A Level · CIE · Maths

1 hour 13 questions

Practice Paper 1 (Pure 1)

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Total Marks /75

1 (a) The fifth term of an arithmetic series is k, where k is a constant, and the sum of the first eight terms of the series is $2k$.

Show that the first term, a, of the series is $-5k$.

(3 marks)

(b) Find an expression for the common difference, d, of the series in terms of k.

(2 marks)

2 (a) Find the first three terms in the expansion of $(4 - 3x)^9$.

(3 marks)

(b) Given that x is small such that x^3 and higher powers of x can be ignored show that

$$(3 - 2x^2)(4 - 3x)^9 \approx 786432 - 5308416x + 15400960x^2$$

(3 marks)

3 (a) A ball is dropped and bounces such that the height of each bounce is 80% of the height of the previous bounce.

The first bounce of the ball reaches a height of 1.60 m.

Find the height the ball bounces on its 8th bounce.

(2 marks)

(b) Find the total vertical distance travelled by the ball from when it first hits the ground until it hits the ground at the end of its twentieth bounce.

(2 marks)

(c) Give one reason why this model may be unrealistic.

(1 mark)

4 (a) The point P(3, —12) lies on the curve with equation $y = x^2 - 12x + 15$.

The graph is stretched so that the point P is mapped to the point (3, —4). Write down the equation of the transformed function in the form $y = ax^2 + bx + c$, where a, b and c are constants to be found.

(2 marks)

(b) The graph is stretched so that the point P is mapped to the point $(1, -12)$. Write down the equation of the transformed function in the form $y = (dx)^2 - 12(dx) + 15$, where d is a constant to be found.

(2 marks)

5 (a) The curve C has equation $y = x^2 - 3x + 2$. The line l has equation $y = 3x - 7$.

Find any points of intersection between C and l.

(3 marks)

(b) Sketch the graphs of C and l, showing clearly any points of intersection with the coordinate axes for both graphs, the minimum point of C and any points of intersection found between C and l.

(3 marks)

6 (a) The functions $\mathrm{f}(x)$ and $\mathrm{g}(x)$ are defined as follows

$$\mathrm{f}(x) = 3x^2 + 2 \qquad x \in \mathbb{R}$$

$$\mathrm{g}(x) = 1 - 3x \qquad x \in \mathbb{R}$$

Write down the range of $\mathrm{f}(x)$.

(1 mark)

(b) Find

(i) $\mathrm{fg}(x)$

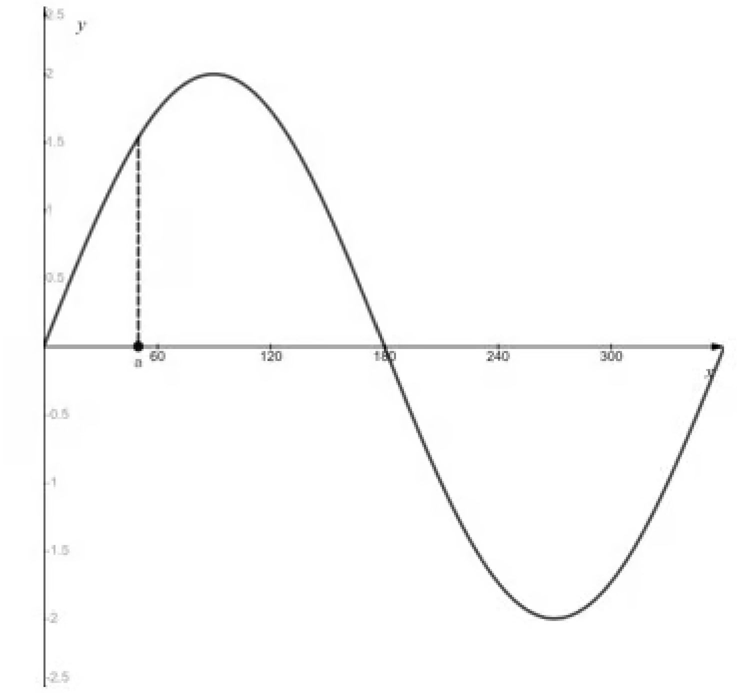
(ii) $\mathrm{gf}(x)$

(4 marks)

(c) Solve the equation $\mathrm{f}(x) = \mathrm{g}(x) + 1$

(2 marks)

7 The graph below shows the curve with equation $y = 2\sin\theta$, in the interval $0° \leq \theta \leq 360°$. One value of θ has been labelled $(\theta = a°)$.



