

MS.2 Rearranging equations

Here are some tips for rearranging equations:

- Whatever you do to one side of an equation, you must do to the other.
- Don't use the $\div$ symbol. (e.g. write $\frac{F}{m}$ rather than $F \div m$).



videos

Equations with involving adding and subtracting

The following equation has a as the subject (i.e. $a = \dots$):

$$a = b + c$$

Making b the subject:

$$a - c = b + \cancel{-c} - \cancel{-c}$$

Subtract c from both sides and cancel

$$a - c = b$$

$$b = a - c$$

Making c the subject:

$$a - b = \cancel{+c} - \cancel{+c} + c$$

Subtract b from both sides and cancel

$$a - b = c$$

$$c = a - b$$

Practice

1) ✎ Make y the subject in the following equation:

$$x = y + z$$

2) ✎ Make *braking distance* the subject in the following equation:

$$\text{stopping distance} = \text{thinking distance} + \text{braking distance}$$

Equations with involving adding and subtracting

The following equation has F as the subject (i.e. $F = \dots$):

$$F = m \times a$$

Making m the subject:

$$\frac{F}{a} = \frac{m \times \cancel{a}}{\cancel{a}}$$

Divide both sides
by a and cancel

$$\frac{F}{a} = m$$

$$m = \frac{F}{a}$$

Making a the subject:

$$\frac{F}{m} = \frac{\cancel{m} \times a}{\cancel{m}}$$

Divide both sides
by m and cancel

$$\frac{F}{m} = a$$

$$a = \frac{F}{m}$$

Practice

3)  Make m the subject in the following equation:

$$p = m \times v$$

4)  Make *resistance* the subject in the following equation:

$$\text{potential difference} = \text{current} \times \text{resistance}$$

The following equation has P as the subject (i.e. $P = \dots$):

$$P = \frac{E}{t}$$

Making E the subject (note that E is the numerator):

$$P \times t = \frac{E \cancel{\times t}}{\cancel{t}}$$

Multiply both sides by t and cancel

$$P \times t = E$$

$$E = P \times t$$

Making t the subject (note that t is the denominator):

$$P \times t = \frac{E \cancel{\times t}}{\cancel{t}}$$

Multiply both sides by t and cancel

$$P \times t = E$$

$$\frac{\cancel{P} \times t}{\cancel{P}} = \frac{E}{P}$$

Divide both sides by P and cancel

$$t = \frac{E}{P}$$

Practice

5) ✎ Make M the subject in the following equation (M is the numerator):

$$\rho = \frac{M}{V}$$

6) ✎ Make $time$ the subject in the following equation ($time$ is the denominator):

$$speed = \frac{distance}{time}$$

Equations involving squares

The following equation has V^2 as the subject (i.e. $F = \dots$):

$$V^2 = P \times R$$

Making V the subject:

$$\sqrt{V^2} = \sqrt{P \times R}$$

Take the square
root of both sides
and simplify

$$V = \sqrt{P \times R}$$

Practice

7)  Make b the subject in the following equation:

$$b^2 = c \times e$$

8)  Make *current* the subject in the following equation:

$$\text{current}^2 = \frac{\text{power}}{\text{resistance}}$$

Combination equations

Sometimes you will need to do a combination of steps to rearrange. Consider the following equation (kinetic energy is the subject):

$$\text{kinetic energy} = 0.5 \times \text{mass} \times \text{speed}^2$$

Making *mass* the subject:

$$\frac{\text{kinetic energy}}{0.5 \times \text{speed}^2} = \frac{\cancel{0.5 \times \text{mass} \times \text{speed}^2}}{\cancel{0.5 \times \text{speed}^2}}$$

Divide both sides
by $(0.5 \times \text{speed}^2)$
and cancel

$$\frac{\text{kinetic energy}}{0.5 \times \text{speed}^2} = \text{mass}$$

$$\text{mass} = \frac{\text{kinetic energy}}{0.5 \times \text{speed}^2}$$

Making *speed* the subject:

$$\frac{\text{kinetic energy}}{0.5 \times \text{mass}} = \frac{0.5 \times \text{mass} \times \text{speed}^2}{0.5 \times \text{mass}}$$

Divide both sides
by $(0.5 \times \text{mass})$
and cancel

$$\frac{\text{kinetic energy}}{0.5 \times \text{mass}} = \text{speed}^2$$

$$\sqrt{\frac{\text{kinetic energy}}{0.5 \times \text{mass}}} = \sqrt{\text{speed}^2}$$

Take square roots
of both sides and
simplify

$$\sqrt{\frac{\text{kinetic energy}}{0.5 \times \text{mass}}} = \text{speed}$$

$$\text{speed} = \sqrt{\frac{\text{kinetic energy}}{0.5 \times \text{mass}}}$$

Practice

9) ✎ Make *I* the subject in the following equation:

$$P = I^2 R$$

10) ✎ Make *e* the subject in the following equation (note $E_e = \text{elastic energy}$):

$$E_e = 0.5 \times k \times e^2$$

Consider the following equation:

$$v^2 - u^2 = 2as$$

Making u the subject:

$$v^2 - \cancel{u^2} + \cancel{u^2} = 2as + u^2$$

Add u^2 to both sides and cancel

$$v^2 = 2as + u^2$$

$$v^2 - 2as = \cancel{2as} - \cancel{2as} + u^2$$

Subtract $2as$ from both sides and cancel

$$v^2 - 2as = u^2$$

$$\sqrt{v^2 - 2as} = \sqrt{u^2}$$

Take square roots of both sides and simplify

$$\sqrt{v^2 - 2as} = u$$

$$u = \sqrt{v^2 - 2as}$$

Practice

11)  Make v the subject in the following equation:

$$v^2 - u^2 = 2as$$

12)  Make s the subject in the following equation:

$$v^2 - u^2 = 2as$$