

Foundation / Higher



# Maths GCSE Problem Solving Questions Workbook

*Solving quadratic equations*

**GRADES 6 – 9**



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# Solving quadratic equations (area)

**EXAMPLE**

The diagram shows two rectangles

(a) Show the shaded area, in  $cm^2$ , is given by  $12x^2 - 9x + 6$

$$3x(4x + 1) - 2(6x - 3)$$

$$12x^2 + 3x - 12x + 6$$

$$12x^2 - 9x + 6$$

(b) The shaded area is  $6 cm^2$   
Calculate the value of  $x$ .

$$12x^2 - 9x + 6 = 6$$

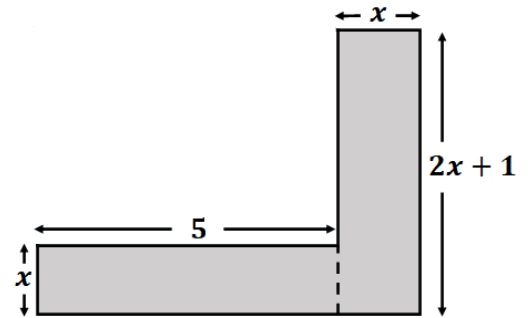
$$12x^2 - 9x = 0$$

$$4x^2 - 3x = 0$$

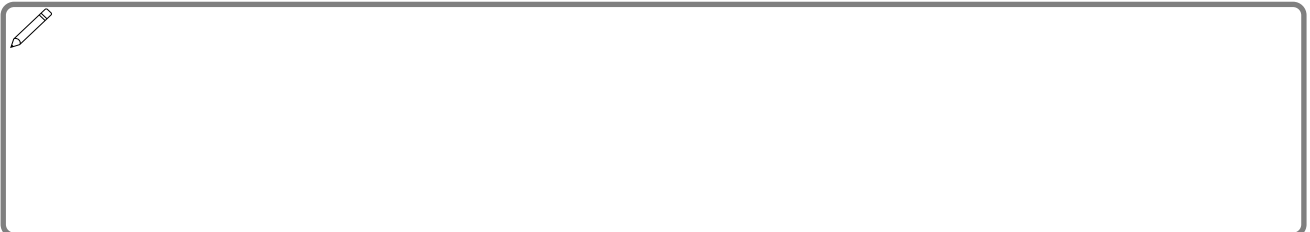
$x(4x - 3) = 0$   
 **$x$  cannot be 0**  
So  $4x - 3 = 0$   
 $4x = 3$   
 $x = \frac{3}{4}$

- 1** The diagram below shows a 6-sided shape.  
All the corners are right angles.  
All the measurements are given in cm.

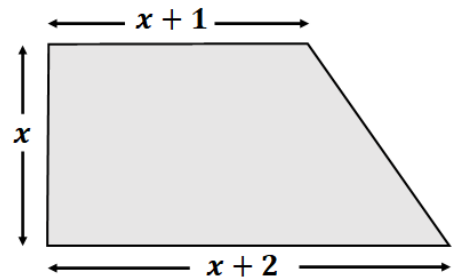
- a) The area of the shape is  $95 cm^2$   
Show that  $2x^2 + 6x - 95 = 0$



- b) Solve the equation  $2x^2 + 6x - 95 = 0$

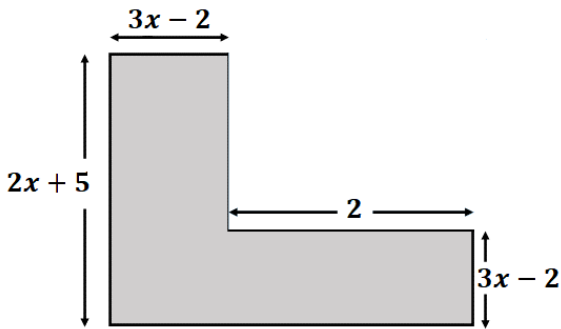


- 2** A trapezium has parallel sides of length  $(x + 1)$  cm and  $(x + 2)$  cm.  
The perpendicular distance between the parallel sides is  $x$  cm.  
The area of the trapezium is  $10 cm^2$   
Find the value of  $x$



## Solving quadratic equations (area)

- 3** All the corners are right angles. All measurements are given in centimetres.  
The area of the shape is  $25 \text{ cm}^2$ .

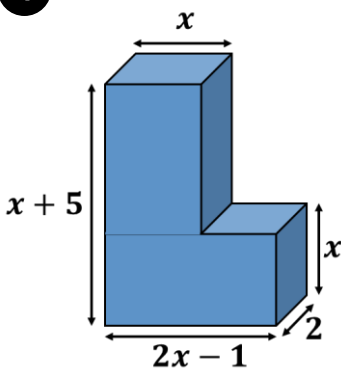


a) Show that  $6x^2 + 17x - 39 = 0$

b) (i) Solve the equation  $6x^2 + 17x - 39 = 0$

b) (ii) Hence work out the perimeter of the shape.

