

Quadratics and Polynomials

5. Quadratics and Polynomials

Section A - Revision Section

This section will help you revise previous learning which is required in this topic

R1 I have had experience of factorising. (common factor, difference of two squares and quadratic trinomials).

1. Factorise fully

(a) $98 - 8x^2$

(b) $5s^2 - 5t^2$

(c) $98 - 2x^2$

(d) $75x^2 - 243$

(e) $72 - 18x^2$

(f) $12x - 3x^3$

(g) $81 - x^4$

(h) $27w - 12w^3$

(i) $64a^4 - 4$

2. Factorise fully

(a) $2x^2 - 7x + 3$

(b) $2x^2 + 11x + 12$

(c) $3x^2 + 10x + 8$

(d) $x^2 + x - 6$

(e) $6x^2 + 7x + 2$

(f) $x^2 - 3x + 2$

(g) $5x^2 + 4x - 1$

(h) $7x^2 + 16x + 4$

(i) $2x^2 + 7x - 15$

3. Factorise fully

(a) $6 - x - x^2$

(b) $20 + 11x - 3x^2$

(c) $3 + x - 2x^2$

(d) $15 - 7x - 2x^2$

(e) $4 - 7x - 2x^2$

(f) $15 - 2x - x^2$

4. Factorise fully

(a) $3x^2 + 6x - 24$

(b) $15x^2y + 5x$

(c) $2x^2 - 32$

(d) $5x^3 - 45x$

(e) $18x^2 - 6x - 12$

(f) $12x^2y + 8xy^3$

(g) $10x^2 + 25x - 15$

(h) $6x^3 + 30x^2 + 36x$

(i) $7x^2 - 28$

(j) $2x^2 - 10x + 12$

(k) $3x^3 + 21x^2 + 30x$

(l) $6x^3 - 54x$

Quadratics and Polynomials

R2 I have revised solving Quadratic Equations

1. Solve each of these quadratic equations

(a) $x^2 + 7x + 12 = 0$ (b) $x^2 - 4 = 0$ (c) $n^2 + 3n + 2 = 0$

(d) $5x^2 + 15x = 0$ (e) $p^2 + 11p + 24 = 0$ (f) $12a - 3a^2 = 0$

(g) $s^2 + 6s + 8 = 0$ (h) $r^2 - 25 = 0$ (i) $n^2 + 5n + 6 = 0$

2. Solve each of these quadratic equations

(a) $x^2 - 11x + 24 = 0$ (b) $4x^2 - 9 = 0$ (c) $n^2 + 3n - 10 = 0$

(d) $5x^2 + 3x = 0$ (e) $p^2 - 10p + 24 = 0$ (f) $5a^2 - 20 = 0$

(g) $2n^2 + 7n + 3 = 0$ (h) $5r^2 + 7r + 2 = 0$ (i) $3n^2 - 4n + 1 = 0$

(j) $n^2 + 8n = -15$ (k) $5r^2 - 44r + 120 = -30 + 11r$

3. Solve these equations giving your answer to 2 significant figures.

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

4. Solve these equations giving your answer to 3 significant figures.

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

R3 I have revised using the discriminant to find the nature of the roots of a quadratic.

Determine the nature of the roots of each quadratic equation using the discriminant.

(a) $x^2 + 8x + 16 = 0$ (b) $x^2 - 3x + 4 = 0$

(c) $2x^2 + 3x - 4 = 0$ (d) $3x^2 - 7x + 2 = 0$

(e) $x^2 - 5x + 3 = 0$ (f) $2x^2 - 4x + 2 = 0$

(g) $4 - 2x - x^2 = 0$ (h) $3 - 3x + 7x^2 = 0$

Quadratics and Polynomials

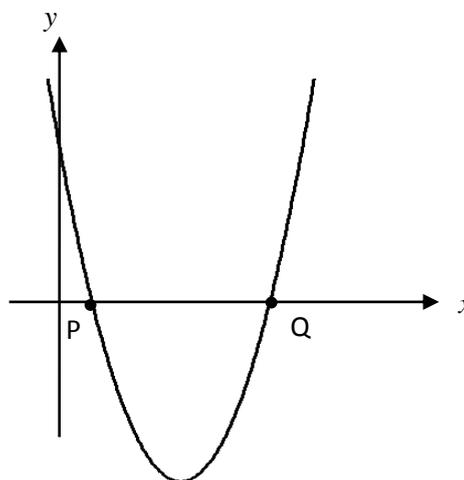
R4 I have revised how to determine where quadratic graph cuts the axes, its turning point and its axis of symmetry.

1. Sketch the graph of $y = (x + 3)(x - 1)$ showing clearly where the graph cuts the axes, the axis of symmetry and the coordinates of the turning point.
2. Sketch the graph of $y = (x + 3)^2 + 6$ showing clearly the coordinates of the turning point and the axis of symmetry.

