


Please check the examination details below before entering your candidate information

Candidate surname					Other names						
Pearson Edexcel International GCSE		Centre Number					Candidate Number				
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<h1>Monday 15 June 2020</h1>											
Afternoon (Time: 2 hours)					Paper Reference 4PM1/01						
<h2>Further Pure Mathematics</h2> <h3>Paper 1</h3>											
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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Pearson

International GCSE in Further Pure Mathematics Formulae sheet

Mensuration**Surface area of sphere** $= 4\pi r^2$ **Curved surface area of cone** $= \pi r \times \text{slant height}$ **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**

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

Calculus**Quotient rule (differentiation)**

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

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

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

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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)



P 6 2 2 8 0 A 0 3 3 2

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

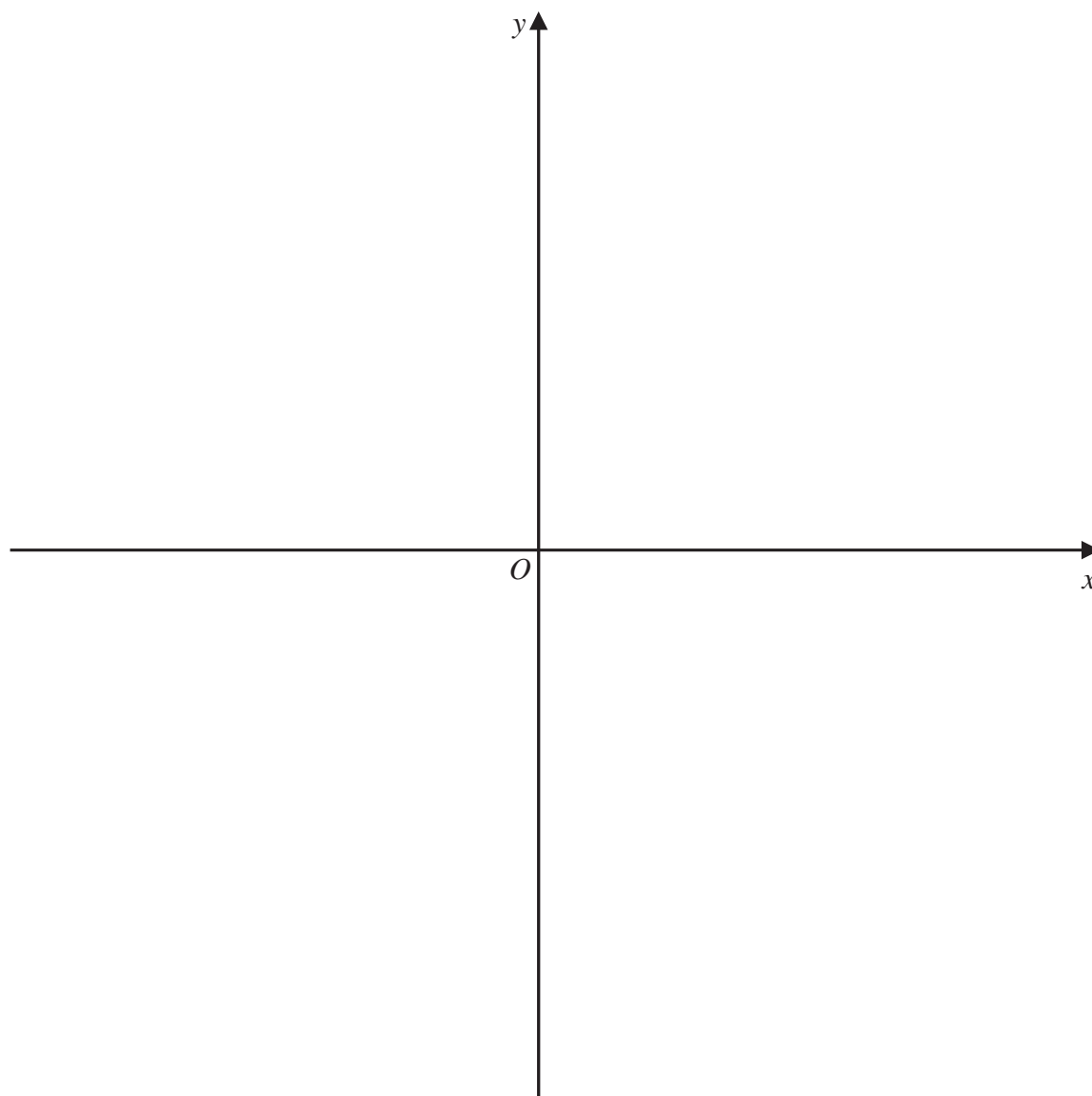
$y \leq 6$

$y + x \leq 10$

$y \geq 2x - 5$

$x \geq 0$

(1)



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Question 2 continued

Handwriting practice area with horizontal dotted lines.

