Maths, Y9 - Formulae

1. Making and using word formulae

Mr Jones is organising an orienteering trip for his group of 6 students.

He uses these rules to work out what he needs.

He lets **p** stand for the **number of people**.

The number of maps needed is 3 more than the number of people.

m = p + 3

For 6 students p = 6

m = 6 + 3

m = 9

Mr Jones needs 9 maps

For every 2 people we need 1 compass.

c = p ÷ 2

For 6 students p = 6

c = 6 ÷ 2

c = 3

Mr Jones needs 3 compasses

We need 3 fewer bags than the number of people.

b = p - 4

For 6 students p = 6

b = 6 - 4

b = 2

Mr Jones needs 2 bags

Buy 2 snacks per person plus 5 extra.

s = 2p + 5

For 6 students p = 6

s = 2 x 6 + 5

s = 12 + 5

s = 17

Mr Jones needs 17 snacks

2. Substituting into formulae

Consider the formula

v = u + at

This formula can be used to calculate **v**.

Find v when u = 10, a = 2, t = 5.

v = 10 + 2 x 5

= 10 + 10

= **20**

Find v when u = 5, a = -4, t = 0.5.

v = 5 + (-4) x 0.5

= 5 + - 2

= **3**

When substituting make sure you remember to apply BIDMAS

$v = \frac{1}{3}\pi r^2 h$

This formula is used to calculate the **volume of a cone**.

Find v when r = 3 and h = 8.

$v = \frac{1}{3} \times \pi \times 3^2 \times 8$

$= \frac{1}{3} \times \pi \times 9 \times 8$

$= \frac{1}{3} \times 72 \times \pi$

$= 24\pi$

= **75.40 cm³** (2 d.p.)

$s = 2\pi rh + 2\pi r^2$

This is the formula for the **surface area of a cylinder**.

Find s when r = 1.5 and h = 6

$s = 2 \times \pi \times 1.5 \times 6 + 2 \times \pi \times 1.5^2$

$= 18\pi + 2 \times \pi \times 2.25$

$= 18\pi + 4.5\pi$

$= 22.5\pi$

= **70.69 cm²** (2 d.p.)

3. Rearranging formulae

A. one step

$$a = bh$$

a is the **subject** of the formula.

Make **b** the subject of the formula.

In this formula **b** is multiplied by **h**.

To make **b** the subject we need to undo this process

Divide by h: $\frac{a}{h} = \frac{bh}{h}$

$$b = \frac{a}{h}$$

B. two step

$$v = u + at$$

Make **a** the subject of this formula.

This formula takes a variable **a**, multiplies it by **t**, then adds **u**.

Reverse this one step at a time

Subtract u: $v - u = at$

Divide by t: $\frac{v-u}{t} = a$

$$a = \frac{v-u}{t}$$

C. formulae containing brackets

$$x = p(y + q)$$

Make **y** the subject of this formula.

We have started with **y**, added **q**, then multiplied the result by **p**.

To make **y** the subject we need to:

Divide by p: $\frac{x}{p} = y + q$

Subtract q: $\frac{x}{p} - q = y$

$$y = \frac{x}{p} - q$$

D. formulae containing fractions

$$\frac{a+5}{x} = 3b$$

Make **x** the subject of this formula.

It would be easier to rearrange if there were no fractions, so we should undo the fractions first.

Multiply by x: $a + 5 = 3bx$

x has been multiplied by 3b

Divide by 3b: $\frac{a+5}{3b} = x$

$$x = \frac{a+5}{3b}$$

E. rearranging quadratic formulae

$$\frac{ax^2 + f}{e} = b$$

Make **x** the subject of this formula.

In words, we start with **x**, square it, multiply by **a** then add **f** and finally divide everything by **e**.

To make **x** the subject, undo the process.

Multiply by e: $ax^2 + f = be$

Subtract f: $ax^2 = be - f$

Divide by a: $x^2 = \frac{be-f}{a}$

Square root both sides:

$$x = \sqrt{\frac{be-f}{a}}$$