3. The graph below shows part of a parabola with equation of the form $y = (x + a)^2 + b$.

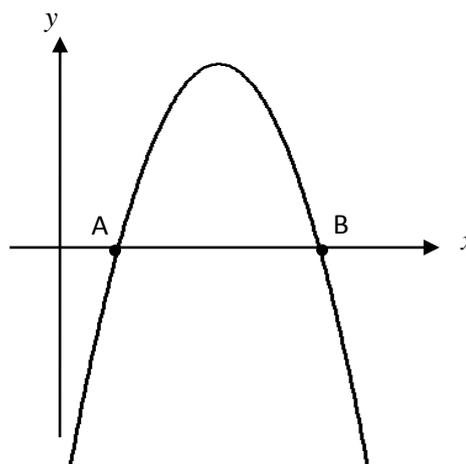
The equation of the axis of symmetry of the parabola is $x = 3$.

- (a) State the value of a .
- (b) P is the point $(1, 0)$. State the coordinates of Q.



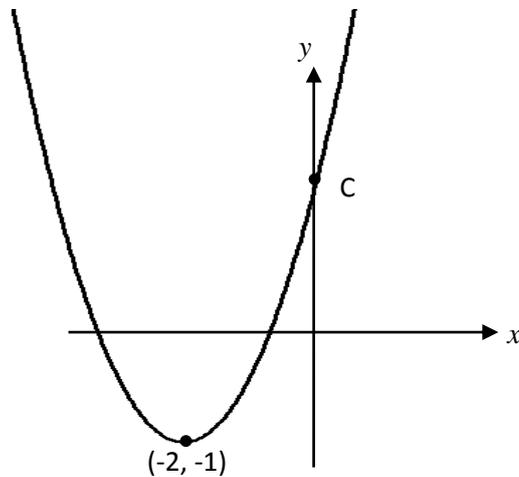
4. The graph below shows part of a parabola with equation of the form $y = -(x - 6)(2 - x)$.

- (a) State the coordinates of A and B.
- (b) State the equation of the axis of symmetry.



Quadratics and Polynomials

5. The graph below shows part of a parabola with equation of the form $y = (x + a)^2 + b$.

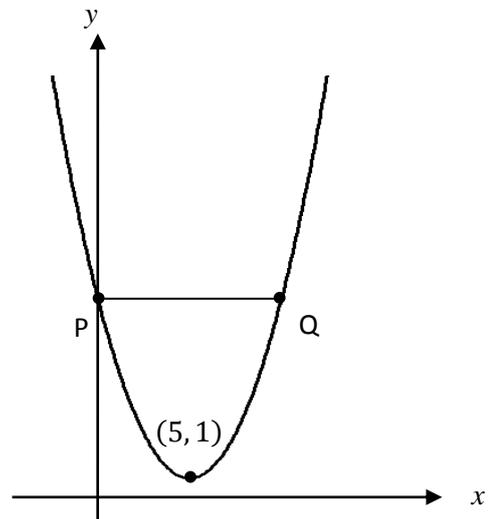


- (a) Write down the equation of the axis of symmetry.
(b) Write down the equation of the parabola.
(c) Find the coordinates of C.

6. The graph below shows part of a parabola with equation of the form $y = (x + a)^2 + b$.

- (a) State the values of a and b .
(b) State the equation of the axis of symmetry.
(c) The line PQ is parallel to the x -axis.

Find the coordinates of P and Q.



Quadratics and Polynomials

R5 I have revised points of intersection of straight lines.

Find the point of intersection between the following straight lines

(1) $5x + 2y = 9$

$$2x + 3y = 8$$

(2) $3x + 5y = 22$

$$5x - 2y = 16$$

(3) $5x - 3y = 12$

$$7x - 2y = 19$$

(4) $4x - 5y = -22$

$$3x + 2y = -5$$

(5) $7x + 8y = -5$

$$9x + 10y = -7$$

(6) $6x + 5y - 9 = 0$

$$2y - 9x + 42 = 0$$

(7) $y = 2x + 8$

$$x - y = -5$$

(8) $y = 3x - 14$

$$x - 2y = 13$$

Quadratics and Polynomials

Section B - Assessment Standard Section

This section will help you practise for your Assessment Standard Test for Quadratics and Polynomials (Relationships and Calculus 1.1)

1. **(a)** **(i)** Show that $(x - 1)$ is a factor of $f(x) = x^3 - 6x^2 + 11x - 6$.
 (ii) Hence factorise $f(x)$ fully.
 (b) Solve $x^3 - 6x^2 + 11x - 6 = 0$.

2. **(a)** Show that $x = 1$ is a root of $x^3 + 8x^2 + 11x - 20 = 0$.
 (b) Hence factorise $x^3 + 8x^2 + 11x - 20$ fully.

3. Solve the cubic equation $f(x) = 0$ given the following:
 - ◆ When $f(x)$ is divided by $2x - 1$, the remainder is zero
 - ◆ $(x + 3)$ is a factor of $f(x)$
 - ◆ the graph of $y = f(x)$ passes through the point $(2, 0)$.

4. State the cubic equation $f(x)$ given the following:
 - ◆ $x = 1$ is a root of $f(x)$
 - ◆ the graph of $y = f(x)$ passes through the point $(-4, 0)$
 - ◆ when $f(x)$ is divided by $x + 5$, the remainder is zero.

