Rearranging Formulae: answers

Worked solutions and mark scheme · GCSE Maths · Foundation tier

M = method mark, A = accuracy mark (needs the method), B = independent mark, ft = follow through from an earlier wrong answer.

Level 1 · Warm-up 9 marks

One or two steps: adding, subtracting, multiplying and dividing.

1 Make t the subject of $v = u + at$.

Answer: $t = \dfrac{v - u}{a}$

$v - u = at$	*Subtract u from both sides*
$t = \dfrac{v - u}{a}$	*Divide both sides by a*

Marks M1 $v - u = at$ A1 $t = \dfrac{v - u}{a}$

2 Make x the subject of $y = 4x - 3$.

Answer: $x = \dfrac{y + 3}{4}$

$y + 3 = 4x$	*Add 3 to both sides*
$x = \dfrac{y + 3}{4}$	*Divide both sides by 4*

Marks M1 $y + 3 = 4x$ A1 $x = \dfrac{y + 3}{4}$

3 Make r the subject of $C = 2\pi r$.

Answer: $r = \dfrac{C}{2\pi}$

$r = \dfrac{C}{2\pi}$	*Divide both sides by 2π*

Marks B1 $r = \dfrac{C}{2\pi}$ oe

4 Make h the subject of $A = \frac{1}{2}bh$.

Answer: $h = \dfrac{2A}{b}$

$2A = bh$	*Multiply both sides by* 2
$h = \dfrac{2A}{b}$	*Divide both sides by* b

Marks M1 $2A = bh$ A1 $h = \dfrac{2A}{b}$

5 Make m the subject of $P = 3m + 2n$.

Answer: $m = \dfrac{P - 2n}{3}$

$P - 2n = 3m$	*Subtract* $2n$ *from both sides*
$m = \dfrac{P - 2n}{3}$	

Marks M1 $P - 2n = 3m$ A1 $m = \dfrac{P - 2n}{3}$

Level 2 · Build

9 marks

Fractions and negatives, and a first look at squares and roots.

6 Make x the subject of $y = \dfrac{x + 5}{2}$.

Answer: $x = 2y - 5$

$2y = x + 5$	*Multiply both sides by* 2 *first*
$x = 2y - 5$	

Marks M1 $2y = x + 5$ A1 $x = 2y - 5$

7 Make v the subject of $s = \frac{1}{2}(u + v)t$.

Answer: $v = \dfrac{2s}{t} - u$

$2s = (u + v)t$	*Multiply both sides by* 2
$\dfrac{2s}{t} = u + v$	*Divide both sides by* t
$v = \dfrac{2s}{t} - u$	

Marks **M1** $2s = (u + v)t$ **M1** $\dfrac{2s}{t} = u + v$ **A1** $v = \dfrac{2s}{t} - u$ oe, e.g. $\dfrac{2s - ut}{t}$

8 Make x the subject of $y = 7 - 2x$.

Answer: $x = \dfrac{7 - y}{2}$

$y + 2x = 7$	*Add* $2x$ *to both sides, so the* x *term is positive*
$2x = 7 - y$	
$x = \dfrac{7 - y}{2}$	

Marks **M1** $2x = 7 - y$ or $-2x = y - 7$ **A1** $x = \dfrac{7 - y}{2}$ oe

9 Make c the subject of $a = b - 3c$.

Answer: $c = \dfrac{b - a}{3}$

$a + 3c = b$	*Add* $3c$ *to both sides*
$3c = b - a$	
$c = \dfrac{b - a}{3}$	

Marks **M1** $3c = b - a$ **A1** $c = \dfrac{b - a}{3}$ oe

Level 3 · Exam-style 10 marks
Formulae in context, using your rearranged formula, and spotting mistakes.

10 (a) The formula $F = \frac{9C}{5} + 32$ converts a temperature in degrees Celsius, C, to degrees Fahrenheit, F. Make C the subject of the formula.

