
 (b) $a = 3$, $b = 4$ and $c = 5$
 (c) $a = 6$, $b = 4$ and $c = 7$

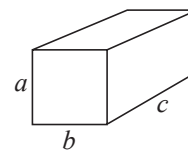


5. The volume of a box is given by the formula

$$V = abc$$

Find V if:

- (a) $a = 2$, $b = 3$ and $c = 10$
 (b) $a = 7$, $b = 5$ and $c = 3$
 (c) $a = 4$, $b = 4$ and $c = 9$



6. Find the value of Q for each formula using the values given.

- (a) $Q = 3x + 7y$ (b) $Q = x^2 + y$
 $x = 4$ and $y = 2$ $x = 3$ and $y = 5$
 (c) $Q = xy + 4$ (d) $Q = 5x - 2y$
 $x = 3$ and $y = 5$ $x = 10$ and $y = 2$

(e) $Q = xy - 2$

$x = 10$ and $y = 2$

(f) $Q = \frac{x}{y}$

$x = 24$ and $y = 2$

(g) $Q = \frac{x+4}{y}$

$x = 8$ and $y = 3$

(h) $Q = \frac{4x+2}{y}$

$x = 5$ and $y = 11$

(i) $Q = 3x + 2y + z$

$x = 4$, $y = 2$ and $z = 10$

(j) $Q = xy + yz$

$x = 2$, $y = 5$ and $z = 8$

(k) $Q = xyz$

$x = 2$, $y = 5$ and $z = 3$

(l) $Q = xy + 4z$

$x = 8$, $y = 3$ and $z = 4$

(m) $Q = \frac{x+y}{z}$

$x = 8$, $y = 10$ and $z = 3$

(n) $Q = \frac{x}{y+z}$

$x = 50$, $y = 2$ and $z = 3$

7. This formula is used to work out Aleale's pay:

$$\text{Pay} = \text{£}20 + \text{Number of hours worked} \times \text{Rate of pay}$$

Her rate of pay is £20 plus £9 per hour.

Work out her pay for 40 hours.

8. A rectangle has a length of
- a
- cm and a width of
- b
- cm.

The perimeter of a rectangle is given by the formula $p = 2(a + b)$.Calculate the perimeter of a rectangle when $a = 4.5$ and $b = 4.2$.

2 Construct and Use Simple Formulae

A *formula* describes how one quantity relates to one or more other quantities. For example, a formula for the area of a rectangle describes how to find the area, given the length and width of the rectangle.

The perimeter of the rectangle would be given by the formula

$$P = 2l + 2w$$

Here again there are no multiplication signs and $2l$ means $2 \times l$ and $2w$ means $2 \times w$.

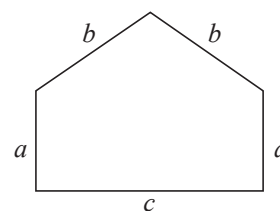


Worked Example 1

- (a) Write down a formula for the perimeter of the shape shown.

- (b) Find the perimeter if

$a = 2 \text{ cm}, b = 3 \text{ cm and } c = 5 \text{ cm}$





Solution

- (a) The perimeter is found by adding together the lengths of all the sides, so the formula will be

$$P = a + b + b + a + c$$

but as a and b are both added in twice, this can be simplified to

$$P = 2a + 2b + c$$

- (b) If $a = 2$ cm, $b = 3$ cm and $c = 5$ cm,

$$\begin{aligned} P &= 2 \times 2 + 2 \times 3 + 5 \\ &= 4 + 6 + 5 \\ &= 15 \text{ cm} \end{aligned}$$



Worked Example 2

When laying a patio, a landscape gardener charges a basic fee of £30 plus £12 per hour. Find a formula for calculating the gardener's charge.



Solution

Let C = charge and n = number of hours.

The charge is made up of

a fixed £30 and £12 $\times$ the number of hours or £12 n .

