Core 1
OCR Past Papers

1 Solve the inequality $x^2 - 6x - 40 \geq 0$. [4]

2 **(i)** Express $3x^2 + 12x + 7$ in the form $3(x + a)^2 + b$. [4]

(ii) Hence write down the equation of the line of symmetry of the curve $y = 3x^2 + 12x + 7$. [1]

3 **(i)** Sketch the curve $y = x^3$. [1]

(ii) Describe a transformation that transforms the curve $y = x^3$ to the curve $y = -x^3$. [2]

(iii) The curve $y = x^3$ is translated by p units, parallel to the x-axis. State the equation of the curve after it has been transformed. [2]

4 Solve the equation $x^6 + 26x^3 - 27 = 0$. [5]

5 **(a)** Simplify $2x^{\frac{2}{3}} \times 3x^{-1}$. [2]

(b) Express $2^{40} \times 4^{30}$ in the form 2^n. [2]

(c) Express $\frac{26}{4 - \sqrt{3}}$ in the form $a + b\sqrt{3}$. [3]

6 Given that $f(x) = (x + 1)^2(3x - 4)$,

(i) express $f(x)$ in the form $ax^3 + bx^2 + cx + d$, [3]

(ii) find $f'(x)$, [2]

(iii) find $f''(x)$. [2]

7 **(i)** Calculate the discriminant of each of the following:

(a) $x^2 + 6x + 9$,

(b) $x^2 - 10x + 12$,

(c) $x^2 - 2x + 5$.

[3]

(ii)

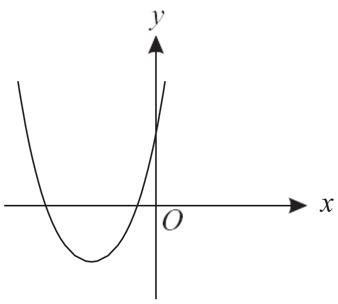

Fig. 1

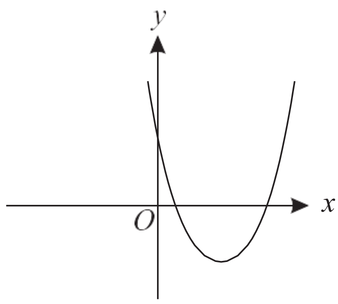

Fig. 2

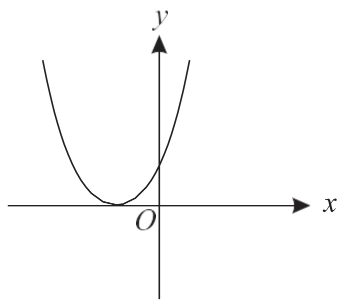

Fig. 3

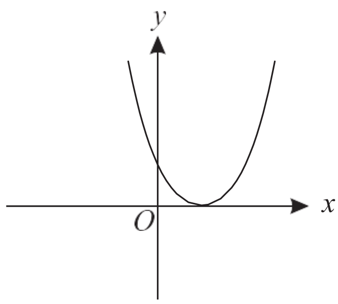

Fig. 4

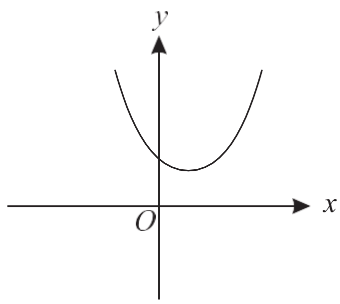

Fig. 5

State with reasons which of the diagrams corresponds to the curve

(a) $y = x^2 + 6x + 9$,

(b) $y = x^2 - 10x + 12$,

(c) $y = x^2 - 2x + 5$.

[4]

8 **(i)** Describe completely the curve $x^2 + y^2 = 25$. [2]

(ii) Find the coordinates of the points of intersection of the curve $x^2 + y^2 = 25$ and the line $2x + y - 5 = 0$. [6]

[Questions 9 and 10 are printed overleaf.]

9 **(i)** Find the gradient of the line l_1 which has equation $4x - 3y + 5 = 0$. [1]

(ii) Find an equation of the line l_2, which passes through the point $(1, 2)$ and which is perpendicular to the line l_1, giving your answer in the form $ax + by + c = 0$. [4]

The line l_1 crosses the x-axis at P and the line l_2 crosses the y-axis at Q.