Answer: $C = \frac{5(F - 32)}{9}$

$F - 32 = \frac{9C}{5}$	*Subtract* 32 *from both sides*
$5(F - 32) = 9C$	*Multiply both sides by* 5
$C = \frac{5(F - 32)}{9}$	*Divide both sides by* 9

Marks M1 $F - 32 = \frac{9C}{5}$ or $5F = 9C + 160$ A1 $C = \frac{5(F - 32)}{9}$ oe

(b) Use your formula to convert $77°$F to degrees Celsius.

Answer: $25°$C

$$C = \frac{5(77 - 32)}{9} = \frac{5 \times 45}{9} = 25$$

Marks B1 25 — ft their formula

11 (a) The cost, C pounds, of hiring a van for d days is $C = 45 + 30d$. Make d the subject of the formula.

Answer: $d = \frac{C - 45}{30}$

$$C - 45 = 30d$$
$$d = \frac{C - 45}{30}$$

Marks M1 $C - 45 = 30d$ A1 $d = \frac{C - 45}{30}$

(b) Hal paid £195 to hire a van. For how many days did he hire it?

Answer: 5 days

$$d = \frac{195 - 45}{30} = \frac{150}{30} = 5$$

Marks B1 5 — ft their formula

12 Ravi makes x the subject of $y = 3x + 5$ and writes $x = \frac{y}{3} - 5$. Explain Ravi's mistake, and write down the correct answer.

Answer: He divided only y by 3; the whole of $y - 5$ must be divided by 3. $x = \frac{y - 5}{3}$.

$y - 5 = 3x$ — *Subtract 5 first*

$x = \frac{y - 5}{3}$ — *Then divide the whole of $y - 5$ by 3*

Marks B1 Explains that 5 must be subtracted before dividing, or that all of $y - 5$ is divided by 3 B1 $x = \frac{y - 5}{3}$

13 The kinetic energy of a moving object is $E = \frac{1}{2}mv^2$. Make m the subject of the formula.

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

$2E = mv^2$ — *Multiply both sides by 2*

$m = \frac{2E}{v^2}$ — *Divide both sides by v^2*

Marks M1 $2E = mv^2$ A1 $m = \frac{2E}{v^2}$

Level 4 · Challenge (Foundation) — 9 marks

Grade 4–5 problem solving: rearranging real formulae and then using them.

14 (a) The time, T minutes, to roast a chicken weighing W kg is $T = 40W + 20$. Make W the subject of the formula.

Answer: $W = \frac{T - 20}{40}$

$T - 20 = 40W$

$W = \frac{T - 20}{40}$

Marks M1 $T - 20 = 40W$ A1 $W = \frac{T - 20}{40}$

(b) A chicken takes 2 hours to roast. Work out its weight.

Answer: 2.5 kg

$$T = 2 \times 60 = 120$$

The formula uses minutes, so convert the hours first

$$W = \frac{120 - 20}{40} = \frac{100}{40} = 2.5$$

Marks M1 $T = 120$ substituted — ft their formula A1 2.5 kg

15 (a) Make m the subject of $y = mx + c$.

Answer: $m = \dfrac{y - c}{x}$

$$y - c = mx$$

$$m = \frac{y - c}{x}$$

Marks M1 $y - c = mx$ A1 $m = \dfrac{y - c}{x}$

(b) Work out the value of m when $y = 17$, $x = 4$ and $c = 5$.

Answer: $m = 3$

$$m = \frac{17 - 5}{4} = \frac{12}{4} = 3$$

Marks B1 3 — ft their formula

16 The area of a trapezium is $A = \frac{1}{2}(a + b)h$. Make h the subject of the formula.

Answer: $h = \dfrac{2A}{a + b}$

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

Multiply both sides by 2

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

Divide by the whole bracket $(a + b)$

Marks M1 $2A = (a + b)h$ A1 $h = \dfrac{2A}{a + b}$