So the total charge in £ is given by

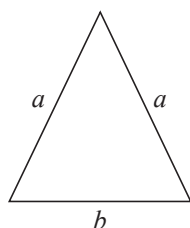
$$C = 30 + 12n$$



Exercises

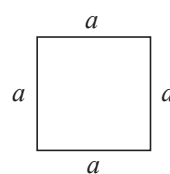
1. Find a formula for the perimeter of each shape, and find the perimeter for the specified values.

(a)



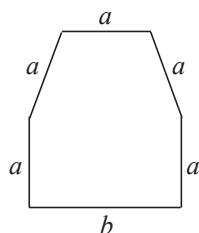
$$a = 6 \text{ cm}, b = 4 \text{ cm}$$

(b)



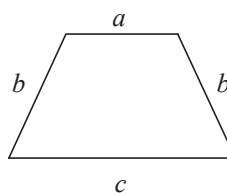
$$a = 5 \text{ cm}$$

(c)



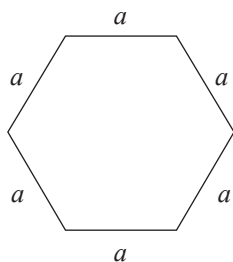
$$a = 6 \text{ cm}, b = 10 \text{ cm}$$

(d)



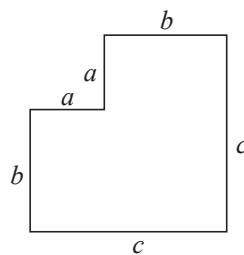
$$a = 5 \text{ cm}, b = 6 \text{ cm}, c = 10 \text{ cm}$$

(e)



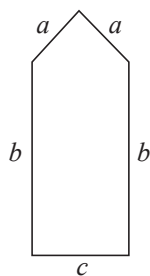
$$a = 10 \text{ cm}$$

(f)



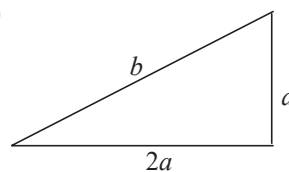
$$a = 4 \text{ cm}, b = 5 \text{ cm}, c = 9 \text{ cm}$$

(g)



$$a = 60 \text{ cm}, b = 160 \text{ cm}, \\ c = 80 \text{ cm}$$

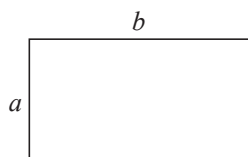
(h)



$$a = 4 \text{ cm}, b = 9 \text{ cm}$$

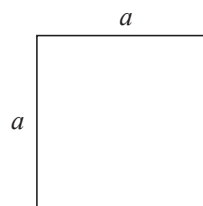
2. Find a formula for the area of each of the shapes below and find the area for the values given.

(a)



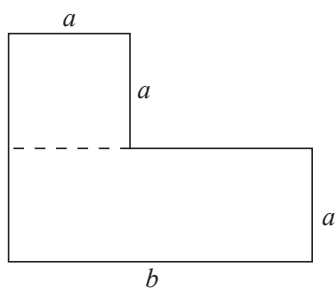
$$a = 6 \text{ cm}, b = 10 \text{ cm}$$

(b)



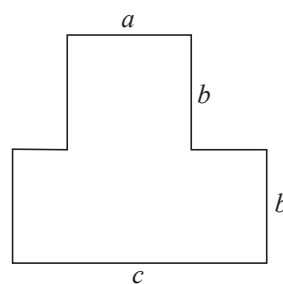
$$a = 3 \text{ cm}$$

(c)



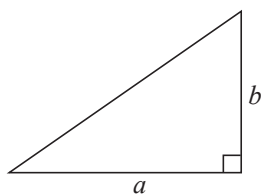
$$a = 2 \text{ cm}, b = 8 \text{ cm}$$

(d)



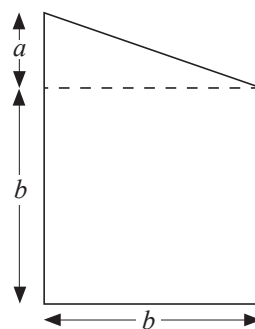
$$a = 3 \text{ cm}, b = 4 \text{ cm}, c = 9 \text{ cm}$$

