

Setting up linear equations

Starter

1. (Review of last lesson)

Solve: (a) $\frac{3x + 1}{7} = \frac{2}{3}x$ (b) $\frac{x + 7}{x + 5} = 3$ (c) $\frac{9}{5x} - 7 = 1$

Working: (a)

Cross-multiply:
Expand the brackets:
Subtract $9x$ from both sides:
Divide both sides by 5:

$$\begin{aligned} \frac{3x + 1}{7} &= \frac{2}{3}x \\ \frac{3x + 1}{7} &\times \frac{3}{3} = \frac{2x}{3} \times \frac{7}{7} \\ \frac{3(3x + 1)}{7} &= \frac{14x}{7} \\ 9x + 3 &= 14x \\ 3 &= 5x \\ \frac{3}{5} &= x \\ x &= \frac{3}{5} \end{aligned}$$

Make sure the unknown is on the LHS:

(b)

Multiply both sides by $x + 5$:
Expand the brackets:
Subtract x from both sides:
Subtract 15 from both sides:
Divide both sides by 2:
Make sure the unknown is on the LHS:

$$\begin{aligned} \frac{x + 7}{x + 5} &= 3 \\ x + 7 &= 3(x + 5) \\ x + 7 &= 3x + 15 \\ 7 &= 2x + 15 \\ -8 &= 2x \\ -4 &= x \\ x &= -4 \end{aligned}$$

(c)

Add 7 to both sides:
Multiply both sides by $5x$:
Divide both sides by 40:
Make sure the unknown is on the LHS:

$$\begin{aligned} \frac{9}{5x} - 7 &= 1 \\ \frac{9}{5x} &= 8 \\ 9 &= 40x \\ \frac{9}{40} &= x \\ x &= \frac{9}{40} \end{aligned}$$

2. Find the value of x , given that the angles in the triangle are $5x$, $7x$ and 20° .

Working: Sum of angles in a triangle is 180° :
Collect like terms:
Subtract 20 from both sides:
Divide both sides by 12:

$$\begin{aligned} 5x + 7x + 20 &= 180 \\ 12x + 20 &= 180 \\ 12x &= 160 \\ x &= \frac{160}{12} = \frac{40}{3} \end{aligned}$$

The value of x is $13\frac{1}{3}^\circ$ or $13.\dot{3}^\circ$.

E.g. 1 The perimeter of a rectangle is 146 cm. Given that the sides are $4x$ and $x + 8$, find:

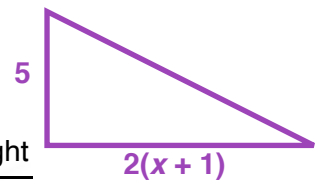
- (a) the value of x and
 (b) the area of the rectangle.

Working: (a) Perimeter of a rectangle = $2 \times \text{length} + 2 \times \text{width}$
 $2 \times 4x + 2(x + 8) = 146$
Expand the brackets: $8x + 2x + 16 = 146$
Collect like terms: $10x + 16 = 146$
Subtract 16 from both sides: $10x = 130$
Divide both sides by 10: $x = 13 \text{ cm}$

(b) Length of rectangle = $4x = 4 \times 13 = 52$
 Width of rectangle = $x + 8 = 13 + 8 = 21$
 Area of rectangle = $52 \times 21 = 1092 \text{ cm}^2$.

E.g. 2 The area of the right-angled triangle is 30 cm^2 . Find:

- (a) the value of x and
 (b) the length of the hypotenuse.



Working: (a) Area of triangle = $\frac{\text{base} \times \text{perpendicular height}}{2}$
 $30 = \frac{5 \times 2(x + 1)}{2}$

Cancelling the 2s gives: $30 = 5(x + 1)$
Expand the brackets: $30 = 5x + 5$
Subtract 5 from each side: $25 = 5x$
Divide both sides by 5: $5 = x$

The value of x is 5.

(b) The value of the triangle is $2(x + 1) = 2(5 + 1) = 12$

Let the length of the hypotenuse be y .

By Pythagoras: $y^2 = 5^2 + 12^2$
 $y^2 = 25 + 144$
 $y^2 = 169$
 $y = \sqrt{169} = 13$

The length of the hypotenuse is 13 cm.

E.g. 3 A woman is 32 years older than her son. Ten years ago she was 3 times as old as her son was then. Find the present age of each.

Working: Let the woman's current age be $x \Rightarrow$ son's current age is $x - 32$
 Ages 10 years ago: Woman = $x - 10$ Son = $x - 32 - 10 = x - 42$
 Ten years ago woman was 3 times as old as son: $x - 10 = 3(x - 42)$
Expand the brackets: $x - 10 = 3x - 126$
Subtract x from each side: $-10 = 2x - 126$
Add 126 to each side: $116 = 2x$
Divide both sides by 2: $x = 58$

Woman's present age is 58 years old.

Son's present age is 26 years old.

E.g. 4 The sum of four consecutive numbers is 90. Find the numbers.

Working: Let the four consecutive numbers be $n, n + 1, n + 2, n + 3$
The sum is 90: $n + n + 1 + n + 2 + n + 3 = 90$
Collect like terms: $4n + 6 = 90$
Subtract 6 from each side: $4n = 84$
Divide both sides by 4: $n = 21$
The four consecutive **even** numbers are 21, 22, 23 and 24.

E.g. 5 The sum of four consecutive **even** numbers is 524. Find the four numbers.

Working: Let the four consecutive **even** numbers be $2n, 2n + 2, 2n + 4, 2n + 6$
The sum is 524: $2n + 2n + 2 + 2n + 4 + 2n + 6 = 524$
Collect like terms: $8n + 12 = 524$
Subtract 12 from each side: $8n = 512$
Divide both sides by 10: $n = 64$
 $2n = 2 \times 64 = 128$
The four consecutive **even** numbers are 128, 130, 132 and 134.

Video: [Forming and solving equations/](#)

[Solutions to Starter and E.g.s](#)

Exercise

9-1 class textbook: p162 M6.4 Qu 1-18
A*-G class textbook: p152 M6.4 Qu 1-16
9-1 homework book: p57 M6.4 Qu 1-10
A*-G homework book: p42 M6.4 Qu 1-8