

GCSE Maths – Algebra

Rearranging Formulae

Worksheet

WORKED SOLUTIONS

This worksheet will show you how to work out different types of questions regarding rearranging formulae. Each section contains a worked example, a question with hints and then questions for you to work through on your own.

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Section A

Worked Example

The temperature conversion formula between Fahrenheit, *F*, and Celsius, *C*, is given by $F = \left(C \times \frac{9}{5}\right) + 32$. What is 40 degrees Celsius in Fahrenheit?

Step 1: Write down all the given values and then substitute these values into the given formula.

Given: C = 40 degrees celsius

We do not need to rearrange the formula since the subject of the formula is F which is what we want to find. Substitute C = 40 into the formula:

$$F = \left(40 \times \frac{9}{5}\right) + 32$$

Step 2: Calculate the value asked in the question. This should be the subject of the formula.

$$F = \left(40 \times \frac{9}{5}\right) + 32 = 104$$

Therefore, 40 degrees Celsius is 104 degrees Fahrenheit.

Guided Example

Consider the equation $a = \frac{v-u}{t}$. Calculate acceleration when v = 105, u = 25 and t = 5.

Step 1: Write down all the given values and then substitute these values into the given formula

v = 105 u = 25 t = 5 $a = \frac{v - u}{t} = \frac{105 - 25}{5}$ f = 5Step 2: Calculate the value asked in the question. This should be the subject of the formula. $a = \frac{105 - 25}{5} = \frac{80}{5} = 16$

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Now it's your turn!

If you get stuck, look back at the worked and guided examples.

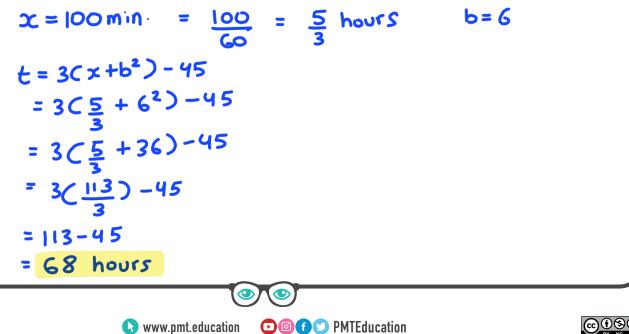
- 1. Use substitution in the following questions to work out the value of the required variable.
- a) Given x = 54 and y = 10, calculate z when $z = \frac{xy}{3} + 3y$.

 $x = 54 \ y = 10$ $z = \frac{xy}{3} + 3y = \frac{(54)(10)}{3} + 3(10)$ $= \frac{540}{3} + 30 = 210$

- b) Consider the equation a = 4(x + 8) + b. Calculate a when x = 10 and b = 33. x = 10 b = 33 a = 4(x+8) + b = 4(10+8) + 33 = 4(18) + 33= 105
- c) A sailor uses the following equation to calculate when their ship will reach its destination:

$$t = 3(x + b^2) - 45$$

Suppose *t* and *x* are time measured in hours and *b* is the number of the people on the ship. Find *t* when x = 100 minutes and the number of people on the ship is 6.





Section B

Worked Example

A trapezium has an area of 60 m². The sum of its parallel sides is 24 m. Find the height of the trapezium. The formula for the area of a trapezium is $A = \frac{(a+b)h}{2}$.

Step 1: Rearrange the formula to make the required variable the subject.

$$A=\frac{(a+b)h}{2}$$

We are finding *h* so we want to make *h* the subject of the equation: Multiply both sides of the equation by 2:

$$2A = (a+b)h$$

Divide both sides of the equation by (a + b):

$$h = \frac{2A}{a+b}$$

Step 2: Write down all the given values and substitute these values into the formula to calculate the required value.

Given values: A = 60, a + b = 24

$$h = \frac{2A}{a+b} = \frac{2(60)}{24} = 5$$
 m

Guided Example

Suppose $x = y^2 + 2ab$. Find b when x = 25, y = 3 and a = 4.

Step 1: Rearrange the formula to make the required variable the subject.

