Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International GCSE

Centre Number | Candidate Number

Thursday 19 November 2020

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

Further Pure Mathematics

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 ▶

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P 6 2 2 8 0 A 0 1 3 2

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 Differentiate with respect to x

$$6e^{3x^2}\cos 2x$$

(3)

(Total for Question 1 is 3 marks)

2 (a) Using the axes below sketch the line with equation

(i) $y = 6$ (ii) $y + x = 10$ (iii) $y = 2x - 5$

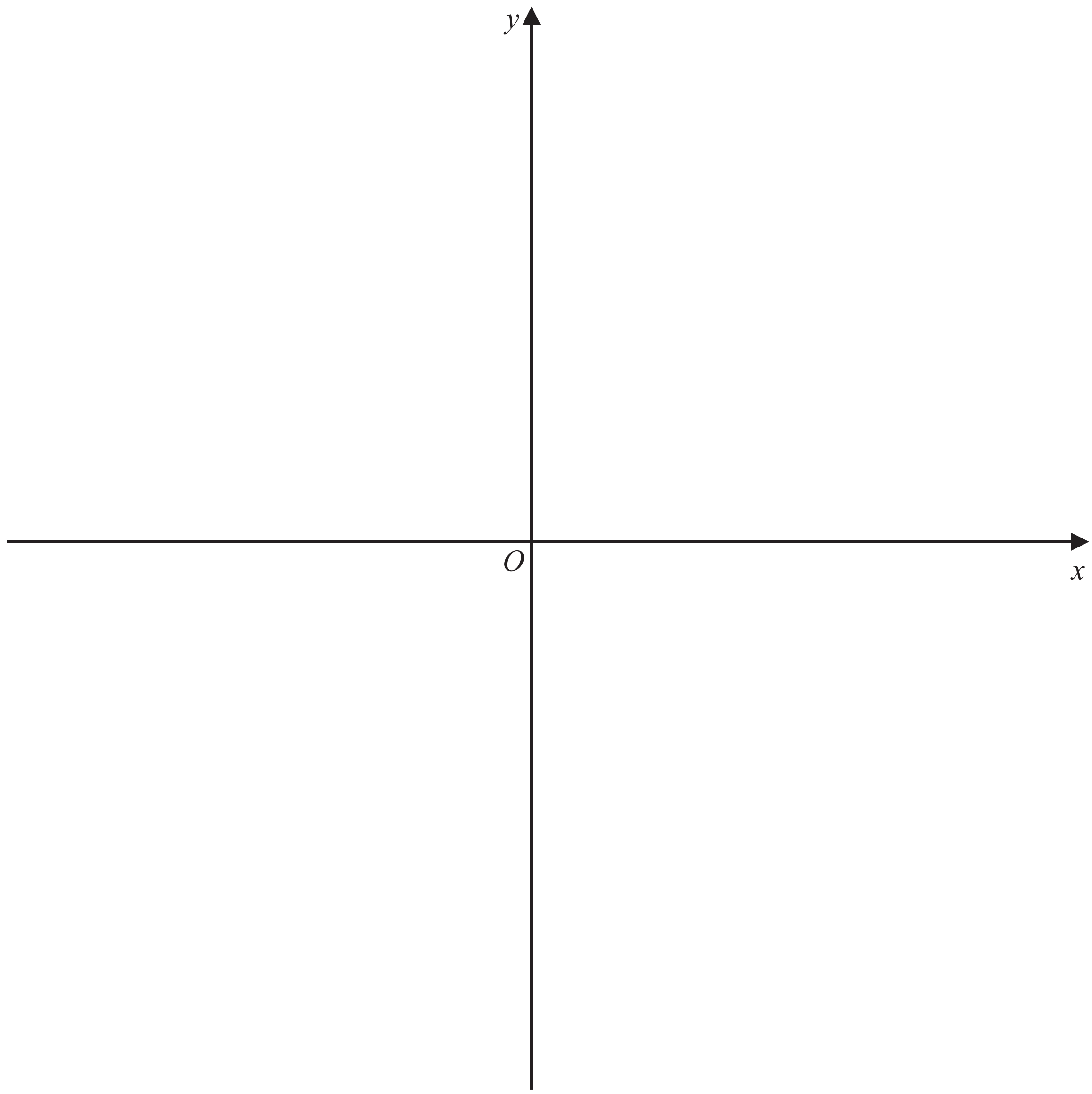
Show the coordinates of any point where each line crosses the coordinate axes.

