

**1**  $ax^2 + bx + c = 0$

$$x^2 + \frac{b}{a}x + \frac{c}{a} = 0$$

$$\left(x + \frac{b}{2a}\right)^2 - \frac{b^2}{4a^2} + \frac{c}{a} = 0$$

$$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2}{4a^2} - \frac{c}{a} = \frac{b^2 - 4ac}{4a^2}$$

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

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

**2 a**  $x = \frac{-4 \pm \sqrt{16-4}}{2}$

$$x = \frac{-4 \pm 2\sqrt{3}}{2}$$

$$x = -2 \pm \sqrt{3}$$

**b**  $t = \frac{-8 \pm \sqrt{64+16}}{-2}$

$$t = \frac{-8 \pm 4\sqrt{5}}{-2}$$

$$t = 4 \pm 2\sqrt{5}$$

**c**  $y = \frac{20 \pm \sqrt{400-364}}{2}$

$$y = \frac{20 \pm 6}{2}$$

$$y = 7 \text{ or } 13$$

**d**  $r = \frac{-2 \pm \sqrt{4+28}}{2}$

$$r = \frac{-2 \pm 4\sqrt{2}}{2}$$

$$r = -1 \pm 2\sqrt{2}$$

**e**  $a = \frac{-18 \pm \sqrt{324-24}}{2}$

$$a = \frac{-18 \pm 10\sqrt{3}}{2}$$

$$a = -9 \pm 5\sqrt{3}$$

**f**  $m^2 - 5m - 5 = 0$

$$m = \frac{5 \pm \sqrt{25+20}}{2}$$

$$m = \frac{1}{2}(5 \pm 3\sqrt{5})$$

**g**  $x = \frac{-11 \pm \sqrt{121-108}}{2}$

$$x = \frac{1}{2}(-11 \pm \sqrt{13})$$

**h**  $u = \frac{-6 \pm \sqrt{36-24}}{4}$

$$u = \frac{-6 \pm 2\sqrt{3}}{4}$$

$$u = \frac{1}{2}(-3 \pm \sqrt{3})$$

**i**  $y = \frac{1 \pm \sqrt{1+20}}{-2}$

$$y = -\frac{1}{2}(1 \pm \sqrt{21})$$

**j**  $2x^2 - 3x - 2 = 0$

$$x = \frac{3 \pm \sqrt{9+16}}{4}$$

$$x = \frac{3 \pm 5}{4}$$

$$x = -\frac{1}{2} \text{ or } 2$$

**k**  $p = \frac{-7 \pm \sqrt{49-12}}{6}$

$$p = \frac{1}{6}(-7 \pm \sqrt{37})$$

**l**  $t^2 - 14t - 14 = 0$

$$t = \frac{14 \pm \sqrt{196+56}}{2}$$

$$t = \frac{14 \pm 6\sqrt{7}}{2}$$

$$t = 7 \pm 3\sqrt{7}$$

**m**  $r^2 + 14r - 9 = 0$

$$r = \frac{-14 \pm \sqrt{196+36}}{2}$$

$$r = \frac{-14 \pm 2\sqrt{58}}{2}$$

$$r = -7 \pm \sqrt{58}$$

**n**  $6u^2 + 4u - 1 = 0$

$$u = \frac{-4 \pm \sqrt{16+24}}{12}$$

$$u = \frac{-4 \pm 2\sqrt{10}}{12}$$

$$u = \frac{1}{6}(-2 \pm \sqrt{10})$$

**o**  $3y^2 - 18y - 4 = 0$

$$y = \frac{18 \pm \sqrt{324+48}}{6}$$

$$y = \frac{18 \pm 2\sqrt{93}}{6}$$

$$y = 3 \pm \frac{1}{3}\sqrt{93}$$

**p**  $4x^2 - 8x - 11 = 0$

$$x = \frac{8 \pm \sqrt{64+176}}{8}$$

$$x = \frac{8 \pm 4\sqrt{15}}{8}$$

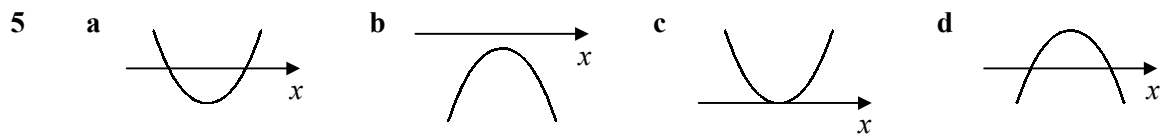
$$x = 1 \pm \frac{1}{2}\sqrt{15}$$

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

$$x = \frac{8 \pm \sqrt{64-24}}{4} = \frac{8 \pm 2\sqrt{10}}{4} = 2 \pm \frac{1}{2}\sqrt{10}$$

$$\therefore (2 - \frac{1}{2}\sqrt{10}, 0) \text{ and } (2 + \frac{1}{2}\sqrt{10}, 0)$$

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



6 a  $b^2 - 4ac = 32$       b  $b^2 - 4ac = -11$       c  $b^2 - 4ac = -4$       d  $b^2 - 4ac = 24$   
 $\therefore$  real and distinct       $\therefore$  not real       $\therefore$  not real       $\therefore$  real and distinct

e  $b^2 - 4ac = 0$       f  $b^2 - 4ac = 13$       g  $b^2 - 4ac = 53$       h  $b^2 - 4ac = -7$   
 $\therefore$  real and equal       $\therefore$  real and distinct       $\therefore$  real and distinct       $\therefore$  not real

i  $b^2 - 4ac = 4$       j  $b^2 - 4ac = -11$       k  $b^2 - 4ac = 0$       l  $b^2 - 4ac = -3$   
 $\therefore$  real and distinct       $\therefore$  not real       $\therefore$  real and equal       $\therefore$  not real

m  $b^2 - 4ac = -7$       n  $b^2 - 4ac = \frac{13}{9}$       o  $b^2 - 4ac = \frac{1}{16}$       p  $b^2 - 4ac = -\frac{13}{75}$   
 $\therefore$  not real       $\therefore$  real and distinct       $\therefore$  real and distinct       $\therefore$  not real

7 equal roots  
 $\therefore b^2 - 4ac = 0$   
 $1 - 4p = 0$   
 $p = \frac{1}{4}$

8 repeated root  
 $\therefore b^2 - 4ac = 0$   
 $4q^2 + 4q = 0$   
 $4q(q + 1) = 0$   
 $q \neq 0 \therefore q = -1$

9  $x^2 + rx - 2x + 4 = 0$  has equal roots  
 $\therefore b^2 - 4ac = 0$   
 $(r - 2)^2 - 16 = 0$   
 $r^2 - 4r - 12 = 0$   
 $(r + 2)(r - 6) = 0$   
 $r = -2$  or  $6$