Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE

Centre Number | Candidate Number

Friday 10 January 2020

Morning (Time: 2 hours) | Paper Reference **4PM1/01**

Further Pure Mathematics
Level 2
Paper 1

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.*
- You must **NOT** write anything on the formulae page. Anything you write on the formulae page will gain NO credit.

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

International GCSE in Further Pure Mathematics Formulae sheet

Mensuration

Surface area of sphere $= 4\pi r^2$

Curved surface area of cone $= \pi r \times$ slant height

Volume of sphere $= \frac{4}{3}\pi r^3$

Series

Arithmetic series

Sum to n terms, $S_n = \frac{n}{2}[2a + (n-1)d]$

Geometric series

Sum to n terms, $S_n = \frac{a(1-r^n)}{(1-r)}$

Sum to infinity, $S_\infty = \frac{a}{1-r} \quad |r| < 1$

Binomial series

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \ldots + \frac{n(n-1)\ldots(n-r+1)}{r!}x^r + \ldots \quad \text{for} \quad |x| < 1, n \in \mathbb{Q}$$

Calculus

Quotient rule (differentiation)

$$\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{\mathrm{f}(x)}{\mathrm{g}(x)}\right) = \frac{\mathrm{f}'(x)\mathrm{g}(x) - \mathrm{f}(x)\mathrm{g}'(x)}{[\mathrm{g}(x)]^2}$$

Trigonometry

Cosine rule

In triangle ABC: $a^2 = b^2 + c^2 - 2bc\cos A$

$\tan\theta = \frac{\sin\theta}{\cos\theta}$

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

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

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

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

$\tan(A+B) = \frac{\tan A + \text{ an } B}{1 - \tan A \text{ an } B}$

$\tan(A-B) = \frac{\tan A - \text{ an } B}{1 + \tan A \text{ an } B}$

Logarithms

$\log_a x = \frac{\log_b x}{\log_b a}$

P 5 9 9 3 8 A 0 2 3 6

Answer all ELEVEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 The nth term of an arithmetic series is t_n and the common difference of the series is d.

Given that $t_2 + t_9 = 0$ and that $t_4 + t_6 + t_{10} = 14$

(a) (i) show that $d = 4$

(ii) find the first term of this series.

(4)

A different arithmetic series A has first term 24 and common difference 6
For series A, the sum of the first $2n$ terms is 3 times the sum of the first n terms.

(b) Find the value of n.

(5)

Question 1 continued

Question 1 continued

(Total for Question 1 is 9 marks)

