

- 1** **a** $= (x+1)^2 - 1 + 4$ **b** $= (x-1)^2 - 1 + 4$ **c** $= (x-2)^2 - 4 + 1$ **d** $= (x+3)^2 - 9$
 $= (x+1)^2 + 3$ $= (x-1)^2 + 3$ $= (x-2)^2 - 3$
- e** $= (x+2)^2 - 4 + 8$ **f** $= (x-4)^2 - 16 - 5$ **g** $= (x+6)^2 - 36 + 30$ **h** $= (x-5)^2 - 25 + 25$
 $= (x+2)^2 + 4$ $= (x-4)^2 - 21$ $= (x+6)^2 - 6$ $= (x-5)^2$
- i** $= (x+3)^2 - 9 - 9$ **j** $= (x-2)^2 - 4 + 18$ **k** $= (x + \frac{3}{2})^2 - \frac{9}{4} + 3$ **l** $= (x + \frac{1}{2})^2 - \frac{1}{4} - 1$
 $= (x+3)^2 - 18$ $= (x-2)^2 + 14$ $= (x + \frac{3}{2})^2 + \frac{3}{4}$ $= (x + \frac{1}{2})^2 - \frac{5}{4}$
- m** $= (x-9)^2 - 81 + 100$ **n** $= (x - \frac{1}{2})^2 - \frac{1}{4} - \frac{1}{2}$ **o** $= (x + \frac{9}{2})^2 - \frac{81}{4} + 20$ **p** $= (x - \frac{7}{2})^2 - \frac{49}{4} - 2$
 $= (x-9)^2 + 19$ $= (x - \frac{1}{2})^2 - \frac{3}{4}$ $= (x + \frac{9}{2})^2 - \frac{1}{4}$ $= (x - \frac{7}{2})^2 - \frac{57}{4}$
- q** $= (x - \frac{3}{2})^2 - \frac{9}{4} + 5$ **r** $= (x - \frac{11}{2})^2 - \frac{121}{4} + 37$ **s** $= (x + \frac{1}{3})^2 - \frac{1}{9} + 1$ **t** $= (x - \frac{1}{4})^2 - \frac{1}{16} - \frac{1}{4}$
 $= (x - \frac{3}{2})^2 + \frac{11}{4}$ $= (x - \frac{11}{2})^2 + \frac{27}{4}$ $= (x + \frac{1}{3})^2 + \frac{8}{9}$ $= (x - \frac{1}{4})^2 - \frac{5}{16}$
- 2** **a** $= 2[x^2 + 2x] + 3$ **b** $= 2[x^2 - 4x] - 7$ **c** $= 3[x^2 - 2x] + 3$ **d** $= 4[x^2 + 6x] + 11$
 $= 2[(x+1)^2 - 1] + 3$ $= 2[(x-2)^2 - 4] - 7$ $= 3[(x-1)^2 - 1] + 3$ $= 4[(x+3)^2 - 9] + 11$
 $= 2(x+1)^2 + 1$ $= 2(x-2)^2 - 15$ $= 3(x-1)^2$ $= 4(x+3)^2 - 25$
- e** $= -[x^2 + 2x] - 5$ **f** $= -[x^2 - 10x] + 1$ **g** $= 2[x^2 + x] - 1$ **h** $= 3[x^2 - 3x] + 5$
 $= -[(x+1)^2 - 1] - 5$ $= -[(x-5)^2 - 25] + 1$ $= 2[(x + \frac{1}{2})^2 - \frac{1}{4}] - 1$ $= 3[(x - \frac{3}{2})^2 - \frac{9}{4}] + 5$
 $= -(x+1)^2 - 4$ $= -(x-5)^2 + 26$ $= 2(x + \frac{1}{2})^2 - \frac{3}{2}$ $= 3(x - \frac{3}{2})^2 - \frac{7}{4}$
- i** $= 3[x^2 - 8x] + 48$ **j** $= 3[x^2 - 5x]$ **k** $= 5[x^2 + 8x] + 70$ **l** $= 2[x^2 + \frac{5}{2}x] + 2$
 $= 3[(x-4)^2 - 16] + 48$ $= 3[(x - \frac{5}{2})^2 - \frac{25}{4}]$ $= 5[(x+4)^2 - 16] + 70$ $= 2[(x + \frac{5}{4})^2 - \frac{25}{16}] + 2$
 $= 3(x-4)^2$ $= 3(x - \frac{5}{2})^2 - \frac{75}{4}$ $= 5(x+4)^2 - 10$ $= 2(x + \frac{5}{4})^2 - \frac{9}{8}$
- m** $= 4[x^2 + \frac{3}{2}x] - 7$ **n** $= -2[x^2 - 2x] - 1$ **o** $= -3[x^2 + \frac{2}{3}x] + 4$ **p** $= \frac{1}{3}[x^2 + \frac{3}{2}x] - \frac{1}{4}$
 $= 4[(x + \frac{3}{4})^2 - \frac{9}{16}] - 7$ $= -2[(x-1)^2 - 1] - 1$ $= -3[(x + \frac{1}{3})^2 - \frac{1}{9}] + 4$ $= \frac{1}{3}[(x + \frac{3}{4})^2 - \frac{9}{16}] - \frac{1}{4}$
 $= 4(x + \frac{3}{4})^2 - \frac{37}{4}$ $= -2(x-1)^2 + 1$ $= -3(x + \frac{1}{3})^2 + \frac{13}{3}$ $= \frac{1}{3}(x + \frac{3}{4})^2 - \frac{7}{16}$
- 3** **a** $(y-2)^2 - 4 + 2 = 0$ **b** $(p+1)^2 - 1 - 2 = 0$ **c** $(x-3)^2 - 9 + 4 = 0$ **d** $(r+5)^2 - 25 + 7 = 0$
 $(y-2)^2 = 2$ $(p+1)^2 = 3$ $(x-3)^2 = 5$ $(r+5)^2 = 18$
 $y-2 = \pm\sqrt{2}$ $p+1 = \pm\sqrt{3}$ $x-3 = \pm\sqrt{5}$ $r+5 = \pm\sqrt{18} = \pm 3\sqrt{2}$
 $y = 2 \pm\sqrt{2}$ $p = -1 \pm\sqrt{3}$ $x = 3 \pm\sqrt{5}$ $r = -5 \pm 3\sqrt{2}$
- e** $(x-1)^2 - 1 = 11$ **f** $(a-6)^2 - 36 - 18 = 0$ **g** $(m - \frac{3}{2})^2 - \frac{9}{4} + 1 = 0$ **h** $(t - \frac{7}{2})^2 - \frac{49}{4} + 9 = 0$
 $(x-1)^2 = 12$ $(a-6)^2 = 54$ $(m - \frac{3}{2})^2 = \frac{5}{4}$ $(t - \frac{7}{2})^2 = \frac{13}{4}$
 $x-1 = \pm\sqrt{12} = \pm 2\sqrt{3}$ $a-6 = \pm\sqrt{54} = \pm 3\sqrt{6}$ $m - \frac{3}{2} = \pm\frac{\sqrt{5}}{2}$ $t - \frac{7}{2} = \pm\frac{\sqrt{13}}{2}$
 $x = 1 \pm 2\sqrt{3}$ $a = 6 \pm 3\sqrt{6}$ $m = \frac{1}{2}(3 \pm \sqrt{5})$ $t = \frac{1}{2}(7 \pm \sqrt{13})$

