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Surname	Other names

Pearson Edexcel
International GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Further Pure Mathematics

Paper 2

Monday 22 January 2018 – 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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Pearson

Answer all ELEVEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1

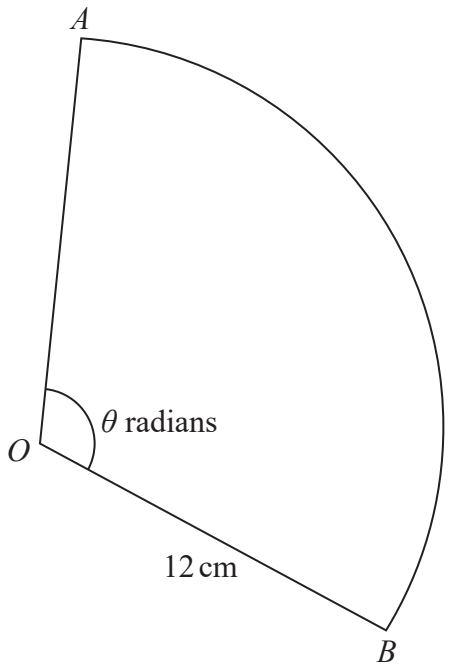

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Figure 1

Figure 1 shows the sector AOB of a circle with centre O and radius 12 cm. The angle AOB is θ radians and the area of the sector is 192 cm^2

Calculate

(a) the value of θ,

(2)

(b) the length, in cm, of the arc AB.

(2)

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Question 1 continued

(Total for Question 1 is 4 marks)

2 (a) Show that $\sum_{r=1}^{n}(3r+2) = \frac{n}{2}(7+3n)$

(2)

(b) Hence, or otherwise, evaluate $\sum_{r=10}^{20}(3r+2)$

(3)

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Question 2 continued

(Total for Question 2 is 5 marks)

3

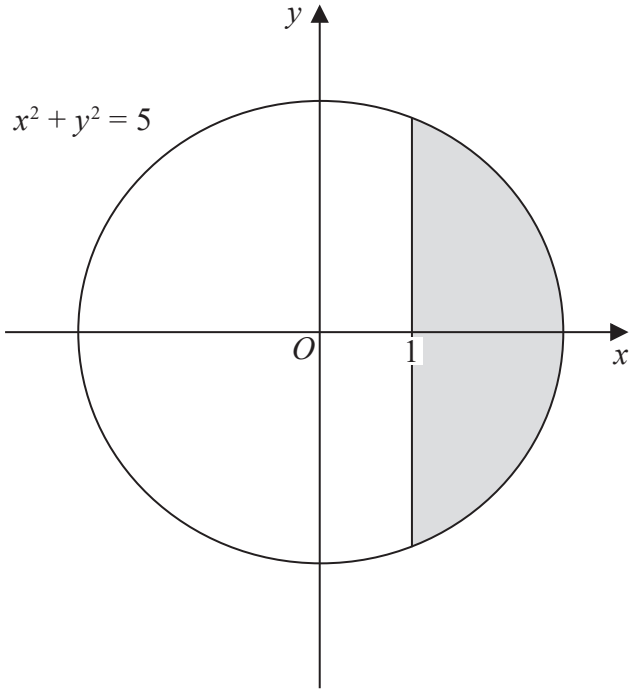

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Figure 2

The region enclosed by the circle with equation $x^2 + y^2 = 5$ and the straight line with equation $x = 1$, shown shaded in Figure 2, is rotated through 360° about the y-axis.

Use algebraic integration to find the exact volume of the solid generated.

(5)

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Question 3 continued

(Total for Question 3 is 5 marks)

4 Here is a quadratic equation $3x^2 + px + 4 = 0$ where p is a constant.

(a) Find the set of values of p for which the equation has two real distinct roots.

(5)

(b) List all the possible integer values of p for which the equation has no real roots.

(1)

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Question 4 continued

(Total for Question 4 is 6 marks)

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5 Given that $y = 2e^x(3x^2 - 6)$

show that $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 12e^x$

(7)

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Question 5 continued

(Total for Question 5 is 7 marks)

6

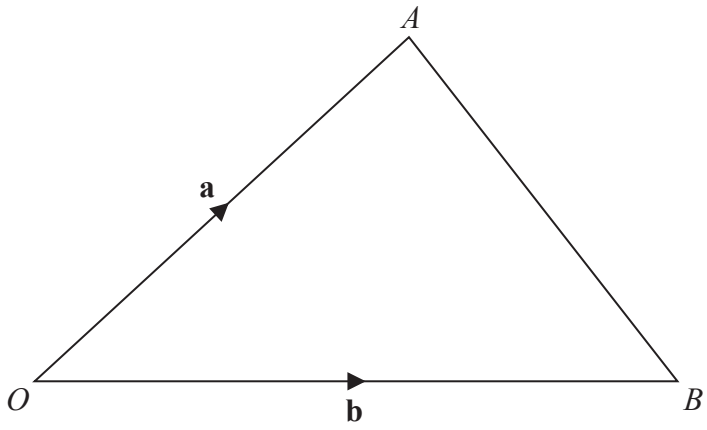

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Figure 3

Figure 3 shows the triangle OAB with $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

(a) Find $\overrightarrow{AB}$ in terms of **a** and **b**.