(iii) Find the coordinates of the mid-point of PQ. [3]

(iv) Calculate the length of PQ, giving your answer in the form $\frac{\sqrt{a}}{b}$, where a and b are integers. [3]

10 **(i)** Given that $y = \frac{1}{3}x^3 - 9x$, find $\frac{dy}{dx}$. [2]

(ii) Find the coordinates of the stationary points on the curve $y = \frac{1}{3}x^3 - 9x$. [3]

(iii) Determine whether each stationary point is a maximum point or a minimum point. [3]

(iv) Given that $24x + 3y + 2 = 0$ is the equation of the tangent to the curve at the point (p, q), find p and q. [5]

1 Solve the equations

(i) $x^{\frac{1}{3}} = 2$, [1]

(ii) $10^t = 1$, [1]

(iii) $(y^{-2})^2 = \frac{1}{81}$. [2]

2 **(i)** Simplify $(3x + 1)^2 - 2(2x - 3)^2$. [3]

(ii) Find the coefficient of x^3 in the expansion of

$$(2x^3 - 3x^2 + 4x - 3)(x^2 - 2x + 1).$$ [2]

3 Given that $y = 3x^5 - \sqrt{x} + 15$, find

(i) $\frac{dy}{dx}$, [3]

(ii) $\frac{d^2y}{dx^2}$. [2]

4 **(i)** Sketch the curve $y = \frac{1}{x^2}$. [2]

(ii) Hence sketch the curve $y = \frac{1}{(x-3)^2}$. [2]

(iii) Describe fully a transformation that transforms the curve $y = \frac{1}{x^2}$ to the curve $y = \frac{2}{x^2}$. [3]

5 **(i)** Express $x^2 + 3x$ in the form $(x + a)^2 + b$. [2]

(ii) Express $y^2 - 4y - \frac{11}{4}$ in the form $(y + p)^2 + q$. [2]

A circle has equation $x^2 + y^2 + 3x - 4y - \frac{11}{4} = 0$.

(iii) Write down the coordinates of the centre of the circle. [1]

(iv) Find the radius of the circle. [2]

6 **(i)** Find the coordinates of the stationary points on the curve $y = x^3 - 3x^2 + 4$. [6]

(ii) Determine whether each stationary point is a maximum point or a minimum point. [3]

(iii) For what values of x does $x^3 - 3x^2 + 4$ increase as x increases? [2]

7 **(i)** Solve the equation $x^2 - 8x + 11 = 0$, giving your answers in simplified surd form. [4]

(ii) Hence sketch the curve $y = x^2 - 8x + 11$, labelling the points where the curve crosses the axes. [3]

(iii) Solve the equation $y - 8y^{\frac{1}{2}} + 11 = 0$, giving your answers in the form $p \pm q\sqrt{5}$. [4]

8 **(i)** Given that $y = x^2 - 5x + 15$ and $5x - y = 10$, show that $x^2 - 10x + 25 = 0$. [2]

(ii) Find the discriminant of $x^2 - 10x + 25$. [1]

(iii) What can you deduce from the answer to part **(ii)** about the line $5x - y = 10$ and the curve $y = x^2 - 5x + 15$? [1]

(iv) Solve the simultaneous equations

$$y = x^2 - 5x + 15 \quad \text{and} \quad 5x - y = 10.$$ [3]

(v) Hence, or otherwise, find the equation of the normal to the curve $y = x^2 - 5x + 15$ at the point $(5, 15)$, giving your answer in the form $ax + by = c$, where a, b and c are integers. [4]

9 The points A, B and C have coordinates $(5, 1)$, $(p, 7)$ and $(8, 2)$ respectively.

(i) Given that the distance between points A and B is twice the distance between points A and C, calculate the possible values of p. [7]

(ii) Given also that the line passing through A and B has equation $y = 3x - 14$, find the coordinates of the mid-point of AB. [4]

1 The points $A\ (1, 3)$ and $B\ (4, 21)$ lie on the curve $y = x^2 + x + 1$.

(i) Find the gradient of the line AB. [2]

(ii) Find the gradient of the curve $y = x^2 + x + 1$ at the point where $x = 3$. [2]

2 **(i)** Evaluate $27^{-\frac{2}{3}}$. [2]

(ii) Express $5\sqrt{5}$ in the form 5^n. [1]

(iii) Express $\dfrac{1-\sqrt{5}}{3+\sqrt{5}}$ in the form $a + b\sqrt{5}$. [3]

3 **(i)** Express $2x^2 + 12x + 13$ in the form $a(x + b)^2 + c$. [4]

(ii) Solve $2x^2 + 12x + 13 = 0$, giving your answers in simplified surd form. [3]

4 **(i)** By expanding the brackets, show that

$$(x-4)(x-3)(x+1) = x^3 - 6x^2 + 5x + 12.$$ [3]

(ii) Sketch the curve

$$y = x^3 - 6x^2 + 5x + 12,$$

giving the coordinates of the points where the curve meets the axes. Label the curve C_1. [3]

(iii) On the same diagram as in part **(ii)**, sketch the curve

$$y = -x^3 + 6x^2 - 5x - 12.$$

Label this curve C_2. [2]

5 Solve the inequalities

(i) $1 < 4x - 9 < 5$, [3]

(ii) $y^2 \geq 4y + 5$. [5]

6 **(i)** Solve the equation $x^4 - 10x^2 + 25 = 0$. [4]

(ii) Given that $y = \frac{2}{5}x^5 - \frac{20}{3}x^3 + 50x + 3$, find $\frac{dy}{dx}$. [2]

(iii) Hence find the number of stationary points on the curve $y = \frac{2}{5}x^5 - \frac{20}{3}x^3 + 50x + 3$. [2]

7 **(i)** Solve the simultaneous equations

$$y = x^2 - 5x + 4, \qquad y = x - 1.$$ [4]

(ii) State the number of points of intersection of the curve $y = x^2 - 5x + 4$ and the line $y = x - 1$. [1]

(iii) Find the value of c for which the line $y = x + c$ is a tangent to the curve $y = x^2 - 5x + 4$. [4]

8 A cuboid has a volume of 8 m^3. The base of the cuboid is square with sides of length x metres. The surface area of the cuboid is A m^2.