2 (a) On the grid below, draw the line with equation

(i) $5x + 2y = 10$ (ii) $y = x$

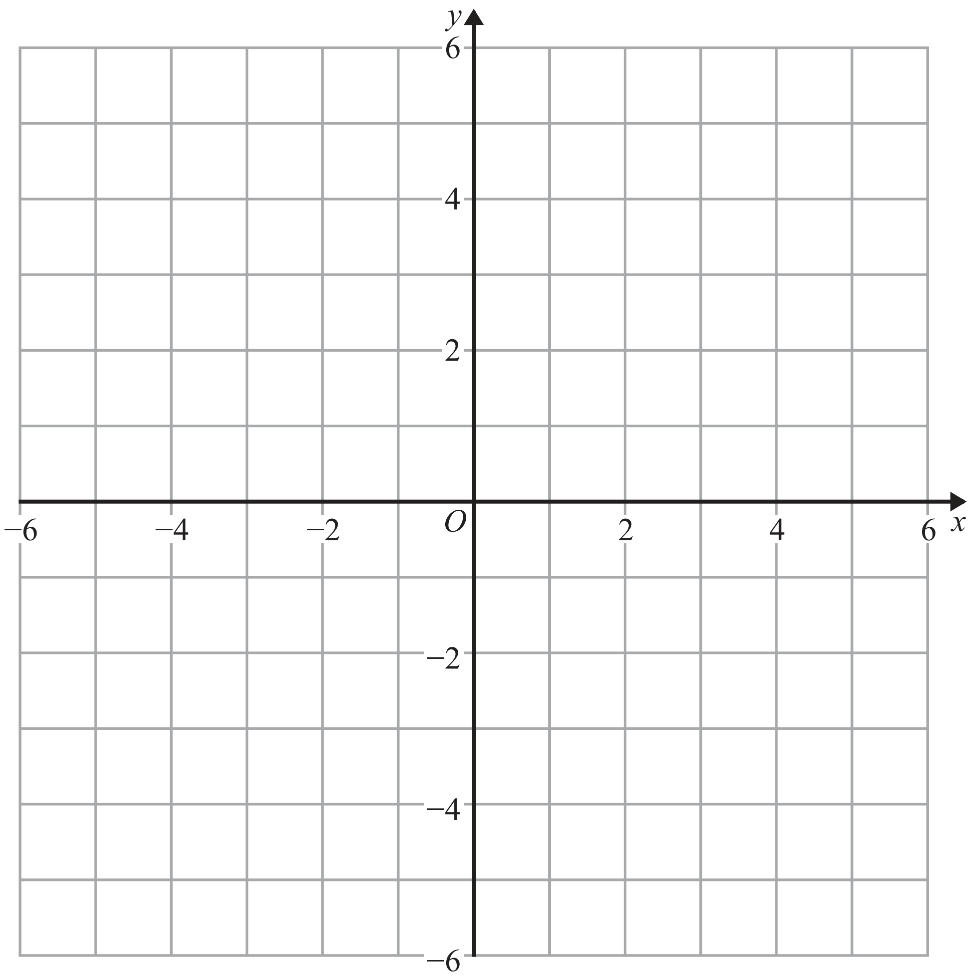
(2)

(b) Show, by shading on the grid, the region R defined by the inequalities

$y \leqslant x$ $5x + 2y \leqslant 10$ $y \geqslant -2$ $x \geqslant 1$

Label the region R.

(2)



....

....

....

....

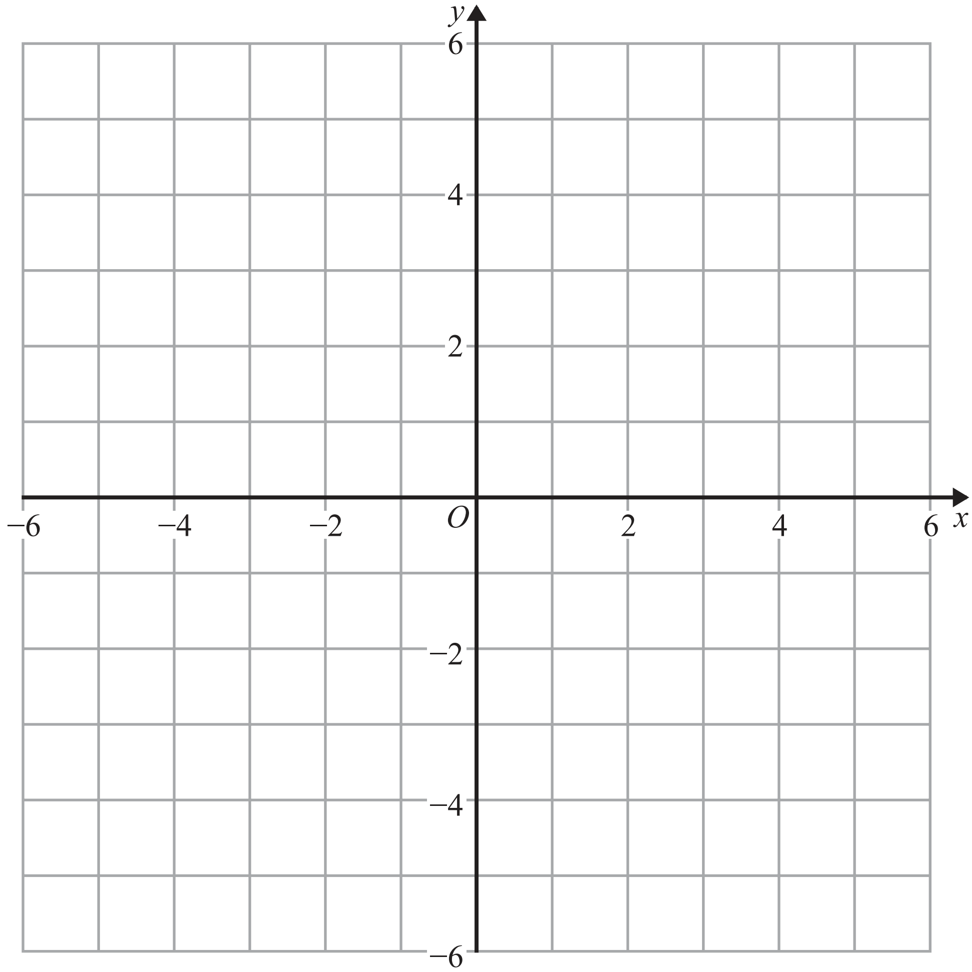
....

