

3. For each equation, draw a suitable sketch and find the roots.

- (a)  $x^2 - 4x = 0$
  - (b)  $x^2 + 6x = 0$
  - (c)  $x^2 - 5x = 0$
  - (d)  $x^2 - 8x + 15 = 0$
  - (e)  $x^2 + 6x + 9 = 0$
  - (f)  $x^2 - 4x + 4 = 0$
  - (g)  $x^2 + 6x + 8 = 0$
  - (h)  $x^2 + 8x + 12 = 0$
  - (i)  $x^2 - 7x + 10 = 0$
  - (j)  $x^2 - 5x + 4 = 0$
  - (k)  $x^2 + x - 6 = 0$
  - (l)  $x^2 - x - 2 = 0$
  - (m)  $12 - 4x - x^2 = 0$
  - (n)  $5 + 4x - x^2 = 0$
  - (o)  $2 - x - x^2 = 0$
1. Solve these quadratic equations, which are already in factorised form.
- (a)  $x(x - 5) = 0$
  - (b)  $x(x + 7) = 0$
  - (c)  $x(x - 1) = 0$
  - (d)  $2b(b - 3) = 0$
  - (e)  $3a(a + 1) = 0$
  - (f)  $5m(m - 2) = 0$
  - (g)  $(a - 4)(a - 2) = 0$
  - (h)  $(y - 3)(y - 4) = 0$
  - (i)  $(c - 5)(c - 3) = 0$
  - (j)  $(w + 1)(w + 2) = 0$
  - (k)  $(s + 5)(s + 4) = 0$
  - (l)  $(z + 7)(z + 8) = 0$
  - (m)  $(x + 3)(x - 1) = 0$
  - (n)  $(t + 2)(t - 12) = 0$
  - (o)  $(y + 1)(y - 9) = 0$
  - (p)  $(a - 4)(a + 4) = 0$
  - (q)  $(p - 7)(p + 7) = 0$
  - (r)  $(c - 5)(c + 5) = 0$
  - (s)  $(d - 4)(2d - 1) = 0$
  - (t)  $(2x + 3)(x + 2) = 0$
  - (u)  $(3s + 1)(2s - 5) = 0$

**FACTORISING**

4. Solve these quadratic equations by factorising first.

- (a)  $x^2 + 4x + 3 = 0$
- (b)  $y^2 + 6y + 5 = 0$
- (c)  $a^2 + 8a + 7 = 0$
- (d)  $m^2 + 5m + 6 = 0$
- (e)  $c^2 + 6c + 8 = 0$
- (f)  $z^2 + 7z + 12 = 0$
- (g)  $15 - 2x - x^2 = 0$
- (h)  $b^2 - 8b + 16 = 0$
- (i)  $x^2 - 7x + 10 = 0$
- (j)  $w^2 - 12w + 27 = 0$
- (k)  $18 + 7y - y^2 = 0$
- (l)  $k^2 - 10k + 24 = 0$
- (m)  $8 - 2x - x^2 = 0$
- (n)  $6 + m - m^2 = 0$
- (o)  $t^2 - 7t - 30 = 0$
- (p)  $a^2 + 5a - 14 = 0$
- (q)  $c^2 - 2c - 15 = 0$
- (r)  $12 - 4p - p^2 = 0$

5. Solve these quadratic equations by factorising first.

- (a)  $2x^2 + 7x + 5 = 0$
- (b)  $2p^2 + 11p + 5 = 0$
- (c)  $3t^2 + 10t + 3 = 0$
- (d)  $3k^2 + 7k + 2 = 0$
- (e)  $3y^2 + 8y + 5 = 0$
- (f)  $6 - 7a - 5a^2 = 0$
- (g)  $3 - 5w - 2w^2 = 0$
- (h)  $3d^2 - 5d + 2 = 0$
- (i)  $5x^2 - 16x + 3 = 0$
- (j)  $3m^2 - 14m + 8 = 0$
- (k)  $7 + 5c - 2c^2 = 0$
- (l)  $1 - 5y - 6y^2 = 0$
- (m)  $3x^2 - 2x = 1$
- (n)  $4q^2 + 5q = 6$
- (o)  $4t(t - 1) - 3 = 0$
- (p)  $3m^2 + 2m = 5$
- (q)  $36v^2 = -v + 2$
- (r)  $7s^2 = 4 + 27s$

