

3 Rearranging Equations

Whatever is done to one side of an equals sign must be done to the other also. Take, for example, the equation:

$$a = b + c$$

a is the subject. To make b the subject, one must look at what is done to b and do the **inverse** to both sides. In the above equation, c is added to b , so b is made the subject by **subtracting** c from both sides of the equals sign:

- Subtracting c : $a - c = b + c - c$
- Simplifying the right hand side: $a - c = b$
- Writing b as the subject: $b = a - c$

Addition and **subtraction** are inverse operations.

Multiplication and division are inverse operations.

Powers and **roots** are inverse operations.

Example 1 – Make y the subject of $x = 2 \times y + z$

The last operation on y is the addition of z , so subtract z from both sides:

$$x - z = 2 \times y$$

y is multiplied by 2, so divide both sides of the equation by 2:

$$(x - z)/2 = y$$

Example 2 – Make g the subject of $5\sqrt{g} = h + j$

Divide by 5:

$$\sqrt{g} = (h + j)/5$$

Square both sides:

$$g = (h + j)^2/25$$

3.1 Rearrange the following equations to make the variable in brackets the subject:

(a) $p = mv$ (m) (f) $M = Fd$ (d)

(b) $Q = It$ (I) (g) $V/R = I$ (R)

(c) $v = s/t$ (s) (h) $P/I = V$ (P)

(d) $F = ma$ (a) (i) $v = f\lambda$ (λ)

(e) $W = mg$ (m) (j) $\rho = m/V$ (V)

3.2 Rearrange the following equations to make the variable in brackets the subject:

(a) $E = mgh$ (m)

(b) $P_1V_1 = P_2V_2$ (P_2)

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

(d) $\sin(c) = 1/n$ (n)

(e) $V_p/V_s = N_p/N_s$ (N_s)

3.3 Make v the subject of the following equation:

$$E = \frac{1}{2}mv^2$$

3.4 If $u = 0$, make t the subject of the following equation:

$$s = ut + \frac{1}{2}at^2$$

3.5 Make $\sin(r)$ the subject of the following equation:

$$n = \frac{\sin(i)}{\sin(r)}$$

3.6 Make x the subject of the following equation:

$$10(x + y) = 5(x - y)$$

3.7 Make λ the subject of the following equation:

$$t = k/\lambda$$

3.8 Make r the subject of the following equation:

$$F = \frac{kQ_1Q_2}{r^2}$$

3.9 Make T the subject of the following equation:

$$r \left(\frac{2\pi}{T} \right)^2 = \frac{GM}{r^2}$$