5. Find the value of k for which $2x^2 + 4x - k = 0$ has equal roots.

6. Find the values of k so that the graph of $y = kx^2 - 2x + 3$ does not cut or touch the x -axis.

Quadratics and Polynomials

Section C - Operational Skills Section

This section provides problems with the operational skills associated with Quadratics and polynomials.

01 *Given the nature of the roots of a quadratic equation, I can use the discriminant to find an unknown.*

1. Find the value of k for which equation $2x^2 - 3k = 4x^2 + k^2 - 2k$ has equal roots. $k \neq 0$.

2. Find the smallest integer value of k for which

$$f(x) = (x - 2)(x^2 - 2x + k) \text{ has equal roots.}$$

3. Find the values of k which ensures the following equation has equal roots

$$\frac{(x-3)^2}{x^2+3} = k.$$

4. Find two values of p for which the equation

$$p^2x^2 + 2(p + 1)x + 4 = 0$$

has equal roots and solve the equation for x in each case.

5. If the roots of the equation $(x - 1)(x + k) = -9$ are equal, find the values of k .

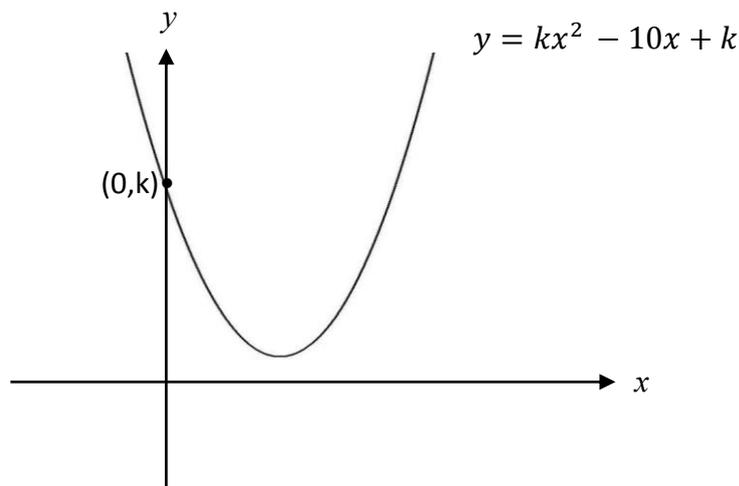
6. Find k , if the roots of the quadratic equation

$$2x^2 + (4k + 2)x + 2k^2 = 0$$

are not real.

Quadratics and Polynomials

7. Find the range of values of k for which $(k + 1)x^2 + 4kx + 9 = 0$ has no real roots.
8. Find the range of values of m for which, $2x^2 + 5mx + m = 0$, has two real and distinct roots.
9. For what range of values of k does the equation $x^2 - 2kx + 2 = k$ have real roots.
10. Calculate the least positive integer value of k so that the graph of $y = kx^2 - 10x + k$ does not cut the x - axis.



11. (a) Determine the nature of the roots of equation $2x^2 + 4x - k = 0$ when $k = 6$.
- (b) Find the value of k for which $2x^2 + 4x - k = 0$ has equal roots.
12. Prove that for all values of k , that the equation $x^2 - 2x + k^2 + 2 = 0$ has no real roots

Quadratics and Polynomials

13. Find the nature of the roots of the equation $(p - 1)^2 + 3p^2 = 6p - 11$.
14. (a) Prove that the roots of the equation,
 $(9p^2 - 4qr)x^2 + 2(q + r)x - 1 = 0$, where $p, q, r \in \mathbb{Q}$, $p \neq 0$,
are real for all values of p, q and r .
- (b) Show also that if $q = r$ the roots are rational.

02 I can apply the condition for tangency.

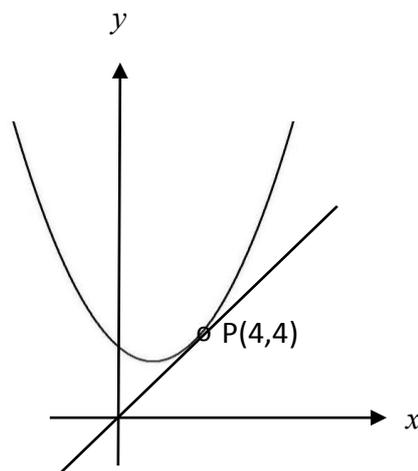
1. The point $P(4,4)$ lies on the parabola $y = x^2 + mx + n$

(a) Find a relationship between m and n .

(b) The tangent to the parabola at point P is the line $y = x$.

Find the value of m .

(c) Using your values for m and n , find the value of the discriminant of $x^2 + mx + n = 0$. What feature of the above sketch is confirmed by this value?



2. Show that $y = 17 - 7x$ is a tangent to the parabola $y = -x^2 - x + 8$ and find the point of contact.
3. The line $y = -8x + k$ is a tangent to the parabola $y = 6x - x^2$.
Find the equation of the tangent.

Quadratics and Polynomials

4. (a) Show that the line $y = x + 5$ is a tangent to the curve with equation $y = \frac{1}{4}x^2 + 3x + 9$.
- (b) Find the point of contact of the tangent to the curve.