**USING QUADRATIC FORMULA**

2. Solve these quadratic equations by factorising first.

- (a)  $x^2 + 4x = 0$
- (b)  $c^2 - 2c = 0$
- (c)  $y^2 + 8y = 0$
- (d)  $p^2 - p = 0$
- (e)  $z^2 + z = 0$
- (f)  $t^2 + 7t = 0$
- (g)  $2t^2 + 4t = 0$
- (h)  $5x^2 - 20x = 0$
- (i)  $6b^2 - 18b = 0$
- (j)  $4y^2 - 6y = 0$
- (k)  $6a^2 + 9a = 0$
- (l)  $14x^2 + 21x = 0$
- (m)  $5x - x^2 = 0$
- (n)  $9b - b^2 = 0$
- (o)  $2m - m^2 = 0$
- (p)  $6w - 4w^2 = 0$
- (q)  $9c - 12c^2 = 0$
- (r)  $4y - 10y^2 = 0$

3. Solve these quadratic equations by factorising first.

- (a)  $x^2 - 25 = 0$
- (b)  $b^2 - 1 = 0$
- (c)  $y^2 - 4 = 0$
- (d)  $a^2 - 36 = 0$
- (e)  $z^2 - 9 = 0$
- (f)  $k^2 - 64 = 0$
- (g)  $x^2 - 16 = 0$
- (h)  $p^2 - 144 = 0$
- (i)  $m^2 - 100 = 0$
- (j)  $t^2 - 49 = 0$
- (k)  $a^2 - 81 = 0$
- (l)  $s^2 - 121 = 0$
- (m)  $2a^2 - 18 = 0$
- (n)  $5c^2 - 80 = 0$
- (o)  $4y^2 - 64 = 0$

1. Solve these equations using the quadratic formula.

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

2. Solve these equations using the quadratic formula, giving your answers correct to 2 decimal places.

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

3. Solve these equations using the quadratic formula, giving your answers correct to 2 decimal places.

- (a)  $3x^2 + 8x + 5 = 0$  (b)  $2b^2 + 9b + 3 = 0$  (c)  $2p^2 + 5p + 1 = 0$   
 (d)  $1 + 6c - 4c^2 = 0$  (e)  $3y^2 + 7y + 3 = 0$  (f)  $5d^2 + 9d + 2 = 0$   
 (g)  $8z^2 - 7z + 1 = 0$  (h)  $3 + 12q - 4q^2 = 0$  (i)  $3w^2 - 6w + 2 = 0$   
 (j)  $5d^2 - 10d + 4 = 0$  (k)  $5x^2 - 7x + 1 = 0$  (l)  $3 + 8m - 2m^2 = 0$   
 (m)  $5y^2 + 8y - 2 = 0$  (n)  $5 - 2k - 6k^2 = 0$  (o)  $10c^2 + 2c - 1 = 0$   
 (p)  $8 - 9t - 4t^2 = 0$  (q)  $3 + 3a - 7a^2 = 0$  (r)  $2z^2 + 2z - 9 = 0$

4. Solve these equations using the quadratic formula, giving your answers correct to 3 significant figures.

- (a)  $x^2 + 5x + 3 = 0$  (b)  $c^2 + 3c + 1 = 0$  (c)  $m^2 + 8m + 2 = 0$   
 (d)  $y^2 + 7y + 7 = 0$  (e)  $p^2 + 6p + 2 = 0$  (f)  $d^2 + 6a + 3 = 0$   
 (g)  $b^2 - 5b + 2 = 0$  (h)  $z^2 - 9z + 4 = 0$  (i)  $q^2 - 7q + 5 = 0$   
 (j)  $x^2 - 10x + 3 = 0$  (k)  $c^2 - 8c + 8 = 0$  (l)  $w^2 - 4w + 2 = 0$   
 (m)  $k^2 + 12k - 20 = 0$  (n)  $d^2 + 11d - 15 = 0$  (o)  $s^2 + 8s - 17 = 0$   
 (p)  $a^2 + 3a - 9 = 0$  (q)  $y^2 + 2y - 11 = 0$  (r)  $c^2 + 3c - 12 = 0$   
 (s)  $8x^2 + 8x = -1$  (t)  $5b^2 + 3b = 9$  (u)  $2p^2 - 9p = 3$   
 (v)  $7m^2 = 6m - 1$  (w)  $3x^2 = 8 - 3x$  (x)  $4c^2 = 9 + 3c$