....

....

Question 2 continued

Only use this grid if you need to redraw your graph.



(Total for Question 2 is 4 marks)

Turn over ▶

3 Given that $(x - 4)$ is a factor of $px^3 - 31x^2 + 25x + 12$ where p is a constant,

(a) show that $p = 6$

(2)

(b) Solve the equation $6x^3 - 31x^2 + 25x + 12 = 0$

Show clear algebraic working.

(4)

Question 3 continued

(Total for Question 3 is 6 marks)

4

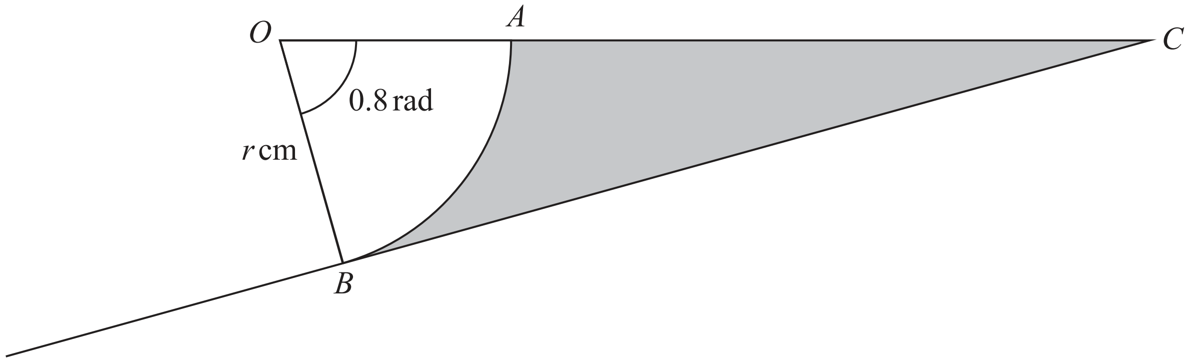


Figure 1

Figure 1 shows a sector AOB of a circle with centre O and radius r cm and a triangle BOC.
The angle of sector AOB is 0.8 radians.
The points O, A and C lie on a straight line so that CB is the tangent to the circle at B.

Given that the area of the shaded region in Figure 1 is 101 cm^2, find the value of r.
Give your answer correct to 3 significant figures.

(6)

Question 4 continued

(Total for Question 4 is 6 marks)

