

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				

Pearson Edexcel International GCSE

Time 2 hours Paper reference **4PM1/02R**

Further Pure Mathematics
PAPER 2R



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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Q:1/1/1/1/




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

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

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

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

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

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

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

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

Logarithms

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

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Question 1 continued

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(Total for Question 1 is 5 marks)

- 2 When poured from a pipe, concrete is formed into the shape of a cuboid with a square base of side x and with a height of $3x$

The volume of the cuboid increases at a constant rate of $8 \text{ m}^3/\text{s}$

Find the rate of increase, in m/s , of x when $x = 2$ metres.

(6)

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Question 2 continued

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(Total for Question 2 is 6 marks)

3 A geometric series has first term a and common ratio r , where $r > 0$

Given that the 3rd term of the series is 5 and that the 5th term of the series is $\frac{5}{2}$

(a) find

(i) the exact value of r

(ii) the value of a

(4)

(b) Find the sum to infinity of this series.

Give your answer in the form $p + q\sqrt{2}$ where p and q are integers.

(2)

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Question 3 continued

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(Total for Question 3 is 6 marks)

4

$$f(x) = x^3 + px^2 + qx + 7 \quad \text{where } p \text{ and } q \text{ are integers.}$$

$(x + 1)$ is a factor of $f(x)$

The remainder when $f(x)$ is divided by $(x + 2)$ is -5

(a) Find the value of p and the value of q

(5)

(b) Hence, show that $f(x) = 0$ has only one real root.

(3)

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Question 4 continued

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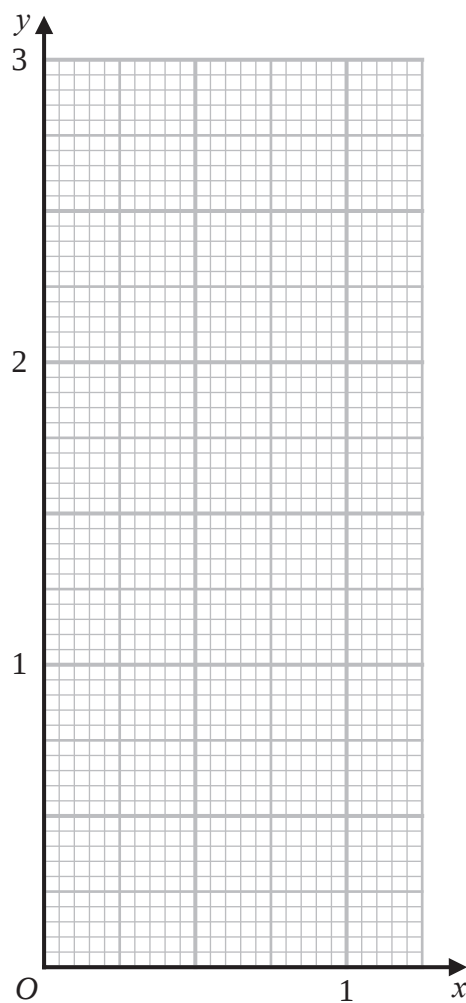
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(Total for Question 4 is 8 marks)

- (3)

Question 5 continued



Turn over for a spare grid if you need to redraw your graph.



Question 5 continued

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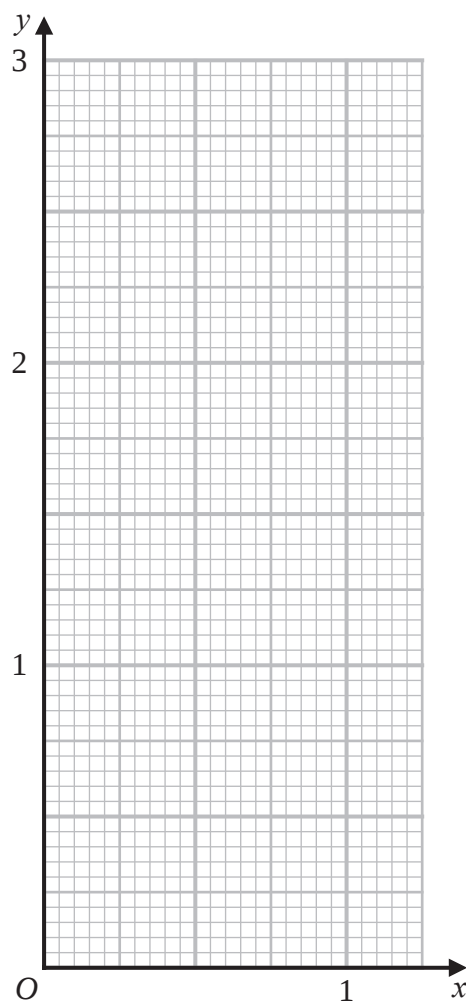
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Question 5 continued