03 I can factorise a polynomial expression using the factor theorem.

1. Show that $x = -4$ is a root of $x^3 + 8x^2 + 11x - 20 = 0$.
Hence factorise $x^3 + 8x^2 + 11x - 20$ fully.
2. (a) Show that $(x + 2)$ is a factor of $f(x) = 2x^3 + 3x^2 - 5x - 6$.
(b) Hence factorise $f(x)$ fully.
3. (a) Show that $(x + 1)$ is a factor of $f(x) = 2x^3 - 3x^2 - 3x + 2$.
(b) Hence factorise $f(x)$ fully.
4. Show that $(x - 2)$ is a factor of $f(x) = x^3 - 5x^2 + 2x + 8$.
(a) Factorise $x^3 - 5x^2 + 2x + 8$ fully
(b) Solve $x^3 + 2x = 5x^2 - 8$
5. Factorise fully
- | | |
|-------------------------------|----------------------------|
| (a) $x^3 - 7x + 6$ | (b) $2x^3 + 3x^2 - 2x - 3$ |
| (c) $2x^3 - x^2 - 13x - 6$ | (d) $3x^3 + 8x^2 - 5x - 6$ |
| (e) $2x^4 + 6x^3 + 6x^2 + 2x$ | (f) $x^5 + x^4 - x - 1$ |

Quadratics and Polynomials

04 I can evaluate an unknown coefficient of a polynomial by applying the remainder and/or the factor theorem.

1. $f(x) = 2x^3 + ax^2 + bx + 4.$

Given that $(x - 2)$ is a factor of $f(x)$, and the remainder when $f(x)$ is divided by $(x - 5)$ is 54, find the values of a and b .

2. Find p if $(x - 4)$ is a factor of $x^3 - 9x^2 + px - 28.$

3. Given that $(x + 1)$ is a factor of $2x^3 + 3x^2 + px - 6$

(a) Find the value of p

(b) Hence or otherwise, solve $2x^3 + 3x^2 + px - 6 = 0$

4. Find the value of k if $(x+5)$ is a factor of $3x^4 + 15x^3 - kx^2 - 9x + 5$

5. Given that $(x - 1)$ is a factor of $x^3 + x^2 - (t + 1)x - 4$, find the value of t .

6. Given that $x = 3$ is a root of the equation $x^4 - 3x^3 + px - 5$, find p .

7. When $x^4 - 3x^3 + px - 5$ is divided by $(x + 3)$ the remainder is 16.

Find the value of p .

Quadratics and Polynomials

05 I can solve polynomial equations

1. Solve

(a) $x^3 + x^2 - 2x = 0$

(b) $x^3 - 7x - 6 = 0$

(c) $x^3 - 8x^2 + 9x + 18 = 0$

(d) $x^3 + x^2 - 9x - 9 = 0$

(e) $x^3 + 3x^2 - 18x - 40 = 0$

(f) $x^3 - 3x + 2 = 0$

2. The graph of $f(x) = x^2 + 6$ and the graph of $g(x) = x^3 + 3x^2 - 5x$ intersect at $(-1, 7)$.

Find all the points of intersection.

3. A curve with equation $y = x^3 - x^2 - 3x + 1$ and a straight line with equation $y = 2x - 4$ meet at the point $(1, -2)$.

Find the x -coordinates of the other points of contact.

Quadratics and Polynomials

06 I can solve a polynomial equation to determine where a curve cuts the x -axis.

1. A function is defined on the set of real numbers by $f(x) = (x + 3)(x^2 + 4)$.
Find where the graph of $y = f(x)$ cuts:
 - (a) the x -axis;
 - (b) the y -axis.

2. A function is defined by the formula $g(x) = 2x^3 - 7x^2 - 17x + 10$ where x is a real number.
 - (a) Show that $(x - 5)$ is a factor of $g(x)$, and hence factorise $g(x)$ fully.
 - (b) Find the coordinates of the points where the curve with equation $y = g(x)$ crosses the x and y -axes.

3. A function is defined by the formula $f(x) = 5x - x^3$.
Find the coordinates of the points where the graph of $y = f(x)$ meets the x and y -axes.

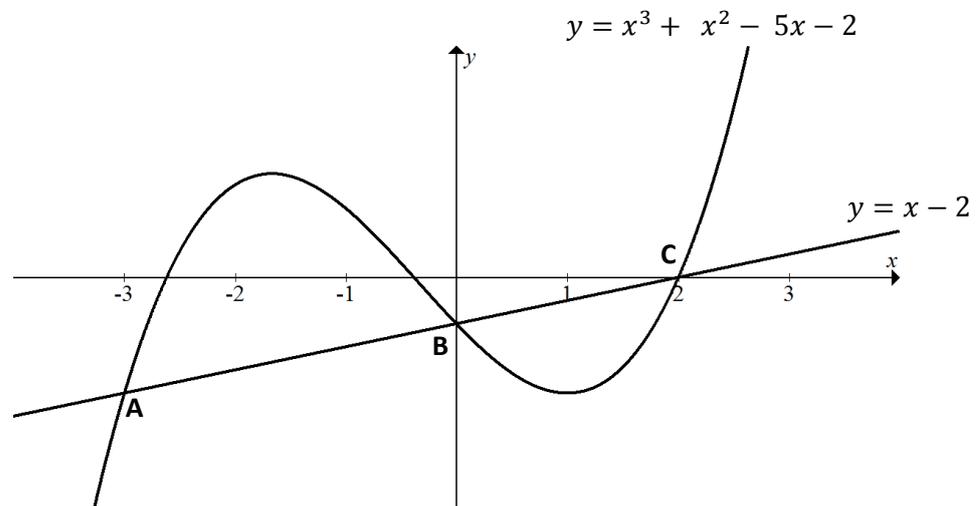
4. $h(x) = x^3 - 5x^2 + 3x + 9$
 - (a)
 - (i) Show that $(x + 1)$ is a factor of $h(x)$.
 - (ii) Hence or otherwise factorise $h(x)$ fully.
 - (b) One of the turning points of the graph of $y = h(x)$ lies on the x -axis.
Write down the coordinates of this turning point.