5

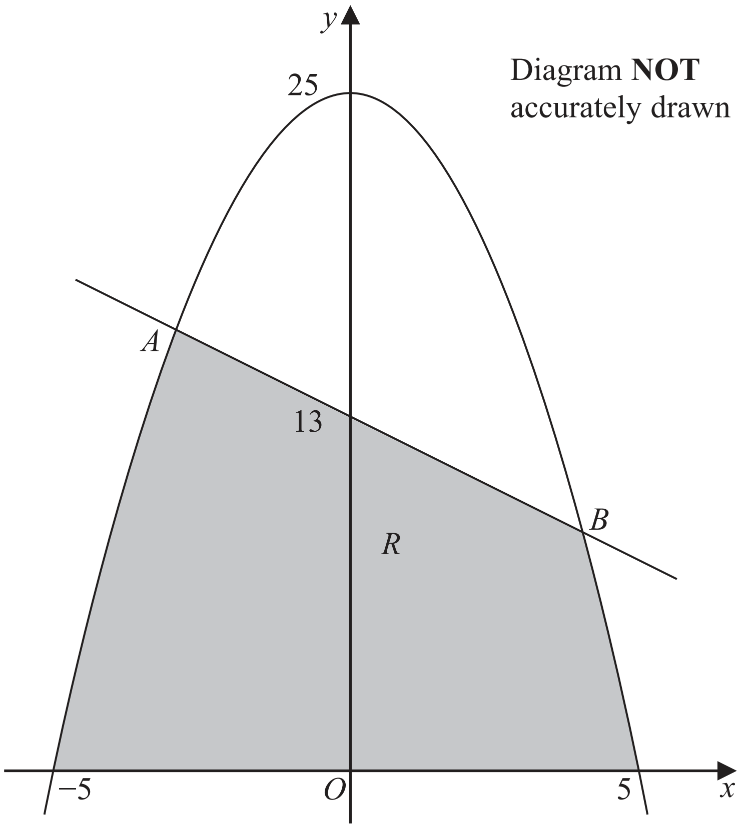


Figure 2

Figure 2 shows part of the curve with equation $y = 25 - x^2$ and part of the line with equation $y + x = 13$

The curve and the line intersect at the points A and B.

(a) Use algebra to find the coordinates of A and the coordinates of B.

(4)

The region R, shown shaded in Figure 2, is bounded by the curve, the straight line and the x-axis.

(b) Use algebraic integration to find the area of R.

(7)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

Question 5 continued

P 5 9 9 3 8 A 0 1 3 3 6

Question 5 continued

Question 5 continued

(Total for Question 5 is 11 marks)

6 The point A has coordinates (3, 0) and the point B has coordinates (2, 2).
The line L_1 passes through B and is perpendicular to AB.

(a) Find an equation of L_1

Give your answer in the form $ax + by + c = 0$

(5)

The line L_2 with equation $x - 7y - 3 = 0$ intersects the line L_1 at the point C.
The midpoint of AC is M.

(b) Find the coordinates of M.

(5)

(c) Find the area of the triangle ABM.

(4)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 6 continued

Question 6 continued

Question 6 continued

(Total for Question 6 is 14 marks)

7 Solve the equation

$$\log_7 (8x^2 - 6x + 3) - \log_{49} x^2 = 3\log_7 2$$

(5)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

Question 7 continued

(Total for Question 7 is 5 marks)

8 (a) Solve, to the nearest integer, the equation

$$\sin(2x - 75)^\circ = -0.515 \qquad \text{for } 0 \leqslant x < 180$$

(3)

(b) Giving your solutions to one decimal place, where appropriate, solve the equation

$$2\tan y^\circ + 5\sin y^\circ = 0 \qquad \text{for } 0 \leqslant y \leqslant 180$$

(4)

(c) Explain mathematically why there are no values of θ that satisfy the equation

$$3\cos^2\theta^\circ - 3\sin^2\theta^\circ + \sin\theta^\circ + 12 = 0$$

(4)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

Question 8 continued

P 5 9 9 3 8 A 0 2 3 3 6

Question 8 continued

Question 8 continued

(Total for Question 8 is 11 marks)

9 (a) Expand $\sqrt{1-4x}$ in ascending powers of x up to and including the term in x^3, giving each coefficient as an integer.

(3)

(b) Use your expansion with a suitable value for x to obtain an estimate of $\sqrt{0.76}$
Give your answer correct to 4 decimal places.

