Write your name here

Surname	Other names

Edexcel
International GCSE

Centre Number | Candidate Number

Further Pure Mathematics
Paper 2

Thursday 16 June 2016 – Afternoon
Time: 2 hours

Paper Reference
4PM0/02

Calculators may be used.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Without sufficient working, correct answers may be awarded no marks.
- Answer the questions in the spaces provided – *there may be more space than you need.*

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Check your answers if you have time at the end.

Turn over ▶

PEARSON

Answer all TEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 A triangle has sides of length 10 cm, 8 cm and 9 cm.

(a) Calculate, in degrees to the nearest 0.1°, the size of the largest angle of this triangle.
(3)

(b) Find, to 3 significant figures, the area of this triangle.
(2)

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Question 1 continued

(Total for Question 1 is 5 marks)

P 4 6 9 0 2 A 0 3 3 2

2 Relative to a fixed origin O, the point A has position vector $6\mathbf{i} + 5\mathbf{j}$ and the point B has position vector $3\mathbf{i} + 9\mathbf{j}$

(a) Find $\overrightarrow{AB}$ as a simplified vector in terms of $\mathbf{i}$ and $\mathbf{j}$

(2)

The line PQ is parallel to AB. Given that $\overrightarrow{PQ} = 12\mathbf{i} + \lambda\mathbf{j}$

(b) find the value of λ.

(2)

(c) Find a unit vector parallel to AB.

(2)

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P 4 6 9 0 2 A 0 4 3 2

Question 2 continued

(Total for Question 2 is 6 marks)

3 A geometric series has first term $(11x - 3)$, second term $(5x + 3)$ and third term $(3x - 3)$.

(a) Find the two possible values of x.

(4)

For each of your values of x,

(b) find the corresponding value of the common ratio of the series.

(3)

Given that the series is convergent,

(c) find the sum to infinity of the series.

(3)

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Question 3 continued

Question 3 continued

(Total for Question 3 is 10 marks)

4 Differentiate with respect to x

$$e^{2x} \cos 3x$$

(3)

(Total for Question 4 is 3 marks)

5 A solid cuboid has volume 772 cm^3
The cuboid has width x cm, length $4x$ cm and height h cm.
The total surface area of the cuboid is A cm^2

(a) Show that $A = 8x^2 + \dfrac{1930}{x}$ **(3)**

(b) Find, to 3 significant figures, the value of x for which A is a minimum, justifying that this value of x gives a minimum value of A. **(5)**

(c) Find, to 3 significant figures, the minimum value of A. **(2)**

Question 5 continued

Question 5 continued

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Question 5 continued

(Total for Question 5 is 10 marks)

6 (a) Use algebra to find the coordinates of the points of intersection of the curve with equation $y = x^2 + 2x - 6$ and the line with equation $y = 5x + 4$

(5)

(b) Use algebraic integration to find the exact area of the finite region bounded by the curve and the line.

(5)

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Question 6 continued

Question 6 continued

Question 6 continued

(Total for Question 6 is 10 marks)

7 A particle P moves in a straight line so that, at time t seconds ($t \geqslant 0$), its velocity, v m/s, is given by $v = 3t^2 - 4t + 7$

Find

(a) the acceleration of P at time $t = 2$

(2)

(b) the minimum speed of P.

(3)

When $t = 0$, P is at the point A and has velocity V m/s.

(c) Write down the value of V.

(1)

When P reaches the point B, the velocity of P is also V m/s.

(d) Find the distance AB.

(6)

Question 7 continued

Question 7 continued

Question 7 continued

(Total for Question 7 is 12 marks)

8 A curve C has equation

$$y = \frac{3x^2 - 1}{3x + 2} \qquad \text{where } x \neq -\frac{2}{3}$$

(a) Write down an equation of the asymptote to C which is parallel to the y-axis.
(1)

(b) Find the coordinates of the stationary points on C.
(8)

The curve crosses the y-axis at the point A.

