

Rearranging Harder Formulae

Solutions

For AQA GCSE Mathematics (8300) • Higher tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (1 mark)

Rearrange $h = 2g^2$ to make g the subject.

Circle your answer.

Options: $g = \frac{\sqrt{h}}{2}$, $g = \sqrt{\frac{h}{2}}$, $g = \sqrt{2h}$, $g = \frac{h^2}{2}$

g has been squared and then multiplied by 2.

Undo these in reverse order.

Divide both sides by 2: $\frac{h}{2} = g^2$

Square root both sides: $g = \sqrt{\frac{h}{2}}$

Answer: $g = \sqrt{\frac{h}{2}}$

Tip: Divide by 2 **before** you square root. $\frac{\sqrt{h}}{2}$ would only be right if the formula were $h = 4g^2$.

2 (2 marks)

Rearrange $P = 4d - 3t$ to make t the subject.

The t term is being subtracted, so add $3t$ to both sides to make it positive:

$$P + 3t = 4d$$

Subtract P from both sides:

$$3t = 4d - P$$

Divide both sides by 3:

$$t = \frac{4d - P}{3}$$

Answer: $t = \frac{4d - P}{3}$

Tip: Watch the signs. $t = \frac{P - 4d}{3}$ is wrong: check it by putting in numbers, e.g. $d = 3$ and $t = 2$ give $P = 6$.

Marks: 1 mark for $3t = 4d - P$ (or $-3t = P - 4d$). 1 mark for the correct answer.

3 (2 marks)

Make r the subject of $V = \frac{1}{3}\pi r^2 h$

Multiply both sides by 3:

$$3V = \pi r^2 h$$

Divide both sides by πh :

$$r^2 = \frac{3V}{\pi h}$$

Square root both sides:

$$r = \sqrt{\frac{3V}{\pi h}}$$

Answer: $r = \sqrt{\frac{3V}{\pi h}}$

Tip: Draw the square root sign over the **whole** fraction, not just the top.

Marks: 1 mark for $r^2 = \frac{3V}{\pi h}$. 1 mark for the correct answer.

4 (3 marks)

Make L the subject of $T = 2\pi\sqrt{\frac{L}{g}}$

Divide both sides by 2π :

$$\frac{T}{2\pi} = \sqrt{\frac{L}{g}}$$

Square both sides to remove the square root:

$$\frac{T^2}{(2\pi)^2} = \frac{L}{g}, \text{ so } \frac{T^2}{4\pi^2} = \frac{L}{g}$$

Multiply both sides by g :

$$L = \frac{gT^2}{4\pi^2}$$

Answer: $L = \frac{gT^2}{4\pi^2}$

Tip: When you square $\frac{T}{2\pi}$, square everything: $(2\pi)^2 = 4\pi^2$, not $2\pi^2$.

Marks: 1 mark for dividing by 2π . 1 mark for squaring both sides correctly. 1 mark for the correct answer.

5 (3 marks)

Make x the subject of $ax + b = cx + d$

x appears twice, so get all the x terms on one side.

Subtract cx from both sides: $ax - cx + b = d$

Subtract b from both sides: $ax - cx = d - b$

Factorise the left side (take out x):

$$x(a - c) = d - b$$

Divide both sides by $(a - c)$:

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

Answer: $x = \frac{d-b}{a-c}$

Marks: 1 mark for collecting the x terms on one side. 1 mark for factorising. 1 mark for the correct answer.

6 (3 marks)

Make f the subject of $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

Add the fractions on the left, using the common denominator uv :

$$\frac{1}{u} + \frac{1}{v} = \frac{v}{uv} + \frac{u}{uv} = \frac{u+v}{uv}$$

$$\text{So } \frac{u+v}{uv} = \frac{1}{f}$$

Now there is one fraction on each side, so you can turn both sides upside down:

$$\frac{uv}{u+v} = f$$

Answer: $f = \frac{uv}{u+v}$

Tip: You cannot just flip each fraction to get $f = u + v$. Combine the left side into one fraction first.

Marks: 1 mark for using the common denominator uv . 1 mark for $\frac{u+v}{uv} = \frac{1}{f}$. 1 mark for the correct answer.

7 (3 marks)

Rearrange $w = \frac{2x}{x-5}$ to make x the subject.

Multiply both sides by $(x-5)$ to clear the fraction:

$$w(x-5) = 2x$$

Expand the bracket:

$$wx - 5w = 2x$$

Get the x terms on the left and the other term on the right:

$$wx - 2x = 5w$$

Factorise the left side:

$$x(w - 2) = 5w$$

Divide both sides by $(w - 2)$:

$$x = \frac{5w}{w - 2}$$

Answer: $x = \frac{5w}{w - 2}$

Tip: x appears twice, so you must collect the x terms together and then factorise. An answer with x on both sides is not finished.

Marks: 1 mark for $wx - 5w = 2x$. 1 mark for $x(w - 2) = 5w$. 1 mark for the correct answer.

8 (4 marks)

Rearrange $\frac{x+1}{x-4} = \frac{y}{2}$ to make x the subject.

Multiply both sides by 2 and by $(x - 4)$ to clear both fractions:

$$2(x + 1) = y(x - 4)$$

Expand both brackets:

$$2x + 2 = xy - 4y$$

Get the x terms on one side and the other terms on the other side:

$$2 + 4y = xy - 2x$$

Factorise the right side:

$$2 + 4y = x(y - 2)$$

Divide both sides by $(y - 2)$:

$$x = \frac{4y + 2}{y - 2}$$

Answer: $x = \frac{4y + 2}{y - 2}$ (or an equivalent, e.g. $\frac{-4y - 2}{2 - y}$)

Tip: Use brackets when you cross-multiply: $y(x - 4)$ gives $xy - 4y$. Writing $xy - 4$ loses a term.

Marks: 1 mark for $2(x + 1) = y(x - 4)$. 1 mark for collecting the x terms on one side. 1 mark for factorising. 1 mark for the correct answer.

9 (4 marks)

Rearrange $t(5 - x) = 2(x + t^2)$ to make x the subject.

Expand both brackets:

$$5t - tx = 2x + 2t^2$$

Get the x terms on one side and the other terms on the other side.

Add tx to both sides and subtract $2t^2$ from both sides:

$$5t - 2t^2 = 2x + tx$$

Factorise the right side:

$$5t - 2t^2 = x(2 + t)$$

Divide both sides by $(2 + t)$:

$$x = \frac{5t - 2t^2}{2 + t}$$

Answer: $x = \frac{5t - 2t^2}{t + 2}$ (or an equivalent, e.g. $\frac{t(5 - 2t)}{t + 2}$)

Tip: Collect the x terms on the side where they are positive. Here, adding tx to both sides avoids a minus sign in front of the bracket.

Marks: 1 mark for expanding both brackets. 1 mark for collecting the x terms on one side. 1 mark for factorising. 1 mark for the correct answer.
