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Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE

Tuesday 21 May 2024

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

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

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

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

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

Logarithms

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

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Answer all TEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 In triangle ABC, $AB = 2x\,\text{cm}$, $BC = 3x\,\text{cm}$ and $AC = 4x\,\text{cm}$

The area of triangle ABC is $50\ \text{cm}^2$

Find, to 2 decimal places, the value of x

(4)

(Total for Question 1 is 4 marks)

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2 $f(x) = 2x^2 + 4x + 9$

Given that $f(x)$ can be written in the form $A(x + B)^2 + C$, where A, B and C are integers,

(a) find the value of A, the value of B and the value of C

(3)

(b) Hence, or otherwise, find

(i) the value of x for which $\frac{1}{f(x)}$ is a maximum

(ii) the maximum value of $\frac{1}{f(x)}$

(2)

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Question 2 continued

(Total for Question 2 is 5 marks)

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3 (a) Show that $\sum_{r=1}^{n}(5r-3) = \frac{n}{2}(5n-1)$

(3)

(b) Hence, or otherwise, evaluate $\sum_{r=31}^{60}(5r-3)$

(2)

Given that $\sum_{r=1}^{n}(5r-3) = 3783$

(c) find the value of n

(3)

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Question 3 continued

(Total for Question 3 is 8 marks)

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4 The surface area of a sphere with radius r cm is increasing at a constant rate of 50π cm^2/s

Find, in cm^3, the exact volume of the sphere at the instant when the rate of increase of r is $\frac{5}{12}$ cm/s

(8)

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Question 4 continued

(Total for Question 4 is 8 marks)

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5 A particle P is moving along the x-axis.
At time t seconds $(t \geqslant 0)$ the acceleration, a m/s^2, of P is given by $a = 3t - 4$

When $t = 0$, P is at rest.

(a) Find the velocity of P when $t = 4$

(3)

At time T seconds, $T > 0$, P is instantaneously at rest.

(b) Find the value of T

(2)

When $t = 0$, P is at the point with coordinates $(-10, 0)$

(c) Find the displacement of P from the origin when $t = 3$

(4)

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Question 5 continued

(Total for Question 5 is 9 marks)

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6 The line l passes through the point A with coordinates $(-2, 2)$ and the point B with coordinates $(3, 12)$
The point C with coordinates (p, q) lies on l such that $AC : CB = 3 : 2$

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

(2)

The line k is perpendicular to l and passes through the point C

(b) Show that an equation of k is $2y + x - 17 = 0$

(4)

The line k crosses the x-axis at the point D

(c) Find the exact length of CD

(3)

The point X with coordinates (m, n) lies on l such that

$$\text{area of triangle } DXC = 80 \text{ units}^2$$

Given that $m > 0$

(d) find the value of m and the value of n

(7)

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Question 6 continued

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Question 6 continued

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Question 6 continued

(Total for Question 6 is 16 marks)

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7

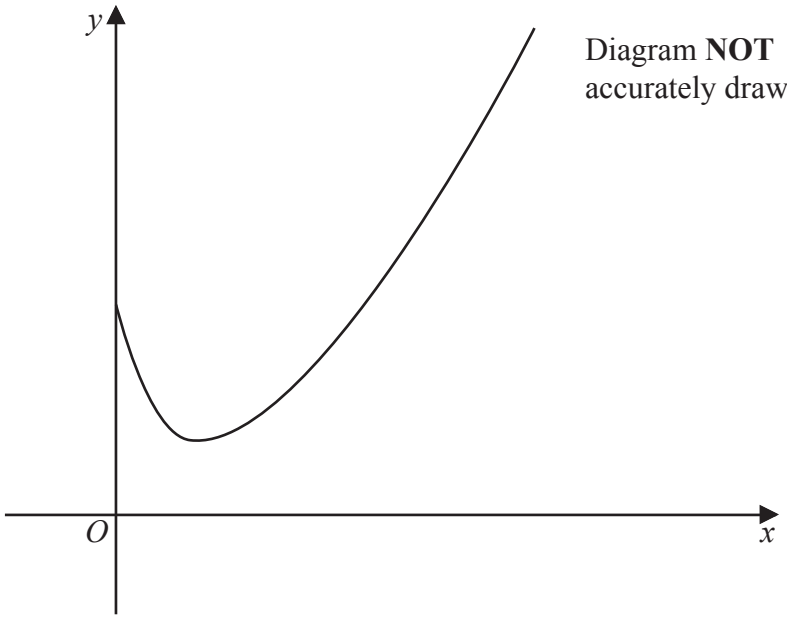

Diagram **NOT** accurately drawn

Figure 1

Figure 1 shows a sketch of part of the curve C with equation

$$y = \frac{x^2}{4} - 3\sqrt{x} + 8$$

The point P lies on C and has coordinates $(4, a)$

(a) Show that $a = 6$

(1)

The line L is the normal to C at the point P

(b) Show that an equation of L is $5y + 4x - 46 = 0$

(6)

The finite region R is bounded by the curve C, the line L, the x-axis and the line with equation $x = 1$

(c) Use calculus to find the exact area of R

(6)

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Question 7 continued

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Question 7 continued

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Question 7 continued

(Total for Question 7 is 13 marks)

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8 The sum of the first and second terms of a geometric series G is 400

The sum of the second and third terms of G is 100

(a) Show that the common ratio of G is $\frac{1}{4}$

(4)

(b) Show that the first term of G is 320

(2)

(c) Find the sum to infinity of G

(2)

The sum to n terms of G is S_n

(d) Find, using logarithms, the least value of n such that

$$S_n > 426.6$$

(4)

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Question 8 continued

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Question 8 continued

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Question 8 continued

(Total for Question 8 is 12 marks)

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9 (a) Find the value of a such that $\log_a 8 = \frac{3}{4}$

(2)

(b) Show that

$$3x\log_2 x - 4\log_{16} 8 + 6x\log_4 8 - \log_2 x = \log_2 (8x)^{3x-1}$$

(4)

(c) Hence solve the equation $3x\log_2 x - 4\log_{16} 8 + 6x\log_4 8 - \log_2 x = 0$

(3)

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Question 9 continued

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Question 9 continued

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Question 9 continued

(Total for Question 9 is 9 marks)

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10 The curve C has equation $y = \dfrac{ax - 5}{b - x}$ where a and b are integers and $x \neq b$

One intersection of C with the coordinate axes is at the point with coordinates $\left(\dfrac{5}{4}, 0\right)$

The asymptote parallel to the y-axis has equation $x = 3$

(a) Find the value of a and the value of b

(2)

(b) Sketch C, showing clearly the asymptotes with their equations and the coordinates of the points of intersection with the coordinate axes.

(5)

The straight line l with equation $4y - 7x = k$ has no points of intersection with C

(c) Show, using algebra, that the range of possible values of k can be written as

$$m < k < n$$

where m and n are integers to be found.

(9)

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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 PAPER IS 100 MARKS

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