

CHAPTER 5 FORMULAE

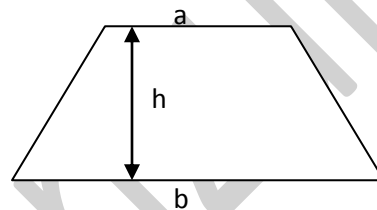
SECTION 5.1 USING FORMULAS (SUBSTITUTION)

A formula expresses the value of one variable as the others in the formula change.

Example 1

The formula for the area of a trapezium is:

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



Find the area of the trapezium when $a = 5$, $b = 9$ and $h = 3$.

$$A = \frac{(5 + 9) \times 3}{2} = \frac{14 \times 3}{2} = 21$$

Always **substitute** the numbers for the letters before trying to work out the value of the expression. You are less likely to make a mistake this way.

Consolidation

1. Work out the value of the following when $x = 3$ and $y = 4$:

a. $Z = 5(x + y)$

b. $Z = 5 - (y - x)$

c. $Z = 3 - 2(x - 2y)$

2. Evaluate when $a = 3$ and $b = 2$

$$X = \frac{a^3 - b^3}{a^3 + b^3}$$

3. Evaluate when $p = -1$ and $q = -3$

a. $R = \frac{3q}{2p}$

b. $R = 3 - \frac{6p}{q}$

c. $R = \frac{2p - 3q}{pq}$

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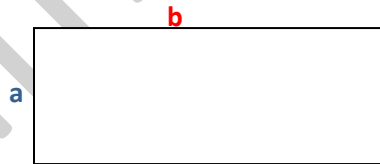
SECTION 5.2 WRITING FORMULAS

Example 1

The diagram shows a rectangle

a = the length of the rectangle

b = the width of the rectangle



The perimeter of the shape is the total distance around the edges of the shape.

The perimeter of the rectangle is $a + b + a + b$

We can collect like terms = $2a + 2b$

Let P represent the perimeter of the shape

$$P = 2(a + b)$$

Example 2

In football matches, 3 points are awarded for a win, 1 point is awarded for a draw and no points are awarded for a loss. Work out a formula for how the points are worked out.

P = total number of points

w = for the number of wins

d = for the number of draws

Since there are 3 points for each win = $3 \times w = 3w$

Since there are 1 points for each draw = $1 \times d = 1d = d$

The formula for the total number of points is $P = 3w + d$

Consolidation

1. A model shop sells c number of cars at 60 cents each and p number of planes at 80 cents each a day. At the end of the day he would have earned €200. Write an equation for his earnings.

2. A shop sells two brands of baked beans. It has N tins of baked beans altogether; y of them are one brand and z of them are the other brands. Find the formula for N in terms of y and z .

3. A rectangle is x centimeters wide and y centimeters long and its perimeter is P meters. Find the formula for P in terms of x and y .

4. Fertiliser is applied at the rate of a grams per square meter. It takes b kilograms to cover a field of area c square meters. Find a formula for b in terms of a and c .

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SECTION 5.3 CHANGING THE SUBJECT OF THE FORMULA (ADDITION & SUBTRACTION)

The **subject** of the formula, is on the left hand side of the equation. Everything else goes on the right hand side of the equation.

For example, in the formula: $v = u + at$, ' v ' is the subject.

Formulas are used to calculate the value of the subject when values of all of the other variables are known.

To *change* the subject of a formula, **begin with the variable to become the new subject**, and **apply inverse operations** as for solving equations, in the opposite order to the order convention.

Example 1

$$a + b = c \quad (\text{c is the subject of the formula})$$

Rearrange the formula to get b subject of the formula.

$$a - a + b = c - a \quad (\text{Subtract a on both sides})$$

$$b = c - a$$

Example 2

The following steps can be used to change the subject of this formula: $v = u + at$

(1) make 'u' the subject of the formula:

According to the order convention, beginning with 'u', you add 'at' to get 'v'.

