1 By completing the square, show that the roots of the equation $ax^2 + bx + c = 0$ are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

2 Use the quadratic formula to solve each equation, giving your answers as simply as possible in terms of surds where appropriate.

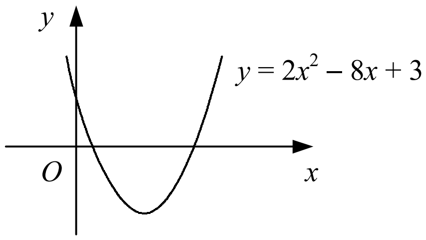
a $x^2 + 4x + 1 = 0$ **b** $4 + 8t - t^2 = 0$ **c** $y^2 - 20y + 91 = 0$ **d** $r^2 + 2r - 7 = 0$

e $6 + 18a + a^2 = 0$ **f** $m(m - 5) = 5$ **g** $x^2 + 11x + 27 = 0$ **h** $2u^2 + 6u + 3 = 0$

i $5 - y - y^2 = 0$ **j** $2x^2 - 3x = 2$ **k** $3p^2 + 7p + 1 = 0$ **l** $t^2 - 14t = 14$

m $0.1r^2 + 1.4r = 0.9$ **n** $6u^2 + 4u = 1$ **o** $\frac{1}{2}y^2 - 3y = \frac{2}{3}$ **p** $4x(x - 3) = 11 - 4x$

3



The diagram shows the curve with equation $y = 2x^2 - 8x + 3$.

Find and simplify the exact coordinates of the points where the curve crosses the x-axis.

4 State the condition for which the roots of the equation $ax^2 + bx + c = 0$ are

a real and distinct **b** real and equal **c** not real

5 Sketch the curve $y = ax^2 + bx + c$ and the x-axis in the cases where

a $a > 0$ and $b^2 - 4ac > 0$ **b** $a < 0$ and $b^2 - 4ac < 0$

c $a > 0$ and $b^2 - 4ac = 0$ **d** $a < 0$ and $b^2 - 4ac > 0$

6 By evaluating the discriminant, determine whether the roots of each equation are real and distinct, real and equal or not real.

a $x^2 + 2x - 7 = 0$ **b** $x^2 + x + 3 = 0$ **c** $x^2 - 4x + 5 = 0$ **d** $x^2 - 6x + 3 = 0$

e $x^2 + 14x + 49 = 0$ **f** $x^2 - 9x + 17 = 0$ **g** $x^2 + 3x = 11$ **h** $2 + 3x + 2x^2 = 0$

i $5x^2 + 8x + 3 = 0$ **j** $3x^2 - 7x + 5 = 0$ **k** $9x^2 - 12x + 4 = 0$ **l** $13x^2 + 19x + 7 = 0$

m $4 - 11x + 8x^2 = 0$ **n** $x^2 + \frac{2}{3}x = \frac{1}{4}$ **o** $x^2 - \frac{3}{4}x + \frac{1}{8} = 0$ **p** $\frac{2}{5}x^2 + \frac{3}{5}x + \frac{1}{3} = 0$

7 Find the value of the constant p such that the equation $x^2 + x + p = 0$ has equal roots.

8 Given that $q \neq 0$, find the value of the constant q such that the equation $x^2 + 2qx - q = 0$ has a repeated root.

9 Given that the x-axis is a tangent to the curve with the equation

$$y = x^2 + rx - 2x + 4,$$

find the two possible values of the constant r.