Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | Candidate Number

Thursday 08 October 2020

Afternoon (Time: 1 hour 30 minutes) | Paper Reference **9FM0/02**

Further Mathematics

Advanced

Paper 2: Core Pure Mathematics 2 **Shadow Set 1**

You must have:
Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for algebraic manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 7 questions in this question paper. The total mark for this paper is 75.
- 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.
- Try to answer every question.
- Check your answers if you have time at the end.

1. The curve C has equation

$$y = \frac{3}{2}\sinh 2x - 17\sinh x \qquad x \in \mathbb{R}$$

Determine, in terms of natural logarithms, the exact x coordinates of the stationary points of C.

(7)

(Total for Question 1 is 7 marks)

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2. In an Argand diagram, the points A and B are represented by the complex numbers $2 + 2\text{i}$ and $-4 - 6\text{i}$ respectively. The points A and B are the end points of a diameter of a circle C.

(*a*) Find the equation of C, giving your answer in the form

$$|z - a| = b \qquad a \in \mathbb{C},\ b \in \mathbb{R}$$

(3)

The circle D, with equation $|z - 3 + 4\text{i}| = \sqrt{5}$, intersects C at the points representing the complex numbers z_1 and z_2

(*b*) Find the complex numbers z_1 and z_2

(6)

(Total for Question 2 is 9 marks)

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3. (*a*) Find the general solution of the differential equation

$$2\frac{\mathrm{d}^2y}{\mathrm{d}t^2}+7\frac{\mathrm{d}y}{\mathrm{d}t}+3y = 3t^2 + 11t$$

(8)

(*b*) Find the particular solution of this differential equation for which $y = 1$ and $\frac{\mathrm{d}y}{\mathrm{d}t} = 1$

when $t = 0$

(5)

(*c*) For this particular solution, calculate the value of y when $t = 1$.

(1)

(Total for Question 3 is 14 marks)

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4. (*a*) Use de Moivre's theorem to prove that

$$\cos 6\theta = 32\cos^6\theta - 48\cos^4\theta + 18\cos^2\theta - 1$$

(5)

(*b*) Hence find the distinct roots of the equation

$$32x^6 - 48x^4 + 18x^2 - 2 = 0$$

(5)

(Total for Question 4 is 10 marks)

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5. (*a*) $$y = \tan^{-1} x$$

Assuming the derivative of $\tan x$, prove that

$$\frac{dy}{dx} = \frac{1}{1+x^2}$$

(3)

$$f(x) = x^3 \tan^{-1} x$$

(*b*) Show that

$$\int f(x)\,dx = A(x^4 \tan^{-1} x + Bx^3 + x - \tan^{-1} x) + k$$

where k is an arbitrary constant and A and B are constants to be determined.

(5)

(*c*) Hence find, in exact form, the mean value of $f(x)$ over the interval $\left[0, \frac{1}{\sqrt{3}}\right]$

(2)

(Total for Question 5 is 10 marks)

6.

$$\mathbf{M} = \begin{pmatrix} 6 & k & -1 \\ 1 & 1 & -1 \\ k & 2 & 1 \end{pmatrix} \quad \text{where } k \text{ is a constant}$$

(*a*) Given that $k \neq \pm 4$, find, in terms of k, the inverse of the matrix **M**.

(4)

(*b*) Find, in terms of p, the coordinates of the point where the following planes intersect.

$$6x + 2y - z = 5$$
$$x + y - z = p$$
$$2x + 2y + z = 9$$

(3)

(*c*) (i) Find the value of q for which the following planes intersect in a straight line.

$$6x + 4y - z = 5$$
$$x + y - z = q$$
$$4x + 2y + z = 9$$

(ii) For this value of q, determine a vector equation for the line of intersection.

(7)

(Total for Question 6 is 14 marks)

7.

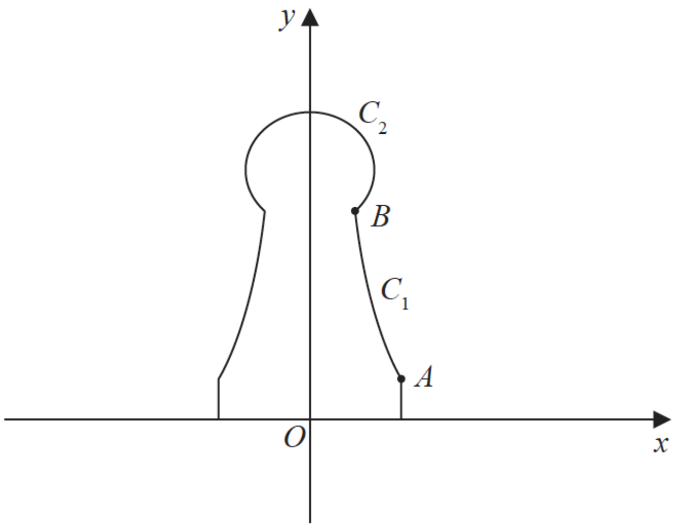

Figure 1

Figure 1 shows the central vertical cross-section of a solid shape. The solid shape is formed by rotating the region bounded by the y-axis, the x-axis, the line with equation $x = 2$, the curve C_1 and the curve C_2 through 360° about the y-axis.

The point A has coordinates (2, 1) and the point B has coordinates (1, 3) where the units are centimetres.

The curve C_1 is modelled by the equation

$$x = \frac{a}{y+b} \qquad 1 \leqslant y \leqslant 3$$

(a) Determine the value of a and the value of b according to the model.

(2)

The curve C_2 is modelled to be an arc of the circle with centre (0, 4).

(b) Use calculus to determine the volume of material required to make the solid shape according to the model.

(9)

(Total for Question 7 is 11 marks)

TOTAL FOR PAPER IS 75 MARKS