Finding b:

$$-y^2$$

 $z^2 = 2ab$
 $x = y^2 + 2ab$
 $x - y^2 = 2ab$
 $x - y^2 = b$
 $x - y^2 = b$

Step 2: Write down all the given values and substitute these values into the formula to calculate the required value.

$$x = 25$$
 $y = 3$ $a = 4$
 $b = x - y^2 = 25 - 3^2 = 3$

20

$$= \frac{16}{8} = 2$$

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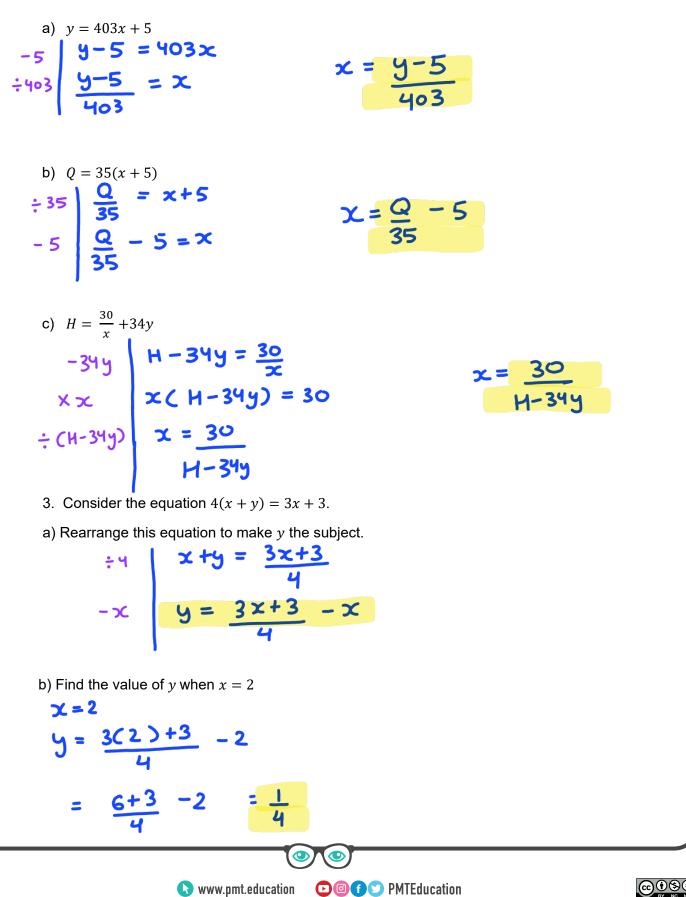
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Now it's your turn!

If you get stuck, look back at the worked and guided examples.

2. Rearrange the following equations to make *x* the subject:





Section C

Worked Example

Make *m* the subject of the equation $n = \frac{m-4}{m-13}$. Find the value of *m*, when n = 9.

Step 1: Try to eliminate the fraction.

We are making m the subject.

Multiply both sides by (m - 13) and expand any brackets:

$$n = \frac{m-4}{m-13}$$
$$n(m-13) = m-4$$
$$nm-13n = m-4$$

Step 2: Bring all the terms with the subject onto one side and then factorise the subject out of the terms.

Bring both the terms containing m onto the left-hand side of the equation by subtracting m from both sides of the equation. Add 13n to both sides of the equation to move the terms without m to the right-hand side of the equation.

nm - 13n = m - 4nm - 13n - m = -4nm - m = 13n - 4m(n - 1) = 13n - 4

Step 3: Divide by the bracket which the subject has been factored out of to obtain an expression with only the subject on one side of the equation.

$$m(n-1) = 13n - 4$$
$$m = \frac{13n - 4}{n-1}$$

Step 4: Write down all the given values and substitute these values into the formula.

Given values: n = 9

$$m = \frac{13n - 4}{n - 1} = \frac{13(9) - 4}{9 - 1} = \frac{113}{8}$$

So, when n = 9, $m = \frac{113}{8}$.

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Worked Example

Make *u* the subject of the equation $\frac{13}{a} = \frac{1}{b-1} - \frac{1}{u}$.

Step 1: Aim to eliminate all the fractions, by multiplying the expression by the denominators.

Multiply the equation by a:

$$13 = \frac{a}{b-1} - \frac{a}{u}$$

Multiply the equation by (b - 1):

$$13(b-1) = a - \frac{a(b-1)}{u}$$

Multiply by u:

13u(b-1) = au - a(b-1)

Step 2: Bring all the terms with the subject onto one side and then factorise the subject out of the terms.

13u(b-1) = au - a(b-1)13u(b-1) - au = -a(b-1)u(13(b-1) - a) = -a(b-1)

Step 3: Divide by the bracket which the subject has been factored out of to obtain an expression with only the subject on one side of the equation.

$$u(13(b-1) - a) = -a(b-1)$$
$$u = \frac{-a(b-1)}{13(b-1) - a}$$

$$u=\frac{-ab-a}{13b-13-a}$$

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Guided Example

Make s the subject of the equation $j = \frac{2s-1}{s-2}$.

Step 1: Aim to eliminate the fraction.

