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 ▶

1/1/1/1/

P 5 9 9 3 8 A 0 1 3 6

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

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

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

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

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

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

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

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

Logarithms

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

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) $y = x$

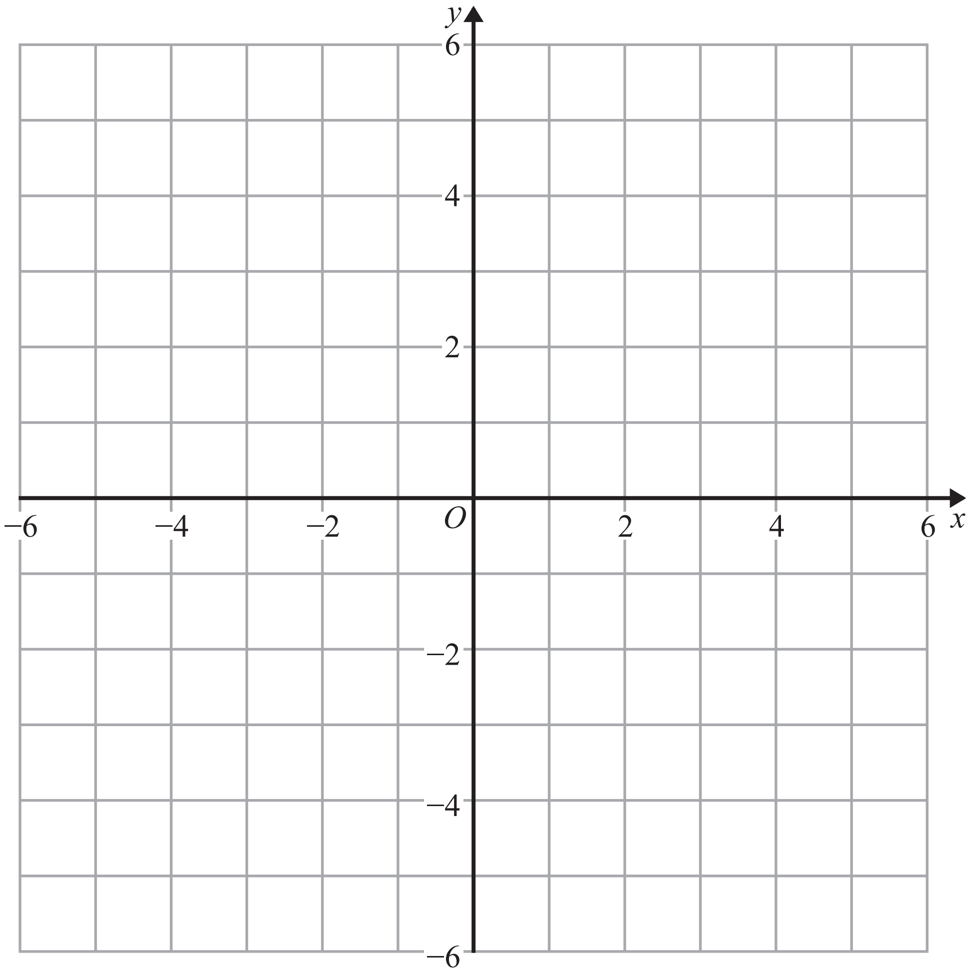
(2)