$$\begin{array}{llll} \text{i} & (u + \frac{7}{2})^2 - \frac{49}{4} = 44 & \text{j} & y^2 - 2y + \frac{1}{2} = 0 & \text{k} & p^2 + 6p = -\frac{23}{3} & \text{l} & x^2 + 6x = \frac{9}{2} \\ & (u + \frac{7}{2})^2 = \frac{225}{4} & & (y - 1)^2 - 1 + \frac{1}{2} = 0 & & (p + 3)^2 - 9 = -\frac{23}{3} & & (x + 3)^2 - 9 = \frac{9}{2} \\ & u + \frac{7}{2} = \pm \frac{15}{2} & & (y - 1)^2 = \frac{1}{2} & & (p + 3)^2 = \frac{4}{3} & & (x + 3)^2 = \frac{27}{2} \\ & u = -\frac{7}{2} \pm \frac{15}{2} & & y - 1 = \pm \frac{1}{\sqrt{2}} = \pm \frac{1}{2}\sqrt{2} & & p + 3 = \pm \frac{2}{\sqrt{3}} = \pm \frac{2}{3}\sqrt{3} & & x + 3 = \pm \sqrt{\frac{27}{2}} = \pm \frac{3}{2}\sqrt{6} \\ & u = -11 \text{ or } 4 & & y = 1 \pm \frac{1}{2}\sqrt{2} & & p = -3 \pm \frac{2}{3}\sqrt{3} & & x = -3 \pm \frac{3}{2}\sqrt{6} \end{array}$$

