Write your name here

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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P 5 3 2 9 2 A 0 1 3 6

Pearson

Answer all ELEVEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1

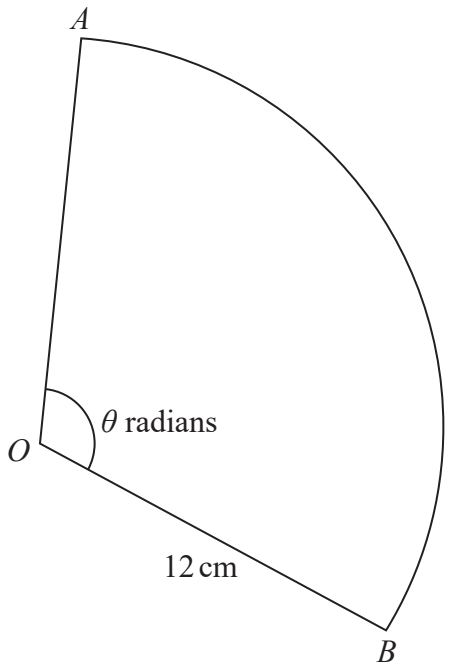

Diagram **NOT** accurately drawn

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)

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)

Question 2 continued

(Total for Question 2 is 5 marks)

3

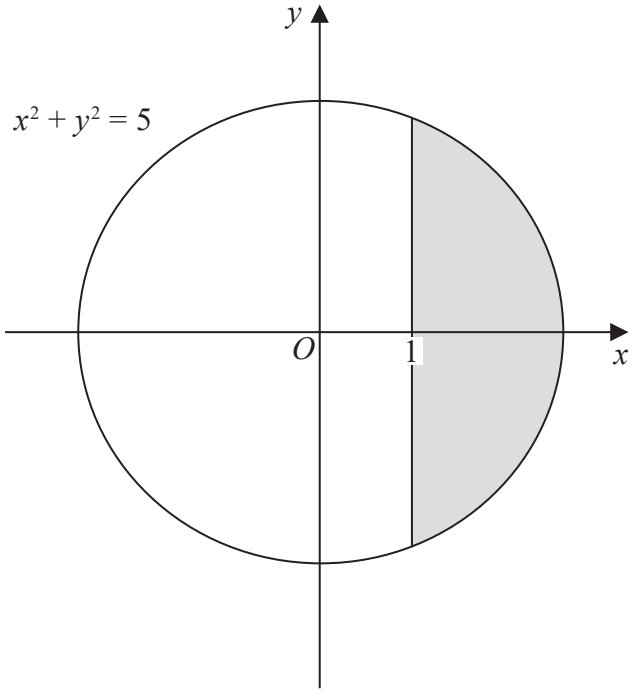

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Figure 2

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)

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)

Question 4 continued

(Total for Question 4 is 6 marks)

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

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

(7)

Question 5 continued

(Total for Question 5 is 7 marks)

6

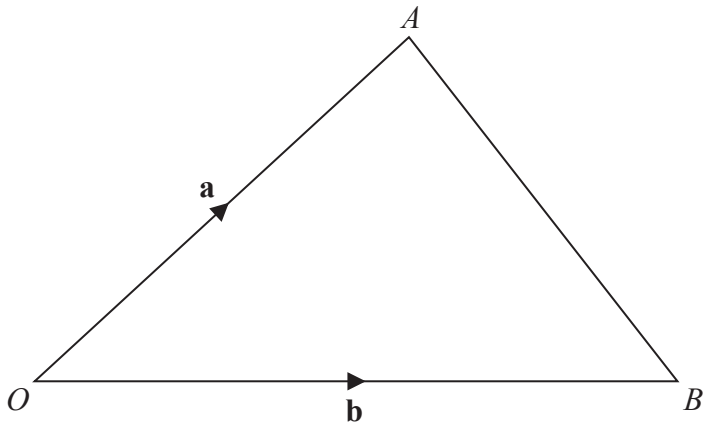

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Figure 3

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)

Question 6 continued

Question 6 continued

Question 6 continued

(Total for Question 6 is 10 marks)

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)

Question 7 continued

Question 7 continued

Question 7 continued

(Total for Question 7 is 11 marks)

8

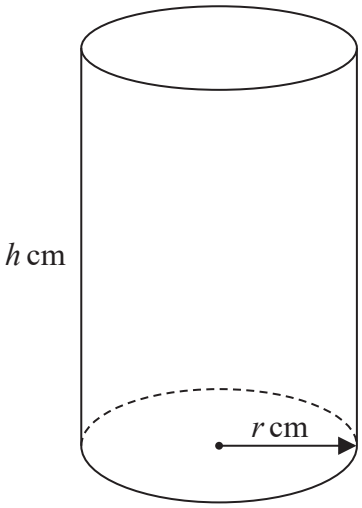

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Figure 4

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)

Question 8 continued

Question 8 continued

Question 8 continued

(Total for Question 8 is 11 marks)