(Total for Question 2 is 4 marks)



3

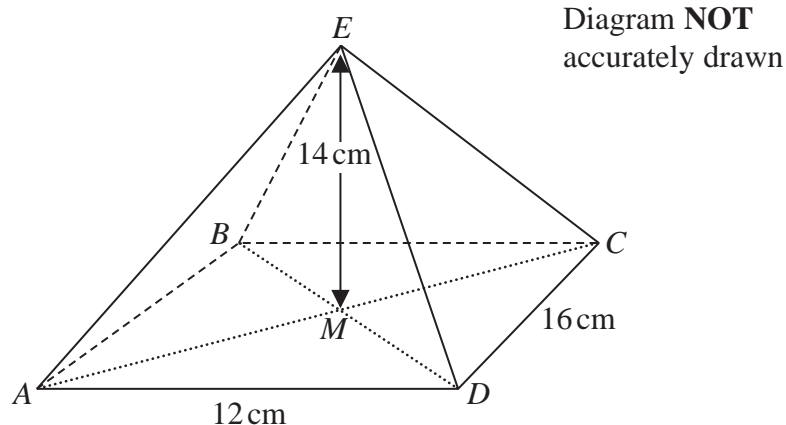
**Figure 1**

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)

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Question 3 continued

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(Total for Question 3 is 9 marks)



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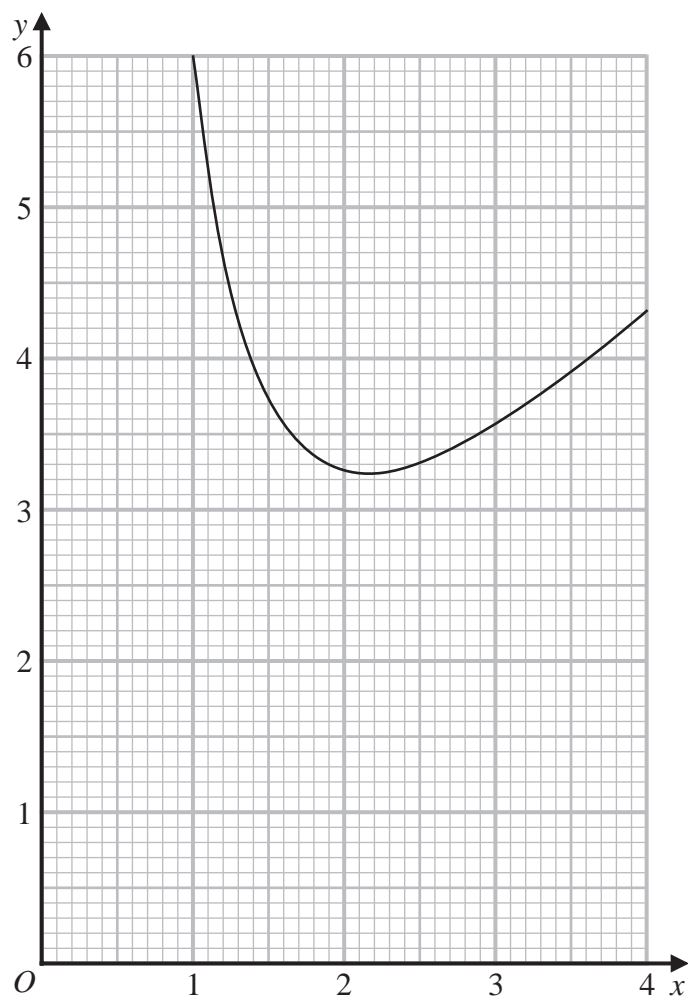


Figure 2

Figure 2 shows the graph of $y = x + \frac{5}{x^2}$ for $1 \leq x \leq 4$ 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 $1 \leq x \leq 4$

(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 $1 \leq x \leq 4$

(4)

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Question 4 continued

Handwriting practice area with horizontal dotted lines.

(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

Handwriting practice area with horizontal dotted lines.