5. Find where the graph of $y = x^4 + 6x^3 - 12x^2 - 88x - 96$ meets the x and y -axes.

Quadratics and Polynomials

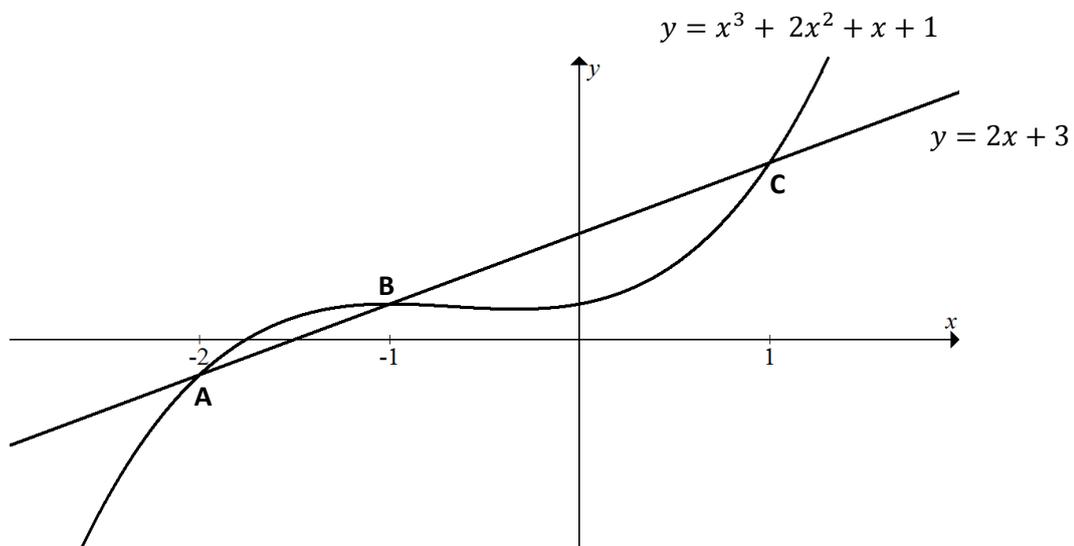
07 I can find points of intersection by solving polynomial equations.

1.



Find the coordinates of the points of intersection A, B and C where the line $y = x - 2$ meets the graph $y = x^3 + x^2 - 5x - 2$.

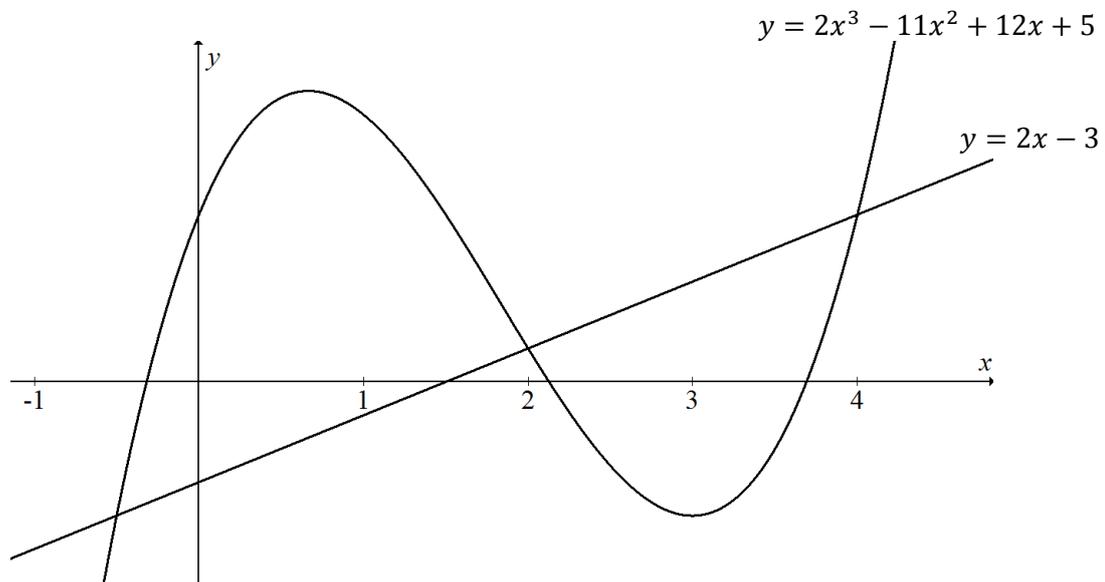
2.