(e)



$$a = 4 \text{ cm}, b = 5 \text{ cm}$$

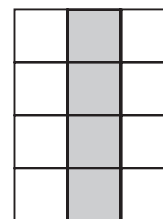
(f)



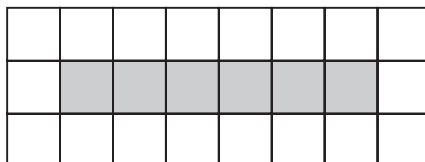
$$a = 50 \text{ cm}, b = 200 \text{ cm}$$

3. Three consecutive numbers are to be added together.
 - (a) If x is the smallest number, what are the other two numbers in terms of x ?
 - (b) Write down a formula for the total, T , of the three numbers in terms of x , using your answer to (a).
4.
 - (a) Write down a formula to find the mean, M , of the two numbers x and y .
 - (b) Write down a formula to find the mean, M , of the five numbers p , q , r , s , and t .
5. Tickets for a school concert are sold at £6 for adults and £4 for children.
 - (a) If p adults and q children buy tickets, write a formula for the total value, T , of the ticket sales.
 - (b) Find the total value of the ticket sales if $p = 50$ and $q = 20$.
6. A rectangle is 3 cm longer than it is wide.
If x is the width, write down a formula for:
 - (a) the perimeter, P ;
 - (b) the area, A , of the rectangle.
7. Rachel is one year older than Bradley. Carla is three years younger than Bradley.
If Bradley is x years old, write down expressions for:
 - (a) Rachel's age;
 - (b) Carla's age;
 - (c) the sum of all three children's ages.
8. A window cleaner charges a fee of £8 for visiting a house and £4 for every window that he cleans.
 - (a) Write down a formula for finding the total cost C , in £, when n windows are cleaned.
 - (b) Find C if $n = 8$.
9. A taxi driver charges a fee of £5, plus £4 for every km that the taxi travels.
 - (a) Find a formula for the cost C of a journey that covers x km.
 - (b) Find C if $x = 3$.

10. A gardener builds paths using paving slabs laid out in a pattern as shown, with white slabs on each side of a row of red slabs.

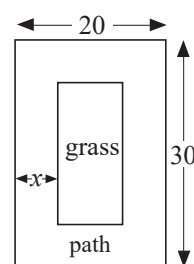


- (a) If n red slabs are used, how many white slabs are needed?
- (b) Another gardener puts a white slab at each end of the path as shown below.



If n red slabs are used, how many white slabs are needed?

11. A path of width x is laid around a rectangular lawn as shown.



- (a) Find an expression for the perimeter of the grass.
- (b) Find an expression for the area of the grass.

12. Juice drinks cost 27 p each.

Write down a formula for the cost, C p, of n drinks.

13. (a) Fuel costs 80 p per litre.

Write down a formula for the cost, C p, of l litres of fuel.

- (b) Fuel costs x p per litre.

Write down a formula for the cost, C p, of l litres of fuel.

14. Write down an expression for the TOTAL cost, in pounds, of 8 metres of fabric at x pounds per metre and y reels of thread at 2 pounds per reel.

15. Mr James works a basic week of 40 hours at a rate of £16 an hour. His overtime rate is £4 per hour MORE than his basic rate.

Calculate

- (i) his TOTAL wage for a basic week.
- (ii) his wage for a week in which he worked 47 hours.



Note

Before starting the next section on formulae it is useful to revise how to work with negative numbers.

When multiplying or dividing two numbers, if they have the *same* sign the result will be *positive*, but if they have *different* signs the result will be *negative*.

3 Substitution into Formulae

The process of replacing the letters in a formula is known as *substitution*.



Worked Example 1

The length of a metal rod is l cm. The length changes with temperature and can be found by the formula

$$l = 40 + 0.02 T$$

where T is the temperature.

