

Write your name here	
Surname	Other names
Edexcel	Centre Number
International GCSE	Candidate Number
<h1 style="margin: 0;">Further Pure Mathematics</h1> <h2 style="margin: 0;">Paper 2</h2>	
Thursday 16 June 2016 – Afternoon	Paper Reference
Time: 2 hours	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 ►

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PEARSON

Question 1 continued

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A large rectangular area with horizontal dotted lines for writing.

(Total for Question 1 is 5 marks)



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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Question 2 continued

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(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

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4 Differentiate with respect to x

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

(3)

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(Total for Question 4 is 3 marks)



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

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

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Question 5 continued

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Area for writing answers, consisting of multiple horizontal dotted lines.



Question 5 continued

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(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

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Question 6 continued

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(Total for Question 6 is 10 marks)



7 A particle P moves in a straight line so that, at time t seconds ($t \geq 0$), 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)

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Question 7 continued

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Question 7 continued

Area with horizontal dotted lines for writing answers.

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Question 7 continued

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(Total for Question 7 is 12 marks)



8 A curve C has equation

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

(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)

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Question 8 continued

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Question 8 continued

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(Total for Question 8 is 16 marks)



$$9 \quad \sin(A + B) = \sin A \cos B + \cos A \sin B$$

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

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 $0 \leq \theta < \pi$ giving your answers in terms of π , the equation

$$6 \cos \theta - 8 \cos^3 \theta + 1 = 0$$
 (4)

(e) find

(i) $\int (8 \cos^3 \theta + 4 \sin \theta) d\theta$

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

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Question 9 continued

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Area for writing answers, consisting of multiple horizontal dotted lines.



Question 9 continued

Area for writing answers, consisting of multiple horizontal dotted lines.

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Question 9 continued

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Area with horizontal dotted lines for writing answers.

(Total for Question 9 is 16 marks)



10

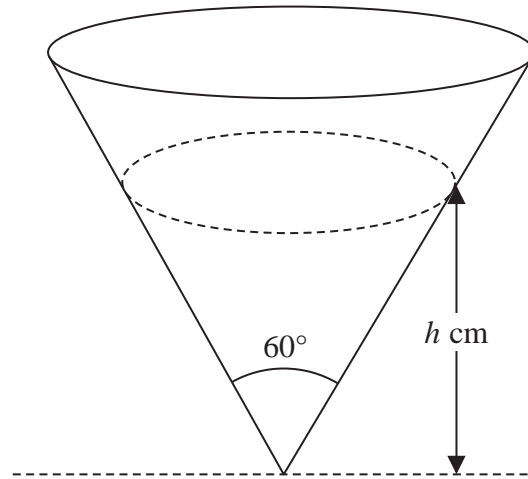
Diagram **NOT**
accurately drawn

Figure 1

A conical container is fixed with its axis of symmetry vertical. Oil is dripping into the container at a constant rate of $0.4 \text{ cm}^3/\text{s}$. 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 $h^3 = \frac{18t}{5\pi}$ (4)

Given that the area of the top surface of the oil is $A \text{ cm}^2$

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

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Question 10 continued

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Question 10 continued

Area with horizontal dotted lines for writing answers.

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(Total for Question 10 is 12 marks)

TOTAL FOR PAPER IS 100 MARKS

