



1 Solve $x^2 + 5x + 3 = 0$

Give your solutions correct to 2 decimal places.

(3 marks)

For $ax^2 + bx + c = 0$, the quadratic formula is $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

Match a , b and c including their signs. $\pm$ means calculate once with $+$ and once with $-$, and divide the entire numerator by $2a$

Use the quadratic formula with $a = 1$, $b = 5$, $c = 3$

$$x = \frac{-5 \pm \sqrt{25 - 12}}{2} = \frac{-5 \pm \sqrt{13}}{2}$$

$$\sqrt{13} = 3.60555..., \text{ so } x = \frac{-5 + 3.60555...}{2} = -0.69722... \text{ or } x = \frac{-5 - 3.60555...}{2} = -4.30277..$$

To 2 decimal places, $x = -0.70$ or $x = -4.30$

$$x = -0.70, x = -4.30$$

2 Here is the quadratic formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Write down the values of a , b and c for $5x^2 - 3x - 11 = 0$, then substitute them into the formula. You do not need to simplify.

(2 marks)

$$a = 5, b = -3, c = -11$$

Use brackets for the negatives

$$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4 \times 5 \times (-11)}}{2 \times 5}$$

3

Solve $x^2 - 4x - 9 = 0$

Give your solutions correct to 2 decimal places.

(3 marks)

For $ax^2 + bx + c = 0$, the quadratic formula is $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.Match a, b and c including their signs. $\pm$ means calculate once with + and once with -, and divide the entire numerator by 2aUse the quadratic formula with $a = 1$, $b = -4$, $c = -9$

$$x = \frac{4 \pm \sqrt{(16 + 36)}}{2} = \frac{4 \pm \sqrt{52}}{2}$$

$$\sqrt{52} = 7.21110..., \text{ so } x = \frac{4 + 7.21110...}{2} = 5.60555... \text{ or } x = \frac{4 - 7.21110...}{2} = -1.60555..$$

To 2 decimal places, $x = 5.61$ or $x = -1.61$. Take care with the signs: $-b = 4$ and $-4ac = +36$

$$x = 5.61, x = -1.61$$

4

Solve $x^2 - 6x - 5 = 0$

Give your answers in the form $p \pm \sqrt{q}$, where p and q are integers.

(3 marks)

$$a = 1, b = -6, c = -5$$

$$x = \frac{6 \pm \sqrt{(36 + 20)}}{2}$$

$$= \frac{6 \pm \sqrt{56}}{2}$$

$$\sqrt{56} = 2\sqrt{14}$$

$$= \frac{6 \pm 2\sqrt{14}}{2}$$

$$x = 3 \pm \sqrt{14}$$

5 Solve $2x^2 + 7x - 3 = 0$

Give your solutions correct to 2 decimal places.

(3 marks)

For $ax^2 + bx + c = 0$, the quadratic formula is $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. Match a, b and c including their signs. $\pm$ means calculate once with + and once with -, and divide the entire numerator by 2a

Use the quadratic formula with $a = 2$, $b = 7$, $c = -3$

$$x = \frac{-7 \pm \sqrt{(49 + 24)}}{4} = \frac{-7 \pm \sqrt{73}}{4}$$

$$\sqrt{73} = 8.54400\dots, \text{ so } x = \frac{-7 + 8.54400\dots}{4} = 0.38600\dots \text{ or } x = \frac{-7 - 8.54400\dots}{4} = -3.88600\dots$$

To 2 decimal places, $x = 0.39$ or $x = -3.89$

$$x = 0.39, x = -3.89$$

6 Solve $3x^2 - 7x - 4 = 0$

Give your solutions correct to 2 decimal places.

(3 marks)

$$a = 3, b = -7, c = -4$$

$$x = \frac{7 \pm \sqrt{(49 + 48)}}{6}$$

$$= \frac{7 \pm \sqrt{97}}{6}$$

$$x = \frac{7 + 9.849}{6} = 2.81$$

$$x = \frac{7 - 9.849}{6} = -0.47$$

$$x = 2.81 \text{ or } x = -0.47$$

7

Solve $3x^2 - 5x - 7 = 0$

Give your solutions correct to 2 decimal places.

(3 marks)

For $ax^2 + bx + c = 0$, the quadratic formula is $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. Match a , b and c including their signs. $\pm$ means calculate once with $+$ and once with $-$, and divide the entire numerator by $2a$

Use the quadratic formula with $a = 3$, $b = -5$, $c = -7$

$$x = \frac{5 \pm \sqrt{(25 + 84)}}{6} = \frac{5 \pm \sqrt{109}}{6}$$

$$\sqrt{109} = 10.44030\dots, \text{ so } x = \frac{5 + 10.44030\dots}{6} = 2.57338\dots \text{ or } x = \frac{5 - 10.44030\dots}{6} = -0.90671\dots$$

To 2 decimal places, $x = 2.57$ or $x = -0.91$

$$x = 2.57, x = -0.91$$

8

Solve $3x(x - 2) = 5$

Give your solutions correct to 3 significant figures.