Find the length of the rod when

(a) $T = 50^\circ\text{C}$ and (b) $T = -10^\circ\text{C}$



Solution

(a) Using $T = 50$ gives

$$\begin{aligned} l &= 40 + 50 \times 0.02 \\ &= 40 + 1 \\ &= 41 \text{ cm} \end{aligned}$$

(b) Using $T = -10$ gives

$$\begin{aligned} l &= 40 + (-10) \times 0.02 \\ &= 40 + (-0.2) \\ &= 40 - 0.2 \\ &= 39.8 \text{ cm} \end{aligned}$$



Worked Example 2

The profit in £ made by a salesman when he sells n books is calculated by the formula

$$P = 4n - 50$$

Find the profit if he makes

(a) 30 sales (b) 9 sales



Solution

(a) Here $n = 30$ so the formula gives

$$\begin{aligned} P &= 4 \times 30 - 50 \\ &= 120 - 50 \\ &= 70 \end{aligned}$$

So the salesman's profit after 30 sales is £70.

(b) Here $n = 9$ so the formula gives

$$\begin{aligned} P &= 4 \times 9 - 50 \\ &= 36 - 50 \\ &= -14 \end{aligned}$$

He makes a loss of £14 if only 9 sales are made.



Worked Example 3

If $x * y$ is defined by

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

what is the value of $x * y$ when

(a) $x = 4$, $y = -2$

(b) $x = -2$, $y = 4$?



Solution

$$\begin{aligned} \text{(a)} \quad 4 * (-2) &= 4^2 - 4(-2)^2 \\ &= 16 - 4 \times 4 \\ &= 16 - 16 \\ &= 0 \end{aligned}$$

$$\begin{aligned} \text{(b)} \quad (-2) * 4 &= (-2)^2 - 4 \times 4^2 \\ &= 4 - 4 \times 16 \\ &= 4 - 64 \\ &= -60 \end{aligned}$$



Exercises

1. The formula below is used to convert temperatures in degrees Celsius to degrees Fahrenheit, where F is the temperature in degrees Fahrenheit and C is the temperature in degrees Celsius.

$$F = 1.8 C + 32$$

Find F if:

(a) $C = 10$

(b) $C = 20$

(c) $C = -10$

(d) $C = -5$

(e) $C = -20$

(f) $C = 15$

2. The formula

$$s = \frac{1}{2}(u + v)t$$

is used to calculate the distance, s , that an object travels if it starts with a velocity u and has a velocity v , t seconds later.

Find s if:

(a) $u = 2$, $v = 8$, $t = 2$

(b) $u = 3$, $v = 5$, $t = 10$

(c) $u = 1.2$, $v = 3.8$, $t = 4.5$

(d) $u = -4$, $v = 8$, $t = 2$

(e) $u = 4$, $v = -8$, $t = 5$

(f) $u = 1.6$, $v = 2.8$, $t = 3.2$

3. The length, l , of a spring is given by the formula

$$l = 20 - 0.08F$$

where F is the size of the force applied to the spring to compress it.

Find l if:

- (a) $F = 5$ (b) $F = 20$
 (c) $F = 24$ (d) $F = 15$

4. The formula

$$P = 120n - 400$$

gives the profit, P in £, made when n phones are sold in a day at a shop.

Find P if:

- (a) $n = 1$ (b) $n = 3$
 (c) $n = 4$ (d) $n = 10$

How many phones must be sold to make a profit?

5. Work out the value of each function by substituting the values given, *without* using a calculator.

(a) $V = p^2 + q^2$ (b) $p = a^2 - b^2$
 $p = 8$ and $q = 4$ $a = 10$ and $b = 7$

(c) $z = \sqrt{x + y}$ (d) $Q = \sqrt{x - y}$
 $x = 10$ and $y = 6$ $x = 15$ and $y = 6$

(e) $P = \frac{x + y}{2}$ (f) $Q = \sqrt{\frac{a}{b}}$
 $x = 4$ and $y = -10$ $a = 100$ and $b = 4$

(g) $V = \frac{x + 2y + z}{5}$ (h) $R = \frac{1}{a} + \frac{1}{b}$
 $x = 2$, $y = -5$ and $z = 8$ $a = 4$ and $b = 2$

(i) $S = \frac{a}{b} + \frac{b}{c}$ (j) $R = 0.2a + 0.4b$
 $a = 3$, $b = 4$ and $c = 16$ $a = 10$ and $b = 20$