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(Total for Question 5 is 7 marks)



6

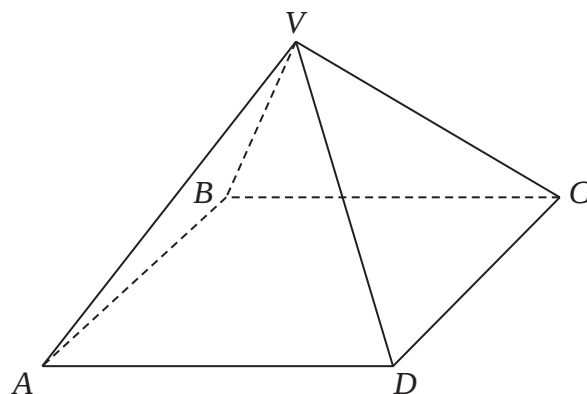


Diagram **NOT**
accurately drawn

Figure 1

Figure 1 shows a right pyramid $VABCD$ with vertex V and square base $ABCD$.

Each of the edges of the pyramid has the same length.

Find the size, in degrees to one decimal place, of the angle between the plane CVD and the base $ABCD$.

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Question 6 continued

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(Total for Question 6 is 6 marks)

Question 7 continued

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Question 7 continued

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Question 7 continued

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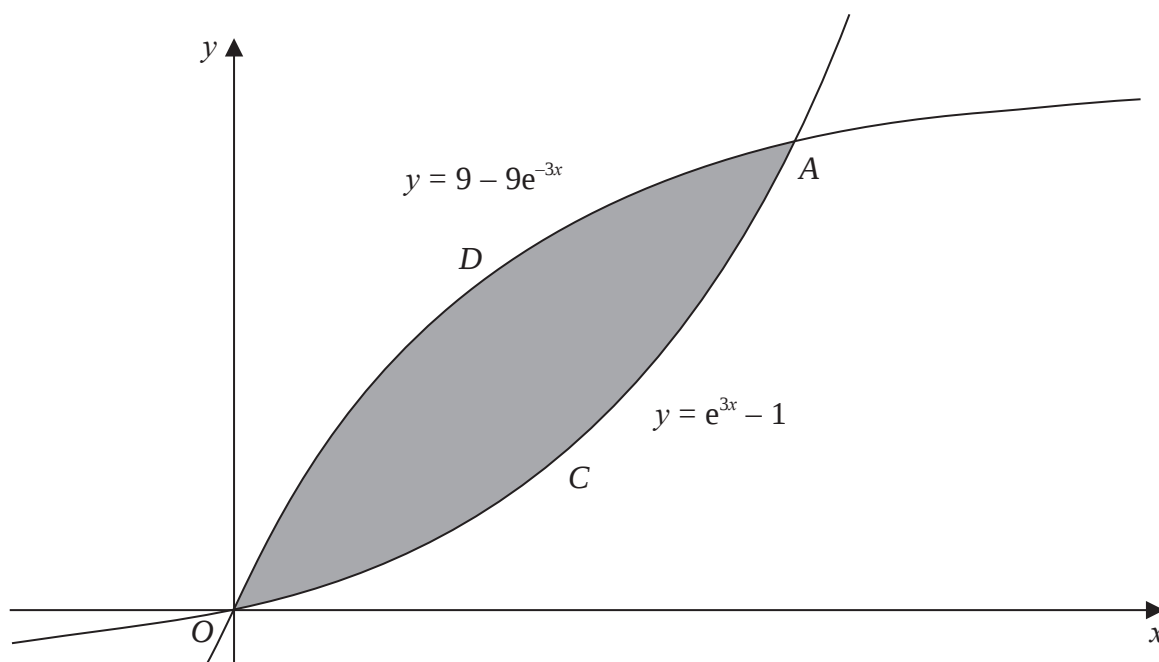


Figure 2

Figure 2 shows part of the curve C with equation $y = e^{3x} - 1$ and part of the curve D with equation $y = 9 - 9e^{-3x}$.

The curves intersect at the origin O and the point A .

- (a) (i) Show that the x coordinate of the point A satisfies the equation

$$(e^{3x})^2 - 10e^{3x} + 9 = 0$$

- (ii) Hence, show that the x coordinate of the point A is $\frac{1}{3} \ln 9$

(5)

The finite region bounded by C and by D is shown shaded in Figure 2.

- (b) Use calculus to find the exact area of this region.