(3)

(c) Hence find, to 3 decimal places, an estimate of $\sqrt{19}$

(2)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 9 continued

Question 9 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 9 continued

(Total for Question 9 is 8 marks)

P 5 9 9 3 8 A 0 2 9 3 6

10

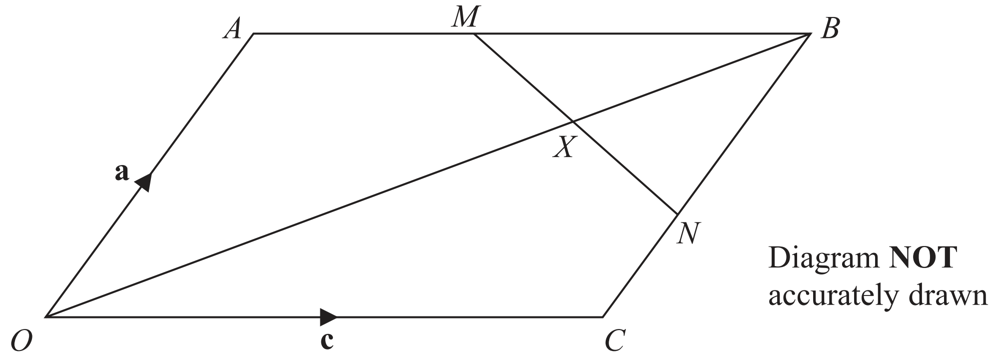


Figure 3

Figure 3 shows the parallelogram *OABC*

$$\overrightarrow{OA} = \mathbf{a} \qquad \overrightarrow{OC} = \mathbf{c}$$

The midpoint of *AB* is *M* and the midpoint of *BC* is *N*.

The line *OB* intersects *MN* at the point *X*.

(a) Find in terms of **a** and **c**,

(i) $\overrightarrow{OB}$

(ii) $\overrightarrow{MN}$

(2)

Given $\overrightarrow{MX} = \lambda\overrightarrow{MN}$ and that $\overrightarrow{OX} = \mu\overrightarrow{OB}$,

(b) use a vector method to find the value of λ and the value of μ.

(8)

(c) Hence find, in its simplest form, the ratio

Area of quadrilateral *OXNC* : Area of parallelogram *OABC*.

(3)

Question 10 continued

Question 10 continued

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

Question 10 continued

(Total for Question 10 is 13 marks)

P 5 9 9 3 8 A 0 3 3 3 6

11

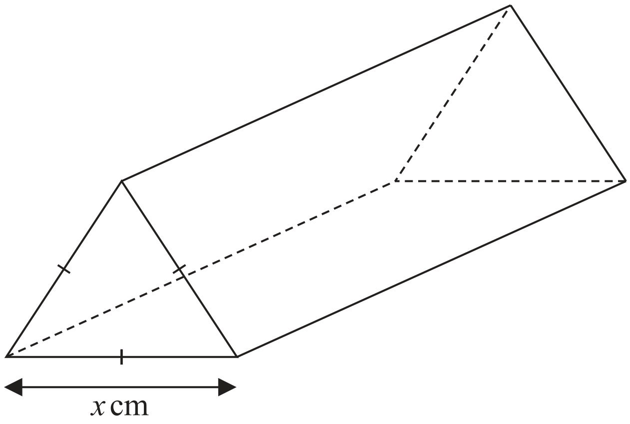


Figure 4

A company manufactures chocolate bars that are inside packaging that is in the shape of a right triangular prism.

The cross section of the prism is an equilateral triangle with sides of length x cm, as shown in Figure 4.

The volume of the prism is $72\,\text{cm}^3$

The total surface area of the prism is $S\,\text{cm}^2$

(a) Show that

$$S = \frac{\sqrt{3}x^2}{2} + \frac{288\sqrt{3}}{x}$$

(6)

Given that x can vary,

(b) use calculus to find, to 4 significant figures, the value of x for which S is a minimum, justifying that this value gives a minimum value of S.

(5)

(c) Find, to 3 significant figures, the minimum value of S.

(2)

Question 11 continued

Turn over

Question 11 continued

(Total for Question 11 is 13 marks)

TOTAL FOR PAPER IS 100 MARKS