(k) $T = \frac{a}{2} + \frac{b}{5}$ (l) $C = \frac{ab}{a + b}$
 $a = -20$ and $b = 40$ $a = 10$ and $b = -5$

(m) $P = 2\sqrt{\frac{x^2}{y}}$ (n) $A = \frac{ab^2}{c}$
 $x = 10$ and $y = 4$ $a = 2$, $b = 3$ and $c = 100$

$$(o) \quad X = \frac{b+c}{a}$$

$$a = 10, \quad b = 1.7 \quad \text{and} \quad c = 2.1$$

$$(p) \quad z = \sqrt{x^2 + y^2}$$

$$x = -3 \quad \text{and} \quad y = 4$$

$$(q) \quad P = \sqrt{a^2 - b^2}$$

$$a = -10 \quad \text{and} \quad b = 6$$

$$(r) \quad Q = \sqrt{x^2 + y^2 + z^2}$$

$$x = -10, \quad y = 5 \quad \text{and} \quad z = 10$$

6. Work out the value of each function by substituting the values given, using a calculator if necessary.

$$(a) \quad P = \frac{x-y}{z}$$

$$x = 10, \quad y = 2.02 \\ \text{and} \quad z = 2.1$$

$$(b) \quad V = \frac{x-y}{x+y}$$

$$x = 4.9 \quad \text{and} \quad y = 3.1$$

$$(c) \quad R = \frac{x^2 - y^2}{4}$$

$$x = 3.6 \quad \text{and} \quad y = 1.6$$

$$(d) \quad D = \frac{2}{x} + \frac{2}{y}$$

$$x = 0.4 \quad \text{and} \quad y = 0.8$$

$$(e) \quad Q = \frac{x^2 + y^2}{5}$$

$$x = 3.7 \quad \text{and} \quad y = 5.9$$

$$(f) \quad V = \frac{3x + 2y}{x + y}$$

$$x = 1.6 \quad \text{and} \quad y = 2.4$$

7. If $a * b = a^2 - 4ab$, what is the value of $a * b$ when

$$(a) \quad a = 2, \quad b = -2$$

$$(b) \quad a = -3, \quad b = -1$$

8. The formula to convert temperatures from degrees Fahrenheit ($^{\circ}\text{F}$) into degrees Celsius ($^{\circ}\text{C}$) is

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

Calculate the temperature in degrees Celsius which is equivalent to a temperature of -4°F .

9. Given that $a = 2$, $b = -3$ and $c = 0$, evaluate

$$(i) \quad 4a - 2b + 3c$$

$$(ii) \quad a^c$$

10. Given that $m = \frac{1}{2}$, $p = \frac{3}{4}$, $t = -2$, calculate

$$(a) \quad mp + t$$

$$(b) \quad \frac{(m+p)}{t}$$

4 More Complex Formulae

Some formulae such as

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \quad \text{and} \quad z^2 = x^2 + y^2$$

arise in science or mathematics, but when used do not lead directly to values of f or z .

Here we show how to use the formula to calculate these values.



Worked Example 1

Use the formula

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

to find f if $u = 10$ and $v = 8$.



Solution

Substituting into the formula gives

$$\frac{1}{f} = \frac{1}{10} + \frac{1}{8}$$

First add together the two fractions using 40 as a common denominator:

$$\frac{1}{f} = \frac{4}{40} + \frac{5}{40}$$

$$\frac{1}{f} = \frac{9}{40}$$

Now to find f , turn both fractions upside-down to give

$$\frac{f}{1} = \frac{40}{9} \quad \text{or} \quad f = 4\frac{4}{9}$$



Worked Example 2

Find z using the formula

$$z^2 = x^2 + y^2$$

if $x = 3.6$ and $y = 4.8$.