(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

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(Total for Question 6 is 10 marks)

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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)

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Question 7 continued

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Question 7 continued

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Question 7 continued

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(Total for Question 7 is 13 marks)

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

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

(5)

(b) find the value of $\frac{dy}{dx}$ 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)

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Question 8 continued

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Question 8 continued

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Question 8 continued

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(Total for Question 8 is 10 marks)

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9

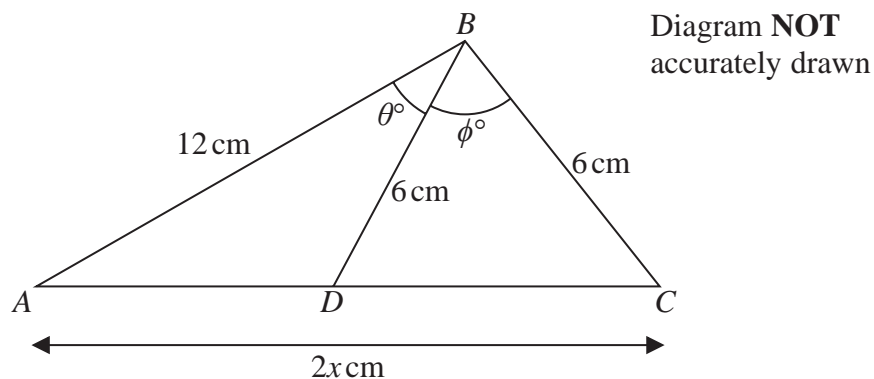


Figure 3

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.

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

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

(b) Hence, or otherwise, show that $AC = 6\sqrt{6}$ cm. (4)

(c) Show that $\sin(\theta^\circ + \phi^\circ) = \sin \phi^\circ$ (4)

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



Question 9 continued

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Question 9 continued

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Question 9 continued

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(Total for Question 9 is 12 marks)

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10

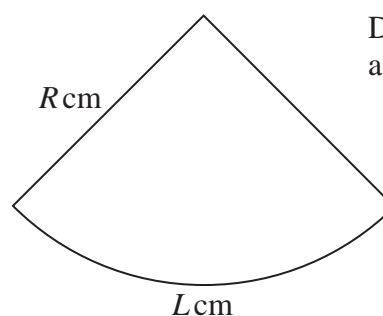
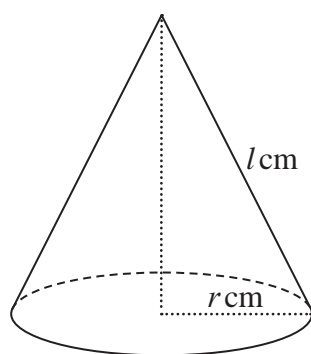
Diagram **NOT**
accurately drawn**Figure 4**

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

The area of the curved surface of the cone is $A\text{ cm}^2$

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 $A = \pi r l$

(4)

Sand is poured onto a horizontal surface at a constant rate of $1.5\text{ cm}^3/\text{s}$.

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, $A\text{ cm}^2$, 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 $\frac{dA}{dr} = k\pi r$, 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

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Question 10 continued

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Question 10 continued

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(Total for Question 10 is 12 marks)

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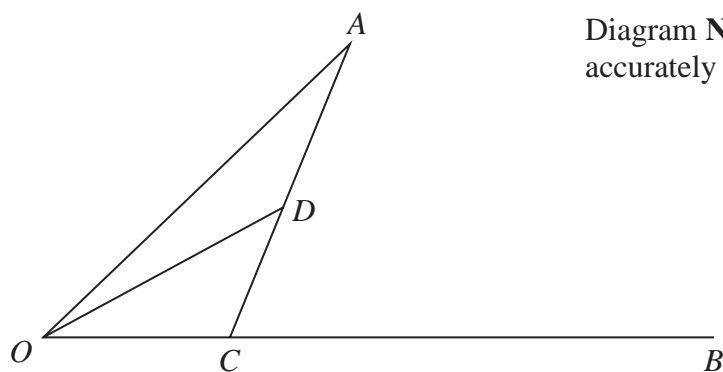
Diagram **NOT**
accurately drawn

Figure 5

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

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 \mathbf{a} and \mathbf{b}

(i) \vec{AC}

(ii) \vec{OD}

(iii) \vec{BD}

(5)

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

Given that E , D and B are collinear

(b) find the value of λ

(4)

Given that $\frac{\text{area } \triangle OAC}{\text{area } \triangle OEB} = \mu$

(c) find the value of μ

(4)

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Question 11 continued

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Question 11 continued

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(Total for Question 11 is 13 marks)**TOTAL FOR PAPER IS 100 MARKS**