

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)  $xy = 7 - 4w^5$

**Working:** (a)

**Square both sides:**  
**Add  $w$  to make  $w$  positive:**  
**Subtract  $c^2$  from both sides:**

$$\begin{aligned} c &= \sqrt{n - w} \\ c^2 &= n - w \\ c^2 + w &= n \\ w &= n - c^2 \end{aligned}$$

(b)

**Add  $4w^5$  to make  $w$  positive:**  
**Subtract  $xy$  from both sides:**  
**Divide both sides by 4:**  
**5th root both sides:**

$$\begin{aligned} xy &= 7 - 4w^5 \\ xy + 4w^5 &= 7 \\ 4w^5 &= 7 - xy \\ w^5 &= \frac{7 - xy}{4} \\ w &= \sqrt[5]{\frac{7 - xy}{4}} \end{aligned}$$

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

**Working:**  $xy + x = x(y + 1)$  *note the 1 in the bracket*

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

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

**Working:** (a)

**Subtract  $2x$  from both sides:**  
**Divide both sides by 3:**

$$\begin{aligned} 5x &= 2x + 4y \\ 3x &= 4y \\ x &= \frac{4y}{3} \end{aligned}$$

(b)

**Subtract  $ax$  from both sides:**  
**Factorise the LHS:**  
**Divide both sides by  $5 - a$ :**

$$\begin{aligned} 5x &= ax + 4y \\ 5x - ax &= 4y \\ x(5 - a) &= 4y \\ x &= \frac{4y}{5 - a} \end{aligned}$$

**E.g. 1** Make  $y$  the subject: (a)  $ay + d = 3d + py$

(b)  $my - c = e - ny$

**Working:** (a)

**Subtract  $py$  from both sides:**  
**Subtract  $d$  from both sides:**  
**Factorise the LHS:**  
**Divide both sides by  $a - p$ :**

$$\begin{aligned} ay + d &= 3d + py \\ ay - py + d &= 3d \\ ay - py &= 2d \\ y(a - p) &= 2d \\ y &= \frac{2d}{a - p} \end{aligned}$$

(b)

*Add ny to both sides:*  
*Add c to both sides:*  
*Factorise the LHS:*  
*Divide both sides by m + n:*

$$\begin{aligned} my - c &= e - ny \\ my + ny - c &= e \\ my + ny &= e + c \\ y(m + n) &= e + c \\ y &= \frac{e + c}{m + n} \end{aligned}$$

**E.g. 2** Make x the subject: (a)  $a(x + 2) = 3(4 - 5x)$

**Working:** (a)

*Expand the brackets:*  
*Add 15x to both sides:*  
*Subtract 2a from both sides:*  
*Factorise the LHS:*

(b)  $5(x - p) = q(7 + x)$

$$\begin{aligned} a(x + 2) &= 3(4 - 5x) \\ ax + 2a &= 12 - 15x \\ ax + 15x + 2a &= 12 \\ ax + 15x &= 12 - 2a \\ x(a + 15) &= 12 - 2a \\ x &= \frac{12 - 2a}{a + 15} \end{aligned}$$

(b)

*Expand the brackets:*  
*Subtract qx from both sides:*  
*Add 5p to both sides:*  
*Factorise the LHS:*

$$\begin{aligned} 5(x - p) &= q(7 + x) \\ 5x - 5p &= 7q + qx \\ 5x - qx - 5p &= 7q \\ 5x - qx &= 7q + 5p \\ x(5 - q) &= 7q + 5p \\ x &= \frac{7q + 5p}{5 - q} \end{aligned}$$

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

**Working:** (a)

*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:*

(b)  $\frac{2y + p}{q - y} = \frac{t}{3}$

$$\begin{aligned} \frac{a - y}{b + y} &= d \\ a - y &= d(b + y) \\ a - y &= bd + dy \\ a &= bd + dy + y \\ a - bd &= dy + y \\ a - bd &= y(d + 1) \\ \frac{a - bd}{d + 1} &= y \\ y &= \frac{a - bd}{d + 1} \end{aligned}$$

(b)

*Cross multiply:*  
*Expand the brackets:*  
*Add ty to both sides:*  
*Subtract 3p from both sides:*  
*Factorise the LHS:*  
*Divide both sides by 6 + t:*

$$\begin{aligned} \frac{2y + p}{q - y} &= \frac{t}{3} \\ 3(2y + p) &= t(q - y) \\ 6y + 3p &= qt - ty \\ 6y + 3p + ty &= qt \\ 6y + ty &= qt - 3p \\ y(6 + t) &= qt - 3p \\ x &= \frac{qt - 3p}{6 + t} \end{aligned}$$

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

