

A formula is an algebraic rule that contains a mixture of letters, numbers and mathematical symbols. It uses the letters to represent values that can be changed (variables). A formula is different to an expression as it always contains the '=' sign.

Writing a formula When we write a rule to describe the relationship between variables using letters instead of words.

E.g. 1) The cost of hiring a playcentre for a private birthday party is £6 a child plus a standard charge of £80. If x is the number of children attending a birthday party, write down a formula for the hire charge H in terms of x .

Hire Charge = £6 x the number of children + £80

$$H = 6 \times x + 80$$

$$H = 6x + 80$$

E.g. 2) Sioned is looking to change her mobile phone contract. The monthly cost is 4p a minute for calls plus £12 for unlimited texts and data. If m is the number of minutes used a month, write down the formula for the monthly cost C in terms of m .

Cost = (£0.04 x the number of minutes + £12) x 1.05

$$C = (0.04 \times m + 12) \times 1.05$$

$$C = 0.04m + 12$$

Check that you:

- can use letters to represent unknowns
- understand the basic rules of algebra for +, -, x and ÷
- can +, -, x and ÷ negative numbers, fractions and decimals
- recognise expressions and equations
- can form an expression given some information
- know the inverse of an operation
- can solve linear equations e.g. $3x - 7 = 17$

$$3x = 24$$

$$x = 8$$

Substituting into a formula When we replace the letters in a formula with numbers.

1 E.g. The hire charge at a playcentre for a birthday party is given by the formula $H = 6x + 80$. If x is the number of children attending a birthday party, find H the cost of hiring the playcentre for 16 children.

$$H = 6x + 80$$

$$H = 6 \times 16 + 80$$

$$H = 96 + 80$$

$$H = \pounds 176$$

2 E.g. The monthly cost of a mobile phone contract is given by the formula $C = 0.04m + 12$. If m is the number of minutes used a month, find C the monthly cost when 250 minutes are used.

$$C = 0.04m + 12$$

$$C = 0.04 \times 250 + 12$$

$$C = 10 + 12$$

$$C = \pounds 22$$

3 E.g. The formula to convert Fahrenheit (F) to Celsius (C) is given by $C = \frac{5}{9}(F - 32)$.

(a) If $F = 86$ find C

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

$$C = \frac{5}{9}(86 - 32)$$

$$C = \frac{5}{9}(54)$$

$$C = 30$$

(a) If $F = -13$ find C

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

$$C = \frac{5}{9}(-13 - 32)$$

$$C = \frac{5}{9}(-45)$$

$$C = -25$$

Take care when substituting negative values, fractions or decimals into a formula.

The subject of the formula. In the formula $m = 3n - p$, m is the subject of the formula as it's the letter that is on its own on the one side of the '='. There are also no other m terms on the other side of the equation.

$$a = 2b + 3c \quad a \text{ is the subject of the formula}$$

$$5r^2 - t = s \quad s \text{ is the subject of the formula}$$

Changing the subject of a formula

We can rearrange formulas using the balancing method and our knowledge of inverse operations.

E.g. 1. Make b the subject of the formula

$$a = 4b - 5$$

$$a = 4b - 5$$

$$+5 \quad +5$$

$$a + 5 = 4b$$

$$\div 4 \quad \div 4$$

$$\frac{a+5}{4} = b \quad \text{or} \quad b = \frac{a+5}{4}$$

E.g. 2. Make y the subject of the formula

$$2y + 3x = c$$

$$2y + 3x = c$$

$$-3x \quad -3x$$

$$2y = c - 3x$$

$$-3x \quad -3x$$

$$y = \frac{c - 3x}{2}$$

Changing the subject of a formula containing 2 or $\sqrt{\quad}$

Finding the square root is the inverse of squaring a number.

E.g. 3. Make a the subject of the formula

$$a^2 + b^2 = c^2$$

$$a^2 + b^2 = c^2$$

$$-b^2 \quad -b^2$$

$$a^2 = c^2 - b^2$$

$$\sqrt{\quad} \quad \sqrt{\quad}$$

$$a = \sqrt{c^2 - b^2}$$

E.g. 4. Make x the subject of the formula

$$y = \sqrt{5x + z}$$

$$y = \sqrt{5x + z}$$

$$\dots^2 \quad \dots^2$$

$$y^2 = 5x + z$$

$$-z \quad -z$$

$$y^2 - z = 5x$$

$$\div 5 \quad \div 5$$

$$\frac{y^2 - z}{5} = x \quad \text{or} \quad x = \frac{y^2 - z}{5}$$

Remember '=' means equal to so both sides must balance at all times, so make sure you do exactly the same to both sides of the formula just as you would when solving an equation.