9

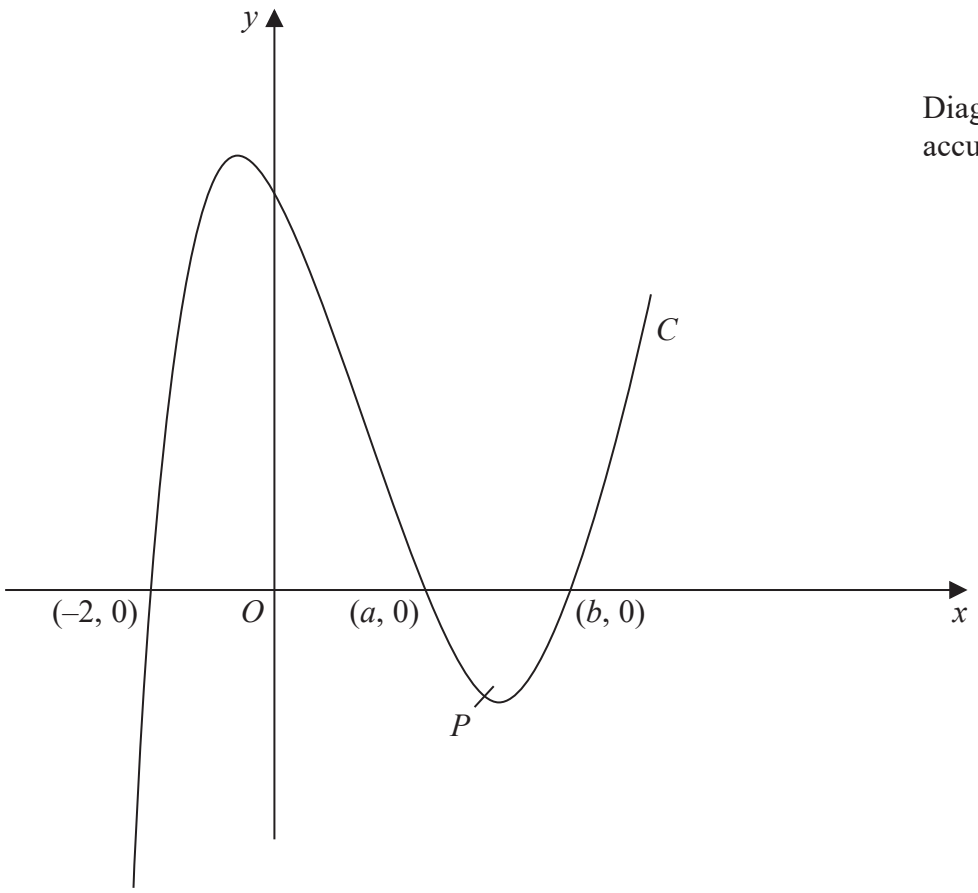

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Figure 5

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)

Question 9 continued

Question 9 continued

Question 9 continued

(Total for Question 9 is 14 marks)

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)

Question 10 continued

Question 10 continued

Question 10 continued

(Total for Question 10 is 15 marks)

11

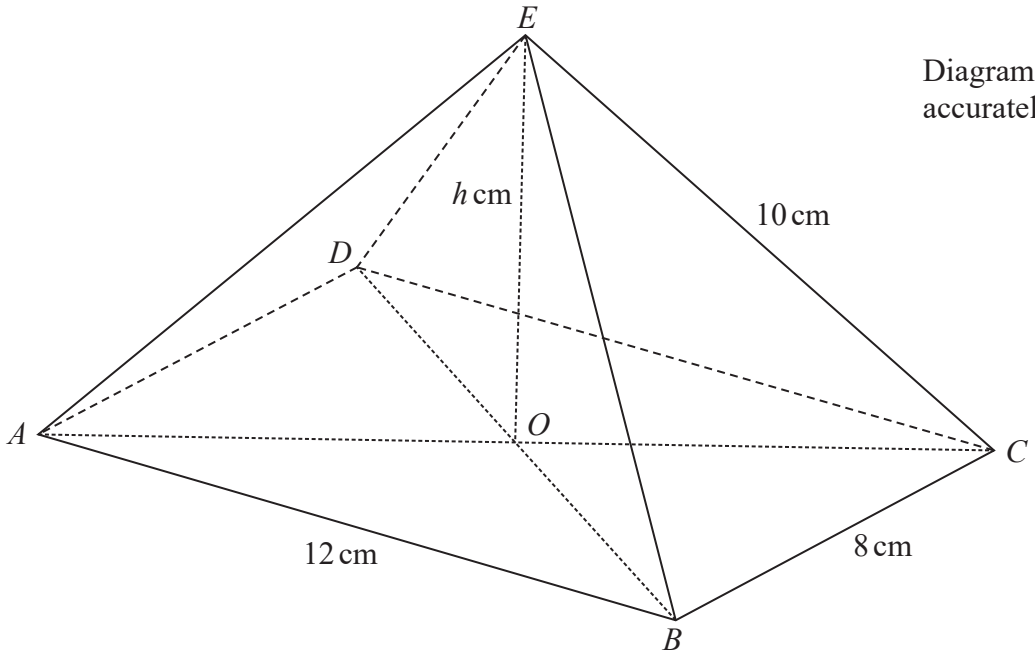

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Figure 6

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)

Question 11 continued

Question 11 continued

Question 11 continued

Question 11 continued

(Total for Question 11 is 12 marks)

TOTAL FOR PAPER IS 100 MARKS