Core Mathematics C1 Paper E

1. (i) Express $\dfrac{21}{\sqrt{7}}$ in the form $k\sqrt{7}$. [2]

   (ii) Express $8^{-\frac{1}{3}}$ as an exact fraction in its simplest form. [2]

2. Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ when

   (i) $y = x - 2x^2$, [2]

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

3. (a) Express $x^2 - 10x + 27$ in the form $(x + p)^2 + q$. [3]

   (b) Sketch the curve with equation $y = x^2 - 10x + 27$, showing on your sketch

   (i) the coordinates of the vertex of the curve,

   (ii) the coordinates of any points where the curve meets the coordinate axes. [3]

4. The straight line l_1 has gradient 2 and passes through the point with coordinates $(4, -5)$.

   (i) Find an equation for l_1 in the form $y = mx + c$. [2]

   The straight line l_2 is perpendicular to the line with equation $3x - y = 4$ and passes through the point with coordinates $(3, 0)$.

   (ii) Find an equation for l_2. [3]

   (iii) Find the coordinates of the point where l_1 and l_2 intersect. [3]

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5. Given that the equation

$$4x^2 - kx + k - 3 = 0,$$

where k is a constant, has real roots,

(i) show that

$$k^2 - 16k + 48 \geq 0,$$ [2]

(ii) find the set of possible values of k, [3]

(iii) state the smallest value of k for which the roots are equal and solve the equation when k takes this value. [3]

6. The points P and Q have coordinates $(-2, 6)$ and $(4, -1)$ respectively.

Given that PQ is a diameter of circle C,

(i) find the coordinates of the centre of C, [2]

(ii) show that C has the equation

$$x^2 + y^2 - 2x - 5y - 14 = 0.$$ [5]

The point R has coordinates $(2, 7)$.

(iii) Show that R lies on C and hence, state the size of $\angle PRQ$ in degrees. [2]

7. *(i)* Describe fully the single transformation that maps the graph of $y = f(x)$ onto the graph of $y = f(x - 1)$. [2]

(ii) Showing the coordinates of any points of intersection with the coordinate axes and the equations of any asymptotes, sketch the graph of $y = \dfrac{1}{x-1}$. [3]

(iii) Find the x-coordinates of any points where the graph of $y = \dfrac{1}{x-1}$ intersects the graph of $y = 2 + \dfrac{1}{x}$. Give your answers in the form $a + b\sqrt{3}$, where a and b are rational. [5]

Turn over

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8.
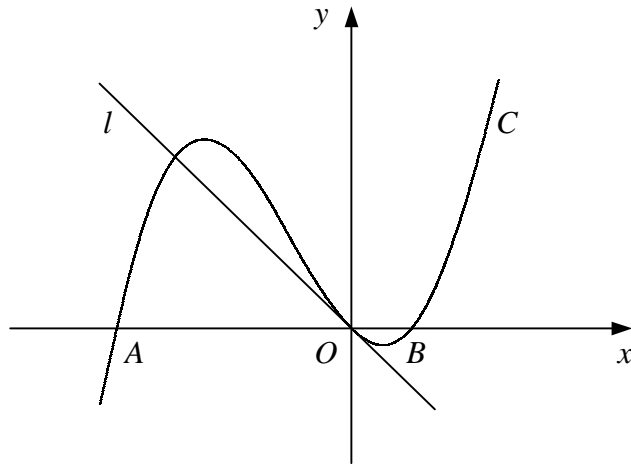
The diagram shows the curve C with the equation $y = x^3 + 3x^2 - 4x$ and the straight line l.

The curve C crosses the x-axis at the origin, O, and at the points A and B.

(i)   Find the coordinates of A and B. [3]

The line l is the tangent to C at O.

(ii)   Find an equation for l. [4]

(iii)   Find the coordinates of the point where l intersects C again. [4]

9.   The curve with equation $y = 2x^{\frac{3}{2}} - 8x^{\frac{1}{2}}$ has a minimum at the point A.

(i)   Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$. [3]

(ii)   Find the x-coordinate of A. [3]

The point B on the curve has x-coordinate 2.

(iii)   Find an equation for the tangent to the curve at B in the form $y = mx + c$. [6]

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