OXFORD AQA

INTERNATIONAL QUALIFICATIONS

Please write clearly in block capitals.

Centre number | | | | | |

Candidate number | | | | |

Surname ____________________

Forename(s) ____________________

Candidate signature ____________________

I declare this is my own work.

INTERNATIONAL AS

FURTHER MATHEMATICS

(9665/FM01) Unit FP1 Pure Mathematics

Wednesday 7 January 2026 07:00 UK Time Time allowed: 1 hour 30 minutes

Materials

- For this paper you must have the OxfordAQA 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	

Answer **all** questions in the spaces provided.

1 The complex number z is given by

$$z = -\sqrt{3} - \mathrm{i}$$

1 (a) (i) Express z in the form $r(\cos\theta + \mathrm{i}\sin\theta)$ where $r \geq 0$ and $-\pi < \theta \leq \pi$

[3 marks]

Answer ______________________

1 (a) (ii) Hence write down z^* in the form $r(\cos\theta + \mathrm{i}\sin\theta)$ where $r \geq 0$ and $-\pi < \theta \leq \pi$

[1 mark]

Answer ______________________

Do not write outside the box

1 (b) On an Argand diagram, the point P represents z and the point Q represents z^*

Find the acute angle POQ where O is the origin.

[2 marks]

Answer ______________________

6

Turn over for the next question

2 The curve C has equation

$$y = 8 - 3x - 6x^2$$

2 (a) The line L passes through two points on C, one where $x = 7$ and the other where $x = 7 + h$

Find the gradient of L in the form $p + qh$ where p and q are constants.

[3 marks]

Answer ______________________

Do not write outside the box

2 (b) Use your answer to **part (a)** to find the gradient of C at the point where $x = 7$

Show the limiting process used.

[2 marks]

Answer ______________________________

5

Turn over for the next question

3 (a) Show that

$$\frac{1}{3r-1} - \frac{1}{3r+2} = \frac{3}{9r^2+3r-2}$$

[1 mark]

3 (b) Hence use the method of differences to show that

$$\sum_{r=1}^{n} \frac{3}{9r^2+3r-2}$$

can be written in the form $\dfrac{3n}{cn+d}$ where c and d are integers.

[4 marks]

Do not write outside the box

3 (c) Find the value of p such that

$$\sum_{r=p}^{\infty} \frac{3}{9r^2+3r-2} = \frac{1}{1001}$$

[3 marks]

$p =$ ______

8

Turn over ►

Do not write outside the box

4 The integral I_k is defined by

$$I_k = \int_k^5 \left(\frac{1}{x^2}\right) \mathrm{d}x$$

where $k < 5$

4 (a) Write down the range of values of k for which I_k is an improper integral.

[1 mark]

Answer

4 (b) Explain why I_{-3} does not have a finite value.

[1 mark]

2

Do not write outside the box

5 Solve the equation

$$z^2 = 4 - 4\sqrt{15}\,\mathrm{i}$$

No marks will be awarded for calculator-only working in this question.

[5 marks]

Answer

5

Turn over ►

Do not write outside the box

6 (a) Expand and simplify $(2r-1)^3$

[1 mark]

Answer

6 (b) Express $\sum_{r=1}^{n}(2r-1)^3$ in the form $n^2\,\mathrm{f}(n)$ where f is a function of n

[4 marks]

Do not write outside the box

Answer

6 (c) Use your answer to **part (b)** to find the sum of the cubes of all positive odd numbers less than 100

[2 marks]

Answer

7

Do not write outside the box

7 The equation

$$\cos\left(3x+\frac{\pi}{4}\right)=\frac{1}{2}$$

has the general solution

$$x=\frac{\pi}{36}\left(24n \pm a + b\right)$$

where a and b are **positive** integers.

7 (a) A student claims that n can be any real number. This student's claim is incorrect.

Write down a correct statement about the values n can take.