(i) Show that $A = 2x^2 + \dfrac{32}{x}$. [3]

(ii) Find $\dfrac{\mathrm{d}A}{\mathrm{d}x}$. [3]

(iii) Find the value of x which gives the smallest surface area of the cuboid, justifying your answer. [4]

9 The points A and B have coordinates $(4, -2)$ and $(10, 6)$ respectively. C is the mid-point of AB. Find

(i) the coordinates of C, [2]

(ii) the length of AC, [2]

(iii) the equation of the circle that has AB as a diameter, [3]

(iv) the equation of the tangent to the circle in part **(iii)** at the point A, giving your answer in the form $ax + by = c$. [5]

1 Express $\frac{5}{2-\sqrt{3}}$ in the form $a + b\sqrt{3}$, where a and b are integers. [3]

2 Evaluate

(i) 6^0, [1]

(ii) $2^{-1} \times 32^{\frac{4}{5}}$. [3]

3 Solve the inequalities

(i) $3(x - 5) \leq 24$, [2]

(ii) $5x^2 - 2 > 78$. [3]

4 Solve the equation $x^{\frac{2}{3}} + 3x^{\frac{1}{3}} - 10 = 0$. [5]

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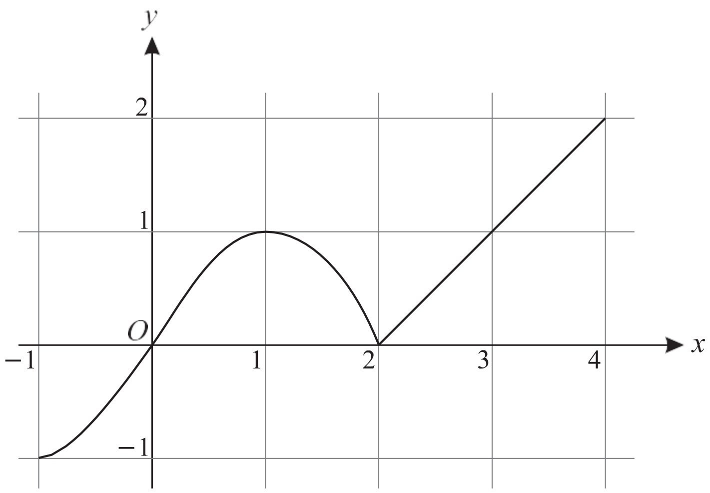

The graph of $y = \mathrm{f}(x)$ for $-1 \leq x \leq 4$ is shown above.

(i) Sketch the graph of $y = -\mathrm{f}(x)$ for $-1 \leq x \leq 4$. [2]

(ii) The point P $(1, 1)$ on $y = \mathrm{f}(x)$ is transformed to the point Q on $y = 3\mathrm{f}(x)$. State the coordinates of Q. [2]

(iii) Describe the transformation which transforms the graph of $y = \mathrm{f}(x)$ to the graph of $y = \mathrm{f}(x + 2)$. [2]

6 **(i)** Express $2x^2 - 24x + 80$ in the form $a(x - b)^2 + c$. [4]

(ii) State the equation of the line of symmetry of the curve $y = 2x^2 - 24x + 80$. [1]

(iii) State the equation of the tangent to the curve $y = 2x^2 - 24x + 80$ at its minimum point. [1]

7 Find $\frac{dy}{dx}$ in each of the following cases.

(i) $y = 5x + 3$ [1]

(ii) $y = \frac{2}{x^2}$ [3]

(iii) $y = (2x + 1)(5x - 7)$ [4]

8 **(i)** Find the coordinates of the stationary points of the curve $y = 27 + 9x - 3x^2 - x^3$. [6]

(ii) Determine, in each case, whether the stationary point is a maximum or minimum point. [3]

(iii) Hence state the set of values of x for which $27 + 9x - 3x^2 - x^3$ is an increasing function. [2]

9 A is the point $(2, 7)$ and B is the point $(-1, -2)$.

(i) Find the equation of the line through A parallel to the line $y = 4x - 5$, giving your answer in the form $y = mx + c$. [3]

(ii) Calculate the length of AB, giving your answer in simplified surd form. [3]

(iii) Find the equation of the line which passes through the mid-point of AB and which is perpendicular to AB. Give your answer in the form $ax + by + c = 0$, where a, b and c are integers. [6]

10 A circle has equation $x^2 + y^2 + 2x - 4y - 8 = 0$.

(i) Find the centre and radius of the circle. [3]

(ii) The circle passes through the point $(-3, k)$, where $k < 0$. Find the value of k. [3]