$$\begin{array}{llll} \text{m} & m^2 - m = 1 & \text{n} & 4x^2 - 28x + 49 = 0 & \text{o} & t^2 + \frac{1}{3}t = \frac{1}{3} & \text{p} & a^2 - \frac{7}{2}a + 2 = 0 \\ & (m - \frac{1}{2})^2 - \frac{1}{4} = 1 & & x^2 - 7x + \frac{49}{4} = 0 & & (t + \frac{1}{6})^2 - \frac{1}{36} = \frac{1}{3} & & (a - \frac{7}{4})^2 - \frac{49}{16} + 2 = 0 \\ & (m - \frac{1}{2})^2 = \frac{5}{4} & & (x - \frac{7}{2})^2 - \frac{49}{4} + \frac{49}{4} = 0 & & (t + \frac{1}{6})^2 = \frac{13}{36} & & (a - \frac{7}{4})^2 = \frac{17}{16} \\ & m - \frac{1}{2} = \pm \frac{\sqrt{5}}{2} & & (x - \frac{7}{2})^2 = 0 & & t + \frac{1}{6} = \pm \frac{\sqrt{13}}{6} & & a - \frac{7}{4} = \pm \frac{\sqrt{17}}{4} \\ & m = \frac{1}{2}(1 \pm \sqrt{5}) & & x = \frac{7}{2} & & t = \frac{1}{6}(-1 \pm \sqrt{13}) & & a = \frac{1}{4}(7 \pm \sqrt{17}) \end{array}$$

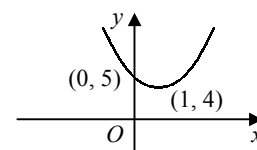
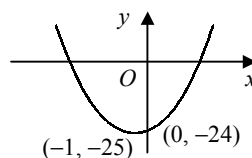
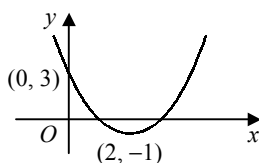
$$\begin{array}{lll} 4 \quad \text{a} & y = (x - 1)^2 - 1 + 7 & \text{b} & y = (x + 1)^2 - 1 - 3 \\ & y = (x - 1)^2 + 6 & & y = (x + 1)^2 - 4 \\ & y = 6 \text{ at } x = 1, \text{ minimum} & & y = -4 \text{ at } x = -1, \text{ minimum} \\ & & \text{c} & y = (x - 3)^2 - 9 + 1 \\ & & & y = (x - 3)^2 - 8 \\ & & & y = -8 \text{ at } x = 3, \text{ minimum} \end{array}$$

$$\begin{array}{lll} \text{d} & y = (x + 5)^2 - 25 + 35 & \text{e} & y = -[x^2 - 4x] + 4 \\ & y = (x + 5)^2 + 10 & & y = -[(x - 2)^2 - 4] + 4 \\ & y = 10 \text{ at } x = -5, \text{ minimum} & & y = -(x - 2)^2 + 8 \\ & & & y = 8 \text{ at } x = 2, \text{ maximum} \\ \text{f} & & & y = (x + \frac{3}{2})^2 - \frac{9}{4} - 2 \\ & & & y = (x + \frac{3}{2})^2 - \frac{17}{4} \\ & & & y = -\frac{17}{4} \text{ at } x = -\frac{3}{2}, \text{ minimum} \end{array}$$