[1 mark]

7 (b) In the case when $a = 4$ find the least possible value of b

[3 marks]

$b =$ ______

7 (c) In the case when $b = 9$ find the least possible value of a

[3 marks]

$a =$ ______

Do not write outside the box

7 (d) Find the number of solutions of the equation

$$\cos\left(3x+\frac{\pi}{4}\right)=\frac{1}{2}$$

which lie in the interval $-\pi < x \leq \pi$

[2 marks]

Answer ______________________

7 (e) Hence, or otherwise, find the number of solutions of the equation

$$\cos\left(3x+\frac{\pi}{4}\right)=\frac{1}{2}$$

which lie in the interval $\theta < x \leq \theta + 80\pi$ where θ is a constant.

[2 marks]

Answer ______________________

11

8 The point S has coordinates $(2k, 0)$ where $k > 1$

The line L has equation $x = \frac{2}{k}$

The locus of a point R is such that the distance from R to S is equal to k times the distance from R to L

The locus of R is the hyperbola H

8 (a) Find the Cartesian equation of H in terms of k

Give your answer in the form

$$px^2 - y^2 = q$$

where p and q are constants in terms of k

[4 marks]

Answer ______________________

8 (b) The asymptotes of H are perpendicular to each other.

8 (b) (i) Find the value of k

[3 marks]

$k =$ ______________________

Question 8 continues on the next page

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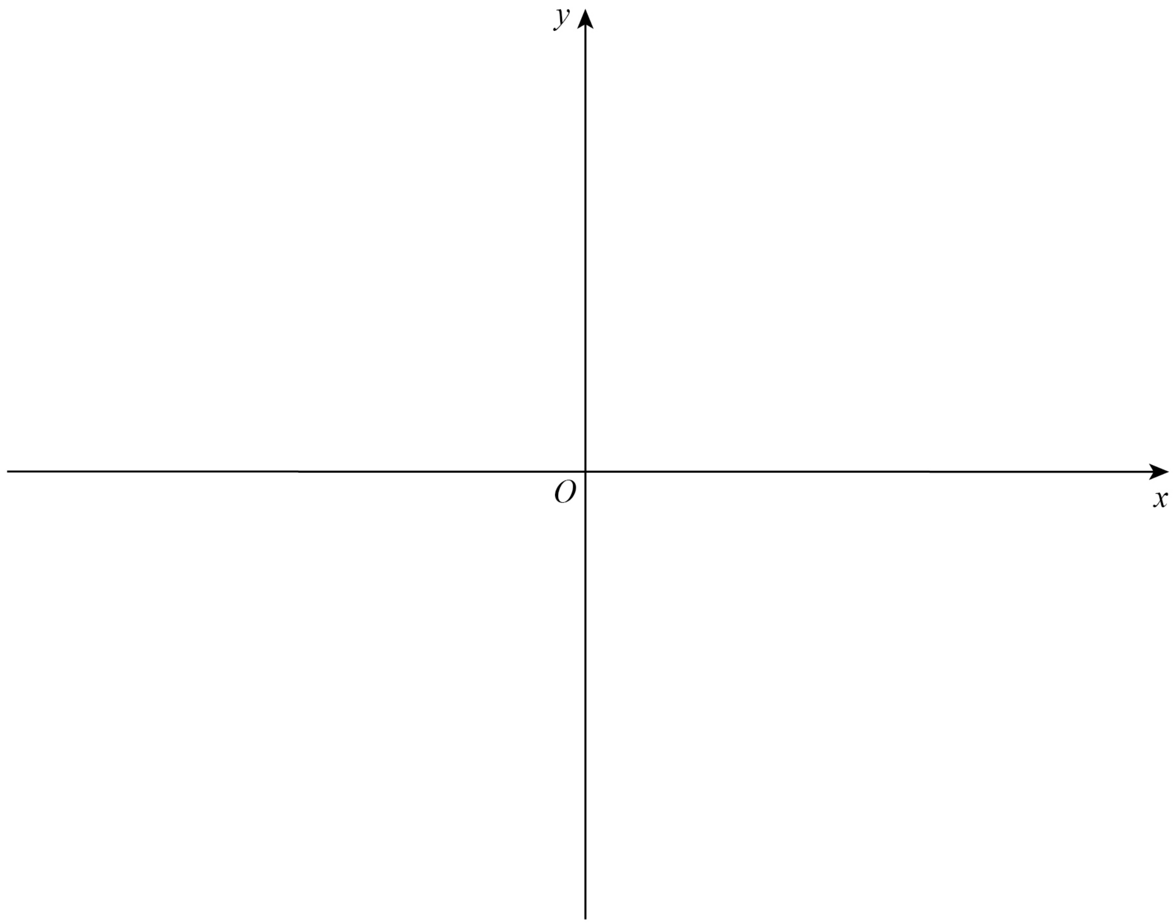
8 (b) (ii) Sketch the graph of H on **Figure 1**