(1)

The point P is such that $\overrightarrow{OP} = \frac{3}{4}\overrightarrow{OA}$, and the point Q is the midpoint of AB.

(b) Find $\overrightarrow{PQ}$ as a simplified expression in terms of **a** and **b**.

(2)

The point R is such that PQR and OBR are straight lines where

$$\overrightarrow{QR} = \mu\overrightarrow{PQ} \text{ and } \overrightarrow{BR} = \lambda\overrightarrow{OB}$$

(c) Express $\overrightarrow{QR}$ in terms of

(i) **a**, **b** and μ

(ii) **a**, **b** and λ

(3)

(d) Hence find the value of

(i) μ

(ii) λ

(4)

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Question 6 continued

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Question 6 continued

(Total for Question 6 is 10 marks)

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7 (i) Solve the equation $\dfrac{\left(8^x\right)^x}{32^x} = 4$

(4)

(ii) Solve the equation $\log_x 64 + 3\log_4 x - \log_x 4 = 5$

(7)

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Question 7 continued

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Question 7 continued

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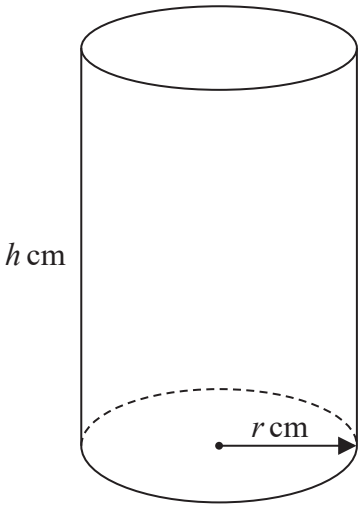

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Figure 4

A solid right circular cylinder has radius r cm and height h cm, as shown in Figure 4.
The cylinder has a volume of 355 cm^3 and a total surface area of S cm^2

(a) Show that $S = 2\pi r^2 + \dfrac{710}{r}$

(4)

Given that r can vary,

(b) using calculus find, to 3 significant figures, the minimum value of S.

(5)

(c) Verify that your answer to part (b) does give the minimum value of S.

(2)

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Question 8 continued

Question 8 continued

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Question 8 continued

(Total for Question 8 is 11 marks)

9

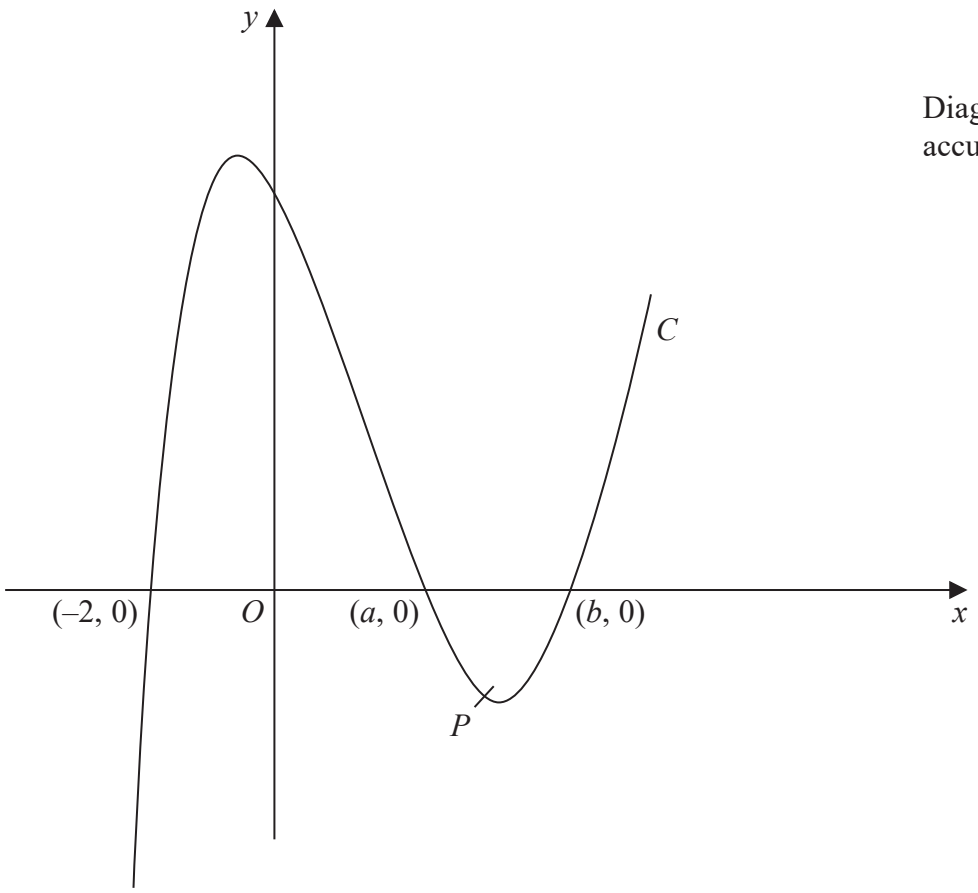

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Figure 5

Figure 5 shows the curve C with equation $y = x^3 - 2x^2 - 5x + 6$

The curve C crosses the x-axis at the points with coordinates $(-2, 0)$, $(a, 0)$ and $(b, 0)$

(a) (i) Show that $a = 1$

(ii) Find the value of b.

