

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

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Forename(s)

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Candidate signature

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I declare this is my own work.

INTERNATIONAL AS FURTHER MATHEMATICS

(9665/FM01) Unit FP1 Pure Mathematics

Wednesday 4 January 2023 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

- For this paper you must have the Oxford International AQA Booklet of Formulae and Statistical Tables (enclosed).
- You may use a graphical calculator.

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- Show all necessary working; otherwise marks may be lost.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	



J A N 2 3 F M 0 1 0 1

IB/G/Jan23/E6

FM01

1 A curve has equation $y = 2x^2 + 3x$

Find the gradient of this line in the form $a+bh$ where a and b are integers.

[illegible]

Answer _____



- 1 (b)** Show how the answer to **part (a)** can be used to find the gradient of the curve at the point where $x = -\frac{5}{4}$

[2 marks]

6

Turn over for the next question

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4



- 3** For each of the improper integrals below, either find its exact value or explain why it has no finite value.

Show **all** necessary working.

3 (a) $\int_3^{\infty} \frac{1}{\sqrt[5]{x}} dx$

[3 marks]

Answer _____

3 (b) $\int_3^{\infty} \frac{1}{x^2} dx$

[3 marks]

Answer _____



$$\sin\left(5x - \frac{\pi}{12}\right) = 0.5$$

[4 marks]

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on its right side, suggesting it's resting on a surface.

Answer



$$\sin\left(5x - \frac{\pi}{12}\right) = 0.5$$

[3 marks]

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Answer _____

7

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5 (a) Show that

$$\frac{1}{r!} - \frac{1}{(r+1)!} = \frac{r}{(r+1)!}$$

[1 mark]

5 (b) Use the method of differences to find an expression for the sum of the series

$$\frac{1}{2!} + \frac{2}{3!} + \frac{3}{4!} + \dots + \frac{n}{(n+1)!}$$

[4 marks]

Answer _____



$$\sum_{r=5}^{\infty} \frac{r}{(r+1)!}$$

[2 marks]

[illegible]

Answer _____

7

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Find all the solutions of the equation

[7 marks]

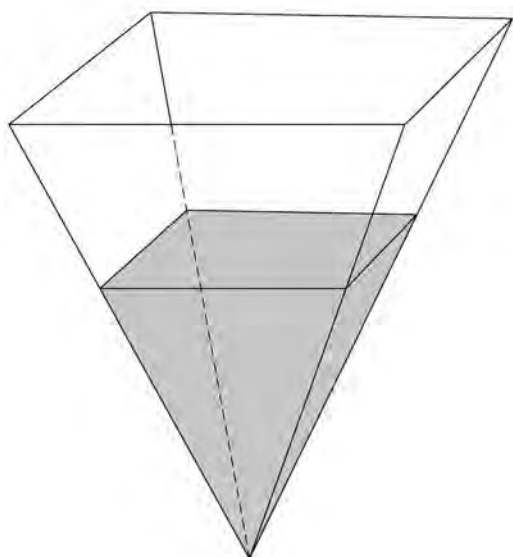
[illegible]

7

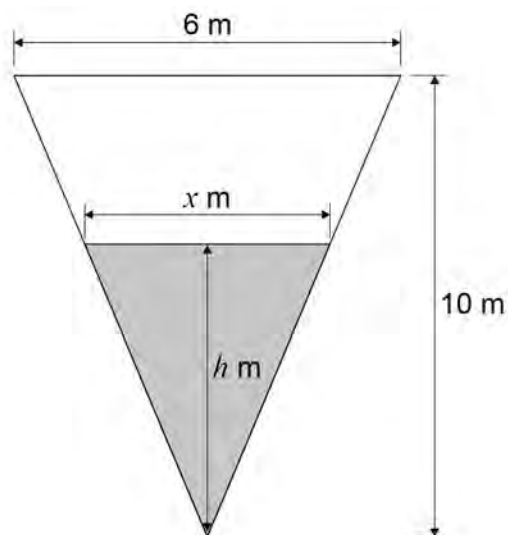
- 7 [The volume of a square-based pyramid is given by the formula $V = \frac{1}{3}a^2h$ where a is the length of the side of the square base, and h is the height.]