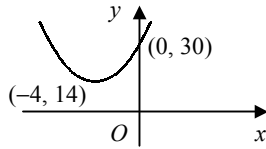
$$\begin{array}{lll} \text{g} & y = 2[x^2 + 4x] + 5 & \text{h} & y = -3[x^2 - 2x] \\ & y = 2[(x + 2)^2 - 4] + 5 & & y = -3[(x - 1)^2 - 1] \\ & y = 2(x + 2)^2 - 3 & & y = -3(x - 1)^2 + 3 \\ & y = -3 \text{ at } x = -2, \text{ minimum} & & y = 3 \text{ at } x = 1, \text{ maximum} \\ \text{i} & & & y = -[x^2 + 5x] + 7 \\ & & & y = -[(x + \frac{5}{2})^2 - \frac{25}{4}] + 7 \\ & & & y = -(x + \frac{5}{2})^2 + \frac{53}{4} \\ & & & y = \frac{53}{4} \text{ at } x = -\frac{5}{2}, \text{ maximum} \end{array}$$

$$\begin{array}{lll} \text{j} & y = 4[x^2 - 3x] + 9 & \text{k} & y = 4[x^2 + 5x] - 8 \\ & y = 4[(x - \frac{3}{2})^2 - \frac{9}{4}] + 9 & & y = 4[(x + \frac{5}{2})^2 - \frac{25}{4}] - 8 \\ & y = 4(x - \frac{3}{2})^2 & & y = 4(x + \frac{5}{2})^2 - 33 \\ & y = 0 \text{ at } x = \frac{3}{2}, \text{ minimum} & & y = -33 \text{ at } x = -\frac{5}{2}, \text{ minimum} \\ \text{l} & & & y = -2[x^2 + x] + 17 \\ & & & y = -2[(x + \frac{1}{2})^2 - \frac{1}{4}] + 17 \\ & & & y = -2(x + \frac{1}{2})^2 + \frac{35}{2} \\ & & & y = \frac{35}{2} \text{ at } x = -\frac{1}{2}, \text{ maximum} \end{array}$$

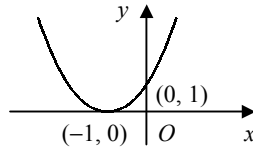
$$\begin{array}{lll} 5 \quad \text{a} & y = (x - 2)^2 - 4 + 3 & \text{b} & y = (x + 1)^2 - 1 - 24 \\ & y = (x - 2)^2 - 1 & & y = (x + 1)^2 - 25 \\ & \text{minimum } (2, -1) & & \text{minimum } (-1, -25) \\ \text{c} & & & y = (x - 1)^2 - 1 + 5 \\ & & & y = (x - 1)^2 + 4 \\ & & & \text{minimum } (1, 4) \end{array}$$



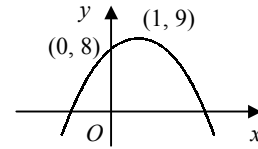
$$\begin{aligned} \text{d } y &= (x+4)^2 - 16 + 30 \\ y &= (x+4)^2 + 14 \\ \text{minimum } &(-4, 14) \end{aligned}$$



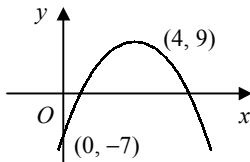
$$\begin{aligned} \text{e } y &= (x+1)^2 - 1 + 1 \\ y &= (x+1)^2 \\ \text{minimum } &(-1, 0) \end{aligned}$$



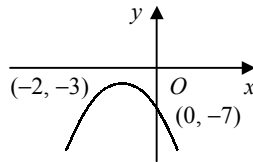
$$\begin{aligned} \text{f } y &= -[x^2 - 2x] + 8 \\ y &= -[(x-1)^2 - 1] + 8 \\ y &= -(x-1)^2 + 9 \\ \text{maximum } &(1, 9) \end{aligned}$$



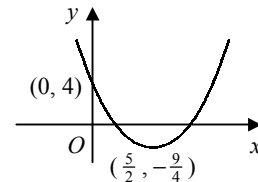
$$\begin{aligned} \text{g } y &= -[x^2 - 8x] - 7 \\ y &= -[(x-4)^2 - 16] - 7 \\ y &= -(x-4)^2 + 9 \\ \text{maximum } &(4, 9) \end{aligned}$$



