LEVEL 1

1. Which of the following are quadratic equations?

(a) $3x + x - 7 = 0$ (b) $5x^2 - 5x + 1 = 0$ (c) $16 - y^2 = 0$

2. Factorise the following.

(a) $x^2 + x$ (b) $2x - x^2$ (c) $4ax + ax^2$

(d) $6y^2 + 12y$ (e) $9b^2 - 3b$ (f) $12ay^2 + 4ay$

3. Factorise the following.

(a) $2(a + b) + a(a + b)$ (b) $z(z - 1) - 3(z - 1)$ (c) $x(x + 1) - 2(x + 1)$

LEVEL 2

1. Factorise the following.

(a) $x^2 + 3x - 4$ (b) $y^2 - 6y + 5$ (c) $x^2 + 5x - 14$

(d) $a^2 - 2a + 1$ (e) $a^2 - 2a - 3$ (f) $y^2 - 16y + 63$

2. Factorise the following.

(a) $2x^2 + 5x - 3$ (b) $3x^2 + 4x + 1$ (c) $2y^2 + y - 3$

(d) $6z^2 + 5z + 1$ (e) $12x^2 + 25x + 12$ (f) $5x^2 - 14x - 3$

3. Solve the following equations:

i. $x^2 + 3x - 4 = 0$ ii. $x^2 - 6x + 5 = 0$ iii. $x^2 + 5x + 6 = 0$

iv. $x^2 - 2x + 1 = 0$ v. $x^2 + 5x - 14 = 0$ vi. $x^2 - 16x + 63 = 0$

4. Use the quadratic formula to solve these equations (give answers in exact form):

i. $x^2 + x - 7 = 0$ ii. $2x^2 + 3x - 4 = 0$ iii. $-x^2 - 4x + 9 = 0$

iv. $5x^2 - 3x - 4 = 0$ v. $2x^2 - 5x + 7 = 0$ vi. $3x^2 + 5x - 9 = 0$

LEVEL 3

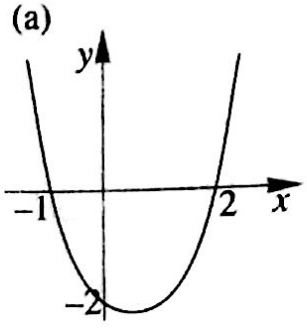
1. Find the turning points of the graphs of the following functions:

i. $y = x^2 - 6x + 13$ ii. $y = x^2 + 2x + 4$ iii. $y = 2x^2 - 4x - 1$

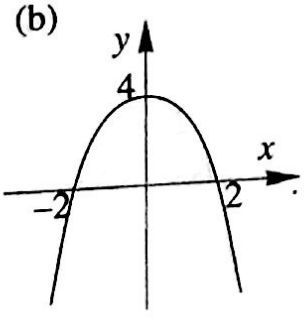
iv. $y = 3x^2 - 6x + 4$ v. $y = x^2 - x + \frac{13}{4}$ vi. $y = 5x^2 - 10x + 5$

2. Give equations for the functions whose graphs are shown:

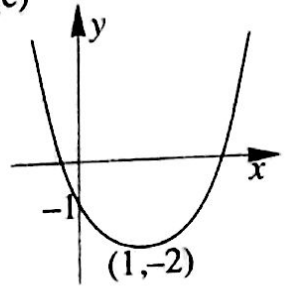
(a)



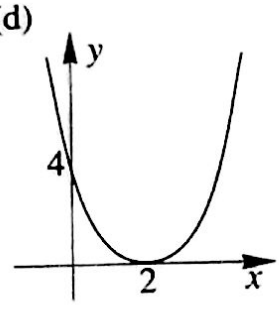
(b)



(c)



(d)



3. By making use of completing the square, find the roots of the following quadratic equations.

(a) $x^2 + x - 4 = 0$ (b) $2x^2 - 2x - 7 = 0$

(c) $x^2 - 6x - 1 = 0$ (d) $3x^2 - 12x + 3 = 0$

(e) $2x^2 - x - 2 = 0$ (f) $x^2 - 6x + 2 = 0$

4. Sketch the graph of the following functions. On your graphs indicate clearly the coordinates of the turning point and the intercepts with the y–axis.