The inverse operation is then to subtract 'at':

- **Subtract 'at'** from both sides:
 - $v - at = u + at - at$
- **Simplify:**
 - $v - at = u$
- **Swap** sides so the subject is on the left hand side:
 $u = v - at$

Consolidation

1. Rearrange so that b is the subject of the formula: $a = bx + c$

2. Make s the subject of the formula: $n = m - 3s$

3. Make a subject of the formula: $ab - c = p$

4. Make a subject of the formula: $5a - b + c = d$

5. Make s subject of the formula: $p = 2s + r$

6. Make v subject of the formula: $V = 2v + 3u$

7. Make s subject of the formula: $N = It - 2s$

Support Exercise Pg 288 Ex 18C No 1

SECTION 5.4 CHANGING SUBJECT OF THE FORMULA (MULTIPLICATION & DIVISION)

Example 1

Make r the subject of the formula $p = \frac{q - r}{s}$

$$p = \frac{q - r}{s}$$

$$sp = q - r \quad \text{(Multiply both sides by } s)$$

$$sp + r = q - r + r \quad \text{(Add } r \text{ to both sides)}$$

$$sp + r = q$$

Example 2

Make b subject of the formula $s = 3(a + b)$

$$s = 3(a + b)$$

$$\frac{s}{3} = a + b$$

(Divide both sides by 3)

$$\frac{s}{3} - a = a - a + b$$

(Subtract a on both sides)

$$\frac{s}{3} - a = b$$

Consolidation

1. Make m subject of the formula $L = \frac{m}{n}$

2. Make R subject of the formula $I = \frac{PTR}{100}$

3. Make y subject of the formula $x = \frac{3y}{4}$

4. Make c subject of the formula $a = b + \frac{1}{2}c$

5. Make l subject of the formula $A = P + \frac{1}{10}l$

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SECTION 5.5 CHANGING SUBJECT OF THE FORMULA (ROOTS & POWERS)

Example 1

Make x subject of the formula in $c = x^2 + y^2$

$$c = x^2 + y^2$$

$$c - y^2 = x^2 - y^2 \quad (\text{Subtract } y^2 \text{ on both sides})$$

$$c - y^2 = x^2$$

$$\sqrt{c - y^2} = \sqrt{x^2} \quad (\text{Square root both sides})$$

$$\sqrt{c - y^2} = x$$

Example 2

Make y subject of the formula in $g = 2x^2 - y^2$

$$g = 2x^2 - y^2$$

$$y^2 + g = 2x^2 - y^2 + y^2 \quad (\text{Add } y^2 \text{ on both sides})$$

$$y^2 + g = 2x^2$$

$$y^2 + g - g = 2x^2 - g \quad (\text{Subtract } g \text{ on both sides})$$

$$y^2 = 2x^2 - g$$

$$\sqrt{y^2} = \sqrt{(2x^2 - g)} \quad (\text{Square root both sides})$$

$$y = \sqrt{(2x^2 - g)}$$

Example 3

Make t subject of the formula $v = ut + 2nt$

$$v = ut + 2nt$$

In order to get only one t we must factorise the right hand side.

$$v = t(u + 2n) \quad (\text{Factorise the right hand side})$$

$$\frac{v}{u + 2n} = \frac{t(u + 2n)}{u + 2n} \quad (\text{Divide both sides by } (u+2n))$$

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

Consolidation

1. Make x subject of the formula in $H = \sqrt{(x^2 + 4)}$

$$T = 2\pi \sqrt{\frac{l}{g}}$$

2. Make l subject of the formula

3. Make t subject of the formula $\frac{1}{2}(a^2 - t^2) = pq$

4. Make c subject of the formula $a + b + \sqrt{c-1} = d$

5. Make p subject of the formula $\frac{a}{b}\sqrt{p-q} = 1$

6. Make n subject of the formula $I = \frac{nE}{R + nr}$

Support Exercise Pg 292 Ex 18E No 1 – 13

Handout

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