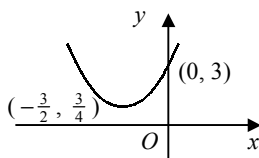
$$\begin{aligned} \text{h } y &= -[x^2 + 4x] - 7 \\ y &= -[(x+2)^2 - 4] - 7 \\ y &= -(x+2)^2 - 3 \\ \text{maximum } &(-2, -3) \end{aligned}$$



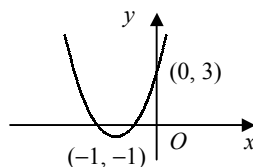
$$\begin{aligned} \text{i } y &= (x - \frac{5}{2})^2 - \frac{25}{4} + 4 \\ y &= (x - \frac{5}{2})^2 - \frac{9}{4} \\ \text{minimum } &(\frac{5}{2}, -\frac{9}{4}) \end{aligned}$$



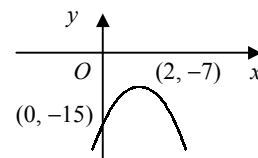
$$\begin{aligned} \text{j } y &= (x + \frac{3}{2})^2 - \frac{9}{4} + 3 \\ y &= (x + \frac{3}{2})^2 + \frac{3}{4} \\ \text{minimum } &(-\frac{3}{2}, \frac{3}{4}) \end{aligned}$$



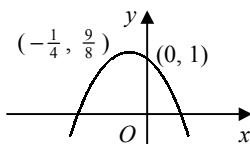
$$\begin{aligned} \text{k } y &= 4[x^2 + 2x] + 3 \\ y &= 4[(x+1)^2 - 1] + 3 \\ y &= 4(x+1)^2 - 1 \\ \text{minimum } &(-1, -1) \end{aligned}$$



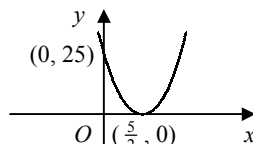
$$\begin{aligned} \text{l } y &= -2[x^2 - 4x] - 15 \\ y &= -2[(x-2)^2 - 4] - 15 \\ y &= -2(x-2)^2 - 7 \\ \text{maximum } &(2, -7) \end{aligned}$$



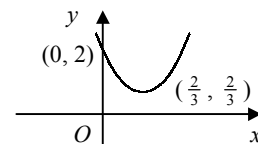
$$\begin{aligned} \text{m } y &= -2[x^2 + \frac{1}{2}x] + 1 \\ y &= -2[(x + \frac{1}{4})^2 - \frac{1}{16}] + 1 \\ y &= -2(x + \frac{1}{4})^2 + \frac{9}{8} \\ \text{maximum } &(-\frac{1}{4}, \frac{9}{8}) \end{aligned}$$



$$\begin{aligned} \text{n } y &= 4[x^2 - 5x] + 25 \\ y &= 4[(x - \frac{5}{2})^2 - \frac{25}{4}] + 25 \\ y &= 4(x - \frac{5}{2})^2 \\ \text{minimum } &(\frac{5}{2}, 0) \end{aligned}$$



$$\begin{aligned} \text{o } y &= 3[x^2 - \frac{4}{3}x] + 2 \\ y &= 3[(x - \frac{2}{3})^2 - \frac{4}{9}] + 2 \\ y &= 3(x - \frac{2}{3})^2 + \frac{2}{3} \\ \text{minimum } &(\frac{2}{3}, \frac{2}{3}) \end{aligned}$$



$$\begin{aligned} \text{6 a } &= (x - 2\sqrt{2})^2 - 8 + 5 \\ &= (x - 2\sqrt{2})^2 - 3 \end{aligned}$$

$$\text{b } x = 2\sqrt{2}$$

$$\begin{aligned} \text{7 } x^2 + 2kx - 3 &= 0 \\ (x+k)^2 - k^2 - 3 &= 0 \\ (x+k)^2 &= k^2 + 3 \\ x+k &= \pm\sqrt{k^2 + 3} \\ x &= -k \pm \sqrt{k^2 + 3} \end{aligned}$$