(a) $y = (x-1)^2 + 3$ (b) $y = (x+2)^2 - 1$

(c) $y = 4 - (x-2)^2$ (d) $y = 2(x+1)^2 - 4$

(e) $y = 9 - (x+3)^2$ (f) $y = \frac{1}{2}(x+4)^2 + 2$

5. Sketch the graph of the following functions. On each graph indicate clearly all intercepts with the axes.

(a) $y = x^2 - 2x$ (b) $y = x^2 - 4x - 5$

(c) $y = 9 - x^2$ (d) $y = -x^2 + 6x - 5$

(e) $y = x^2 - 6x + 12$ (f) $y = x^2 - 6x + 9$

6. Solve the system of equations

(a) $y = 2x^2 + 5x - 10$, $y = x^2 + 3x + 5$ (b) $y = x^2 + 4x - 6$, $y = 2(x+1)$

7. The factors of the function $f(x) = ax^2 - 7x + c$ are $(2x+1)(x-k)$.

(a) Determine the values of a, c and k.

(b) Find the x-intercepts for the graph of $y = f(x)$.

(c) Find the equation of the axis of symmetry.

(d) Find the minimum value of $f(x)$.

LEVEL 4

1. Find the coordinates of the turning point on the graph of the function $y = x^2 + kx + 4$ in terms of the parameter k, where k is a real number.

2. (a) Show that $N = a^2 - 3a + 3$ is positive for all real values of a.

(b) Find the minimum value of N.

3. (a) On the same set of axes, sketch the graphs of $y = x^2 - 3x + 2$ and $y = 4 - x^2$, showing all intercepts with the axes.

(b) Solve the quadratic equation $2x^2 - 3x - 2 = 0$.

(c) Hence, find the coordinates of the points of intersection of the curves in (a).

4. (a) Solve for x: $\frac{x}{a} + \frac{1}{x} + \left(1 + \frac{1}{a}\right) = 0$.

(b) Hence, solve the quadratic equation $0.5x^2 + 1 + 1.5x = 0$.

1. (a) On the same set of axes, draw accurate graphs of $y = 5 - x$ and $y = 5x - x^2$.

(b) Using part (a), give a geometrical interpretation of the equation $5 - x = 5x - x^2$.

(c) Solve $5 - x = 5x - x^2$ using part (a).

2. (a) On the same set of axes, draw accurate graphs of $y = x + 6$ and $y = x^2$.

(b) Using part (a), give a geometrical interpretation of the equation $x^2 = x + 6$.

(c) Solve $x^2 = x + 6$ using part (a).

3. (a) On the same set of axes, draw accurate graphs of $y = 5$ and $y = x^2 + 1$.

(b) Using part (a), give a geometrical interpretation of the equation $x^2 + 1 = 5$.

(c) Solve $x^2 + 1 = 5$ using part (a).

4. (a) On the same set of axes, draw accurate graphs of $y = x + 1$ and $y = x^2 - x - 2$.

(b) Interpret the equation $x + 1 = x^2 - x - 2$ using part (a).

(c) Solve $x + 1 = x^2 - x - 2$ using part (a).

5. (a) On the same set of axes, draw accurate graphs of $y = 2 - x$ and $y = x^2 - x - 2$.

(b) Interpret the equation $2 - x = x^2 - x - 2$ using part (a).

(c) Solve $2 - x = x^2 - x - 2$ using part (a).

6. Solve the system of equations

(a) $y = x^2$, $y = x + 6$ (b) $y = x^2 + 1$, $y = 5$ (c) $y = -2x + 4$, $y = x^2 - 4x + 5$

(d) $y = x^2 - 4$, $y = x + 2$ (e) $y = -x + 4$, $y = x^2 - 2$ (f) $y = 4x - 3$, $y = x^2 - 2x + 6$

Draw the following curves. The scales given are for one unit of x and y.

1. $y = x^2$, for $0 \leqslant x \leqslant 6$.
   (Scales: 2 cm for x, $\frac{1}{2}$ cm for y)
   Find:
   (a) the gradient of the tangent to the curve at $x = 2$,
   (b) the gradient of the tangent to the curve at $x = 4$,
   (c) the y-value at $x = 3{\cdot}25$.

