

Rearranging Formulae

Starter

1. **(Review of last lesson)**
Expand and simplify: (a) $(5x - 1)(2x - 3)$ (b) $(6 - n)(2n + 1)$
2. What is the difference between an equation and a formula?

Notes

A **formula** has an = symbol and at least 2 letters in it. One letter is usually on its own on the left hand side. This letter is called the **subject of the formula**. For example, the subject of the formula $v = u + at$ is v .

In the same way after solving an equation, we do not write $-x = 4$ and instead write $x = -4$, so the subject of the formula **cannot have a negative symbol in front** of it i.e. write $x = 2a - 3b$ and not $-x = 3b - 2a$.

Changing the subject a formula means **rearranging the formula** so that another letter is on its own on the LHS.

Do not copy

For example, consider the formula $v = u + at$.

We could rearrange to make u the subject of the formula $v = u + at$.

$$v = u + at \quad \text{u is positive so we don't want to move it to the other side}$$

$$v - at = u \quad (-at) \quad \text{u is positive, on its own and at the top but it is not on the LHS}$$

$$u = v - at \quad \text{Swap the formula over}$$

Or we could rearrange to make a the subject of the formula.

$$v = u + at \quad \text{a is positive so we don't want to move it to the other side}$$

$$v - u = at \quad (-u) \quad \text{a is not on its own so we need to move the t}$$

$$\frac{v - u}{t} = a \quad (\div t) \quad \text{Divide by t since division is the opposite to multiplication}$$

$$a = \frac{v - u}{t} \quad \text{Swap the formula over}$$

Please start copying again.

The principles behind solving an equation are exactly the same when you are changing the subject of a formula so we use **SABMIB** to decide which operation to do at each stage.

Solving an equation

Solve $2x + 7 = 15$.

$$2x + 7 = 15$$

$$2x = 8$$

$$x = 4$$

$$(-7)$$

$$(\div 2)$$

Rearranging a formula

Rearrange $ax + b = c$ to make x the subject.

$$ax + b = c$$

$$ax = c - b$$

$$x = \frac{c - b}{a}$$

$$(-b)$$

$$(\div a)$$

When rearranging an equation we need to make sure **PLOT** is in place at the end:

Positive — the new subject must be positive

LHS — the new subject must be on the LHS (if you have $v - at = u$ write $u = v - at$)

On its own — no other letters or number must be with the new subject

Top — the new subject must not be in the *denominator* of a fraction

N.B. LHS \equiv Left-hand side
“Don’t lose the **PLOT**.”

E.g. 1 Rearrange the formula to make x the subject:

(a) $3x - p = q$ (b) $y = mx + c$ (c) $s - t = t + kx$

Working: (a) *x is positive so we don’t want to move it to the other side*
Subtraction before multiplication $3x - p = q$
Add q to both sides $3x = q + p$
Divide both sides by 3 $x = \frac{q + p}{3}$

E.g. 2 Rearrange the formula to make x the subject:

(a) $\frac{x}{c} = a + b$ (b) $\frac{x}{s} + 1 = t$ (c) $a = \frac{x}{m} + n$

Working: (a) *x is positive so we don’t want to move it to the other side*
Multiply both sides by c $\frac{x}{c} = a + b$
 $x = c(a + b)$

N.B. *Expand* brackets *before rearranging unless the new subject is in front of the bracket.*

E.g. 3 Rearrange the formula to make x the subject of the formula:

(a) $s(x + a) = b$ (b) $z = p(3x - y)$ (c) $x(c + d) = e$

Working: (a) *x is positive so we don’t want to move it to the other side*
 x is not in front of the brackets so expand $s(x + a) = b$
Addition before multiplication $sx + as = b$
Subtract as from both sides $sx = b - as$
Divide both sides by s $x = \frac{b - as}{s}$

N.B. When the new subject is negative, it is usually a good idea to *prioritise making it positive*

E.g. 4 Rearrange the formula to make y the subject of the formula:

(a) $e = u - gy$ (b) $w^2 = u^2 - ay$ (c) $t - 5y = b$

Working: (a) *y is negative so we need to move it to the other side*
Add gy to both sides $e = u - gy$
Addition before multiplication $e + gy = u$
Subtract e from both sides $gy = u - e$
Divide both sides by g $y = \frac{u - e}{g}$

Exercise

p23 Ex 12.6 Qu 1ace..., 2-10

Summary

Changing the subject a formula means *rearranging the formula* so that another letter is on its own on the LHS.

The principles behind solving an equation are exactly the same when you are changing the subject of a formula so we use **SABMIB** to decide which operation to do at each stage.

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