(iii) Find the coordinates of the points where the circle meets the line with equation $x + y = 6$. [6]

1 Simplify $(2x+5)^2-(x-3)^2$, giving your answer in the form ax^2+bx+c. [3]

2 **(a)** On separate diagrams, sketch the graphs of

(i) $y=\frac{1}{x}$, [2]

(ii) $y=x^4$. [1]

(b) Describe a transformation that transforms the curve $y=x^3$ to the curve $y=8x^3$. [2]

3 Simplify the following, expressing each answer in the form $a\sqrt{5}$.

(i) $3\sqrt{10}\times\sqrt{2}$ [2]

(ii) $\sqrt{500}+\sqrt{125}$ [3]

4 **(i)** Find the discriminant of kx^2-4x+k in terms of k. [2]

(ii) The quadratic equation $kx^2-4x+k=0$ has equal roots. Find the possible values of k. [3]

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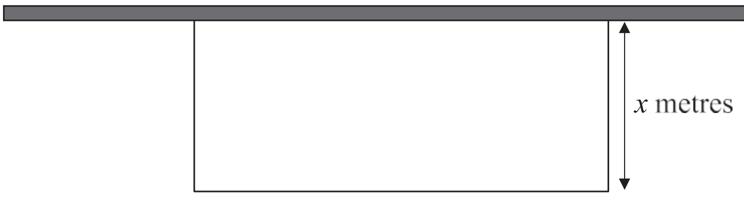

The diagram shows a rectangular enclosure, with a wall forming one side. A rope, of length 20 metres, is used to form the remaining three sides. The width of the enclosure is x metres.

(i) Show that the enclosed area, A m^2, is given by

$$A=20x-2x^2.$$ [2]

(ii) Use differentiation to find the maximum value of A. [4]

6 By using the substitution $y=(x+2)^2$, find the real roots of the equation

$$(x+2)^4+5(x+2)^2-6=0.$$ [6]

7 **(a)** Given that $f(x)=x+\frac{3}{x}$, find $f'(x)$. [4]

(b) Find the gradient of the curve $y=x^{\frac{5}{2}}$ at the point where $x=4$. [5]

8 **(i)** Express $x^2 + 8x + 15$ in the form $(x + a)^2 - b$. [3]

(ii) Hence state the coordinates of the vertex of the curve $y = x^2 + 8x + 15$. [2]

(iii) Solve the inequality $x^2 + 8x + 15 > 0$. [4]

9 The circle with equation $x^2 + y^2 - 6x - k = 0$ has radius 4.

(i) Find the centre of the circle and the value of k. [4]

The points $A\ (3, a)$ and $B\ (-1, 0)$ lie on the circumference of the circle, with $a > 0$.

(ii) Calculate the length of AB, giving your answer in simplified surd form. [5]

(iii) Find an equation for the line AB. [3]

10 **(i)** Solve the equation $3x^2 - 14x - 5 = 0$. [3]

A curve has equation $y = 3x^2 - 14x - 5$.

(ii) Sketch the curve, indicating the coordinates of all intercepts with the axes. [3]

(iii) Find the value of c for which the line $y = 4x + c$ is a tangent to the curve. [6]

1 Express $\frac{4}{3-\sqrt{7}}$ in the form $a + b\sqrt{7}$, where a and b are integers. [3]

2 **(i)** Write down the equation of the circle with centre $(0, 0)$ and radius 7. [1]

(ii) A circle with centre $(3, 5)$ has equation $x^2 + y^2 - 6x - 10y - 30 = 0$. Find the radius of the circle. [2]

3 Given that $3x^2 + bx + 10 = a(x+3)^2 + c$ for all values of x, find the values of the constants a, b and c. [4]
[4]

4 Solve the equations

(i) $10^p = 0.1$, [1]

(ii) $(k^{\frac{1}{2}})^2 = 15$, [3]

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(iii) $t^{-\frac{1}{3}} = \frac{1}{2}$. [2]

5 **(i)** Sketch the curve $y = x^3 + 2$. [2]

(ii) Sketch the curve $y = 2\sqrt{x}$. [2]

(iii) Describe a transformation that transforms the curve $y = 2\sqrt{x}$ to the curve $y = 3\sqrt{x}$. [3]

6 **(i)** Solve the equation $x^2 + 8x + 10 = 0$, giving your answers in simplified surd form. [3]

(ii) Sketch the curve $y = x^2 + 8x + 10$, giving the coordinates of the point where the curve crosses the y-axis. [3]

(iii) Solve the inequality $x^2 + 8x + 10 \geq 0$. [2]

7 **(i)** Find the gradient of the line l which has equation $x + 2y = 4$. [1]

(ii) Find the equation of the line parallel to l which passes through the point $(6, 5)$, giving your answer in the form $ax + by + c = 0$, where a, b and c are integers. [3]

(iii) Solve the simultaneous equations

$$y = x^2 + x + 1 \qquad \text{and} \qquad x + 2y = 4.$$ [4]

8 **(i)** Find the coordinates of the stationary points on the curve $y = x^3 + x^2 - x + 3$. [6]

(ii) Determine whether each stationary point is a maximum point or a minimum point. [3]

(iii) For what values of x does $x^3 + x^2 - x + 3$ decrease as x increases? [2]

9 The points A and B have coordinates $(-5, -2)$ and $(3, 1)$ respectively.

(i) Find the equation of the line AB, giving your answer in the form $ax + by + c = 0$. [3]

(ii) Find the coordinates of the mid-point of AB. [2]

The point C has coordinates $(-3, 4)$.