2. $y = x^2 - 3x$, for $-2 \leqslant x \leqslant 5$.
   (Scales: 2 cm for x, 1 cm for y)
   Find:
   (a) the gradient of the tangent to the curve at $x = 3$,
   (b) the gradient of the tangent to the curve at $x = -1$,
   (c) the value of x where the gradient of the curve is zero.

3. $y = 5 + 3x - x^2$, for $-2 \leqslant x \leqslant 5$.
   (Scales: 2 cm for x, 1 cm for y)
   Find:
   (a) the maximum value of the function $5 + 3x - x^2$,
   (b) the gradient of the tangent to the curve at $x = 2{\cdot}5$,
   (c) the two values of x for which $y = 2$.

4. $y = \dfrac{12}{x}$, for $1 \leqslant x \leqslant 10$.
   (Scales: 1 cm for x and y)

5. $y = \dfrac{9}{x}$, for $1 \leqslant x \leqslant 10$.
   (Scales: 1 cm for x and y)

6. $y = \dfrac{12}{x+1}$, for $0 \leqslant x \leqslant 8$.
   (Scales: 2 cm for x, 1 cm for y)

7. $y = \dfrac{8}{x-4}$, for $-4 \leqslant x \leqslant 3{\cdot}5$.
   (Scales: 2 cm for x, 1 cm for y)

8. $y = \dfrac{15}{3-x}$, for $-4 \leqslant x \leqslant 2$.
(Scales: 2 cm for x, 1 cm for y)

9. $y = \dfrac{x}{x+4}$, for $-3{\cdot}5 \leqslant x \leqslant 4$.
(Scales: 2 cm for x and y)

10. $y = \dfrac{3x}{5-x}$, for $-3 \leqslant x \leqslant 4$.
(Scales: 2 cm for x, 1 cm for y)

11. $y = \dfrac{x+8}{x+1}$, for $0 \leqslant x \leqslant 8$.
(Scales: 2 cm for x and y)

12. $y = \dfrac{x-3}{x+2}$, for $-1 \leqslant x \leqslant 6$.
(Scales: 2 cm for x and y)

13. $y = \dfrac{10}{x} + x$, for $1 \leqslant x \leqslant 7$.
(Scales: 2 cm for x, 1 cm for y)

14. $y = \dfrac{12}{x} - x$, for $1 \leqslant x \leqslant 7$.
(Scales: 2 cm for x, 1 cm for y)

15. $y = \dfrac{15}{x} + x - 7$, for $1 \leqslant x \leqslant 7$.
(Scales: 1 cm for x and y)
Find: (a) the minimum value of y,
(b) the y value when $x = 5{\cdot}5$.

16. $y = x^3 - 2x^2$, for $0 \leqslant x \leqslant 4$.
(Scales: 2 cm for x, $\frac{1}{2}$ cm for y)
Find: (a) the y value at $x = 2{\cdot}5$,
(b) the x value at $y = 15$.

17. $y = \frac{1}{10}(x^3 + 2x + 20)$, for $-3 \leqslant x \leqslant 3$.
(Scales: 2 cm for x and y)
Find:
(a) the x-value where $x^3 + 2x + 20 = 0$,
(b) the gradient of the tangent to the curve at

18. Copy and complete the table for the function $y = 7 - 5x - 2x^2$, giving values of y correct to one decimal place.

x	-4	$-3{\cdot}5$	-3	$-2{\cdot}5$	-2	$-1{\cdot}5$
7	7	7		7		7
$-5x$	20	17·5		12·5		7·5
$-2x^2$	-32	$-24{\cdot}5$		$-12{\cdot}5$		$-4{\cdot}5$
y	5	0		7		10

x	-1	$-0{\cdot}5$	0	0·5	1	1·5	2
7		7		7		7	
$-5x$		2·5		$-2{\cdot}5$		$-7{\cdot}5$	
$-2x^2$		$-0{\cdot}5$		$-0{\cdot}5$		$-4{\cdot}5$	
y		9		4		-5	

Draw the graph, using a scale of 2 cm for x and 1 cm for y. Find:
(a) the gradient of the tangent to the curve at $x = -2{\cdot}5$,
(b) the maximum value of y,
(c) the value of x at which this maximum value occurs.

