



Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

A-level FURTHER MATHEMATICS

Paper 1

Time allowed: 2 hours

Materials

- You must have the AQA Formulae and statistical tables booklet for A-level Mathematics and A-level Further Mathematics.
- You should have a scientific calculator that meets the requirements of the specification. (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 each question in the space provided for that question. If you require 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 **not** write outside the box around each page or on blank pages.
- Show all necessary working; otherwise marks for method may be lost.
- 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 100.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
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7	
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9	
10	
11	
12	
13	
14	
15	
TOTAL	



J U N 2 1 7 3 6 7 1 0 1

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

1 Find

$$\sum_{r=1}^{20} (r^2 - 2r)$$

Circle your answer.

[1 mark]

2450

2660

5320

43680

2

Given that $z = 1 - 3i$ is one root of the equation $z^2 + pz + r = 0$, where p and r are real, find the value of r .

Circle your answer.

[1 mark]

-8

-2

6

10



3 The curve C has polar equation

$$r^2 \sin 2\theta = 4$$

Find a Cartesian equation for C .

Circle your answer.

[1 mark]

$$y = 2x$$

$$y = \frac{x}{2}$$

$$y = \frac{2}{x}$$

$$y = 4x$$

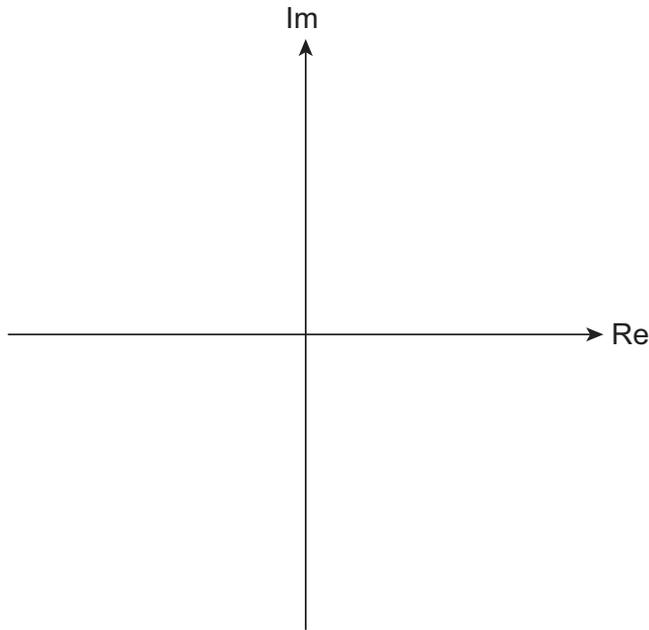
Turn over for the next question

Turn over ►



6 (b) (i) Plot the four solutions to the equation in part (a) on the Argand diagram below and join them together to form a quadrilateral with one line of symmetry.

[2 marks]



6 (b) (ii) Show that the area of this quadrilateral is $\frac{\sqrt{15}}{2}$ square units.

[1 mark]

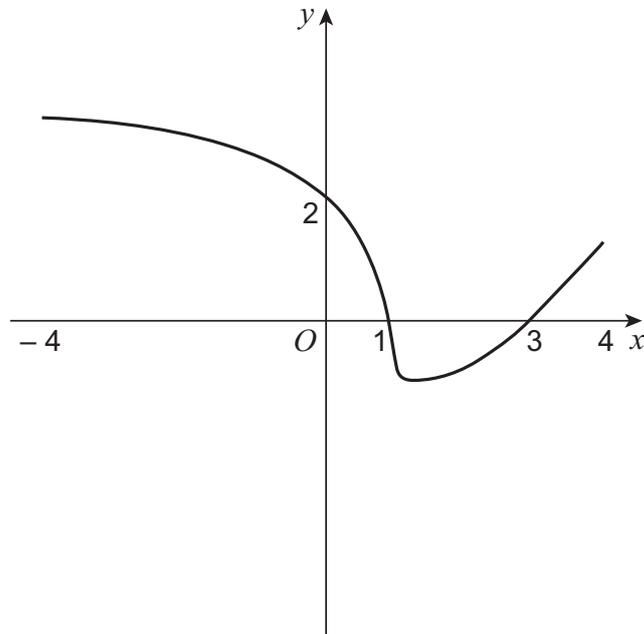
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7 The diagram below shows the graph of $y = f(x)$ ($-4 \leq x \leq 4$)

The graph meets the x -axis at $x = 1$ and $x = 3$

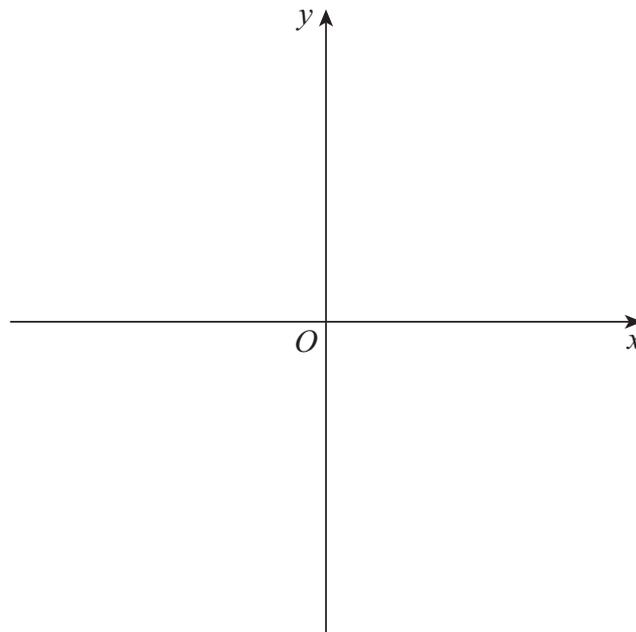
The graph meets the y -axis at $y = 2$



7 (a) Sketch the graph of $y = |f(x)|$ on the axes below.