(3)

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

$y \leqslant 6$ $y + x \leqslant 10$ $y \geqslant 2x - 5$ $x \geqslant 0$

(1)



Question 2 continued

(Total for Question 2 is 4 marks)

3

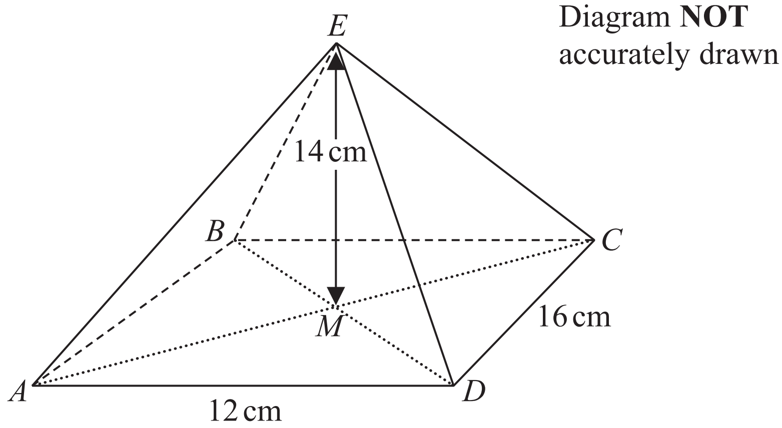


Figure 1

Figure 1 shows the right pyramid $ABCDE$. The base, $ABCD$, of the pyramid is a horizontal rectangle with $AD = 12$ cm and $CD = 16$ cm. The height ME of the pyramid is 14 cm where M is the point of intersection of the diagonals of the base.

The sloping edges, EA, EB, EC and ED of the pyramid are all of equal length.

(a) Calculate, to 3 significant figures, the length of a sloping edge.

(3)

Calculate, in degrees to one decimal place, the size of

(b) the angle between AE and the base,

(3)

(c) the angle between the plane AED and the base.

(3)

Question 3 continued

(Total for Question 3 is 9 marks)

4

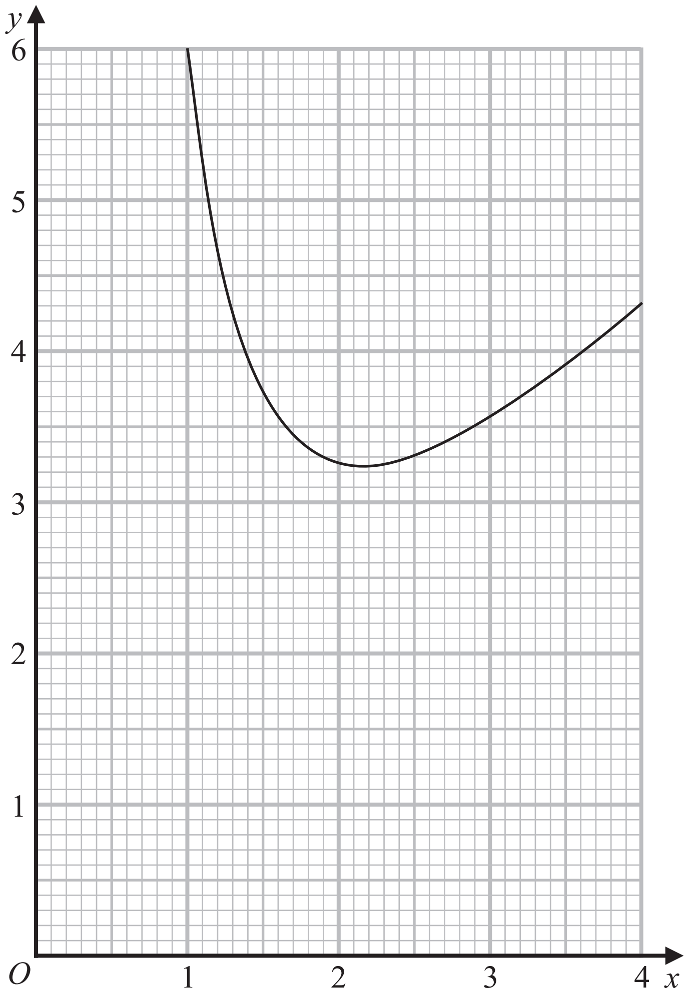


Figure 2

Figure 2 shows the graph of $y = x + \dfrac{5}{x^2}$ for $1 \leqslant x \leqslant 4$ drawn on a grid.