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

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

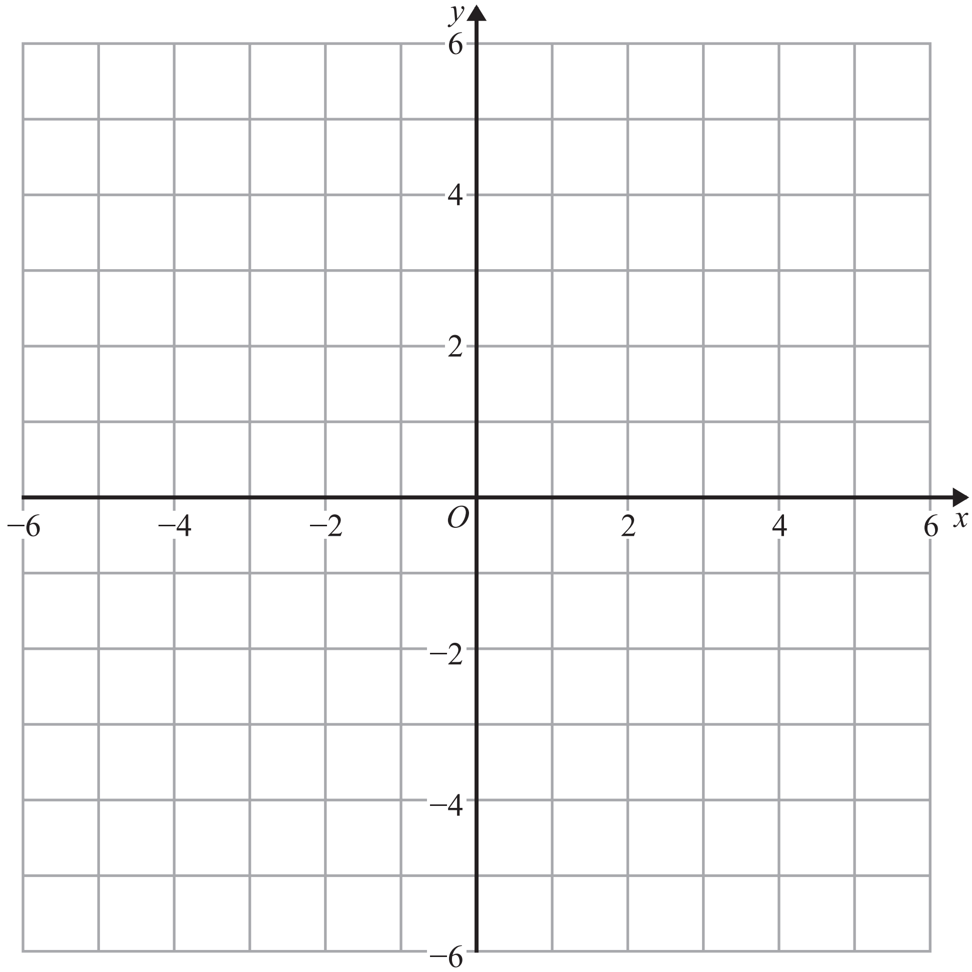
Label the region R.

(2)



Question 2 continued

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



(Total for Question 2 is 4 marks)

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

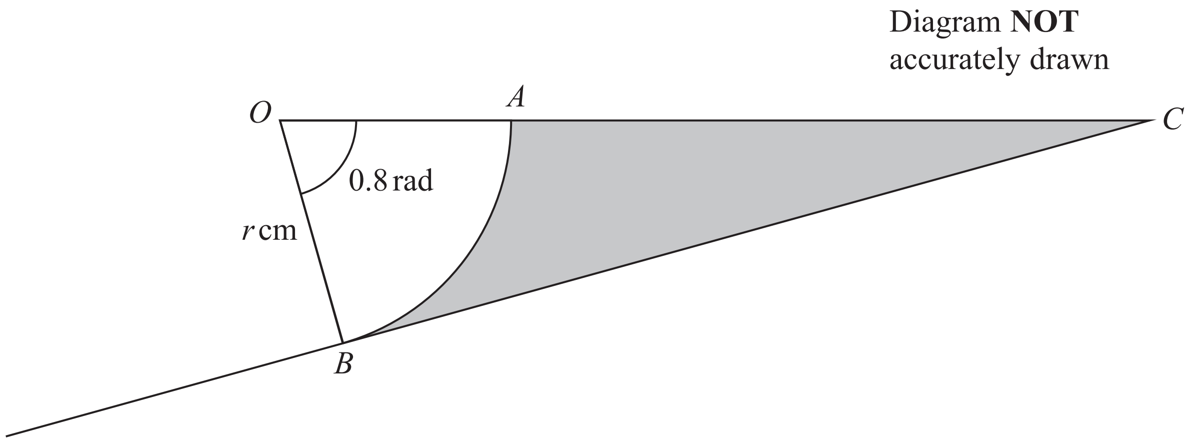


Figure 1

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)

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Question 4 continued

(Total for Question 4 is 6 marks)