Find the coordinates of A, B and C the points of intersection between the line $y = 2x + 3$ and the curve $y = x^3 + 2x^2 + x + 1$.

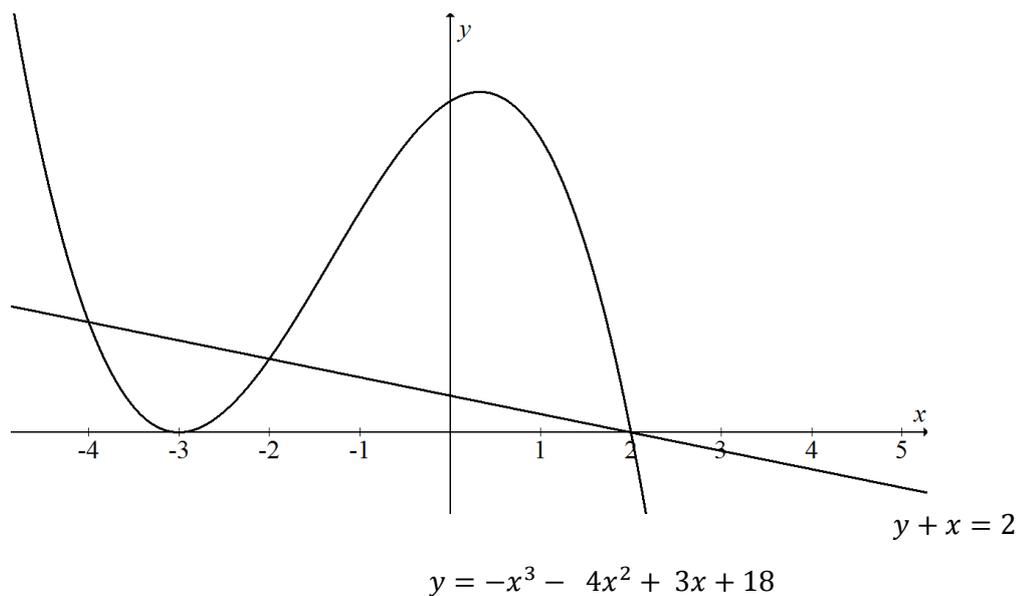
Quadratics and Polynomials

3. (a) Fully factorise the polynomial $2x^3 - 11x^2 + 10x + 8$



- (b) Hence or otherwise find the coordinates of the points of intersection of the line $y = 2x - 3$ and the graph $y = 2x^3 - 11x^2 + 12x + 5$

4. Find the points of intersection graph of the line $y + x = 2$ and the graph of $y = -x^3 - 4x^2 + 3x + 18$.



Quadratics and Polynomials

Section D - Cross Topic Exam Style Questions

Functions and Quadratics

1. Functions f and g are defined on the set of real numbers by

- $f(x) = x^2 + 3$
- $g(x) = x + 4$

(a) Find expressions for

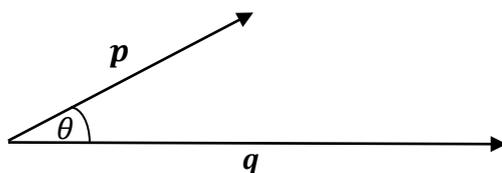
(i) $f(g(x))$

(ii) $g(f(x))$

(b) Show that $f(g(x)) + g(f(x)) = 0$ has no real roots.

Vectors and Polynomials

2. \mathbf{p} and \mathbf{q} are vectors given by $\mathbf{p} = \begin{pmatrix} k^2 \\ 3 \\ k+1 \end{pmatrix}$ and $\mathbf{q} = \begin{pmatrix} k \\ k^2 \\ -2 \end{pmatrix}$, where $k > 0$.



(a) If $\mathbf{p} \cdot \mathbf{q} = 1 - k$, show that $k^3 + 3k^2 - k - 3 = 0$.

(b) Show that $(k + 3)$ is a factor of $k^3 + 3k^2 - k - 3$ and hence factorise fully.

(c) Deduce the only possible value of k .

Quadratics and Polynomials

Vectors and Quadratics

3. P is the point $(1, -3, 0)$, $Q(1, -1, 2)$ and $R(k, -2, 0)$
- (a) Express \overrightarrow{QP} and \overrightarrow{QR} in component form.
- (b) Show that $\cos \hat{PQR} = \frac{3}{\sqrt{2(k^2 - 2k + 6)}}$
- (c) If angle $PQR = 30^\circ$, find the possible values of k .