19. Draw the graph of $y = \dfrac{x}{x^2+1}$, for $-6 \leqslant x \leqslant 6$.
(Scales: 1 cm for x, 10 cm for y)

Student Assessment 1

1. $y = kx$. When $y = 9, x = 3$.
   a) Calculate the value of k.
   b) Calculate y when $x = 4$.
   c) Calculate y when $x = 1$.
   d) Calculate x when $y = 18$.

2. $y = \frac{k}{x}$. When $y = 2, x = 2$.
   a) Calculate the value of k.
   b) Calculate y when $x = 16$.
   c) Calculate x when $y = 1$.
   d) Calculate x when $y = 0.5$.

3. $p = kq^3$. When $p = 4, q = 2$.
   a) Calculate the value of k.
   b) Calculate p when $q = 4$.
   c) Calculate p when $q = 1$.
   d) Calculate q when $p = 108$.

4. $m = \frac{k}{\sqrt{n}}$. When $m = \frac{5}{12}, n = 36$.
   a) Calculate the value of k.
   b) Calculate m when $n = 25$.
   c) Calculate m when $n = 100$.
   d) Calculate n when $m = 10$.

5. $y = \frac{k}{x^2}$. When $y = \frac{1}{16}, x = 2$.
   a) Calculate the value of k.
   b) Calculate y when $x = 1$.
   c) Calculate both values of x when $y = 0.25$.
   d) Calculate both values of x when $y = 0.01$.

Student Assessment 2

1. $y = kx$. When $y = 12, x = 8$.
   a) Calculate the value of k.
   b) Calculate y when $x = 10$.
   c) Calculate y when $x = 2$.
   d) Calculate x when $y = 18$.

2. $y = \frac{k}{x}$. When $y = 2, x = 5$.
   a) Calculate the value of k.
   b) Calculate y when $x = 4$.
   c) Calculate x when $y = 10$.
   d) Calculate x when $y = 0.5$.

3. $p = kq^3$. When $p = 9, q = 3$.
   a) Calculate the value of k.
   b) Calculate p when $q = 6$.
   c) Calculate p when $q = 1$.
   d) Calculate q when $p = 576$.

4. $m = \dfrac{k}{\sqrt{n}}$. When $m = 1, n = 25$.
   a) Calculate the value of k.
   b) Calculate m when $n = 16$.
   c) Calculate m when $n = 100$.
   d) Calculate n when $m = 5$.

5. $y = \dfrac{k}{x^2}$. When $y = 3, x = \dfrac{1}{3}$.
   a) Calculate the value of k.
   b) Calculate y when $x = 0.5$.
   c) Calculate both values of x when $y = \dfrac{1}{12}$.
   d) Calculate both values of x when $y = \dfrac{1}{3}$.

Student Assessment 3

1. Copy and complete the following tables:
   a) $y \propto x$

x	1	2	3	4	5
y			15		

   b) $y \propto \dfrac{1}{x}$

x	1	2	3	4	5
y					6

   c) $y \propto \dfrac{1}{x^2}$

x	1	2	3	4	5
y		5			

2. The braking distance (d metres) of a truck is proportional to the square of its speed (s km/h). If $d = 10$ when $s = 36$, calculate:
   a) d when $s = 60$,
   b) s when $d = 144$.

3. The volume (V cm^3) of a sphere is proportional to the cube of its radius (r cm). When $V = 33.5$, $r = 2$.

a) Write down the relationship between V and r, using k as the constant of variation.

b) Calculate the value of k.

c) Find the volume of the sphere when $r = 3$.

d) What is the radius of a sphere of volume 400 cm^3?

4. The volume (V cm^3) of a square-based pyramid is directly proportional to the product of the base area (A cm^2) and the vertical height (h cm).

a) Write down the relationship between V, A and h, using k as the constant of variation.

b) A square-based pyramid of base area 25 cm^2 and a vertical height of 9 cm has a volume of 75 cm^3. Find the base area of a square-based pyramid with a volume of 20 cm^3 and a vertical height of 5 cm.