(iii) Calculate the length of AC, giving your answer in simplified surd form. [3]

(iv) Determine whether the line AC is perpendicular to the line BC, showing all your working. [4]

10 Given that $f(x) = 8x^3 + \frac{1}{x^3}$,

(i) find $f''(x)$, [5]

(ii) solve the equation $f(x) = -9$. [5]

1 Express each of the following in the form 4^n:

(i) $\frac{1}{16}$, [1]

(ii) 64, [1]

(iii) 8. [2]

2 **(i)** The curve $y = x^2$ is translated 2 units in the positive x-direction. Find the equation of the curve after it has been translated. [2]

(ii) The curve $y = x^3 - 4$ is reflected in the x-axis. Find the equation of the curve after it has been reflected. [1]

3 Express each of the following in the form $k\sqrt{2}$, where k is an integer:

(i) $\sqrt{200}$, [1]

(ii) $\frac{12}{\sqrt{2}}$, [1]

(iii) $5\sqrt{8} - 3\sqrt{2}$. [2]

4 Solve the equation $2x - 7x^{\frac{1}{2}} + 3 = 0$. [5]

5 Find the gradient of the curve $y = 8\sqrt{x} + x$ at the point whose x-coordinate is 9. [5]

6 **(i)** Expand and simplify $(x - 5)(x + 2)(x + 5)$. [3]

(ii) Sketch the curve $y = (x - 5)(x + 2)(x + 5)$, giving the coordinates of the points where the curve crosses the axes. [3]

7 Solve the inequalities

(i) $8 < 3x - 2 < 11$, [3]

(ii) $y^2 + 2y \geq 0$. [4]

8 The curve $y = x^3 - kx^2 + x - 3$ has two stationary points.

(i) Find $\frac{dy}{dx}$. [2]

(ii) Given that there is a stationary point when $x = 1$, find the value of k. [3]

(iii) Determine whether this stationary point is a minimum or maximum point. [2]

(iv) Find the x-coordinate of the other stationary point. [3]

9 **(i)** Find the equation of the circle with radius 10 and centre $(2, 1)$, giving your answer in the form $x^2 + y^2 + ax + by + c = 0$. [3]

(ii) The circle passes through the point $(5, k)$ where $k > 0$. Find the value of k in the form $p + \sqrt{q}$. [3]

(iii) Determine, showing all working, whether the point $(-3, 9)$ lies inside or outside the circle. [3]

(iv) Find an equation of the tangent to the circle at the point $(8, 9)$. [5]

10 **(i)** Express $2x^2 - 6x + 11$ in the form $p(x + q)^2 + r$. [4]

(ii) State the coordinates of the vertex of the curve $y = 2x^2 - 6x + 11$. [2]

(iii) Calculate the discriminant of $2x^2 - 6x + 11$. [2]

(iv) State the number of real roots of the equation $2x^2 - 6x + 11 = 0$. [1]

(v) Find the coordinates of the points of intersection of the curve $y = 2x^2 - 6x + 11$ and the line $7x + y = 14$. [5]

1 Express $\sqrt{45} + \frac{20}{\sqrt{5}}$ in the form $k\sqrt{5}$, where k is an integer. **[3]**

2 Simplify

(i) $(\sqrt[3]{x})^6$, **[1]**

(ii) $\dfrac{3y^4 \times (10y)^3}{2y^5}$. **[3]**

3 Solve the equation $3x^{\frac{2}{3}} + x^{\frac{1}{3}} - 2 = 0$. **[5]**

4 **(i)** Sketch the curve $y = \dfrac{1}{x^2}$. **[2]**

(ii) The curve $y = \dfrac{1}{x^2}$ is translated by 3 units in the negative x-direction. State the equation of the curve after it has been translated. **[2]**

(iii) The curve $y = \dfrac{1}{x^2}$ is stretched parallel to the y-axis with scale factor 4 and, as a result, the point $P\ (1,\ 1)$ is transformed to the point Q. State the coordinates of Q. **[2]**

5 Find $\dfrac{dy}{dx}$ in each of the following cases:

(i) $y = 10x^{-5}$, **[2]**

(ii) $y = \sqrt[4]{x}$, **[3]**

(iii) $y = x(x + 3)(1 - 5x)$. **[4]**

6 **(i)** Express $5x^2 + 20x - 8$ in the form $p(x + q)^2 + r$. **[4]**

(ii) State the equation of the line of symmetry of the curve $y = 5x^2 + 20x - 8$. **[1]**

(iii) Calculate the discriminant of $5x^2 + 20x - 8$. **[2]**

(iv) State the number of real roots of the equation $5x^2 + 20x - 8 = 0$. **[1]**

7 The line with equation $3x + 4y - 10 = 0$ passes through point $A\ (2,\ 1)$ and point $B\ (10, k)$.

(i) Find the value of k. **[2]**

(ii) Calculate the length of AB. **[2]**

A circle has equation $(x - 6)^2 + (y + 2)^2 = 25$.