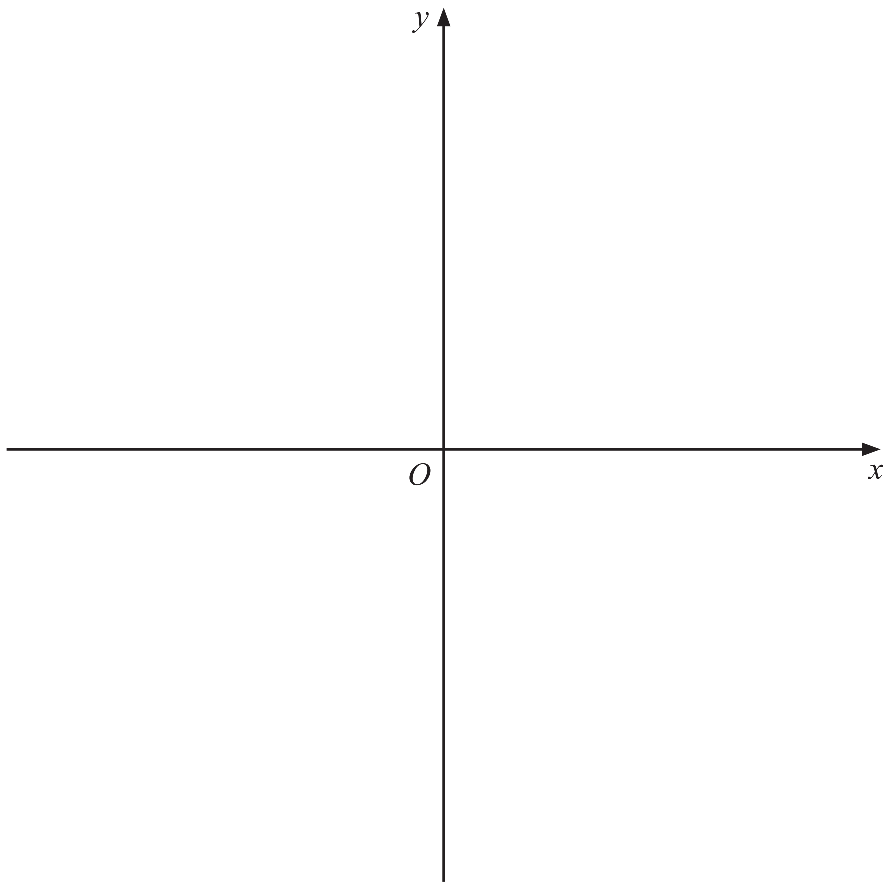
(c) Write down the coordinates of A.
(1)

(d) On the axes on the opposite page, sketch C, showing clearly the asymptote parallel to the y-axis, the coordinates of the stationary points and the coordinates of A.
(3)

The line l is the normal to the curve at A.

(e) Find an equation of l.
(3)

Question 8 continued



Question 8 continued

Question 8 continued

(Total for Question 8 is 16 marks)

9

$$\sin(A + B) = \sin A \cos B + \cos A \sin B$$

$$\cos(A + B) = \cos A \cos B - \sin A \sin B$$

Using the above identities

(a) show that $\cos 2\theta = 2\cos^2\theta - 1$

(3)

(b) find a simplified expression for $\sin 2\theta$ in terms of $\sin\theta$ and $\cos\theta$

(1)

(c) show that $\cos 3\theta = 4\cos^3\theta - 3\cos\theta$

(4)

Hence, or otherwise,

(d) solve, for $0 \leqslant \theta < \pi$ giving your answers in terms of π, the equation

$$6\cos\theta - 8\cos^3\theta + 1 = 0$$

(4)

(e) find

(i) $\int\left(8\cos^3\theta + 4\sin\theta\right)\mathrm{d}\theta$

(ii) the exact value of $\int_0^{\frac{\pi}{3}}\left(8\cos^3\theta + 4\sin\theta\right)\mathrm{d}\theta$

(4)

Question 9 continued

Question 9 continued

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Question 9 continued

(Total for Question 9 is 16 marks)

10

Diagram **NOT** accurately drawn

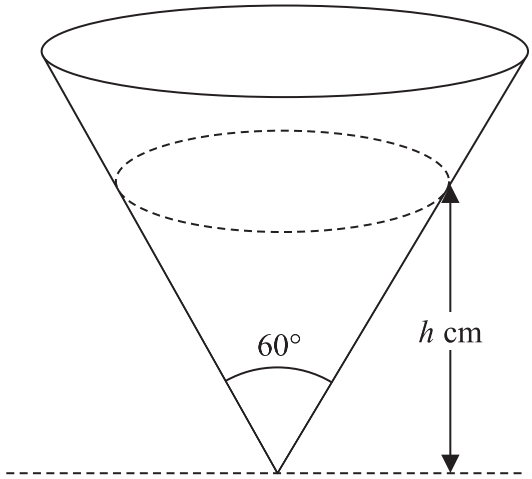

Figure 1

A conical container is fixed with its axis of symmetry vertical. Oil is dripping into the container at a constant rate of 0.4 cm^3/s. At time t seconds after the oil starts to drip into the container, the depth of the oil is h cm. The vertical angle of the container is 60°, as shown in Figure 1

When $t = 0$ the container is empty.

(a) Show that $h^3 = \dfrac{18t}{5\pi}$

(4)

Given that the area of the top surface of the oil is A cm^2

(b) show that $\dfrac{dA}{dt} = \dfrac{4}{5h}$

(6)

(c) Find, in cm^2/s to 3 significant figures, the rate of change of the area of the top surface of the oil when $t = 10$

(2)

Question 10 continued

Question 10 continued

(Total for Question 10 is 12 marks)

TOTAL FOR PAPER IS 100 MARKS