Show any axis intercepts.

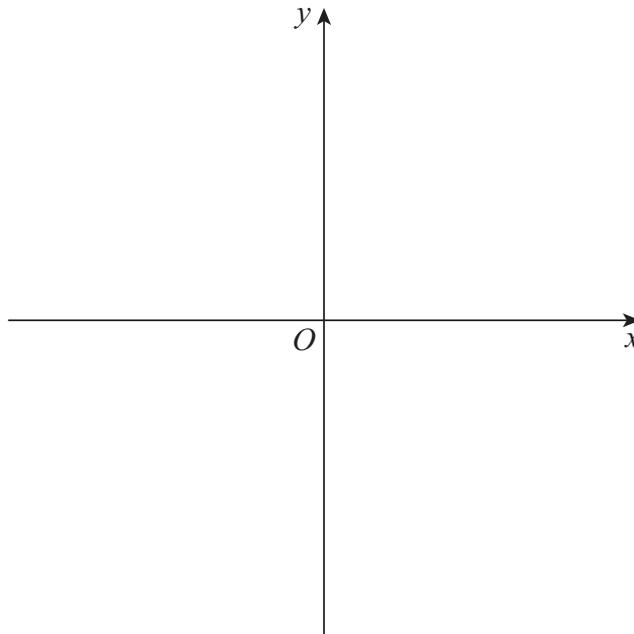
[2 marks]



7 (b) Sketch the graph of $y = \frac{1}{f(x)}$ on the axes below.

Show any axis intercepts and asymptotes.

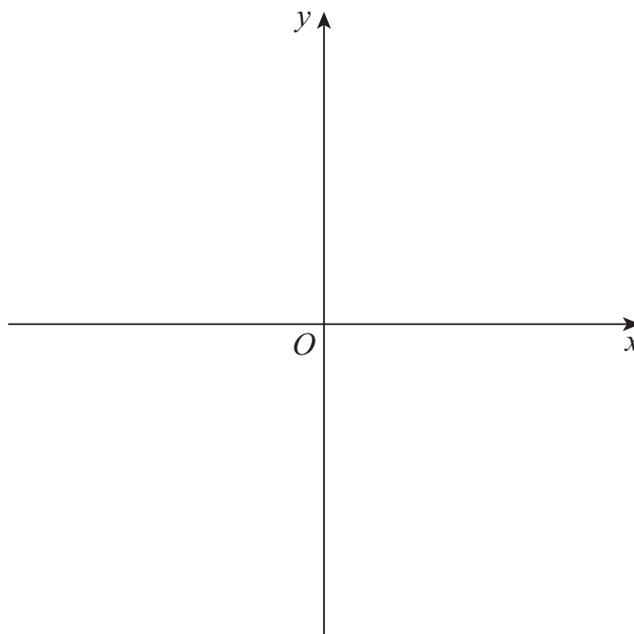
[3 marks]



7 (c) Sketch the graph of $y = f(|x|)$ on the axes below.

Show any axis intercepts.

[2 marks]



Turn over ►



11 The line L_1 has equation $\mathbf{r} = \begin{bmatrix} 2 \\ 2 \\ 3 \end{bmatrix} + \lambda \begin{bmatrix} 2 \\ 3 \\ -1 \end{bmatrix}$

The line L_2 has equation $\mathbf{r} = \begin{bmatrix} 6 \\ 4 \\ 1 \end{bmatrix} + \mu \begin{bmatrix} -2 \\ 1 \\ 1 \end{bmatrix}$

11 (a) Find the acute angle between the lines L_1 and L_2 , giving your answer to the nearest 0.1°

[3 marks]

11 (b) The lines L_1 and L_2 lie in the plane Π_1

11 (b) (i) Find the equation of Π_1 , giving your answer in the form $\mathbf{r} \cdot \mathbf{n} = d$

[4 marks]



15 In this question use $g = 9.8 \text{ m s}^{-2}$

A particle P of mass m is attached to two light elastic strings, AP and BP .

The other ends of the strings, A and B , are attached to fixed points which are 4 metres apart on a rough horizontal surface at the bottom of a container.

The coefficient of friction between P and the surface is 0.68

- When the extension of string AP is e_A metres, the tension in AP is $24me_A$
- When the extension of string BP is e_B metres, the tension in BP is $10me_B$
- The natural length of string AP is 1 metre
- The natural length of string BP is 1.3 metres



15 (a) Show that when $AP = 1.5$ metres, the tension in AP is equal to the tension in BP .

[1 mark]



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