Write your name here

Surname	Other names

Edexcel
International GCSE

Centre Number	Candidate Number

Further Pure Mathematics
Paper 2

Thursday 22 January 2015 – Morning **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 ▶

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Answer all TEN questions.

Write your answers in the spaces provided.

You must write down all stages in your working.

1

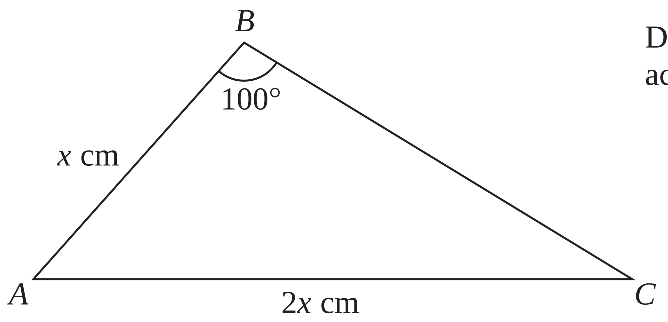


Diagram **NOT** accurately drawn

Figure 1

In triangle *ABC*, $AB = x$ cm, $AC = 2x$ cm and $\angle ABC = 100°$, as shown in Figure 1.

(a) Find, in degrees to the nearest 0.1°, the size of $\angle BAC$.

(4)

Given that the area of triangle *ABC* is 16 cm^2,

(b) find, to 3 significant figures, the value of x.

(3)

Question 1 continued

(Total for Question 1 is 7 marks)

2 A solid right circular cylinder has height h cm and base radius r cm. The total surface area of the cylinder is S cm^2 and the volume of the cylinder is V cm^3

(a) Show that $S = \dfrac{2V}{r} + 2\pi r^2$

(2)

Given that $V = 1600$

(b) find, to 3 significant figures, the minimum value of S.
Verify that the value you have found is a minimum.

(7)

Question 2 continued

Question 2 continued

(Total for Question 2 is 9 marks)

3 The equation $2x^2 + 3x + c = 0$, where c is a constant, has two equal roots.

(a) Find the value of c.

(2)

(b) Solve the equation.

(2)

(Total for Question 3 is 4 marks)

4

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

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

(a) Write down the exact value of sin 45°

(1)

Given that $\sin\theta = \frac{\sqrt{5}}{2\sqrt{2}}$ and $\cos\theta = \frac{\sqrt{3}}{2\sqrt{2}}$

(b) show that $\sin(45° + \theta) = \frac{\sqrt{3} + \sqrt{5}}{4}$

(2)

(c) Find the exact value of $\cos(45° + \theta)$

(2)

(d) Show that $\sin(45° + \theta) \times \cos(45° + \theta) = -\frac{1}{8}$

(2)

Question 4 continued

(Total for Question 4 is 7 marks)

5 The grid opposite shows the graph of $y = 3x \sin x$ for $-1 \leqslant x \leqslant 3$, where x is measured in radians.

(a) Use the graph to estimate, to 1 decimal place, the roots of the equation

$$x \sin x = 1$$

in the interval $-1 \leqslant x \leqslant 3$

(3)

(b) By drawing a suitable straight line on the grid, obtain estimates, to 1 decimal place, of the roots of the equation