Solution

Substituting these values into the formula gives

$$z^2 = 3.6^2 + 4.8^2$$

$$z^2 = 12.96 + 23.04$$

$$z^2 = 36$$

Now the square root can be taken of both sides to give

$$z = +\sqrt{36} \text{ or } -\sqrt{36}$$

$$z = 6 \text{ or } -6$$



Exercises

1. Use the formula

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

to find f if:

(a) $v = 3$ and $u = 4$

(b) $v = 6$ and $u = -5$

(c) $v = 7$ and $u = -3$

(d) $v = 10$ and $u = -4$

2. Find z using the formula

$$z^2 = x^2 + y^2$$

if:

(a) $x = 1.2$ and $y = 0.5$

(b) $x = 4.8$ and $y = 6.4$

(c) $x = 3$ and $y = 1.6$

3. Find the value of z as a fraction or mixed number in each case below.

(a) $\frac{1}{z} = \frac{x}{x+y}$

$x = 4$ and $y = -10$

(b) $\frac{1}{z} = \frac{x}{y} + \frac{y}{x}$

$x = 3$ and $y = 4$

(c) $\frac{1}{z} = \frac{2}{x} + \frac{3}{y}$

$x = 4$ and $y = -5$

(d) $\frac{1}{z} = \frac{x-y}{x+y}$

$x = -7$ and $y = -3$

(e) $\frac{1}{z} = \frac{x}{4} + \frac{3}{y}$

$x = 5$ and $y = -2$

(f) $\frac{1}{z} = \frac{1+x}{1-x}$

$x = 2$

(g) $\frac{1}{z} = \frac{x-2}{x+4}$

$x = \frac{1}{4}$

(h) $\frac{x+y}{x-y} = \frac{1}{z}$

$x = 4$ and $y = \frac{1}{2}$

(i) $\frac{x}{2} + \frac{3}{y} = \frac{1}{z}$

$x = 1$ and $y = 6$

4. Find z in each case below.

(a) $z^2 = 9 + x^2$
 $x = 4$

(b) $z^2 = x + y$
 $x = 147$ and $y = -3$

(c) $z^2 = x - y$
 $x = 44$ and $y = -5$

(d) $z^2 = \frac{x}{y}$
 $x = 363$ and $y = 3$

(e) $z^2 = \frac{x + 6}{y}$
 $x = 6$ and $y = 3$

(f) $z^2 = \frac{x}{8 + y}$
 $x = 16.9$ and $y = -7.9$

5. When three resistors are connected in parallel the total resistance R is given by

$$\frac{1}{R} = \frac{1}{X} + \frac{1}{Y} + \frac{1}{Z}$$

where X , Y and Z are the resistances of each resistor.

Find R if:

- (a) $X = 10$, $Y = 20$ and $Z = 30$
 (b) $X = 1000$, $Y = 5000$ and $Z = 2000$
 (c) $X = 1500$, $Y = 2200$ and $Z = 1600$

6. Use the formula

$$y = \frac{x - 1}{\sqrt{(t - v^2)}}$$

to calculate the value of y given that

$$x = 50, \quad t = 2.5 \quad \text{and} \quad v = 0.6$$

Give your answer correct to 1 decimal place.

Show all necessary working.

7. The formula $f = \frac{uv}{u + v}$ is used in the study of light.

- (a) Calculate f when $u = 14.9$ and $v = -10.2$.
Give your answer correct to 3 significant figures.
 (b) By rounding the values of u and v in part (a) to 2 significant figures, check whether your answer to part (a) is reasonable.
Show your working.

5 Changing the Subject

Sometimes a formula can be rearranged into a more useful format. For example, the formula

$$F = 1.8C + 32$$

can be used to convert temperatures in degrees Celsius to degrees Fahrenheit. It can be rearranged into the form

$$C = \dots$$

to enable temperatures in degrees Fahrenheit to be converted to degrees Celsius. We say that the formula has been rearranged to make C the subject of the formula.



Worked Example 1

Rearrange the formula

$$F = 1.8C + 32$$

to make C the subject of the formula.



Solution

The aim is to remove all terms from the right hand side of the equation except for the C .

First subtract 32 from both sides, which gives

$$F - 32 = 1.8C$$

Then dividing both sides by 1.8 gives

$$\frac{F - 32}{1.8} = C$$

So the formula can be rearranged as

$$C = \frac{F - 32}{1.8}$$



Worked Example 2

The distance, s , travelled by a car in time t from initial speed u to final speed v is given by the formula

$$s = \frac{(u + v)t}{2}$$

Make v the subject of the formula.



