

Simplify each of the following expressions.

- (a)  $a^3 \times a^2 =$  (b)  $a^4 \times a^6 =$  (c)  $x^2 \times x^7 =$   
 (d)  $x^4 \div x^2 =$  (e)  $y^3 \times y^0 =$  (f)  $p^7 \div p^4 =$   
 (g)  $q^6 \div q^3 =$  (h)  $x^7 \times x =$  (i)  $b^4 \div b =$   
 (j)  $\frac{b^6}{b^0} =$  (k)  $\frac{c^7}{c^4} =$  (l)  $\frac{x^8}{x^3} =$   
 (m)  $\frac{y^3}{y} =$  (n)  $\frac{x^4}{x^4} =$  (o)  $x^2 \times x^3 \times x^3 =$   
 (p)  $\frac{p^2 \times p^7}{p^5} =$  (q)  $\frac{x^{10}}{x^2 \times x^5} =$  (r)  $\frac{y^3 \times y^7}{y^2 \times y^4} =$   
 (s)  $\frac{x^2 \times x^3}{x^5} =$  (t)  $\frac{x^7 \times x}{x^3 \times x^4} =$  (u)  $\frac{x^8 \times x^4}{x^0} =$   
 (v)  $(x^2)^4 =$  (w)  $(x^3)^5 =$  (x)  $(x^2 \times x^7)^6 =$

Simplify the following expressions, so that they contain no negative indices.

- (a)  $a^6 \times a^{-7} =$  (b)  $\frac{a^7}{a^{-3}} =$  (c)  $\frac{a^{-5}}{a^{-9}} =$   
 (d)  $a^{-4} \times a^{-2} =$  (e)  $(a^2)^{-1} =$  (f)  $(a^2)^{-3} =$   
 (g)  $(a^{-2})^{-4} =$  (h)  $(a^{\frac{1}{2}})^5 =$  (i)  $(a^3)^{-\frac{1}{2}} =$   
 (j)  $(a^6)^{\frac{1}{3}} =$  (k)  $(a^9)^{-\frac{1}{3}} =$  (l)  $(a^{-12})^{-\frac{1}{4}} =$   
 (m)  $(\frac{a}{b})^2 =$  (n)  $(a^2 \times b^{-4})^3 =$  (o)  $(a^3 b^{\frac{1}{2}})^4 =$   
 (p)  $(a^2 b^{-2})^{-2} =$  (q)  $(\frac{a^2}{b^3})^4 =$  (r)  $(m^{-1} n^3)^{-2} =$   
 (s)  $(\frac{a^6}{b^{10}})^{\frac{1}{2}} =$  (t)  $(\frac{a^2}{m^4})^{-\frac{1}{2}} =$  (u)  $(\frac{a^8 b^2}{c^6})^{-\frac{1}{2}} =$   
 (v)  $(\frac{m^2}{x})^{-1} =$  (w)  $(\frac{x^2 y}{z^3})^{-4} =$  (x)  $[(a^3 b^{-8})^{-\frac{1}{3}}]^2 =$

Expand and simplify, whenever possible, the following.

- (a)  $(a+b)(c+d)$  (b)  $(a+c)(2a+c)$  (c)  $(3a+d)(a-5d)$   
 (d)  $(4x-y)(3x+y)$  (e)  $(4a+d)(a+3d)$  (f)  $(2a+b)(a+4c)$   
 (g)  $(6x-y)(y-3x)$  (h)  $(p+q)(q-2p)$  (i)  $(5x+y)(9x-2y)$   
 (j)  $(4x-2)(x+y)$  (k)  $(2a+b)(2a-c)$  (l)  $(4x-5y)(x-6y)$   
 (m)  $(p-2q)(p+2q)$  (n)  $(5a+2b)(a-3b)$  (o)  $(5x-6y)(2x-3y)$

Factorise each of the following expressions.

- (a)  $5x^2 + x$  (b)  $a^2 + 3a$  (c)  $5n^2 + 2n$   
 (d)  $6n^2 + 3n$  (e)  $5n^2 - 10n$  (f)  $3x^2 + 6x$   
 (g)  $15x^2 + 30x$  (h)  $14x^2 + 21x$  (i)  $16x^2 + 24x$   
 (j)  $30x^2 - 18x$  (k)  $5 + 5n^2$  (l)  $10n^2 - 15$   
 (m)  $3n^3 + 9n$  (n)  $9x^2 - 27x$  (o)  $10x^3 - 5x^2$

Factorise the following expressions.

- (a)  $x^2 + x - 2$  (b)  $x^2 - x - 12$  (c)  $x^2 - 3x - 10$   
 (d)  $x^2 + 4x - 5$  (e)  $x^2 - 5x - 14$  (f)  $x^2 - 2x - 8$   
 (g)  $x^2 + 2x - 15$  (h)  $x^2 - 3x + 2$  (i)  $x^2 - 9x + 20$   
 (j)  $x^2 - 10x + 21$  (k)  $x^2 - 9x + 14$  (l)  $x^2 - 7x + 10$   
 (m)  $x^2 - 6x - 16$  (n)  $x^2 - 17x + 72$  (o)  $x^2 - 5x - 24$

Factorise each of the following expressions.

