

Rearranging Harder Formulae

Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • 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 (2 marks)

Make t the subject of the formula $y = 4a - \frac{t}{2}$

Add $\frac{t}{2}$ to both sides, so the t term is positive:

$$y + \frac{t}{2} = 4a$$

Subtract y from both sides:

$$\frac{t}{2} = 4a - y$$

Multiply both sides by 2:

$$t = 2(4a - y) = 8a - 2y$$

Answer: $t = 8a - 2y$ (or $t = 2(4a - y)$)

Tip: When you multiply by 2, multiply **both** terms: $2(4a - y)$ is $8a - 2y$, not $8a - y$.

Marks: 1 mark for $\frac{t}{2} = 4a - y$ or $2y = 8a - t$. 1 mark for the correct answer.

2 (3 marks)

Make a the subject of $3(a - 2b) = a + 5$

Expand the bracket:

$$3a - 6b = a + 5$$

Subtract a from both sides:

$$2a - 6b = 5$$

Add $6b$ to both sides:

$$2a = 5 + 6b$$

Divide both sides by 2:

$$a = \frac{5 + 6b}{2}$$

Answer: $a = \frac{5 + 6b}{2}$

Marks: 1 mark for expanding the bracket. 1 mark for collecting the a terms. 1 mark for the correct answer (or an equivalent, e.g. $a = 2.5 + 3b$).

3 (2 marks)

Make x the subject of $y = 2\sqrt{x+5}$

Divide both sides by 2:

$$\frac{y}{2} = \sqrt{x+5}$$

Square both sides to remove the square root:

$$\frac{y^2}{4} = x + 5$$

Subtract 5 from both sides:

$$x = \frac{y^2}{4} - 5$$

Answer: $x = \frac{y^2}{4} - 5$ (or $x = \frac{y^2 - 20}{4}$)

Tip: If you square both sides first, remember that $(2\sqrt{x+5})^2 = 4(x+5)$, not $2(x+5)$.

Marks: 1 mark for $\frac{y^2}{4} = x + 5$ or $y^2 = 4(x+5)$. 1 mark for the correct answer.

4 (3 marks)

Make m the subject of $E = \frac{1}{2}mv^2 + mgh$

m is in both terms, so take m out as a common factor:

$$E = m\left(\frac{1}{2}v^2 + gh\right)$$

Divide both sides by the bracket:

$$m = \frac{E}{\frac{1}{2}v^2 + gh}$$

Multiply the top and bottom by 2 to remove the $\frac{1}{2}$:

$$m = \frac{2E}{v^2 + 2gh}$$

Answer: $m = \frac{2E}{v^2 + 2gh}$

Marks: 1 mark for factorising m out. 1 mark for dividing by the bracket. 1 mark for the correct answer (or an equivalent).

5 (3 marks)

Make x the subject of $\frac{x}{a} + \frac{x}{b} = 1$

Multiply **every** term by ab to clear the fractions:

$$\frac{x}{a} \times ab = bx \text{ and } \frac{x}{b} \times ab = ax$$

$$\text{So } bx + ax = ab$$

Factorise the left side:

$$x(a + b) = ab$$

Divide both sides by $(a + b)$:

$$x = \frac{ab}{a+b}$$

Answer: $x = \frac{ab}{a+b}$

Marks: 1 mark for multiplying by ab . 1 mark for factorising. 1 mark for the correct answer.

6 (4 marks)

Make t the subject of the formula $k = \frac{5-2t}{t+3}$

Multiply both sides by $(t+3)$:

$$k(t+3) = 5-2t$$

Expand the bracket:

$$kt+3k = 5-2t$$

Get the t terms on the left and the other terms on the right:

$$kt+2t = 5-3k$$

Factorise the left side:

$$t(k+2) = 5-3k$$

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

$$t = \frac{5-3k}{k+2}$$

Answer: $t = \frac{5-3k}{k+2}$

Tip: Put a bracket round $(t+3)$ when you multiply. Writing $kt+3$ instead of $kt+3k$ is a very common mistake.

Marks: 1 mark for multiplying by $(t+3)$. 1 mark for collecting the t terms. 1 mark for factorising. 1 mark for the correct answer.

7 (1 mark)

Oskar is trying to make x the subject of $y = \frac{3x + 2}{x}$

His method is shown below.

$$xy = 3x + 2$$

$$xy - 3x = 2$$

$$x(y - 3) = 2$$

$$x = \frac{2}{y} - 3$$

Oskar's answer is wrong.

Explain the mistake Oskar has made.

Oskar's first three lines are correct.

In $x(y - 3) = 2$, x is multiplied by the whole bracket $(y - 3)$.

So he should divide both sides by $(y - 3)$: $x = \frac{2}{y - 3}$

Oskar divided by y and then subtracted 3, as if the x were only multiplied by y .

Answer: He should divide by the whole bracket $(y - 3)$, but he divided by y and then subtracted 3 (it should be $x = \frac{2}{y - 3}$)

8 (3 marks)

Make v the subject of the formula $\frac{v - k}{m} = \frac{v}{3}$

Multiply both sides by $3m$ to clear the fractions:

$$3(v - k) = mv$$

Expand the bracket:

$$3v - 3k = mv$$

Get the v terms on one side:

$$3v - mv = 3k$$

Factorise the left side:

$$v(3 - m) = 3k$$

Divide both sides by $(3 - m)$:

$$v = \frac{3k}{3-m}$$

Answer: $v = \frac{3k}{3-m}$ (or $v = \frac{-3k}{m-3}$)

Tip: Multiply the whole of $v - k$ by 3: $3v - 3k$, not $3v - k$.

Marks: 1 mark for $3(v - k) = mv$. 1 mark for collecting the v terms and factorising. 1 mark for the correct answer.

9 (4 marks)

Make p the subject of the formula $t = \sqrt{\frac{p+5}{2p}}$

Square both sides to remove the square root:

$$t^2 = \frac{p+5}{2p}$$

Multiply both sides by $2p$:

$$2pt^2 = p + 5$$

Subtract p from both sides, to get the p terms together:

$$2pt^2 - p = 5$$

Factorise the left side:

$$p(2t^2 - 1) = 5$$

Divide both sides by $(2t^2 - 1)$:

$$p = \frac{5}{2t^2 - 1}$$

Answer: $p = \frac{5}{2t^2 - 1}$

Tip: Remove the square root first. After that, p appears twice, so collect the p terms and factorise.

Marks: 1 mark for squaring both sides. 1 mark for $2pt^2 = p + 5$. 1 mark for factorising. 1 mark for the correct answer.