

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson Edexcel
Level 3 GCE**

Centre Number

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Candidate Number

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Tuesday 25 June 2019

Morning (Time: 1 hour 30 minutes)

Paper Reference **9FM0/4A**

Further Mathematics

Advanced

Paper 4A: Further Pure Mathematics 2

You must have:

Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

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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.
- Answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 8 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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5.

$$I_n = \int \operatorname{cosec}^n x \, dx \quad n \in \mathbb{Z}$$

(a) Prove that, for $n \geq 2$

$$I_n = \frac{n-2}{n-1} I_{n-2} - \frac{\operatorname{cosec}^{n-2} x \cot x}{n-1} \quad (4)$$

(b) Hence show that

$$\int_{\frac{\pi}{3}}^{\frac{\pi}{2}} \operatorname{cosec}^6 x \, dx = \frac{56}{135} \sqrt{3} \quad (4)$$



6. (i) A binary operation $*$ is defined on positive real numbers by

$$a * b = a + b + ab$$

Prove that the operation $*$ is associative.

(4)

- (ii) The set $G = \{1, 2, 3, 4, 5, 6\}$ forms a group under the operation of multiplication modulo 7

(a) Show that G is cyclic.

(2)

The set $H = \{1, 5, 7, 11, 13, 17\}$ forms a group under the operation of multiplication modulo 18

(b) List all the subgroups of H .

(3)

(c) Describe an isomorphism between G and H .

(3)



Question 6 continued

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Question 6 continued

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Question 6 continued

(Total for Question 6 is 12 marks)



7. A transformation from the z -plane to the w -plane is given by

$$w = \frac{3iz - 2}{z + i} \quad z \neq -i$$

(a) Show that the circle C with equation $|z + i| = 1$ in the z -plane is mapped to a circle D in the w -plane, giving a Cartesian equation for D .

(4)

(b) Sketch C and D on Argand diagrams.

(2)



Question 7 continued

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8.

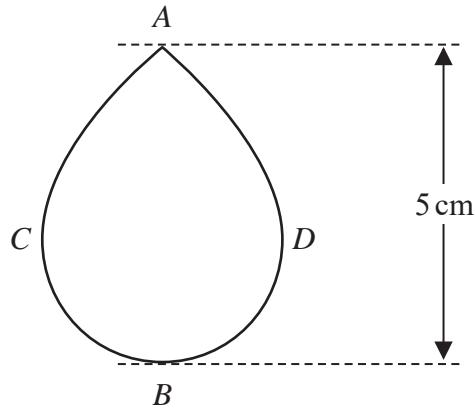


Figure 1

Figure 1 shows the vertical cross section of a child's spinning top. The point A is vertically above the point B and the height of the spinning top is 5 cm.

The line CD is perpendicular to AB such that CD is the maximum width of the spinning top.

The spinning top is modelled as the solid of revolution created when part of the curve with polar equation

$$r^2 = 25 \cos 2\theta$$

is rotated through 2π radians about the initial line.

(a) Show that, according to the model, the surface area of the spinning top is

$$k\pi(2 - \sqrt{2}) \text{ cm}^2$$

where k is a constant to be determined.

(7)

(b) Show that, according to the model, the length CD is $\frac{5\sqrt{2}}{2}$ cm.

(6)



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 13 marks)

TOTAL FOR PAPER IS 75 MARKS

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