- (a)  $3x^2 - 2x - 1$  (b)  $3x^2 + 4x + 1$  (c)  $2x^2 + 5x + 2$   
 (d)  $3x^2 + 8x + 4$  (e)  $3x^2 + 8x - 3$  (f)  $4x^2 - 11x - 3$   
 (g)  $5x^2 + 3x - 2$  (h)  $3x^2 - 8x + 4$  (i)  $5x^2 + 13x - 6$   
 (j)  $6x^2 + 5x + 1$  (k)  $6x^2 - 7x + 2$  (l)  $10x^2 - 3x - 1$   
 (m)  $8x^2 + 10x - 3$  (n)  $6x^2 + 19x - 7$  (o)  $6x^2 - 17x + 12$

Solve the following quadratic equations.

- (a)  $x^2 + x - 12 = 0$  (b)  $x^2 - 2x - 15 = 0$  (c)  $x^2 + 4x - 12 = 0$   
 (d)  $x^2 + 6x = 0$  (e)  $3x^2 - 4x = 0$  (f)  $4x^2 - 9x = 0$   
 (g)  $x^2 - 9 = 0$  (h)  $x^2 - 49 = 0$  (i)  $9x^2 - 64 = 0$   
 (j)  $x^2 - 8x + 16 = 0$  (k)  $x^2 + 10x + 25 = 0$  (l)  $x^2 - 3x - 18 = 0$   
 (m)  $x^2 - 11x + 28 = 0$  (n)  $x^2 + x - 30 = 0$  (o)  $x^2 - 14x + 40 = 0$   
 (p)  $2x^2 + 7x + 3 = 0$  (q)  $2x^2 + 5x - 12 = 0$  (r)  $3x^2 - 7x + 4 = 0$   
 (s)  $4x^2 + x - 3 = 0$  (t)  $2x^2 + 5x - 3 = 0$  (u)  $2x^2 - 19x + 35 = 0$

Use the quadratic equation formula to find the solutions, where they exist, of each of the following equations. Give answers to 2 decimal places.

- (a)  $4x^2 - 7x + 3 = 0$  (b)  $2x^2 + x - 10 = 0$  (c)  $9x^2 - 6x - 11 = 0$   
 (d)  $3x^2 - 5x - 7 = 0$  (e)  $x^2 + x - 8 = 0$  (f)  $4x^2 - 6x - 9 = 0$   
 (g)  $2x^2 + 17x - 9 = 0$  (h)  $x^2 - 14x = 0$  (i)  $x^2 + 2x - 10 = 0$   
 (j)  $3x^2 + 8x - 1 = 0$  (k)  $x^2 + 6 = 0$  (l)  $2x^2 - 8x + 3 = 0$   
 (m)  $4x^2 - 5x - 3 = 0$  (n)  $5x^2 - 4x + 12 = 0$  (o)  $x^2 - 6x - 5 = 0$

Solve each pair of simultaneous equations.

- (a)  $x + 2y = 5$  (b)  $3x + 2y = 19$  (c)  $x - 2y = 4$   
 $3x + y = 5$   $x + 5y = 15$   $4x + 3y = 49$   
 (d)  $2x + 3y = 14$  (e)  $3x + 4y = 2$  (f)  $4x + 2y = 16$   
 $5x + 2y = 24$   $7x - 5y = 9$   $-3x + 2y = -19$   
 (g)  $5x + y = 2$  (h)  $6x - 4y = 12$  (i)  $7x - 2y = 23$   
 $-4x + 3y = 44$   $-9x + 2y = -66$   $3x + 4y = 39$   
 (j)  $8x + 4y = 7$  (k)  $4x - 2y = -0.1$  (l)  $6x - 5y = 41$   
 $-12x + 8y = -6$   $5x + 2y = 1.5$   $4x + 15y = 31$   
 (m)  $-2x + 5y = 14$  (n)  $8x + 5y = -29$  (o)  $6x - 5y = -14$   
 $10x + 7y = 26$   $3x - 7y = -2$   $18x - 4y = 6$   
 (p)  $6x - 8y = -2$  (q)  $\frac{1}{2}x - \frac{1}{4}y = 0$  (r)  $\frac{1}{5}x - \frac{1}{10}y = -1$   
 $5x + 2y = 1.8$   $\frac{1}{3}x + \frac{2}{3}y = 10$   $\frac{1}{4}x + \frac{1}{2}y = 10$

1. In order to find the height of a tree, some children walk 50 metres from the base of the tree and measure the angle of elevation as  $10^\circ$ . Find the height of the tree.
2. From a distance of 20 metres from its base, the angle of elevation of the top of a pylon is  $32^\circ$ . Find the height of the pylon.
3. The height of a church tower is 15 metres. A man looks at the tower from a distance of 120 metres. What is the angle of elevation of the top of the tower from the man?
4. A coastguard looks out from an observation tower of height 9 metres and sees a boat in distress at a distance of 500 metres from the tower. What is the angle of depression of the boat from the tower?
5. A lighthouse is 20 metres high. A life-raft is drifting and one of its occupants estimates the angle of elevation of the top of the lighthouse as  $3^\circ$ .
- (a) Use the estimated angle to find the distance of the life-raft from the lighthouse.
- (b) If the life-raft is in fact 600 metres from the lighthouse, find the correct angle of elevation.