Quadratics and Polynomials

Answers

Section A

R1

1. (a) $2(7 + 2x)(7 - 2x)$ (b) $5(s + t)(s - t)$ (c) $2(7 + x)(7 - x)$
(d) $3(5x + 9)(5x - 9)$ (e) $18(2 + x)(2 - x)$ (f) $3x(2 + x)(2 - x)$
(g) $(9 + x^2)(3 + x)(3 - x)$ (h) $3w(3 + 2w)(3 - 2w)$
(i) $4(4a^2 + 1)(2a + 1)(2a - 1)$
2. (a) $(2x - 1)(x - 3)$ (b) $(2x + 3)(x + 4)$ (c) $(3x + 4)(x + 2)$
(d) $(x + 3)(x - 2)$ (e) $(3x + 2)(2x + 1)$ (f) $(x - 2)(x - 1)$
(g) $(5x - 1)(x + 1)$ (h) $(7x + 2)(x + 2)$ (i) $(2x - 3)(x + 5)$
3. (a) $(3 + x)(2 - x)$ (b) $(4 + 3x)(5 - x)$ (c) $(3 - 2x)(1 + x)$
(d) $(3 - 2x)(5 + x)$ (e) $(4 + x)(1 - 2x)$ (f) $(3 - x)(5 + x)$
4. (a) $3(x + 4)(x - 2)$ (b) $5x(3xy + 1)$ (c) $2(x + 4)(x - 4)$
(d) $5x(x + 3)(x - 3)$ (e) $6(3x + 2)(x - 1)$ (f) $4xy(3x + 2y^2)$
(g) $5(2x - 1)(x + 3)$ (h) $6x(x + 3)(x + 2)$ (i) $7(x + 2)(x - 2)$
(j) $2(x - 2)(x - 3)$ (k) $3x(x + 2)(x + 5)$ (l) $6x(x + 3)(x - 3)$

R2

1. (a) $x = -3, -4$ (b) $x = -2, 2$ (c) $n = -2, -1$
(d) $x = -3, 0$ (e) $p = -3, -8$ (f) $a = 0, 4$
(g) $s = -2, -4$ (h) $r = -5, 5$ (i) $n = -2, -3$
2. (a) $x = 3, 8$ (b) $x = -\frac{3}{2}, \frac{3}{2}$ (c) $n = -5, 2$
(d) $x = -\frac{3}{5}, 0$ (e) $p = 4, 6$ (f) $a = 2, -2$
(g) $n = -3, -\frac{1}{2}$ (h) $r = -\frac{2}{5}, -1$ (i) $n = \frac{1}{3}, 1$
(j) $n = -5, -3$ (k) $r = 5, 6$
3. (a) $x = 3 \cdot 3, -0 \cdot 30$ (b) $x = -2 \cdot 3, -0 \cdot 22$ (c) $x = 1 \cdot 6, -0 \cdot 24$

Quadratics and Polynomials

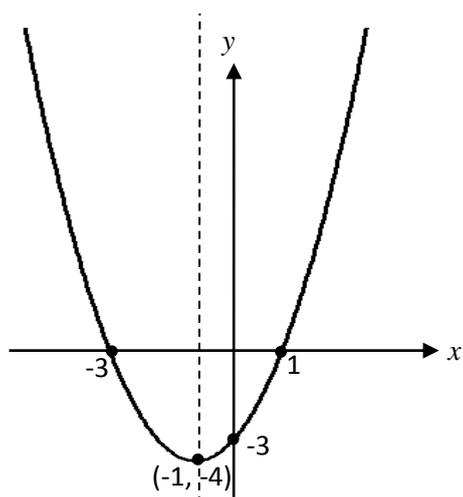
4. (a) $x = 3 \cdot 12, 0 \cdot 214$ (b) $x = 2 \cdot 37, 0 \cdot 634$
 (c) $x = -0.390, 0 \cdot 640$

R3

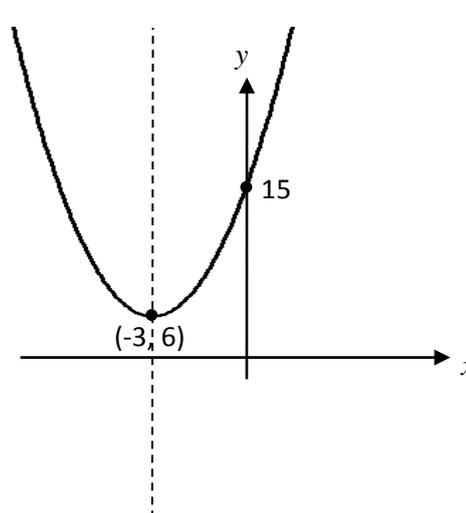
- (a) 0 therefore real and equal (b) -7 therefore no real roots
 (c) 41 therefore real and distinct (d) 25 therefore real and distinct
 (e) 13 therefore real and distinct (f) 0 therefore real and equal
 (g) 20 therefore real and distinct (h) -75 therefore no real roots

R4

1.



2.