Include the coordinates of any axis intercepts.

Include the asymptotes and their equations.

[3 marks]

Figure 1



10

Turn over for the next question

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9 The function f is defined by $\mathrm{f}(x) = \dfrac{x^2+2}{x^2+3x}$

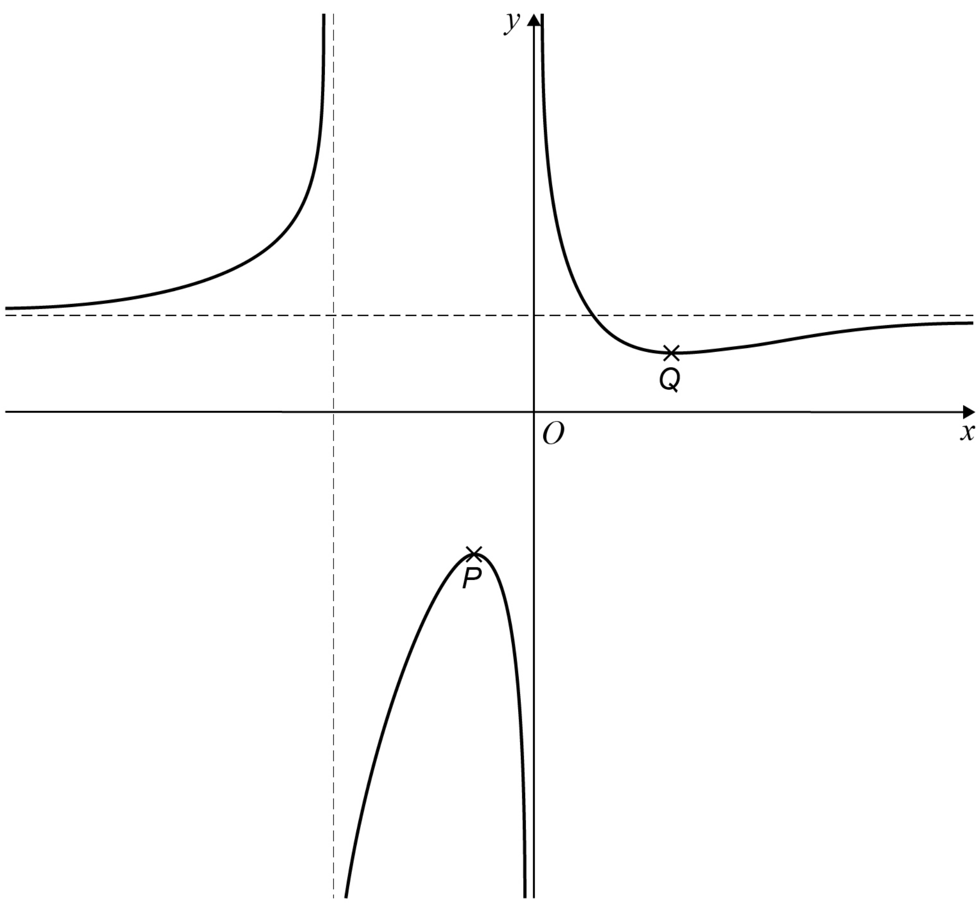
The curve C_1 has equation $y = \mathrm{f}(x)$

The point P is the local maximum of C_1

The point Q is the local minimum of C_1

The graph of C_1 is shown in **Figure 2**

Figure 2



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9 (a) The line with equation $y = k$ intersects C_1

Show that

$$9k^2 + 8k + n \geq 0$$

when n is a constant.

