

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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Pearson Edexcel Level 3 GCE

Monday 5 June 2023

Afternoon (Time: 1 hour 30 minutes)

Paper
reference

9FM0/02

Further Mathematics

Advanced

PAPER 2: Core Pure Mathematics 2

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 symbolic 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 9 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.

Turn over ►

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1.

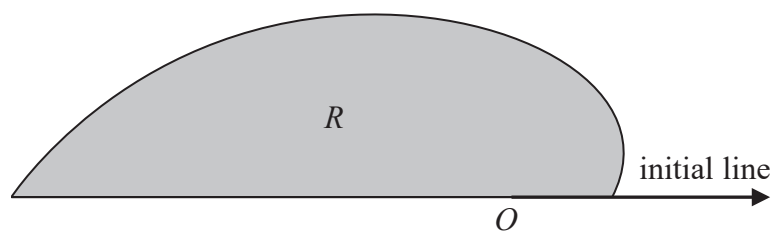
**Figure 1**

Figure 1 shows a sketch of the curve with polar equation

$$r = 2\sqrt{\sinh \theta + \cosh \theta} \quad 0 \leq \theta \leq \pi$$

The region R , shown shaded in Figure 1, is bounded by the initial line, the curve and the line with equation $\theta = \pi$

Use algebraic integration to determine the exact area of R giving your answer in the form $pe^q - r$ where p , q and r are real numbers to be found.

(4)

6. Given that

$$y = e^{2x} \sinh x$$

prove by induction that for $n \in \mathbb{N}$

$$\frac{d^n y}{dx^n} = e^{2x} \left(\frac{3^n + 1}{2} \sinh x + \frac{3^n - 1}{2} \cosh x \right)$$

(6)

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7.

In this question you must show all stages of your working.

Solutions relying entirely on calculator technology are not acceptable.

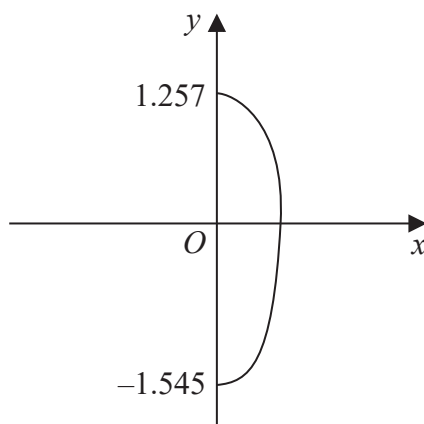


Figure 2

John picked 100 berries from a plant.

The largest berry picked was approximately 2.8 cm long.

The shape of this berry is modelled by rotating the curve with equation

$$16x^2 + 3y^2 - y \cos\left(\frac{5}{2}y\right) = 6 \quad x \geq 0$$

shown in Figure 2, about the y-axis through 2π radians, where the units are cm.

Given that the y intercepts of the curve are -1.545 and 1.257 to four significant figures,

- (a) use algebraic integration to determine, according to the model, the volume of this berry.

(6)

Given that the 100 berries John picked were then squeezed for juice,

- (b) use your answer to part (a) to decide whether, in reality, there is likely to be enough juice to fill a 200 cm^3 cup, giving a reason for your answer.

(2)