A water tank in the shape of an inverted square-based pyramid has height 10 metres, and the length of the side of the square base is 6 metres.

Not drawn to scale



3D image



Cross-section

The tank fills with water at a rate of 0.54 m^3 per minute.

At time t minutes the depth of water in the tank is h metres.

The horizontal surface of the water at time t minutes is in the shape of a square of side x metres.

- 7 (a) Explain why $x = 0.6h$

[1 mark]



[2 marks]

Answer _____

[5 marks]

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Answer _____

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8 The ellipse E_1 has equation

$$\frac{x^2}{4} + y^2 = 1$$

The ellipse E_2 has equation

$$\frac{x^2}{4} + \frac{y^2}{k} = 1$$

where k is a positive constant.

8 (a) Describe fully the transformation that maps E_1 onto E_2

[2 marks]

8 (b) It is given that the line L has equation

$$y = 2x + c$$

where c is a constant.

8 (b) (i) Show that if L intersects E_2 then

$$c^2 - k \leq A$$

where A is a constant to be found.

[5 marks]



[2 marks]

 $k =$

9

9 The function f is defined by

$$f(x) = \frac{4x+5}{x^2+4x+5}$$

9 (a) (i) Explain why the graph of $y = f(x)$ has no vertical asymptotes.

[2 marks]

9 (a) (ii) Write down the equation of the horizontal asymptote of the graph of $y = f(x)$

[1 mark]

Answer _____

9 (b) Prove that if the line $y = k$ where k is a constant, intersects the graph of $y = f(x)$ then

$$k^2 + 3k - 4 \leq 0$$

[4 marks]



- 9 (c) Use the result in **part (b)** to find the coordinates of the stationary points of the graph of $y = f(x)$

[5 marks]

Answer _____

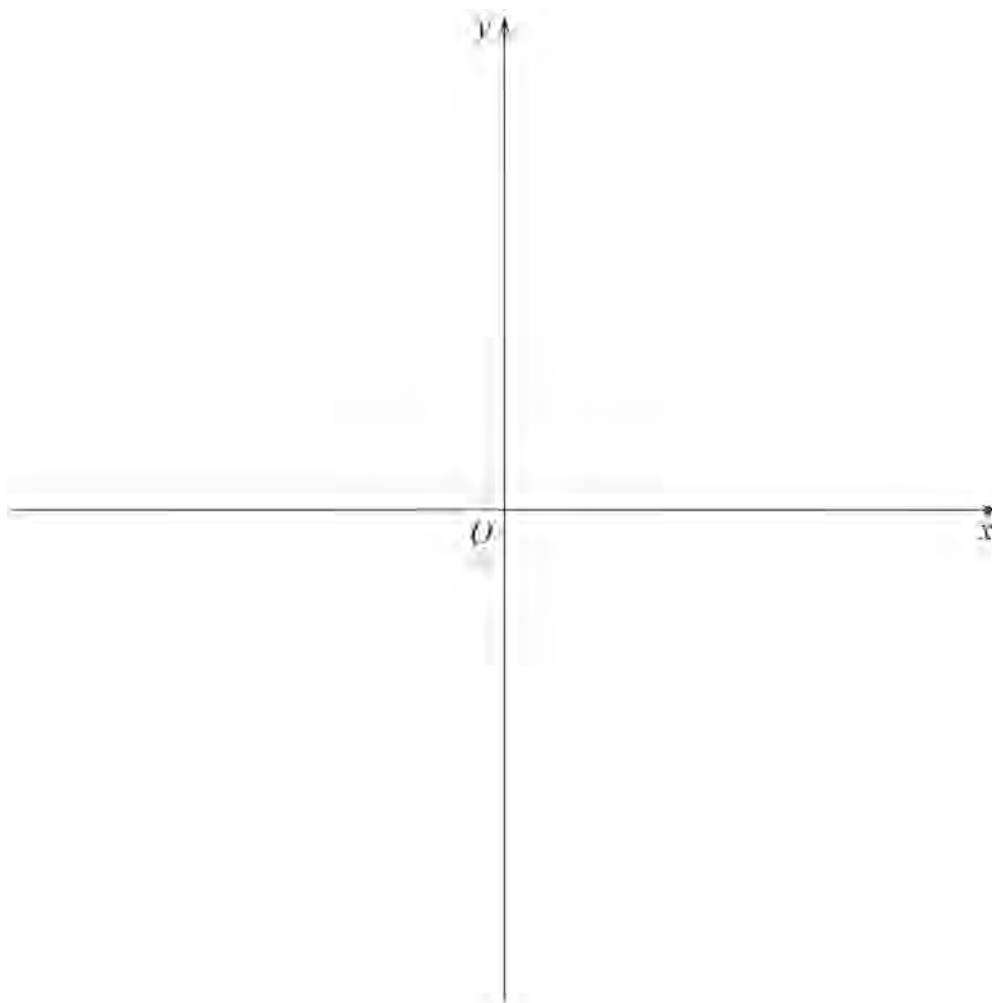
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- 9 (d) Sketch the graph of $y = f(x)$ on the axes below showing the coordinates of the stationary points.

