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

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

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

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

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

Logarithms

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

Answer all 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 cm^2

Find, to 2 decimal places, the value of x

(4)

(Total for Question 1 is 4 marks)

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)

Question 2 continued

(Total for Question 2 is 5 marks)

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)

Question 3 continued

(Total for Question 3 is 8 marks)

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)

Question 4 continued

(Total for Question 4 is 8 marks)

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)

Question 5 continued

(Total for Question 5 is 9 marks)

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)

Question 6 continued

Question 6 continued

Question 6 continued

(Total for Question 6 is 16 marks)

7

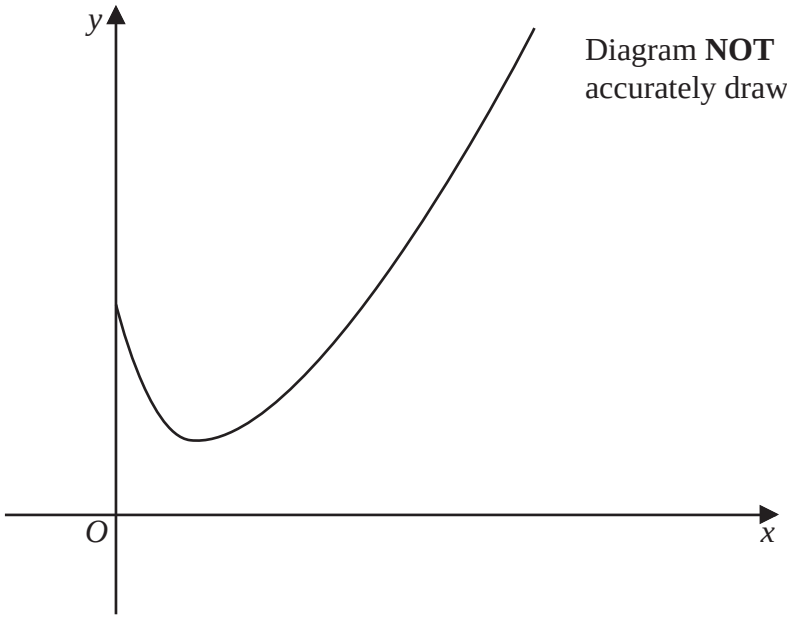

Diagram **NOT** accurately drawn

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)

Question 7 continued

Question 7 continued

Question 7 continued

(Total for Question 7 is 13 marks)

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)

Question 8 continued

Question 8 continued

Question 8 continued

(Total for Question 8 is 12 marks)

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)

Question 9 continued

Question 9 continued

Question 9 continued

(Total for Question 9 is 9 marks)

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)

Question 10 continued

Question 10 continued

Question 10 continued

Question 10 continued

(Total for Question 10 is 16 marks)

TOTAL FOR PAPER IS 100 MARKS