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

$$x^3 - 4x^2 + 5 = 0$$

in the interval $1 \leqslant x \leqslant 4$

(3)

(b) By drawing a suitable straight line on the grid, obtain an estimate, to one decimal place, for the root of the equation

$$x^3 - x^2 - 5 = 0$$

in the interval $1 \leqslant x \leqslant 4$

(4)

Question 4 continued

(Total for Question 4 is 7 marks)

5 The points P, Q, R and S have coordinates (4, 7), (3, 0), (10, 1) and (11, 8) respectively.

(a) Show, by calculation, that the lines PR and QS are perpendicular.

(3)

(b) Find the exact lengths of (i) PR (ii) QS

(2)

(c) Find the area of the quadrilateral $PQRS$

(2)

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Question 5 continued

(Total for Question 5 is 7 marks)

6 An arithmetic series A has first term a and common difference d.

The sum S_n of the first n terms of A is given by $S_n = n(15 + 2n)$

(a) Find the value of a and the value of d.

(4)

(b) Find the 20th term of A.

(2)

Given that $S_{2p} - 2S_p = 1 + S_{(p-1)}$

(c) find the value of p.

(4)

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Question 6 continued

(Total for Question 6 is 10 marks)

P 6 2 2 8 0 A 0 1 3 3 2

7

$$f(x) = x^2 - 9x + 14$$

Given that $f(x)$ can be written in the form $(x + a)^2 + b$, where a and b are constants,

(a) find the value of a and the value of b.

(2)

(b) Hence, or otherwise, find

(i) the minimum value of $f(x)$

(ii) the value of x for which this minimum occurs.

(2)

The curve C has equation $y = f(x)$

The line l has equation $y = x + 5$

(c) Use algebra to find the coordinates of the points of intersection of C and l.

(4)

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

(5)

Question 7 continued

Question 7 continued

Question 7 continued

(Total for Question 7 is 13 marks)

8 Given that $2xy + 5y = e^x$

(a) show that $\dfrac{dy}{dx} = \dfrac{y(2x+3)}{2x+5}$

(5)

(b) find the value of $\dfrac{dy}{dx}$ when $x = 0$

(2)

(c) find an equation of the normal to the curve with equation $2xy + 5y = e^x$ at the point where $x = 0$
Give your answer in the form $px + qy + r = 0$ where p, q and r are integers.

(3)

Question 8 continued

Question 8 continued

Question 8 continued

(Total for Question 8 is 10 marks)

9

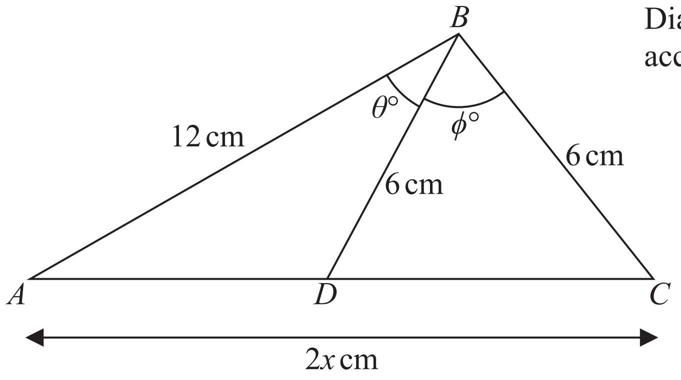

Diagram **NOT** accurately drawn

Figure 3

Figure 3 shows triangle ABC with $AB = 12$ cm, $BC = 6$ cm and $AC = 2x$ cm.

The point D is the midpoint of AC and $BD = 6$ cm.

$\angle ABD = \theta°$ and $\angle DBC = \phi°$ where $\theta \neq 0$ and $\phi \neq 0$

(a) Show that $\cos ADB = \dfrac{x^2 - 108}{12x}$

(2)

(b) Hence, or otherwise, show that $AC = 6\sqrt{6}$ cm.

