

# CHANGING THE SUBJECT OF A FORMULA

Note Title

12/02/2009

In the formula  $y = ax + b$ , 'y' is the subject. We may need to make a different letter the subject. We do this using the same rules as for solving equations.

## Examples

①  $y = 4x + 7$       Make  $x$  the subject

$$\begin{array}{r} (-7) \qquad \qquad (-7) \\ y - 7 = 4x \end{array}$$

$$\begin{array}{r} (\div 4) \qquad \qquad (\div 4) \\ \frac{y - 7}{4} = x \end{array}$$

$$\underline{\underline{x = \frac{y - 7}{4}}}$$

②  $a = \frac{b}{5} - 2$       Make  $b$  the subject

$$\begin{array}{r} (+2) \qquad \qquad (+2) \\ a + 2 = \frac{b}{5} \end{array}$$

$$\begin{array}{r} (\times 5) \qquad \qquad (\times 5) \\ 5(a + 2) = b \end{array}$$

$$\underline{\underline{b = 5(a + 2)}}$$

③

$$a(b + c^2) = d^2$$

Make b the subject

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[Note: we cannot start by subtracting  $c^2$  from each side as we can't take it out from inside the bracket.]

$$(\div a) \qquad (\div a)$$

$$b + c^2 = \frac{d^2}{a}$$

$$(-c^2) \qquad (-c^2)$$
$$b = \frac{d^2}{a} - c^2$$

Alternative Method :-

$$a(b + c^2) = d^2$$
$$ab + ac^2 = d^2$$

$$(-ac^2) \qquad (-ac^2)$$
$$ab = d^2 - ac^2$$

$$(\div a) \qquad (\div a)$$
$$b = \frac{d^2 - ac^2}{a}$$

These two answers are the same, but written in a different way.

④

$$\frac{a}{y} = \frac{b}{c}$$

Make y the subject

[Since y is on the bottom, multiply by y to bring it to the top.]

$$(xy) \qquad (xy)$$
$$a = \frac{b}{c} \times y \qquad \text{or} \qquad \frac{b}{c/y}$$

$$(xc) \qquad (xc)$$
$$ac = by$$

$$(\div b) \qquad (\div b)$$
$$\frac{ac}{b} = y \qquad \text{or} \qquad y = \frac{ac}{b}$$

## MORE EXAMPLES

- ① If the letter to be made the subject is SQUARED,
- Make the squared letter the subject in the usual way
  - FINALLY square root both sides

e.g.  $a(x^2 - b) = c$       Make  $x$  the subject

$$ax^2 - ab = c$$

$$\quad \quad \quad (+ab) \quad \quad (+ab)$$

$$ax^2 = c + ab$$

$$(\div a)$$

$$(\div a)$$

$$x^2 = \frac{c + ab}{a}$$

$$(\sqrt{\quad})$$

$$(\sqrt{\quad})$$

$$x = \sqrt{\frac{c + ab}{a}}$$

[ Note:  $\sqrt{p^2 + q^2}$  cannot be written as  $p + q$  ]  
 - just leave it as it is . ]

- ② If there is a square root in the question, get it on its own, and then square both sides.

e.g.  $p = a\sqrt{x - b}$       Make  $x$  the subject

$$(\div a)$$

$$(\div a)$$

$$\frac{p}{a} = \sqrt{xc - b}$$

(square) (square)

$$\left(\frac{p}{a}\right)^2 = xc - b$$

(+b) (+b)

$$\underline{\underline{\left(\frac{p}{a}\right)^2 + b = xc}}$$

③ If the letter to be made the subject occurs more than once,

- Get all the terms which do contain the letter on one side, and all the terms which don't contain the letter on the other side.
- FACTORISE the required letter out of the terms which contain it.
- DIVIDE by the bracket to leave the letter on its own.

e.g

$$ax - b = p - qx$$

Make  $xc$  the subject

$$(+qx) (+qx)$$

$$ax + qx - b = p$$

(+b) (+b)

$$ax + qx = p + b$$

(FACTORISE :)  $x(a + q) = p + b$

(DIVIDE by the BRACKET:)

$$\underline{\underline{x = \frac{p+b}{a+q}}}$$