**4**



All the corners are right angles.  
All measurements are given in centimetres.  
The volume of the shape is  $192 \text{ cm}^3$ .

a) Show that  $2x^2 + 4x - 96 = 0$

b) (i) Solve the equation  $2x^2 + 4x - 96 = 0$

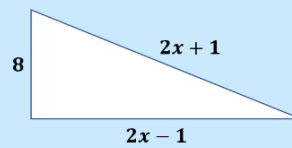
b) (ii) Hence work out the surface area of the shape.

## Solving quadratic equations (Pythagoras)

### EXAMPLE

Work out the value of  $x$

You must show your working.



Pythagoras ...

$$8^2 + (2x - 1)^2 = (2x + 1)^2$$

$$64 + (2x - 1)(2x - 1) = (2x + 1)(2x + 1)$$

$$64 + 4x^2 - 4x + 1 = 4x^2 + 4x + 1$$

$$64 = 8x$$

$$x = 8$$

- 1 Work out the value of  $x$  (all dimensions are in cm) to 2 decimal places.  
You must show your working.



- 2 Work out the value of  $x$  (all dimensions are in cm) to 2 decimal places.  
You must show your working.



- 3 Work out the value of  $x$  (all dimensions are in cm) to 2 decimal places.  
You must show your working.



**Page 1-2 – Solving quadratic equations (area)**

**1. a)**  $5x + x(2x + 1) = 95$

$$5x + 2x^2 + x = 95 \rightarrow 2x^2 + 6x - 95 = 0$$

**b)**  $5.55 : x = \frac{-6 \pm \sqrt{6^2 - (4 \times 2 \times -95)}}{2 \times 2} \rightarrow x = \frac{-6 \pm \sqrt{796}}{4}$

$x = 5.55$  or  $-8.55$  (cannot be negative distance)

**2. x = 2.5 :** Area =  $\frac{1}{2}(a + b)h$

$$\frac{1}{2}(x + 2 + x + 1)x = 10 \rightarrow \frac{1}{2}x(2x + 3) = 10$$

$$x(2x + 3) = 20 \rightarrow 2x^2 + 3x - 20 = 0$$

$$(2x - 5)(x + 4) = 0 \rightarrow (2x - 5) = 0$$

$$2x = 5 \rightarrow x = 2.5$$

**3. a)**  $(3x - 2)(2x + 5) + 2(3x - 2) = 25$

$$6x^2 - 4x + 15x - 10 + 6x - 4 = 25$$

$$6x^2 + 17x - 39 = 0$$

**b) i)**  $x = \frac{3}{2}$  or  $-\frac{13}{3} : (2x - 3)(3x + 13) = 0$

**b) ii)** 25 cm :  $x$  cannot be negative, so  $x = 1.5$

$$2(2x + 5) + 2(3x) = 10x + 10 = 15 + 10$$

**4. a)** CSA =  $(2x - 1)(x + 5) - 5(x + 1)$

$$= 2x^2 + 4x$$

$$2(2x^2 + 4x) = 192 \rightarrow 2x^2 + 4x - 96 = 0$$

**b) i)**  $x = 6$  or  $-8 : x^2 + 2x - 48$

$$\rightarrow (x + 8)(x - 6) = 0$$

**b) ii)** 280 cm<sup>2</sup> : when  $x = 6$

$$2 \times 11 \times 11 = 242, 2 \times 11 \times 2 = 44,$$

$$2 \times 11 \times 2 = 44 \rightarrow 286 + 44 + 44 = 330$$

$$330 - (2 \times 5 \times 5) = 330 - 50 = 280$$

**Page 3 – Solving quadratics (Pythagoras)**

**1. 4.64 cm :**  $(x + 5)^2 + (x - 2)^2 = 10^2$

$$(x + 5)(x + 5) + (x - 2)(x - 2) = 100$$

$$x^2 + 10x + 25 + x^2 - 4x + 4 = 100$$

$$2x^2 + 6x + 29 = 100, \quad 2x^2 + 6x - 71 = 0$$

$$x = \frac{-6 \pm \sqrt{6^2 - (4 \times 2 \times -71)}}{2 \times 2} = \frac{-6 \pm \sqrt{604}}{4}$$

$$x = 4.64 \text{ or } -7.64 \text{ cm}$$

**2. 8cm :**  $x^2 + (x + 7)^2 = (3x - 7)^2$

$$x^2 + x^2 + 14x + 49 = 9x^2 - 42x + 49$$

$$7x^2 - 56x = 0 \rightarrow x^2 - 8x = 0$$

$$x(x - 8) = 0 \rightarrow x = 8 \text{ cm}$$

**3. 7.35cm :**  $(x + 3)^2 + (x + 9)^2 = (x + 12)^2$

$$x^2 + 6x + 9 + x^2 + 18x + 81 = x^2 + 24x + 144$$

$$x^2 - 54 = 0 \rightarrow x^2 = 54 \rightarrow x = 7.35$$