[4 marks]

Question 9 continues on the next page

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9 (b) Use your answer to **part (a)** to find the y-coordinate of P and the y-coordinate of Q

Give your answers in an exact form.

[2 marks]

y-coordinate of $P =$ ________________

y-coordinate of $Q =$ ________________

9 (c) The curve C_2 has equation $y = \dfrac{1}{\mathrm{f}(x)}$

9 (c) (i) Write down the number of asymptotes of C_2

[1 mark]

Answer ________________

9 (c) (ii) Write down the y-coordinate of the point of intersection of C_1 and C_2

[1 mark]

Answer ________________

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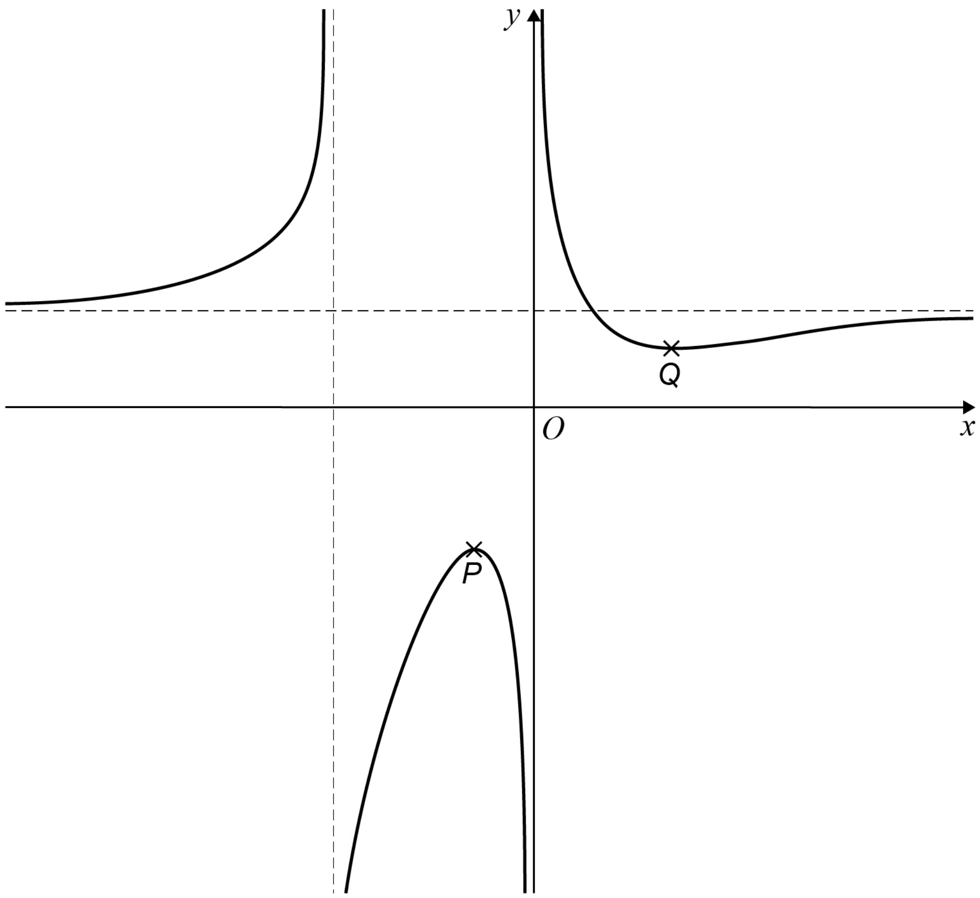
9 (c) (iii) The graph of C_1 is shown again in **Figure 3**

Sketch the graph of C_2 on **Figure 3**

[4 marks]

Figure 3



12

Turn over for the next question

10 The complex number $4-5\mathrm{i}$ is a root of the quadratic equation

$$z^2+mz+n=0$$

where m and n are real constants.