(iii) Write down the coordinates of the centre and the radius of the circle. **[2]**

(iv) Verify that AB is a diameter of the circle. **[2]**

8 **(i)** Solve the equation $5 - 8x - x^2 = 0$, giving your answers in simplified surd form. **[3]**

(ii) Solve the inequality $5 - 8x - x^2 \leq 0$. **[2]**

(iii) Sketch the curve $y = (5 - 8x - x^2)(x + 4)$, giving the coordinates of the points where the curve crosses the coordinate axes. **[5]**

9 The curve $y = x^3 + px^2 + 2$ has a stationary point when $x = 4$. Find the value of the constant p and determine whether the stationary point is a maximum or minimum point. **[7]**

10 A curve has equation $y = x^2 + x$.

(i) Find the gradient of the curve at the point for which $x = 2$. **[2]**

(ii) Find the equation of the normal to the curve at the point for which $x = 2$, giving your answer in the form $ax + by + c = 0$, where a, b and c are integers. **[4]**

(iii) Find the values of k for which the line $y = kx - 4$ is a tangent to the curve. **[6]**

1 Given that $y = x^5 + \frac{1}{x^2}$, find

(i) $\frac{dy}{dx}$, **[3]**

(ii) $\frac{d^2y}{dx^2}$. **[2]**

2 Express $\frac{8+\sqrt{7}}{2+\sqrt{7}}$ in the form $a + b\sqrt{7}$, where a and b are integers. **[4]**

3 Express each of the following in the form 3^n:

(i) $\frac{1}{9}$, **[1]**

(ii) $\sqrt[3]{3}$, **[1]**

(iii) $3^{10} \times 9^{15}$. **[2]**

4 Solve the simultaneous equations

$$4x^2 + y^2 = 10, \qquad 2x - y = 4.$$ **[6]**

5 **(i)** Expand and simplify $(2x+1)(x-3)(x+4)$. **[3]**

(ii) Find the coefficient of x^4 in the expansion of

$$x(x^2 + 2x + 3)(x^2 + 7x - 2).$$ **[2]**

6 **(i)** Sketch the curve $y = -\sqrt{x}$. **[2]**

(ii) Describe fully a transformation that transforms the curve $y = -\sqrt{x}$ to the curve $y = 5 - \sqrt{x}$. **[2]**

(iii) The curve $y = -\sqrt{x}$ is stretched by a scale factor of 2 parallel to the x-axis. State the equation of the curve after it has been stretched. **[2]**

7 **(i)** Express $x^2 - 5x + \frac{1}{4}$ in the form $(x-a)^2 - b$. **[3]**

(ii) Find the centre and radius of the circle with equation $x^2 + y^2 - 5x + \frac{1}{4} = 0$. **[3]**

8 Solve the inequalities

(i) $-35 < 6x + 7 < 1$, **[3]**

(ii) $3x^2 > 48$. **[3]**

9 A is the point $(4, -3)$ and B is the point $(-1, 9)$.

(i) Calculate the length of AB. **[2]**

(ii) Find the coordinates of the mid-point of AB. **[2]**

(iii) Find the equation of the line through $(1, 3)$ which is parallel to AB, giving your answer in the form $ax + by + c = 0$, where a, b and c are integers. **[4]**

10 **(i)** Solve the equation $9x^2 + 18x - 7 = 0$. **[3]**

(ii) Find the coordinates of the stationary point on the curve $y = 9x^2 + 18x - 7$. **[4]**

(iii) Sketch the curve $y = 9x^2 + 18x - 7$, giving the coordinates of all intercepts with the axes. **[3]**

(iv) For what values of x does $9x^2 + 18x - 7$ increase as x increases? **[1]**

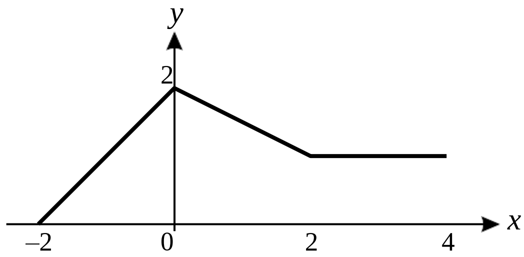
11 The point P on the curve $y = k\sqrt{x}$ has x-coordinate 4. The normal to the curve at P is parallel to the line $2x + 3y = 0$.

(i) Find the value of k. **[6]**

(ii) This normal meets the x-axis at the point Q. Calculate the area of the triangle OPQ, where O is the point $(0, 0)$. **[5]**

1 Express $x^2 - 12x + 1$ in the form $(x - p)^2 + q$. **[3]**

2



The graph of $y = f(x)$ for $-2 \le x \le 4$ is shown above.