### MORE QUADRATICS

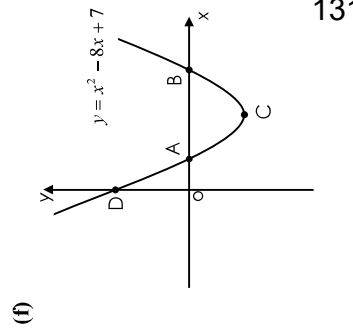
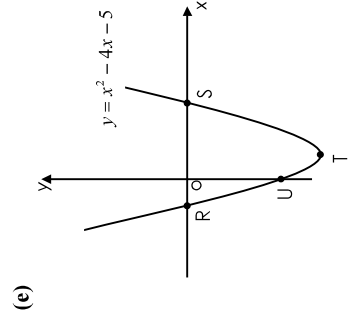
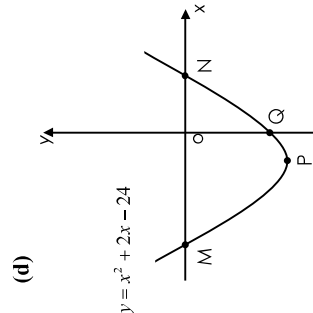
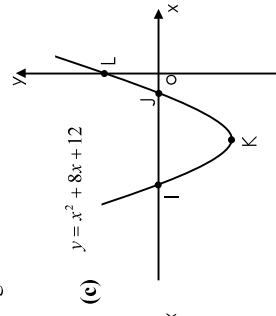
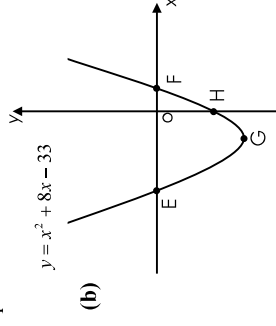
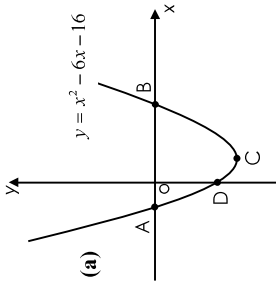
1. Sketch the graphs of the following quadratic functions marking all relevant points.

Then ... for each function answer the following questions ...

- (i) State the *roots* (or zeros) of the function;  
 (ii) write down the equation of the *axis of symmetry*;  
 (iii) state the *coordinates* and *nature* of the turning point;  
 (iv) give the coordinates of the *y-intercept* point;