(6)

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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 11 marks)

Question 9 continued

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Question 9 continued

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Question 9 continued

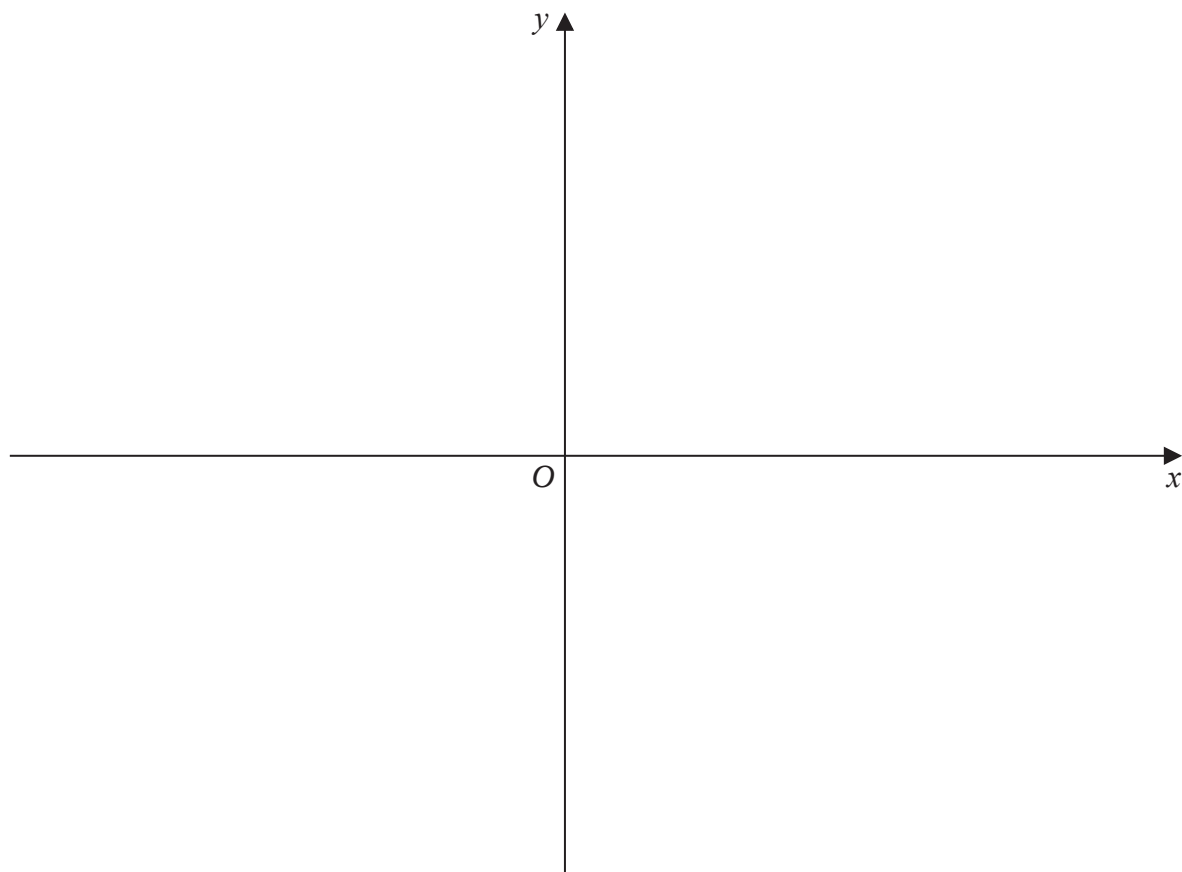
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(Total for Question 9 is 9 marks)

Question 10 continued



Below the coordinate system, there are 15 horizontal dotted lines for writing the answer.

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Question 10 continued

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Question 10 continued

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(Total for Question 10 is 18 marks)

11

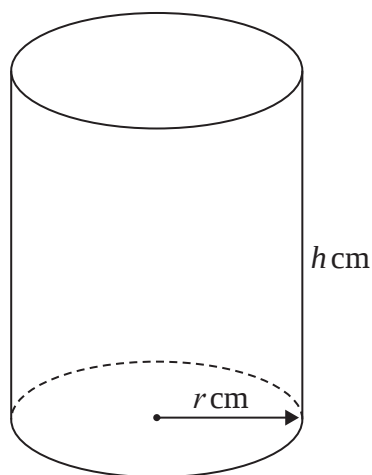
Diagram **NOT**
accurately drawn**Figure 3**

Figure 3 shows a solid metal right circular cylinder of radius r cm and height h cm.

The total surface area of the cylinder is 600 cm^2

The volume of the cylinder is $V\text{ cm}^3$

- (a) Show that $V = 300r - \pi r^3$ (4)

Given that r can vary,

- (b) (i) use calculus to show that the exact value of r for which V is a maximum is

$$r = \sqrt{\frac{100}{\pi}}$$

- (ii) justify that this value of r gives a maximum value of V (5)

The cylinder is melted down and reformed into a sphere of radius p cm.

- (c) Find, to one decimal place, the greatest possible value of p (3)

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Question 11 continued

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Question 11 continued

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(Total for Question 11 is 12 marks)**TOTAL FOR PAPER IS 100 MARKS**