(i) Sketch the graph of $y = 2f(x)$ for $-2 \le x \le 4$ on the axes provided. **[2]**

(ii) Describe the transformation which transforms the graph of $y = f(x)$ to the graph of $y = f(x - 1)$. **[2]**

3 Find the equation of the normal to the curve $y = x^3 - 4x^2 + 7$ at the point $(2, -1)$, giving your answer in the form $ax + by + c = 0$, where a, b and c are integers. **[7]**

4 Solve the equations

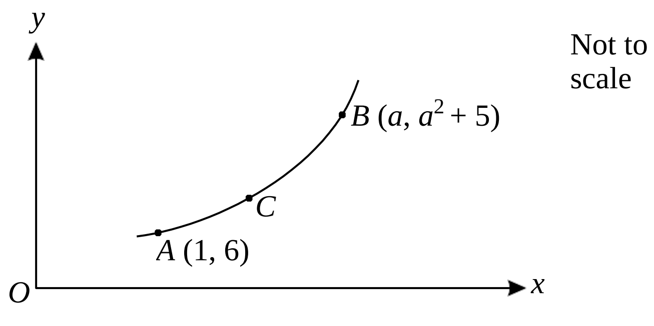
(i) $3^m = 81$, **[1]**

(ii) $(36p^4)^{\frac{1}{2}} = 24$, **[3]**

(iii) $5^n \times 5^{n+4} = 25$. **[3]**

5 Solve the equation $x - 8\sqrt{x} + 13 = 0$, giving your answers in the form $p \pm q\sqrt{r}$, where p, q and r are integers. **[7]**

6



The diagram shows part of the curve $y = x^2 + 5$. The point A has coordinates $(1, 6)$. The point B has coordinates $(a, a^2 + 5)$, where a is a constant greater than 1. The point C is on the curve between A and B.

(i) Find by differentiation the value of the gradient of the curve at the point A. **[2]**

(ii) The line segment joining the points A and B has gradient 2.3. Find the value of a. **[4]**

(iii) State a possible value for the gradient of the line segment joining the points A and C. **[1]**

7

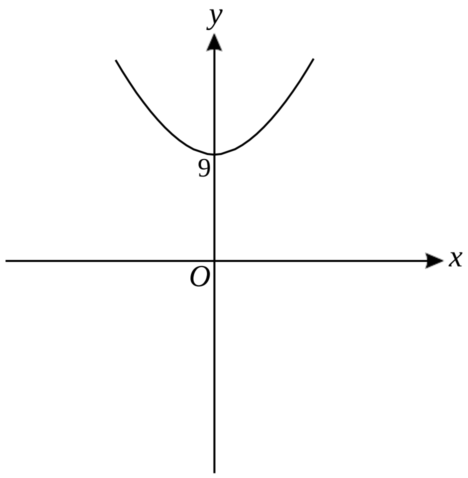


Fig. 1

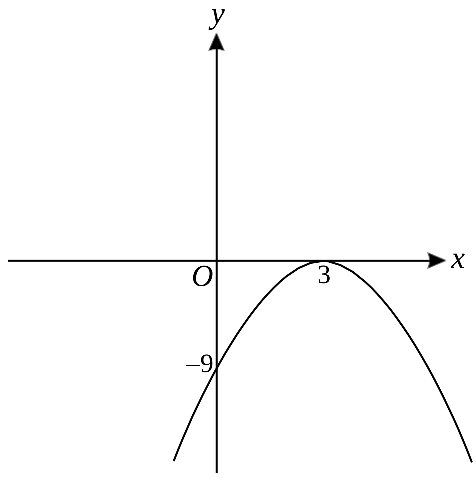


Fig. 2

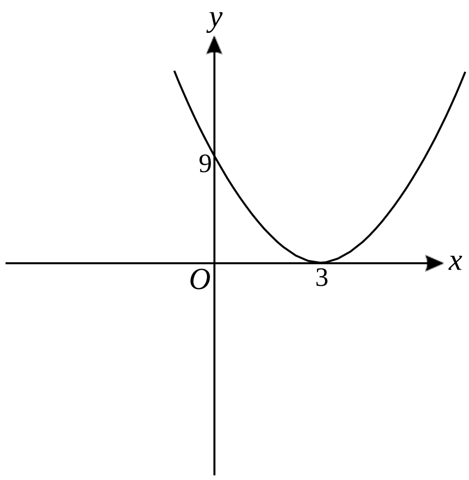


Fig. 3

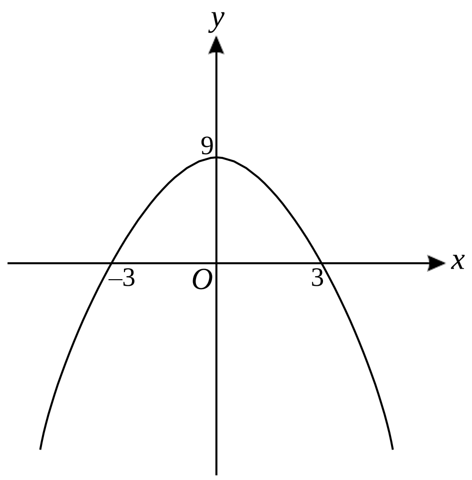


Fig. 4

(i) Each diagram shows a quadratic curve. State which diagram corresponds to the curve