3. (a) -3 (b) $(5, 0)$
 4. (a) $A(2,0), B(6, 0)$ (b) $x = 4$
 5. (a) $x = -2$ (b) $7 = (x + 2)^2 - 1$ (c) $(0, 3)$
 6. (a) $a = -5, b = 1$ (b) $x = 5$ (c) $P(0, 26), Q(10, 26)$

R5

1. $(1, 2)$ 2. $(4, 2)$ 3. $(3, 1)$
 4. $(-3, 2)$ 5. $(-3, 2)$ 6. $(4, -3)$
 7. $(-3, 2)$ 8. $(3, -5)$

Quadratics and Polynomials

Section B

- (a) (i) Proof (ii) $f(x) = (x - 1)(x - 2)(x - 3)$
(b) $x = 1, x = 2$ and $x = 3$
- (a) Proof (b) $(x - 1)(x + 4)(x + 5)$
- $x = -3, x = \frac{1}{2}$ and $x = 2$
- $f(x) = (x - 1)(x + 4)(x + 5)$ OR $f(x) = x^3 + 8x^2 + 11x - 20$
- $k = -2$ 6. $k > \frac{1}{3}$

Section C

01

- $k = -1$
- If $k = 1$ then there are 2 equal roots (of 1).
But $k = 0$ also produces 2 equal roots (of 2).
Therefore $k = 0$ is the smaller value.
- $k = 0, k = 4$
- $p = -\frac{1}{3}, 1$ $x = -6$ repeated, $x = -2$ repeated
- $k = -7, k = 5$ 6. $k < -\frac{1}{4}$ 7. $-\frac{3}{4} < k < 3$
- $m < 0, m > \frac{8}{25}$ 9. $k \leq -2, k \geq 1$ 10. $k = 6$
- (a) Since $b^2 - 4ac > 0$ (64) the roots are real and distinct. (b) $k = -2$
- $-4k^2 < 0$ which is true for all values of x .
- Since $b^2 - 4ac < 0$ (-8) there are no real roots.
- (a) Since $b^2 - 4ac \geq 0$ for all p, q and r , the roots are always real.
(b) $4(9p^2 + (q - r)(q + r))$
 $= 4(9p^2 + (r - r)(r + r))$ since $q = r$
 $= 4(9p^2 + (0)(2r))$
 $= 36p^2 = (6p)^2 \geq 0 \forall p \in Q$ and since $p \neq 0$, the roots are always rational.

Quadratics and Polynomials

02

- (a) $n = -12 - 4m$ (b) $m = -7$
(c) Since $b^2 - 4ac < 0$ (-15), there are no real roots, curve does not cut x -axis.
- $b^2 - 4ac = 0$, one point of contact \therefore line is tangent to parabola. $(3, -4)$
- $k = 49$. $y = -8x + 49$
- (a) $b^2 - 4ac = 0 \Rightarrow$ equal roots \Rightarrow only one point of contact \Rightarrow tangency
(b) $(-4, 1)$

03

- $(x + 4)(x + 5)(x - 1)$ 2. $(x + 2)(2x - 3)(x + 1)$
- $(x + 1)(2x - 1)(x - 2)$
- (a) $(x - 2)(x - 4)(x + 1)$ (b) $x = 2, x = 4, x = -1$
- (a) $(x + 3)(x - 1)(x - 2)$ (b) $(2x + 3)(x + 1)(x - 1)$
(c) $(x + 2)(x - 3)(2x + 1)$ (d) $(3x + 2)(x - 1)(x + 3)$
(e) $2x(x + 1)^3$ (f) $(x + 1)^2(x^2 + 1)(x - 1)$

04

- $a = -10, b = 10$ 2. $p = 27$
- (a) $p = -5$ (b) $x = -1, 1 \cdot 5, -2$
- $k = 2$ 5. $t = -3$ 6. $p = \frac{5}{3}$
- $p = 47$

05

- (a) $x = -2, 0, 1$ (b) $x = -1, -2, 3$ (c) $x = -1, 3, 6$
(d) $x = -3, -1, 3$ (e) $x = -5, -2, 4$ (f) $x = -2, 1$
- $(-3, 15), (2, 10)$ 3. $x = \pm\sqrt{5}$

06

- (a) $(-3, 0)$ (b) $(0, 12)$

Quadratics and Polynomials

2. (a) proof, $(x - 5)(2x - 1)(x + 2)$ (b) $(-2, 0)$, $(\frac{1}{2}, 0)$, $(5, 0)$; $(0, 10)$
3. $(0, 0)$, $(-\sqrt{5}, 0)$, $(\sqrt{5}, 0)$
4. (a) (i) proof (ii) $(x + 1)(x - 3)^2$ (b) $(3, 0)$
5. $(-6, 0)$, $(-2, 0)$ repeated, $(4, 0)$

07

1. A(-3,-5), B(0,-2), C(2,0) 2. A(-2,-1), B(-1,1), C(1,5)
3. (a) $(x - 2)(2x + 1)(x - 4)$ (b) $(-\frac{1}{2}, -4)$ (2,1) (4,5)
4. $(-4, 6)$, $(-2, 4)$, $(2, 0)$

Section D

1. (a) (i) $(x + 4)^2 + 3$ (ii) $x^2 + 7$
(b) Since $b^2 - 4ac = -144 < 0$, there are no real roots.
2. (a) Proof (b) $(k + 3)(k + 1)(k - 1)$ (c) $k = 1$
3. (a) $\overrightarrow{QP} = \begin{pmatrix} 0 \\ -2 \\ -2 \end{pmatrix}$, $\overrightarrow{QR} = \begin{pmatrix} k - 1 \\ -1 \\ -2 \end{pmatrix}$
(b) Proof
(c) $k = 0$ and $k = 2$