(4)

The point P on C has x coordinate 2 and the line l is the tangent to C at P.

(b) Show that l crosses the x-axis at the point with coordinates $(-2, 0)$

(6)

(c) Use algebraic integration to find the exact area of the finite region bounded by C and l.

(4)

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Question 9 continued

Question 9 continued

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Question 9 continued

(Total for Question 9 is 14 marks)

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10 The point A has coordinates $(-6, -4)$ and the point B has coordinates $(4, 1)$
The line l passes through the point A and the point B.

(a) Find an equation of l.

(2)

The point P lies on l such that $AP : PB = 3 : 2$

(b) Find the coordinates of P.

(2)

The point Q with coordinates (m, n) lies on the line through P that is perpendicular to l.

Given that $m < 0$ and that the length of PQ is $3\sqrt{5}$

(c) find the coordinates of Q.

(5)

The point R has coordinates $(-13, 0)$

(d) Show that

(i) AB and RQ are equal in length,

(ii) AB and RQ are parallel.

(4)

(e) Find the area of the quadrilateral $ABQR$.

(2)

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Question 10 continued

Question 10 continued

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Question 10 continued

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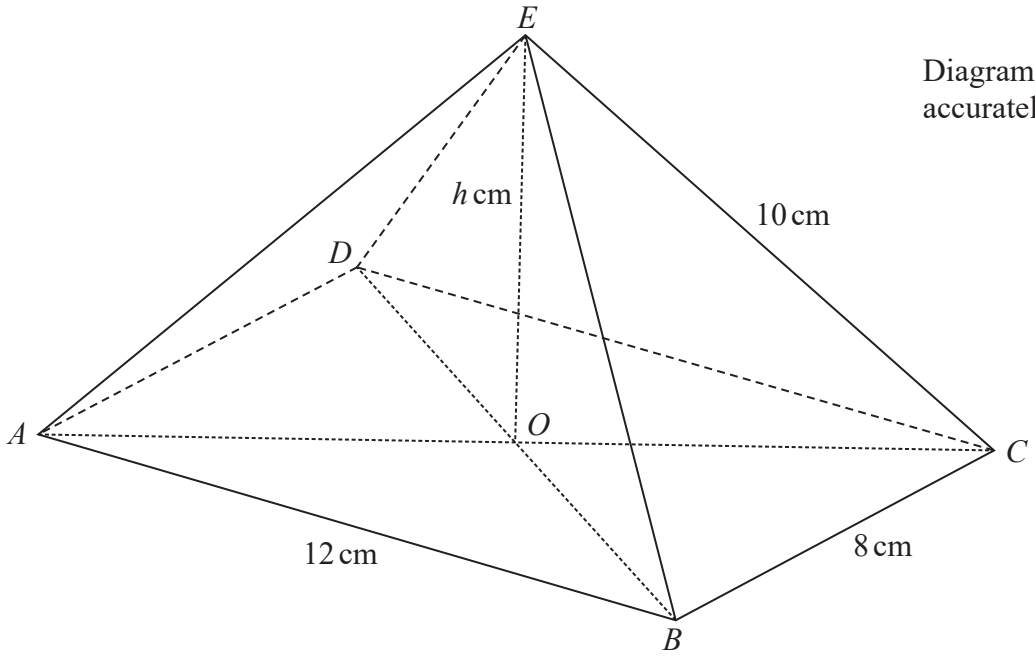

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Figure 6

A pyramid with a rectangular base $ABCD$ and vertex E is shown in Figure 6.

The rectangular base is horizontal with $AB = 12$ cm and $BC = 8$ cm.

The diagonals of the base intersect at the point O.

The vertex E of the pyramid is vertically above O.

The height of the pyramid is h cm and $AE = BE = CE = DE = 10$ cm.

(a) Show that $h = 4\sqrt{3}$

(3)

(b) Find, in degrees to 1 decimal place, the size of angle OCE.

(2)

The angle between OE and the plane CBE is $\theta°$

(c) Show that $\cos\theta° = \dfrac{2\sqrt{7}}{7}$

(3)

The point P is the midpoint of BE and the point Q is the midpoint of CE.

(d) Find, in degrees to 1 decimal place, the size of the angle between the plane OPQ and the plane EPQ.

(4)

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Question 11 continued

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Question 11 continued

Question 11 continued

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TOTAL FOR PAPER IS 100 MARKS

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