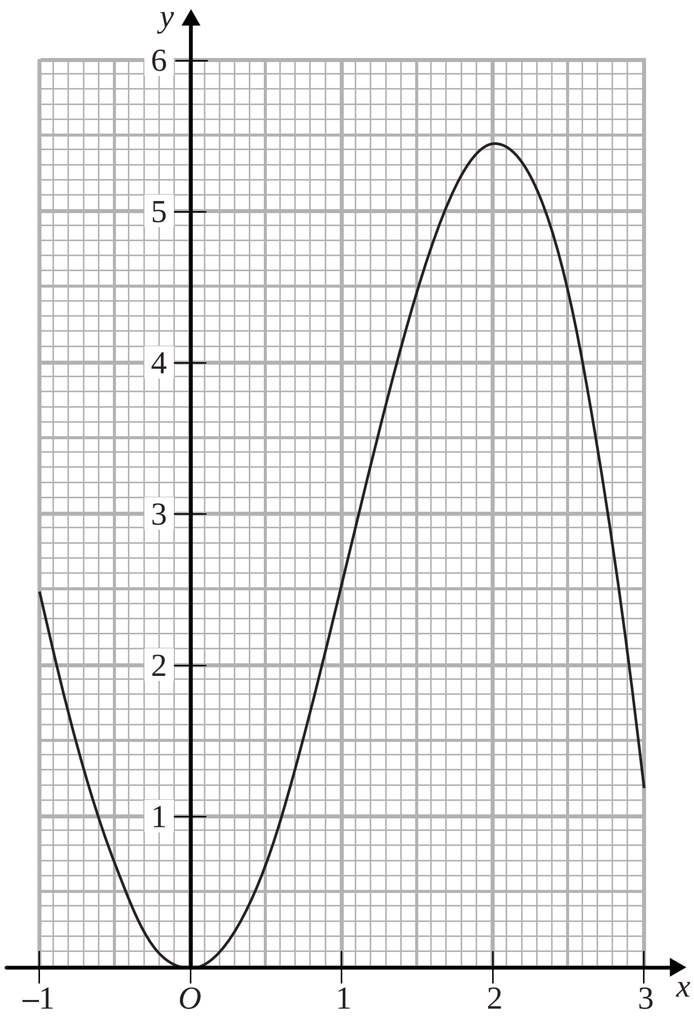
$$2x \sin x - x = 1$$

in the interval $-1 \leqslant x \leqslant 3$

(5)

Question 5 continued

Graph for Question 5



(Total for Question 5 is 8 marks)

6 The equation $2x^2 + px - 3 = 0$, where p is a constant, has roots α and β.

(a) Find the value of

(i) $\alpha\beta$

(ii) $\left(\alpha + \frac{1}{\beta}\right)\left(\beta + \frac{1}{\alpha}\right)$

(4)

(b) Find, in terms of p,

(i) $\alpha + \beta$

(ii) $\left(\alpha + \frac{1}{\beta}\right) + \left(\beta + \frac{1}{\alpha}\right)$

(4)

Given that $\left(\alpha + \frac{1}{\beta}\right) + \left(\beta + \frac{1}{\alpha}\right) = 2\left(\alpha + \frac{1}{\beta}\right)\left(\beta + \frac{1}{\alpha}\right)$

(c) find the value of p.

(1)

(d) Using the value of p found in part (c), find a quadratic equation, with integer coefficients, which has roots $\left(\alpha + \frac{1}{\beta}\right)$ and $\left(\beta + \frac{1}{\alpha}\right)$.

(2)

Question 6 continued

Question 6 continued

Question 6 continued

(Total for Question 6 is 11 marks)

7 The first term of an arithmetic series is –14 and the common difference is 4

(a) Find the 15th term of the series.

(2)

(b) Find the sum of the first 25 terms of the series.

(3)

The sum of nine consecutive terms of the series is 1422

(c) Find the smallest of these nine terms.

(5)

Question 7 continued

Question 7 continued

Question 7 continued

(Total for Question 7 is 10 marks)

8 (a) Find the full binomial expansion of $(1 - 2x)^5$, giving each coefficient as an integer.
(3)

(b) Expand $(1 + 2x)^{-5}$ in ascending powers of x up to and including the term in x^3, giving each coefficient as an integer.
(3)

(c) Write down the range of values of x for which this expansion is valid.
(1)

(d) Expand $\left(\frac{1 - 2x}{1 + 2x}\right)^5$ in ascending powers of x up to and including the term in x^2,

giving each coefficient as an integer.
(3)

