

Rearranging formulae when the required subject appears more than once

Starter

1. (Review of last lesson)

Make w the subject of: (a) $c = \sqrt{n - w}$ (b) $xy = 7 - 4z^5$

2. (Review of previous material) Factorise $xy + x$.

3. (a) Make x the subject of $5x = 2x + 4y$

(b) Using a similar first step to (a), make x the subject of $5x = ax + 4y$.

Notes

When the *new subject appears more than once*, the working requires a *factorisation* step. Before factorising, make sure all the terms including the new subject are in the same side, and all the other terms are on the other side.

E.g. 1 Make y the subject: (a) $ay + d = 3d + py$ (b) $my - c = e - ny$

Working: (a)

$$ay + d = 3d + py$$

Subtract py from both sides:

$$ay - py + d = 3d$$

Subtract d from both sides:

$$ay - py = 2d$$

Factorise the LHS:

$$y(a - p) = 2d$$

Divide both sides by $a - p$:

$$y = \frac{2d}{a - p}$$

When the new subject appears inside separate brackets, expand the brackets before collecting like terms and factorising.

E.g. 2 Make x the subject: (a) $a(x + 2) = 3(4 - 5x)$ (b) $5(x - p) = q(7 + x)$

Working: (a)

$$a(x + 2) = 3(4 - 5x)$$

Expand the brackets:

$$ax + 2a = 12 - 15x$$

Add $15x$ to both sides:

$$ax + 15x + 2a = 12$$

Subtract $2a$ from both sides:

$$ax + 15x = 12 - 2a$$

Factorise the LHS:

$$x(a + 15) = 12 - 2a$$

$$x = \frac{12 - 2a}{a + 15}$$

If the new subject appears in the numerator and denominator of a fraction, multiply by the denominator before expanding brackets.

Cross-multiplication is also a useful method to employ.

E.g. 3 Make y the subject: (a) $\frac{a - y}{b + y} = d$ (b) $\frac{2y + p}{q - y} = \frac{t}{3}$

Working: (a)

$$\frac{a - y}{b + y} = d$$

Multiply both sides by $b + y$:

Expand the brackets:

Add y to both sides:

Subtract bd from both sides:

Factorise the LHS:

Divide both sides by $d + 1$:

New subject on the LHS:

$$a - y = d(b + y)$$

$$a - y = bd + dy$$

$$a = bd + dy + y$$

$$a - bd = dy + y$$

$$a - bd = y(d + 1)$$

$$\frac{a - bd}{d + 1} = y$$

$$y = \frac{a - bd}{d + 1}$$

Video:

[Solving equations with letters on both sides](#)

[Solutions to Starter and E.g.s](#)

Exercise

9-1 class textbook:	p169 M6.7 Qu 1-3, 4ace..., 5, 6, 7ace..., 8, 9
A*-G class textbook:	p162 E6.1 Qu 1-3, 4ace..., 5, 6, 7ace..., 8, 9
9-1 homework book:	p60 M6.7 Qu 1-10
A*-G homework book:	p46 E6.1 Qu 1-10

Summary

When the **new subject appears more than once**, the working requires a **factorisation** step. Before factorising, make sure all the terms including the new subject are in the same side, and all the other terms are on the other side.

When the new subject appears inside separate brackets, expand the brackets before collecting like terms and factorising.

If the new subject appears in the numerator and denominator of a fraction, multiply by the denominator before expanding brackets.