(4 marks)

$$3x(x - 2) = 5$$

$$3x^2 - 6x = 5$$

$$\begin{array}{rcl} -5 & 3x^2 - 6x - 5 & = 0 \end{array}$$

$$a = 3, b = -6, c = -5$$

$$x = \frac{6 \pm \sqrt{(36 + 60)}}{6} = \frac{6 \pm \sqrt{96}}{6}$$

$$x = 2.63$$

$$x = -0.633$$

$$x = 2.63 \text{ or } x = -0.633$$

9

A ball is thrown upwards from a platform. Its height, h metres, above the ground after t seconds is given by

$$h = 2 + 12t - 5t^2$$

Work out how long it takes for the ball to hit the ground. Give your answer correct to 2 decimal places.

(4 marks)

Ground level means $h = 0$

$$5t^2 - 12t - 2 = 0$$

$$a = 5, b = -12, c = -2$$

$$t = \frac{12 \pm \sqrt{(144 + 40)}}{10} = \frac{12 \pm \sqrt{184}}{10}$$

$$t = 2.56 \text{ or } t = -0.16$$

Time cannot be negative

$$t = 2.56 \text{ seconds}$$

10

$$\text{Solve } x^2 + 6x + 4 = 0$$

Give your solutions in the form $a \pm \sqrt{b}$, where a and b are integers.

(3 marks)

For $ax^2 + bx + c = 0$, the quadratic formula is $x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{(2a)}$. Match a , b and c including their signs. $\pm$ means calculate once with $+$ and once with $-$, and divide the entire numerator by $2a$

Use the quadratic formula with $a = 1, b = 6, c = 4$

$$x = \frac{-6 \pm \sqrt{(36 - 16)}}{2} = \frac{-6 \pm \sqrt{20}}{2}$$

Simplify the surd

$$\sqrt{20} = 2\sqrt{5}$$

$$x = \frac{-6 \pm 2\sqrt{5}}{2} = -3 \pm \sqrt{5}$$

$$x = -3 + \sqrt{5}, x = -3 - \sqrt{5}$$

11 Solve $2x^2 - 8x + 5 = 0$

Give your solutions in the form $\frac{p \pm \sqrt{q}}{2}$, where p and q are integers.

(4 marks)

For $ax^2 + bx + c = 0$, the quadratic formula is $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

Match a , b and c including their signs. $\pm$ means calculate once with $+$ and once with $-$, and divide the entire numerator by $2a$

Use the quadratic formula with $a = 2$, $b = -8$, $c = 5$

$$x = \frac{8 \pm \sqrt{(64 - 40)}}{4} = \frac{8 \pm \sqrt{24}}{4}$$

Simplify the surd

$$\sqrt{24} = 2\sqrt{6}, \text{ so } x = \frac{8 \pm 2\sqrt{6}}{4}$$

Divide top and bottom by 2

$$x = \frac{4 \pm \sqrt{6}}{2}$$

Check by substitution

$$\text{if } x = \frac{4 + \sqrt{6}}{2} \text{ then } 2x^2 = 11 + 4\sqrt{6} \text{ and } 8x = 16 + 4\sqrt{6}, \text{ so}$$

$$2x^2 - 8x + 5 = 11 + 4\sqrt{6} - 16 - 4\sqrt{6} + 5 = 0$$

$$x = \frac{4 + \sqrt{6}}{2}, x = \frac{4 - \sqrt{6}}{2}$$

12 a. Using the discriminant, explain why the equation $x^2 + 3x + 7 = 0$ has no real solutions.

b. Write down the number of real solutions of the equation $x^2 - 6x + 9 = 0$. Give a reason for your answer.

(4 marks)

For $ax^2 + bx + c = 0$, the quadratic formula is $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. Match a , b and c including their signs. $\pm$ means calculate once with $+$ and once with $-$, and divide the entire numerator by $2a$

The discriminant of $ax^2 + bx + c = 0$ is $b^2 - 4ac$

For $x^2 + 3x + 7 = 0$: discriminant $= 9 - 28 = -19$. A negative number has no real square root, so the formula gives no real solutions

For $x^2 - 6x + 9 = 0$: discriminant $= 36 - 36 = 0$, so there is exactly one repeated real solution

In fact $x^2 - 6x + 9 = (x - 3)^2$, so the repeated solution is $x = 3$

13

A rectangular lawn has length $(x + 3)$ metres and width x metres.

The area of the lawn is 20 m^2

a. Show that $x^2 + 3x - 20 = 0$

b. Find the perimeter of the lawn. Give your answer correct to 3 significant figures.

(6 marks)

For $ax^2 + bx + c = 0$, the quadratic formula is $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. Match a , b and c including their signs. $\pm$ means calculate once with $+$ and once with $-$, and divide the entire numerator by $2a$

Area of a rectangle = length $\times$ width, so $x(x + 3) = 20$

Expanding gives $x^2 + 3x = 20$, so $x^2 + 3x - 20 = 0$, as required

Solve with the quadratic formula, $a = 1$, $b = 3$, $c = -20$: $x = \frac{-3 \pm \sqrt{9 + 80}}{2} = \frac{-3 \pm \sqrt{89}}{2}$

$\sqrt{89} = 9.43398\dots$, so $x = 3.21699\dots$ or $x = -6.21699\dots$ A length cannot be negative, so $x = 3.21699\dots$

Perimeter = $2(x + x + 3) = 4x + 6 = 4 \times 3.21699\dots + 6 = 18.86796\dots$

To 3 significant figures the perimeter is 18.9 m