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

2. Find the coordinates of the points marked with letters in the diagrams below.



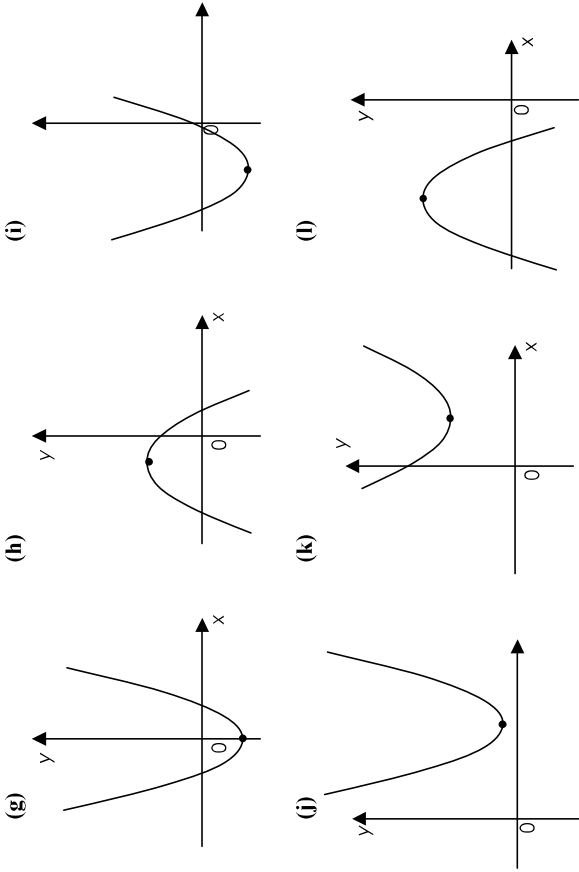
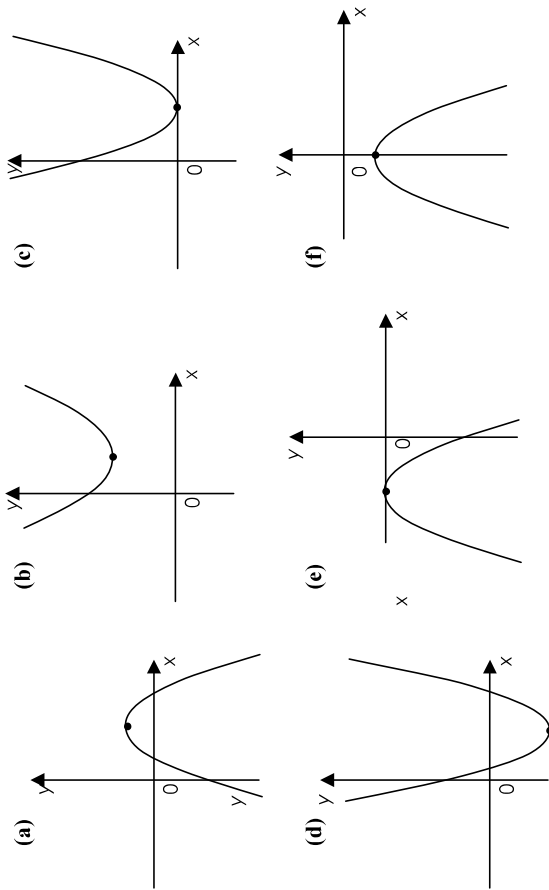
**DISCRIMINANT**

1. Find the discriminant for each of these quadratic equations

- (a)  $x^2 + 4x + 3 = 0$     (b)  $x^2 + 6x + 9 = 0$     (c)  $x^2 + 8x + 7 = 0$
- (d)  $3 - 5w - 2w^2 = 0$     (e)  $2x^2 + 7x + 5 = 0$     (f)  $x^2 - 12x + 36 = 0$
- (g)  $x^2 - 7x + 12 = 0$     (h)  $2x^2 + 7x + 9 = 0$     (i)  $5x^2 - 16x + 3 = 0$
- (j)  $6y^2 - 11y - 2 = 0$     (k)  $x^2 - 8x + 9 = 0$     (l)  $3x^2 + 2x + 7 = 0$
- (m)  $2x^2 - 7x + 4 = 0$     (n)  $4x^2 - 3x + 4 = 0$     (o)  $3x^2 - 2x - 1 = 0$
- (p)  $x^2 + 10x + 25 = 0$     (q)  $3x^2 - 7x + 5 = 0$     (r)  $x^2 - 8x + 16 = 0$