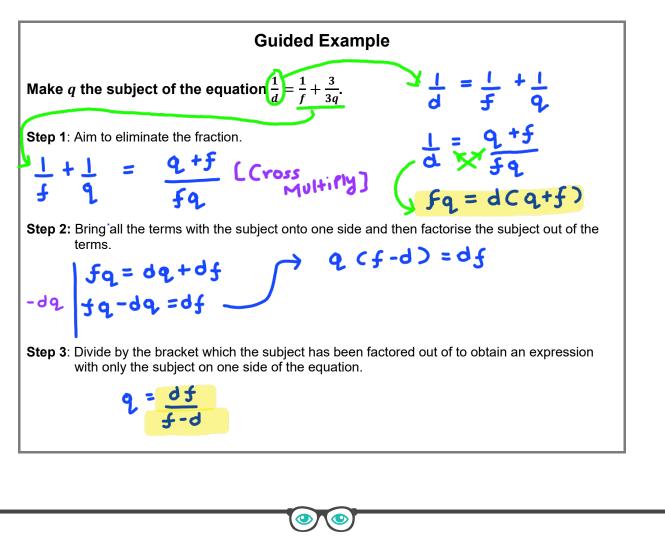
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Step 2: Bring all the terms with the subject onto one side and then factorise the subject out of the terms.

is-2s = -1+2jis-2s = -1+2j

Step 3: Divide by the bracket which the subject has been factored out of to obtain an expression with only the subject on one side of the equation.

 $S = \frac{-1+2j}{j-2}$



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Now it's your turn!

If you get stuck, look back at the worked and guided examples.

4. Rearrange the following equations to make *x* the subject.

a)
$$y = \frac{9x-4}{13-x}$$

-13y -9x
 $x = -4$
 $y(13-x) = 9x-4$
 $13y - xy = 9x - 4$
 $-9x - xy = -4 - 13y$
 $x(-9-y) = -4 - 13y$
 $x = -4 - 13y$
 $-9 - y$

b)
$$3 - y = \frac{1 - x}{3 - 9x}$$

$$\begin{pmatrix} (3 - 9)(3 - 9x) = 1 - x \\ 3(3 - 9x) - 9(3 - 1z) = 1 - x \\ 9 - 27x - 39 + 9x9 = 1 - x \\ 8 - 26x - 39 + 9x9 = 1 - x \\ 8 - 26x - 39 + 9x9 = 0 \\ -26x + 9x9 = 39 - 8 \\ x(-26 + 9y) = 39 - 8 \\ x(-26 + 9y) = 39 - 8 \\ x = \frac{39 - 8}{-26 + 9y}$$

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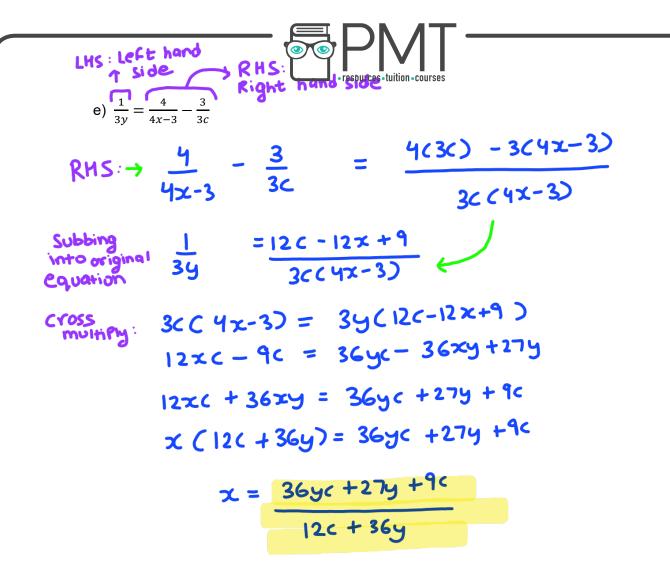


c) $y-3 = \frac{13gx-5}{8-x}$ (y-3) (8-x) = 139x-5y(8-x) - 3 (8-x) = 139x-58y-xy - 24 + 3x = 139x-5all x terms stay on one side -xy + 3x - 139x = -8y+24-5x(-y+3-139) = -8y+19x = -8y+19-y+3 - 139

d)
$$\frac{j}{t} = \frac{3x-2+4x}{4-2x}$$

 $j(4-2x) = t < 3x-2+4x)$
 $4j-2jx = t < 7x-2$)
 $4j-2jx = 7t < -2t$
 $-2jx - 7t × = -2t - 4j$
 $x(-2j-7t) = -2t - 4j$
 $x = \frac{-2t-4j}{-2j-7t}$

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