(a) $y = (3 - x)^2$, **[1]**

(b) $y = x^2 + 9$, **[1]**

(c) $y = (3 - x)(x + 3)$. **[1]**

(ii) Give the equation of the curve which does not correspond to any of the equations in part **(i)**. **[2]**

8 A circle has equation $x^2 + y^2 + 6x - 4y - 4 = 0$.

(i) Find the centre and radius of the circle. **[3]**

(ii) Find the coordinates of the points where the circle meets the line with equation $y = 3x + 4$. **[6]**

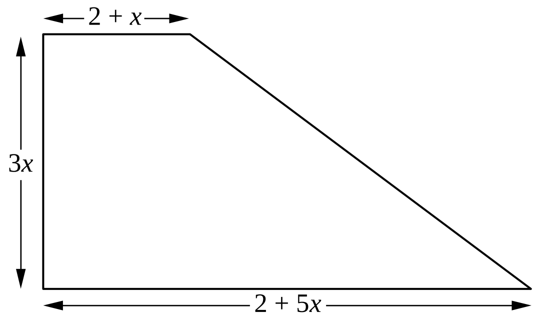
9 Given that $f(x) = \frac{1}{x} - \sqrt{x} + 3$,

(i) find $f'(x)$, **[3]**

(ii) find $f''(4)$. **[5]**

10 The quadratic equation $kx^2 - 30x + 25k = 0$ has equal roots. Find the possible values of k. **[4]**

11 A lawn is to be made in the shape shown below. The units are metres.



(i) The perimeter of the lawn is P m. Find P in terms of x. **[2]**

(ii) Show that the area, A m^2, of the lawn is given by $A = 9x^2 + 6x$. **[2]**

The perimeter of the lawn must be at least 39 m and the area of the lawn must be less than 99 m^2.

(iii) By writing down and solving appropriate inequalities, determine the set of possible values of x. **[7]**

1 **(i)** Evaluate 9^0. **[1]**

(ii) Express $9^{-\frac{1}{2}}$ as a fraction. **[2]**

2 **(i)** Sketch the curve $y = -\frac{1}{x^2}$. **[2]**

(ii) Sketch the curve $y = 3 - \frac{1}{x^2}$. **[2]**

(iii) The curve $y = -\frac{1}{x^2}$ is stretched parallel to the y-axis with scale factor 2. State the equation of the transformed curve. **[1]**

3 **(i)** Express $\frac{12}{3+\sqrt{5}}$ in the form $a - b\sqrt{5}$, where a and b are positive integers. **[3]**

(ii) Express $\sqrt{18} - \sqrt{2}$ in simplified surd form. **[2]**

4 **(i)** Expand $(x-2)^2(x+1)$, simplifying your answer. **[3]**

(ii) Sketch the curve $y = (x-2)^2(x+1)$, indicating the coordinates of all intercepts with the axes. **[3]**

5 Find the real roots of the equation $4x^4 + 3x^2 - 1 = 0$. **[5]**

6 Find the gradient of the curve $y = 2x + \frac{6}{\sqrt{x}}$ at the point where $x = 4$. **[5]**

7 Solve the simultaneous equations

$$x + 2y - 6 = 0, \qquad 2x^2 + y^2 = 57.$$ **[6]**

8 **(i)** Express $2x^2 + 5x$ in the form $2(x+p)^2 + q$. **[3]**

(ii) State the coordinates of the minimum point of the curve $y = 2x^2 + 5x$. **[2]**

(iii) State the equation of the normal to the curve at its minimum point. **[1]**

(iv) Solve the inequality $2x^2 + 5x > 0$. **[4]**

9 **(i)** The line joining the points $A\,(4, 5)$ and $B\,(p, q)$ has mid-point $M\,(-1, 3)$. Find p and q. **[3]**

AB is the diameter of a circle.

(ii) Find the radius of the circle. **[2]**

(iii) Find the equation of the circle, giving your answer in the form $x^2 + y^2 + ax + by + c = 0$. **[3]**

(iv) Find an equation of the tangent to the circle at the point $(4, 5)$. **[5]**

10 **(i)** Find the coordinates of the stationary points of the curve $y = 2x^3 + 5x^2 - 4x$. **[6]**

(ii) State the set of values for x for which $2x^3 + 5x^2 - 4x$ is a decreasing function. **[2]**

(iii) Show that the equation of the tangent to the curve at the point where $x = \frac{1}{2}$ is $10x - 4y - 7 = 0$. **[4]**

(iv) Hence, with the aid of a sketch, show that the equation $2x^3 + 5x^2 - 4x = \frac{5}{2}x - \frac{7}{4}$ has two distinct real roots. **[2]**