2. Use the discriminants from Q1 to state the nature of the roots of each of the quadratic equations.

3. Here are some graphs of quadratic functions. What can you say about the discriminant for each one?



4. Find the value of  $a$  so that these quadratic equations have equal roots.

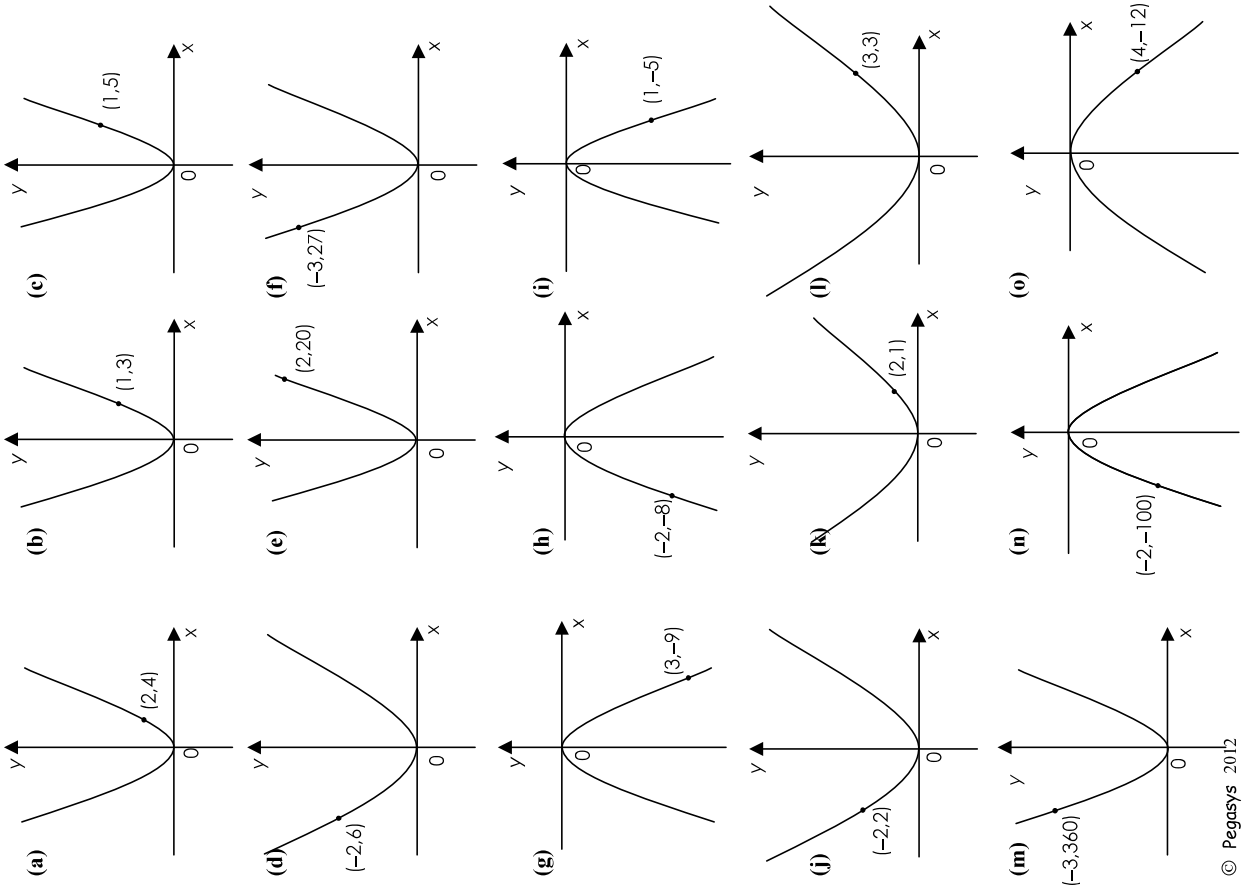
- (a)  $x^2 - 4x - a = 0$     (b)  $2x^2 + 10x + a = 0$     (c)  $ax^2 - 2x + 5 = 0$
- (d)  $ax^2 + (4a - 3)x + a = 0$     (e)  $3x^2 + 8x + a = 0$     (f)  $ax^2 - 7x - 5 = 0$

