# 1 Bridging Unit: Algebra 1

## Topic E: The quadratic formula

Bridging to Ch1.4

You can solve a quadratic equation using the **quadratic formula**. The quadratic formula can also be used to quickly determine how many roots a quadratic equation has.

**Key point**

The quadratic formula for $ax^2+bx+c=0$ is $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$

**Example 1**

Solve the equation $3x^2-5x-7=0$ using the quadratic formula.

$a=3, b=-5, c=-7$

Substitute into the formula, taking care with negatives.

$$x=\frac{-(-5)\pm\sqrt{(-5)^2-4\times3\times(-7)}}{2\times3}$$

$$=\frac{5\pm\sqrt{109}}{6}$$

$=2.57$ or $-0.91$ (to 2 dp)

Use your calculator to give answer as a decimal: $\dfrac{5+\sqrt{109}}{6}=2.57$ and $\dfrac{5-\sqrt{109}}{6}=-0.91$

You can also use the equation solver on your calculator to solve quadratic equations.

**Try It 1**

Use the quadratic formula to solve the quadratic equation $7x^2-4x-6=0$

Inside the square root of the quadratic formula you have the expression $b^2-4ac$. This expression is called the **discriminant**. You can use the discriminant to determine how many roots the equation has.

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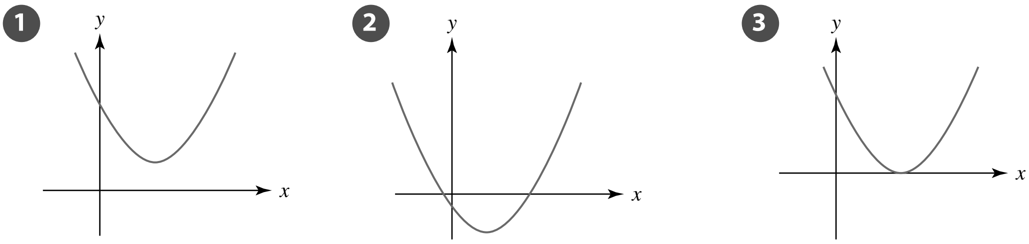
**Key point**

1. If $b^2-4ac<0$ then the equation has no real roots.
2. If $b^2-4ac>0$ then the equation has two real roots.
3. If $b^2-4ac=0$ then the equation has one real root.




1. The curve does not cross the $x$-axis so the discriminant is negative.
2. The curve crosses the $x$-axis twice so the discriminant is positive.
3. The curve touches the $x$-axis once so the discriminant equals zero.

## Example 2

Given that the quadratic equation $x^2+3x+k+1=0$ has exactly one solution, find the value of $k$

$a=1, b=3, c=k+1$

So $b^2-4ac=3^2-4\times1\times(k+1)$ — Find the discriminant.

$=5-4k$

$5-4k=0 \Rightarrow k=\frac{5}{4}$ — The equation has exactly one solution so the discriminant is zero.

## Try It 2

Given that the quadratic equation $kx^2-x+5=0$ has exactly one solution, find the value of $k$

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## Example 3

Given that the quadratic equation $5x^2+3x-k=0$ has real solutions, find the range of possible values of $k$

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

So $b^2-4ac=5^2-4\times5\times(-k)$ — Find the discriminant.

$=25+20k$

$25+20k\geq0\Rightarrow k\geq-\frac{5}{4}$ — The equation has real solutions so the discriminant is greater than or equal to zero.

## Try It 3

Given that the quadratic equation $x^2+3x-k=0$ has real solutions, find the range of possible values of $k$

## Example 4

Given that the quadratic equation $-x^2+7x+3-k=0$ has no real solutions, find the range of possible values of $k$

$a=-1, b=7, c=3-k$

So $b^2-4ac=7^2-4\times(-1)\times(3-k)$ — Find the discriminant.

$=61-4k$

$61-4k<0\Rightarrow k>\frac{61}{4}$ — The equation has no solutions so the discriminant is negative.

## Try It 4

Given that the quadratic equation $kx^2-7x+1=0$ has no real solutions, find the range of possible values of $k$

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# Bridging Exercise Topic E

Bridging to Ch1.4

1 Use the quadratic formula to solve each of these equations.

**a** $7x^2+3x-8=0$

**b** $-x^2+4x-2=0$

**c** $x^2-12x+4=0$

**2** Work out how many real solutions each of these quadratic equations has.

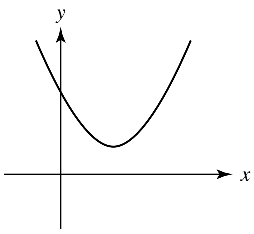
**a** $x^2 - 5x + 7 = 0$

**b** $7 - 2x - 3x^2 = 0$

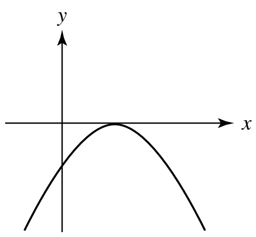
**c** $4x^2 - 28x + 49 = 0$

**3** Choose a possible equation from the box for each of the graphs.

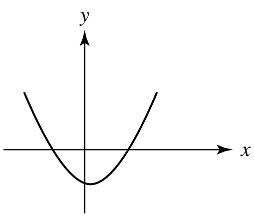
**a**




**b**




**c**




| |
|---|
| $y = -4x^2 + 12x - 9$ |
| $y = -x^2 + 2x - 4$ |
| $y = 7x^2 - 5x + 4$ |
| $y = -x^2 + x + 6$ |
| $y = 6x^2 - x - 15$ |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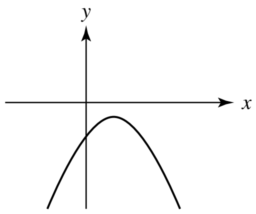
**d**




**4** Find the value of $k$ in each equation given that they each have exactly one solution.

**a** $3x^2+2x-k=0$

**b** $kx^2-x+4=0$

**c** $2x^2+5x+k-5=0$



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5 Find the range of possible values of $k$ for each equation given that they all have real solutions.

**a** $x^2+3x-3k=0$

**b** $kx^2-7x+4=0$

**c** $-x^2+6x-k-2=0$



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6 Find the range of possible values of $k$ for each equation given that they all have no real solutions.

**a** $5x^2 - x + 2k = 0$

**b** $-kx^2 + 4x + 5 = 0$

**c** $6x^2 - 5x + 3 - 2k = 0$


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