10 (a) Find the value of m and the value of n

[4 marks]

$m =$ ______ $n =$ ______

10 (b) Solve the equation

$$z^2+6z+153=0$$

[1 mark]

Answer ______

Do not write outside the box

10 (c) The four roots of the equation

$$\left(z^2 + mz + n\right)\left(z^2 + 6z + 153\right) = 0$$

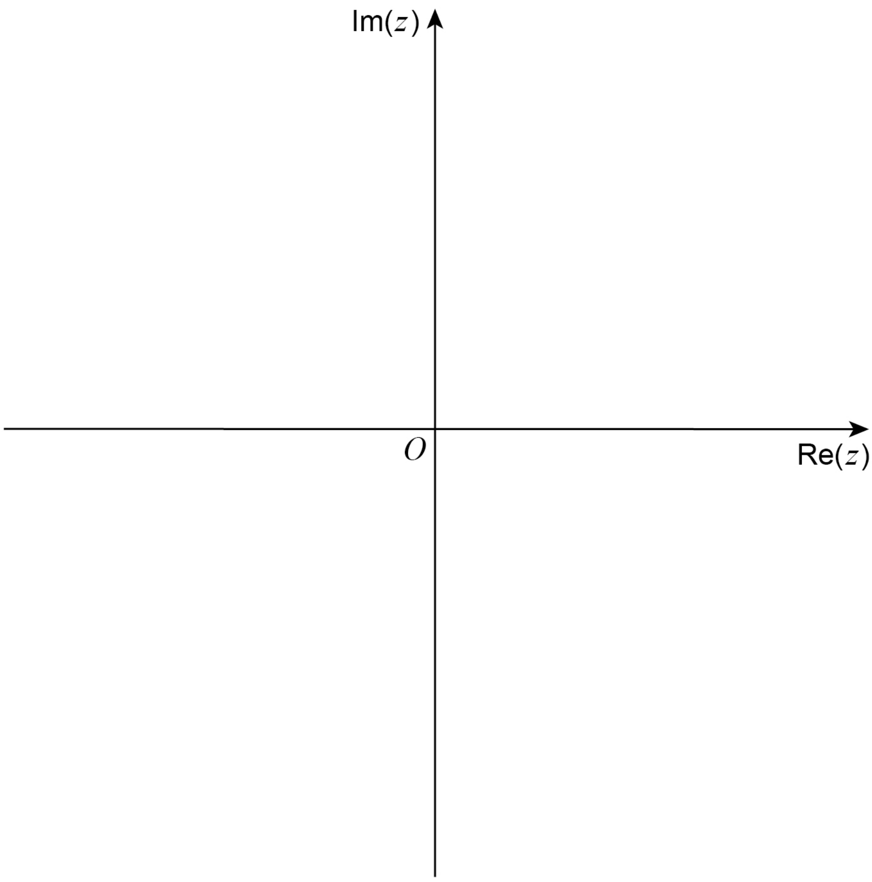
are represented by the points P, Q, R and S on an Argand diagram.

10 (c) (i) Sketch the quadrilateral $PQRS$ on the Argand diagram in **Figure 4**

You are not required to label the vertices or include the axis intercepts.

[2 marks]

Figure 4



10 (c) (ii) Calculate the area of quadrilateral $PQRS$

[2 marks]

Answer

Question 10 continues on the next page

Turn over ►

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10 (d) The four roots of the equation

$$\left(z^2+mz+n\right)\left(z^2+6z+153\right)=0$$

also satisfy the equation

$$|z-\alpha|=\beta$$

where α and β are constants.

10 (d) (i) Find the value of α

[3 marks]

$\alpha =$ ________________

Do not write outside the box

10 (d) (ii) Find the value of β

[2 marks]

$\beta =$ ____________________

14

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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