5

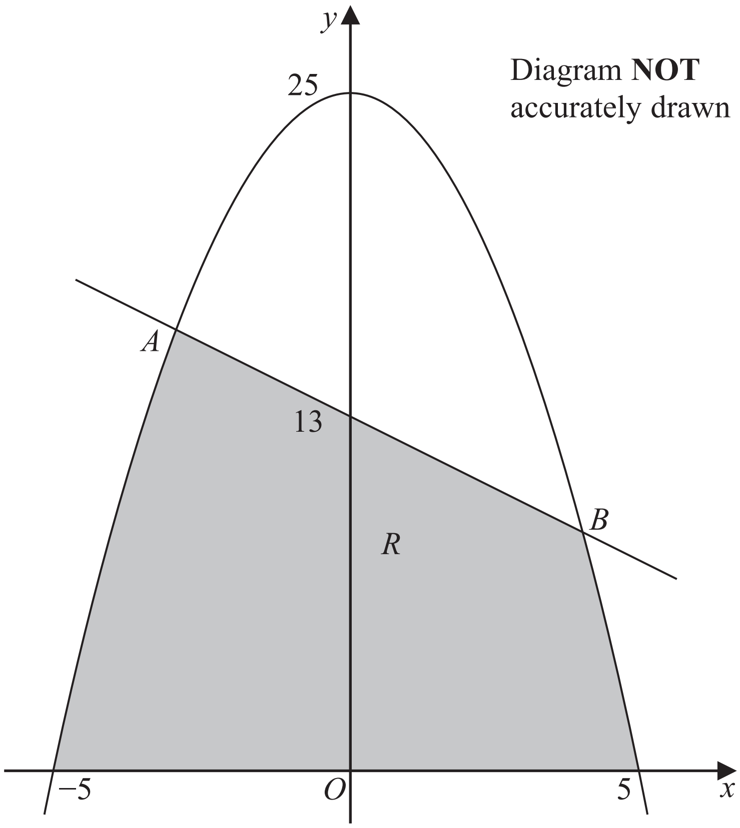

Figure 2

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)

Question 5 continued

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)

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Question 6 continued

P 5 9 9 3 8 A 0 1 7 3 6

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)

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)

Question 8 continued

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)

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Question 9 continued

Question 9 continued

Question 9 continued

(Total for Question 9 is 8 marks)

10

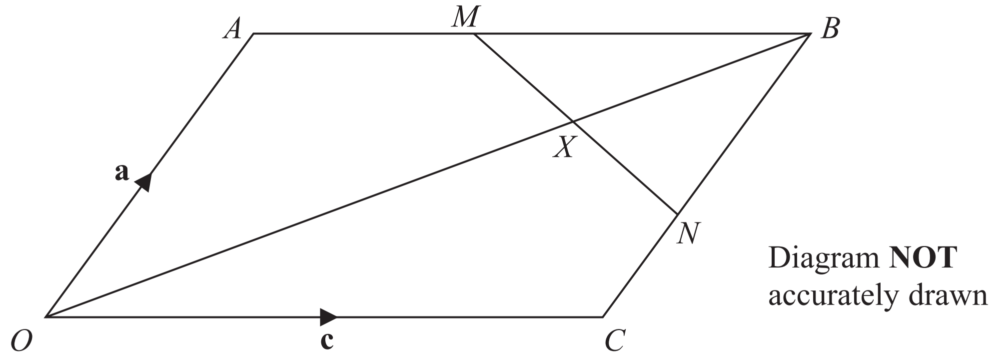

Figure 3

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

Question 10 continued

(Total for Question 10 is 13 marks)

11

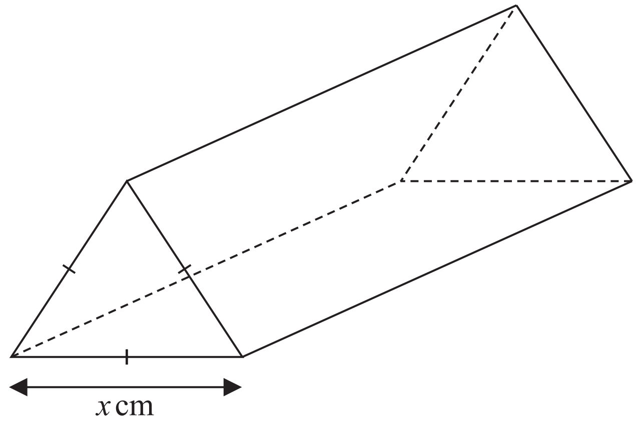

Diagram **NOT** accurately drawn

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

Question 11 continued

(Total for Question 11 is 13 marks)

TOTAL FOR PAPER IS 100 MARKS