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) $V_\mathrm{p}/V_\mathrm{s} = N_\mathrm{p}/N_\mathrm{s}$	(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:
$$F = \frac{kQ_1Q_2}{r^2}$$

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3.9 Make T the subject of the following equation:
$$r\left(\frac{2\pi}{T}\right)^2 = \frac{GM}{r^2}$$