Use the graph, along with the symmetry properties of the sine function, to verify that

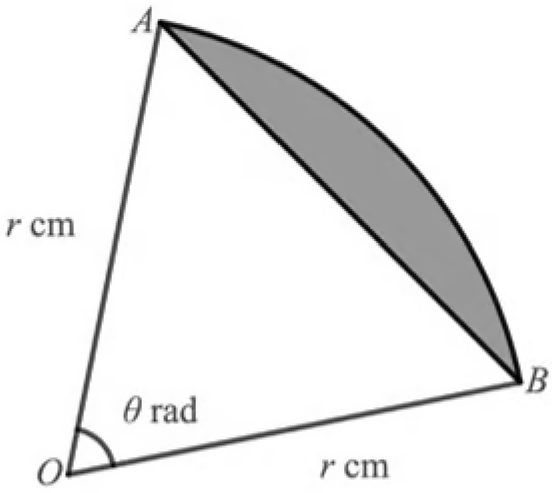
$$2\sin a = 2\sin(180° - a) = -2\sin(180° + a) = -2\sin(360° - a).$$

(2 marks)

8 Solve the equation $2\sin 2\theta = 1$ for $0 \leq \theta \leq 2\pi$.

(3 marks)

9 (a) The diagram below shows the sector of a circle OAB.



Show that the area of the shaded segment is given by $\frac{1}{2}r^2(\theta - \sin\,\theta)$ cm^2.

(3 marks)

(b) Find, in terms of θ, the percentage of the sector that the segment occupies.

(2 marks)

10 (a) A curve is described by the equation $y = \mathrm{f}(x)$, where $\mathrm{f}(x) = 7 - 2x^2 + \sqrt{x}$, $x \geq 0$.

Find $\mathrm{f}'(x)$ and $\mathrm{f}''(x)$.

(3 marks)

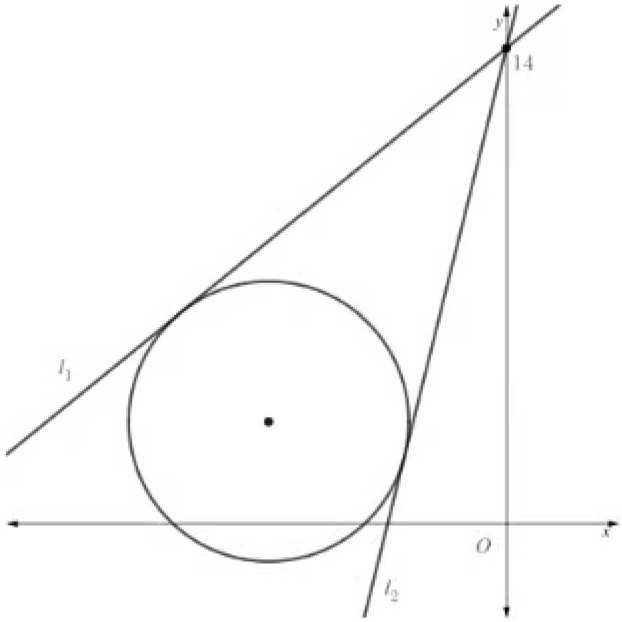
(b) P is the stationary point on the curve.

Find the coordinates of P and determine its nature.

(4 marks)

11 A circle has equation $x^2 + y^2 + 14x - 6y = -41$.

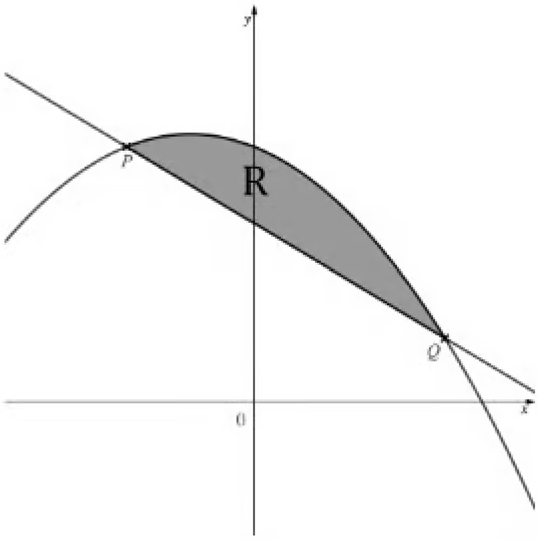
The lines l_1 and l_2 are both tangents to the circle, and they intersect at the point (0, 14).



Find the equations of l_1 and l_2, giving your answers in the form $y = mx + c$.

(7 marks)

12 (a) The line with equation $5y = 14 - 3x$ cuts the curve with equation $5y = 20 - 2x - x^2$ at the points P and Q, as shown.



Find the x- and y-coordinates of the points P and Q.

(5 marks)

(b) Find the exact area of the region labelled R, giving your answer in the form $\frac{a}{b}$, where a and b are integers to be found.

(6 marks)

13 (a) A mathematical model for a bowl is obtained by rotating through $360°$ about the y-axis the part of the curve $y = \frac{1}{a}x^2$ which is between $y = 8$ and $y = 9$ and then adding a flat bottom. a is a constant such that $a > 0$.

Find the capacity of the bowl in terms of a.

(4 marks)

(b) In the case where the boundaries $y = 3$ and $y = 6$ are used in place of $y = 8$ and $y = 9$, the capacity of the bowl is increased by 15π cubic units.
Find the value of a.

(3 marks)