(e) Find the gradient of the curve with equation $y = \left(\frac{1 - 2x}{1 + 2x}\right)^5$ at the point (0, 1).
(2)

Question 8 continued

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Question 8 continued

Question 8 continued

(Total for Question 8 is 12 marks)

9

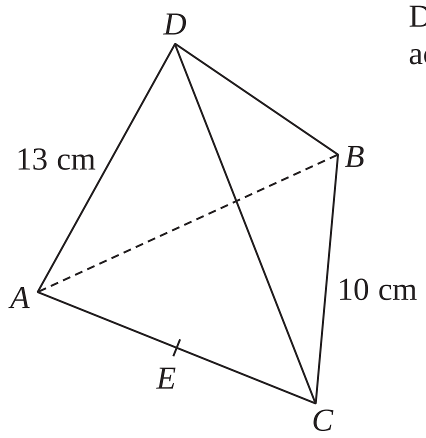

Figure 2

Figure 2 shows a triangular pyramid *ABCD*.
AB = *BC* = *CA* = 10 cm and *DA* = *DB* = *DC* = 13 cm.
The point *E* is the midpoint of *AC*.

(a) Find the exact length of

(i) *DE*

(ii) *BE*

(4)

(b) Find, in degrees to 1 decimal place, the size of the angle between the line *BD* and the line *DE*.

(3)

(c) Find, in degrees to 1 decimal place, the size of the angle between the line *BD* and the plane *ABC*.

(3)

(d) Find, in degrees to 1 decimal place, the size of the angle between the plane *ADC* and the plane *ABC*.

(2)

(e) Find, to 3 significant figures, the volume of the pyramid *ABCD*.

(3)

Question 9 continued

Question 9 continued

Question 9 continued

(Total for Question 9 is 15 marks)

10

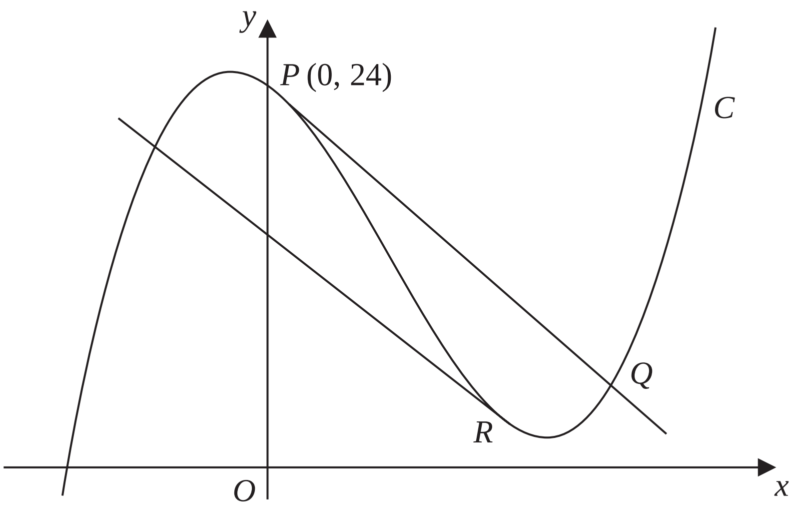

Diagram **NOT** accurately drawn

Figure 3

Figure 3 shows the curve C with equation $y = 9x^3 - 18x^2 - 8x + 24$
The curve cuts the y-axis at the point P with coordinates (0, 24).
The point Q lies on C and the line PQ is the tangent to C at P.

(a) Find an equation of PQ.
(4)

(b) Find the coordinates of Q.
(5)

The point R lies on C and S is the point such that $PQRS$ is a parallelogram.
Given that RS is the tangent to C at R,

(c) find the coordinates of R,
(4)

(d) find the coordinates of S.
(2)

(e) Show that S lies on C.
(2)

Question 10 continued

Question 10 continued

Question 10 continued

Question 10 continued

(Total for Question 10 is 17 marks)

TOTAL FOR PAPER IS 100 MARKS