Solution

First multiply both sides of the formula by 2 to give

$$2s = (u + v)t$$

Then divide both sides by t , to give

$$\frac{2s}{t} = u + v$$

Finally, subtract u from both sides to give

$$\frac{2s}{t} - u = v$$

So the formula becomes

$$v = \frac{2s}{t} - u$$



Exercises

1. Make x the subject of each of the following formulae.

(a) $y = 4x$ (b) $y = 2x + 3$ (c) $y = 4x - 8$

(d) $y = \frac{x+2}{4}$ (e) $y = \frac{x-2}{5}$ (f) $y = x + a$

(g) $y = \frac{x-b}{a}$ (h) $y = ax + c$ (i) $y = \frac{ax+b}{c}$

(j) $y = \frac{ax-c}{b}$ (k) $y = a + b + x$ (l) $y = \frac{x-a+b}{c}$

(m) $y = abx$ (n) $y = abx + c$ (o) $y = \frac{4ax-b}{3c}$

(p) $p = \frac{ax-bc}{d}$ (q) $y = (a+x)b$ (r) $y = \frac{(3+x)a}{4}$

(s) $q = \frac{3(x-4)}{2}$ (t) $v = \frac{5(x+y)}{4}$ (u) $z = a + \frac{(x-3)}{4}$

2. Ohm's law is used in electrical circuits and states that

$$V = IR$$

Write formulae with I and R as their subjects.

3. Newton's Second law states that $F = ma$.

Write formulae with m and a as their subjects.

4. The formula $C = 2\pi r$ can be used to find the circumference of a circle. Make r the subject of this formula.

5. The equation $v = u + at$ is used to find the velocities of objects.

(a) Make t the subject of this formula.

(b) Make a the subject of this formula.

6. The mean of three numbers x , y and z can be found using the formula

$$m = \frac{x + y + z}{3}$$

Make z the subject of this formula.

7. Make a the subject of the following formulae.

(a) $v^2 = u^2 + 2as$

(b) $s = at + \frac{1}{2}at^2$

8. The volume of a tin can is given by

$$V = \pi r^2 h$$

where r is the radius of the base and h is the height of the can.

- (a) Make r the subject of the equation.

- (b) Find r correct to 2 decimal places if $V = 250 \text{ cm}^3$ and $h = 10 \text{ cm}$.

9. A box with a square base has its volume given by

$$V = x^2 h$$

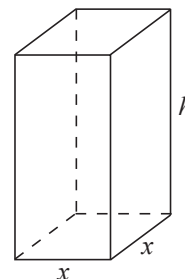
and its surface area given by

$$A = 2x^2 + 4xh$$

- (a) Make h the subject of both formulae.

- (b) Find h if $A = 24 \text{ cm}^2$ and $x = 2 \text{ cm}$.

- (c) Find h if $V = 250 \text{ cm}^3$ and $x = 10 \text{ cm}$.



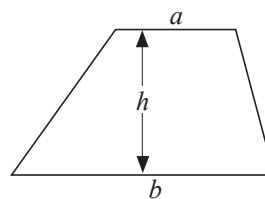
10. The area of a trapezium is given by

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

- (a) Write the formula with a as its subject.

- (b) In a particular trapezium $b = 2a$.

Use this to write a formula that does not involve b , and make a the subject.



11. (a) Average speed, $v \text{ m s}^{-1}$, time, t seconds and distance, d metres, are related by the formula

$$d = vt.$$

Make v the subject of the formula.

- (b) Use the formula to find the average speed for each of the following performances at the Beijing Olympics in 2008. Give your answers correct to 2 decimal places.
- (i) Usain Bolt when he won the men's 100 m race in a time of 9.69 seconds
 - (ii) Usain Bolt when he won the men's 200 m race in a time of 19.30 seconds.
 - (iii) The Jamaican relay team for the men's 4×100 race in a time of 37.10 s.

Explain the differences in the average speeds.