5. Find the value of  $k$  so that these quadratic equations have equal roots.

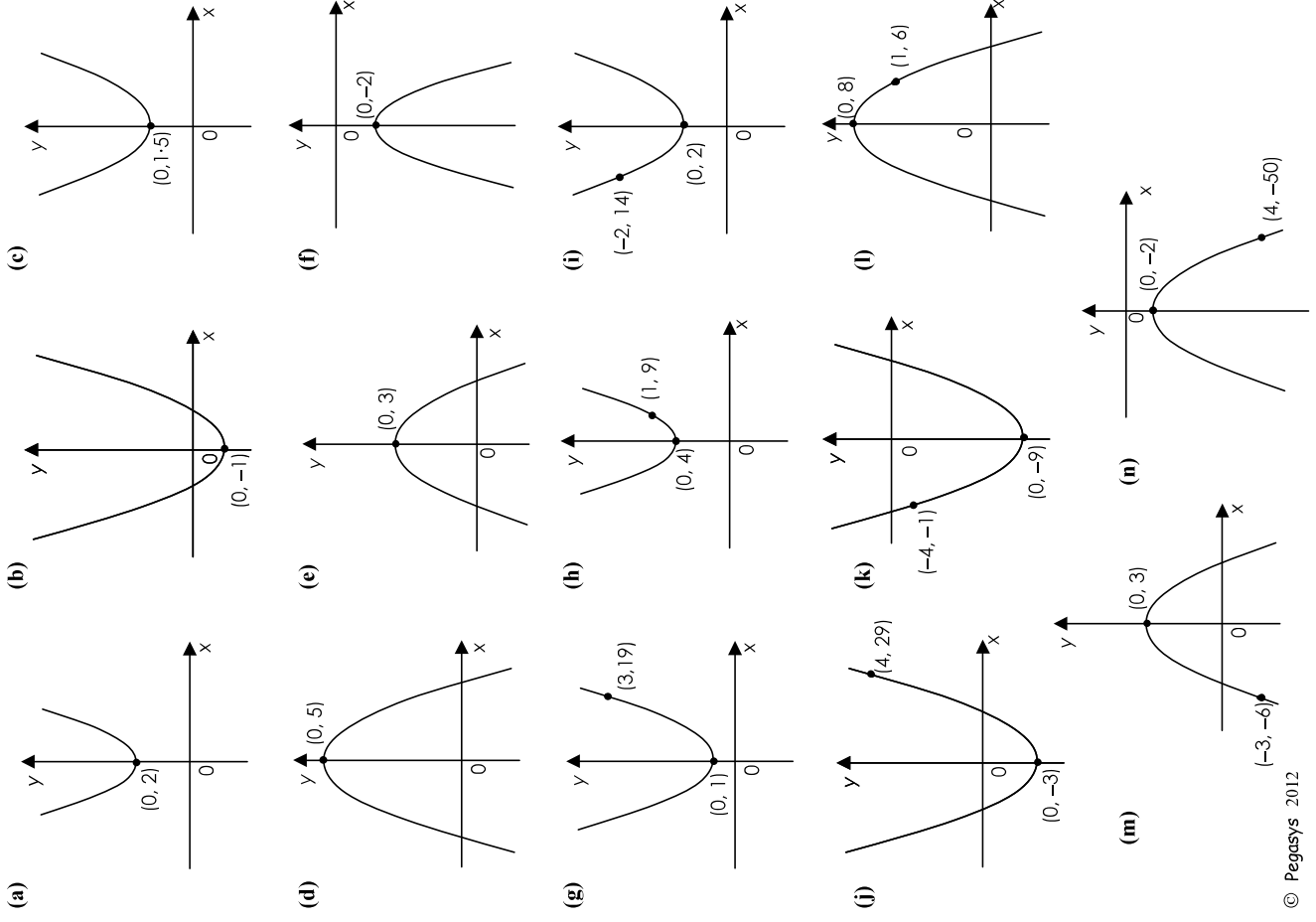
- (a)  $kx^2 - 8x + 4 = 0$     (b)  $kx^2 + 6x + 18 = 0$     (c)  $x^2 - 2kx + 5 = 0$
- (d)  $x^2 - 6x + k = 0$     (e)  $kx^2 + 5x + 10 = 0$     (f)  $x^2 - 3kx + 36 = 0$