(4)

(c) Show that $\sin(\theta° + \phi°) = \sin\phi°$

(4)

(d) Hence show that $\theta = 180 - 2\phi$

(2)

Question 9 continued

Question 9 continued

Question 9 continued

(Total for Question 9 is 12 marks)

10

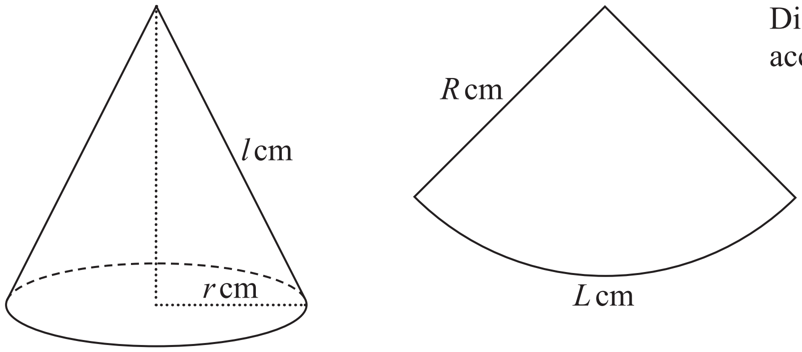

Figure 4

Figure 4 shows a right circular cone with base radius r cm and slant height l cm.
Figure 4 also shows a sector of a circle with radius R cm and arc length L cm.

The area of the curved surface of the cone is A cm^2

By considering how the sector of the circle can be folded to exactly form the curved surface of the cone with R and L suitably chosen,

(a) prove that $A = \pi rl$

(4)

Sand is poured onto a horizontal surface at a constant rate of 1.5 cm^3/s.
The sand forms a pile in the shape of a right circular cone with its base on the surface.
The curved surface area of the cone, A cm^2, increases in such a way that the height of the cone is always three times the radius of the base of the cone.

Given that $\dfrac{\mathrm{d}A}{\mathrm{d}r} = k\pi r$, where k is a constant,

(b) find the exact value of k.

(3)

(c) Calculate the rate, in cm^2/s, to 3 significant figures, at which the curved surface area of the pile is increasing when the height of the pile is 24 cm.

(5)

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Question 10 continued

Question 10 continued

Question 10 continued

(Total for Question 10 is 12 marks)

11

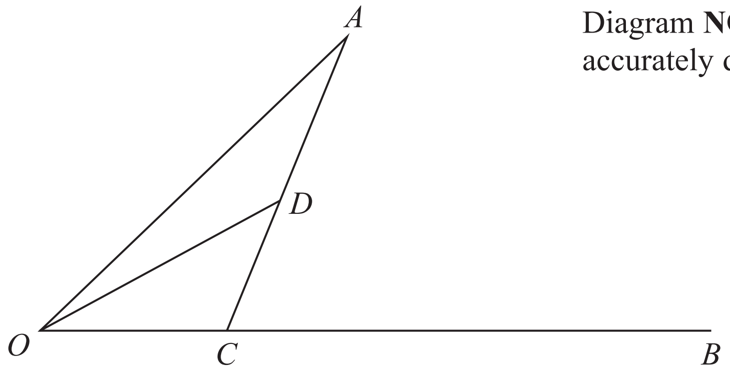

Diagram **NOT** accurately drawn

Figure 5

In Figure 5, $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$

The point C divides OB in the ratio $1:3$
The point D is the midpoint of AC

(a) Find, as a simplified expression in terms of **a** and **b**

(i) $\overrightarrow{AC}$ (ii) $\overrightarrow{OD}$ (iii) $\overrightarrow{BD}$

(5)

The point E is such that $\overrightarrow{OE} = \lambda\overrightarrow{OA}$

Given that E, D and B are collinear

(b) find the value of λ

(4)

Given that $\dfrac{\text{area } \Delta OAC}{\text{area } \Delta OEB} = \mu$

(c) find the value of μ

(4)

Question 11 continued

Question 11 continued

(Total for Question 11 is 13 marks)

TOTAL FOR PAPER IS 100 MARKS