[3 marks]



15



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- 10** The circle C is the locus of points on an Argand diagram such that

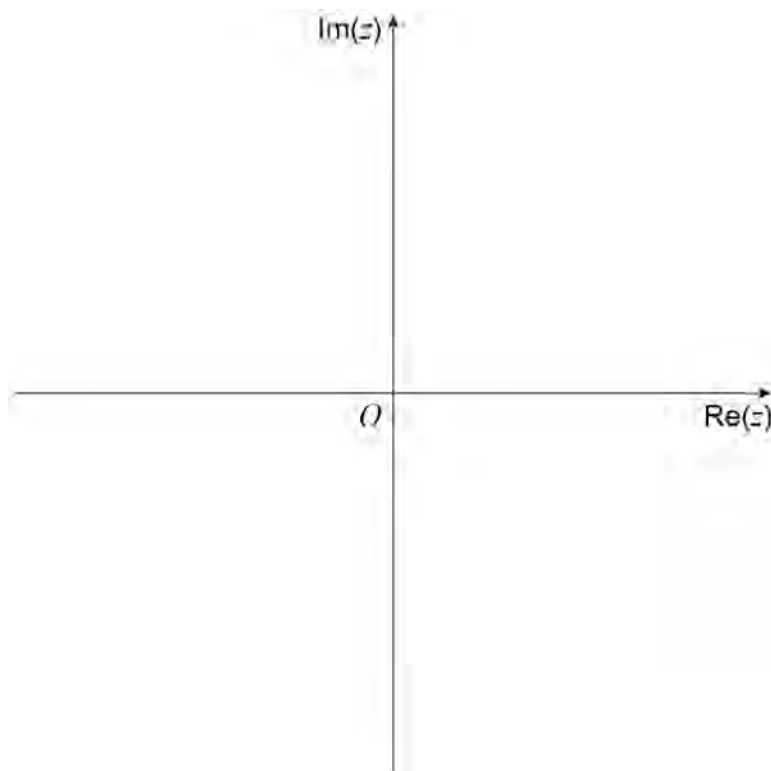
$$|z| = 5$$

The line L is the locus of points on an Argand diagram such that

$$\operatorname{Re}(z) = 3$$

- 10 (a)** Draw C and L on the Argand diagram.

[2 marks]



- 10 (b)** Find all the points which are **both** a distance of exactly one unit from C **and** a distance of exactly one unit from L

[6 marks]



$$\arg(z+5) = \frac{2\pi}{5}$$

[3 marks]

END OF QUESTIONS

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Question number	<p align="center">Additional page, if required.</p> <p align="center">Write the question numbers in the left-hand margin.</p>
	<div style="border: 1px solid black; height: 550px; margin: 5px;"></div>
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