## 2.1 RECOGNISE and DETERMINE the EQUATIONS of QUADRATICS from their GRAPHS

1. Write down the equation of the graphs shown below, which have the form  $y = kx^2$ .

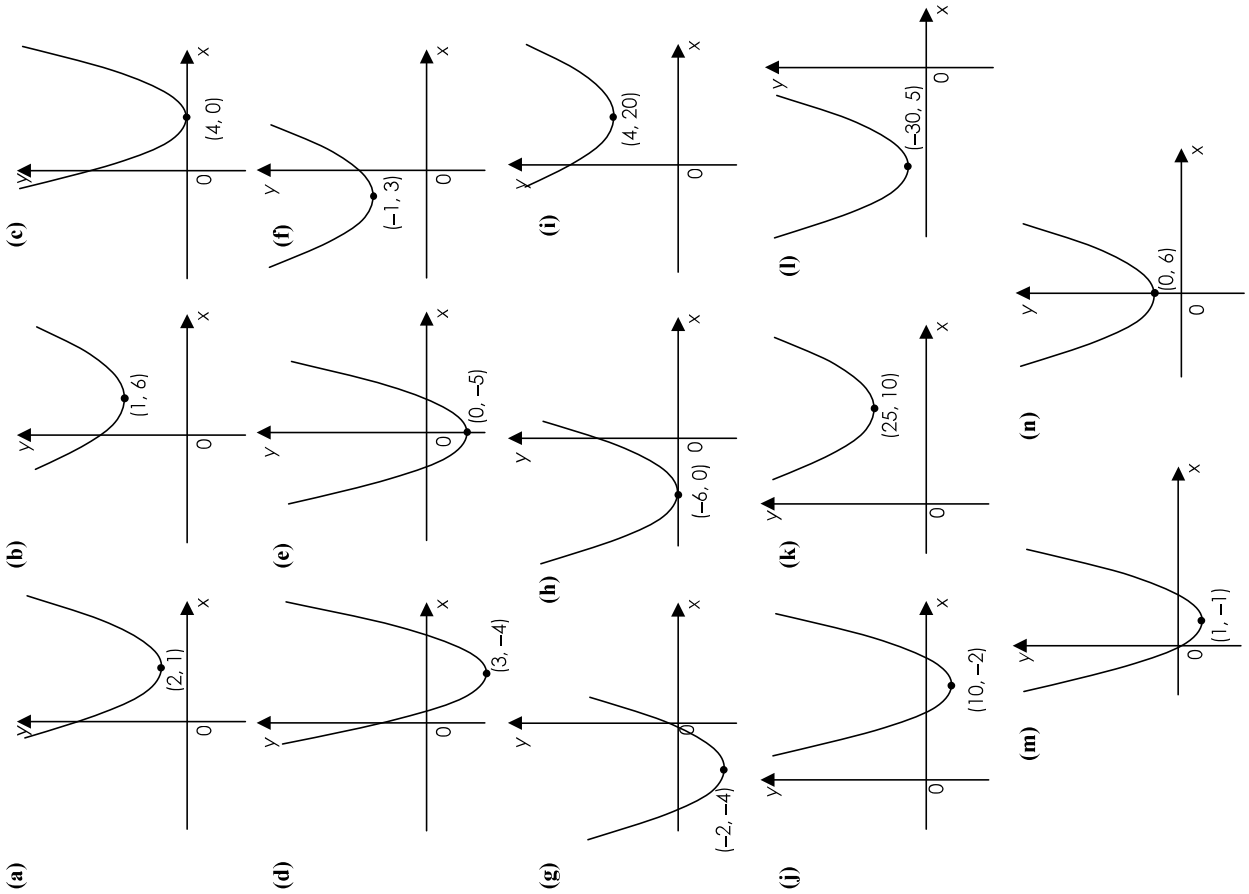


2. Write down the equation of the graphs shown below, which have the form  $y = ax^2 + b$ .



**2.2 SKETCHING the GRAPH of a QUADRATIC FUNCTION**

3. Write down the equation of the graphs shown below, which have the form  $y = (x + a)^2 + b$ .



1. Sketch the graphs with the following equations

- (a)  $y = (x - 4)^2 + 1$       (b)  $y = (x - 2)^2 + 5$       (c)  $y = (x - 1)^2 + 7$
- (d)  $y = (x - 2)^2 - 3$       (e)  $y = (x - 3)^2 - 4$       (f)  $y = (x - 5)^2 - 2$
- (g)  $y = (x + 4)^2 + 6$       (h)  $y = (x + 1)^2 + 5$       (i)  $y = (x + 8)^2 + 1$
- (j)  $y = (x + 3)^2 - 1$       (k)  $y = (x + \frac{1}{2})^2 - \frac{3}{4}$       (l)  $y = (x + 0.5)^2 - 2.5$
- (m)  $y = -(x - 1)^2 + 4$       (n)  $y = -(x + 6)^2 + 3$       (o)  $y = -(x + 7)^2 - 2$
- (p)  $y = (2 - x)^2 + 12$       (q)  $y = (5 - x)^2 - 1$       (r)  $y = (4 - x)^2 + 3.75$

2. Sketch the graphs with the following equations

- (a)  $y = (x - 1)(x - 5)$       (b)  $y = (x - 4)(x - 2)$       (c)  $y = (x - 3)(x - 7)$
- (d)  $y = (x - 6)(x - 8)$       (e)  $y = (x - 5)(x - 2)$       (f)  $y = (x - 8)(x - 5)$
- (g)  $y = (x + 2)(x + 3)$       (h)  $y = (x + 5)(x + 2)$       (i)  $y = (x + 4)(x + 6)$
- (j)  $y = (x + 3)(x + 4)$       (k)  $y = (x + 9)(x + 5)$       (l)  $y = (x + 3)(x + 8)$

3. Sketch the graphs with the following equations

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