RECOGNISING ACHIEVEMENT

Oxford Cambridge and RSA Examinations

Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education

MEI STRUCTURED MATHEMATICS

INTRODUCTION TO ADVANCED MATHEMATICS, C1 **4751**

Specimen Paper

Additional materials: Answer booklet
Graph paper
MEI Examination Formulae and Tables (MF 2)

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and candidate number in the spaces provided on the answer booklet.
- Answer **all** the questions.
- You are **not** permitted to use a calculator in this paper.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- Final answers should be given to a degree of accuracy appropriate to the context.
- The total number of marks for this paper is **72**.

Section A (36 marks)

1 Solve the equations:

(i) $x^{\frac{1}{2}} = 9$ **[1]**

(ii) $x^{-3} = \frac{1}{8}$ **[1]**

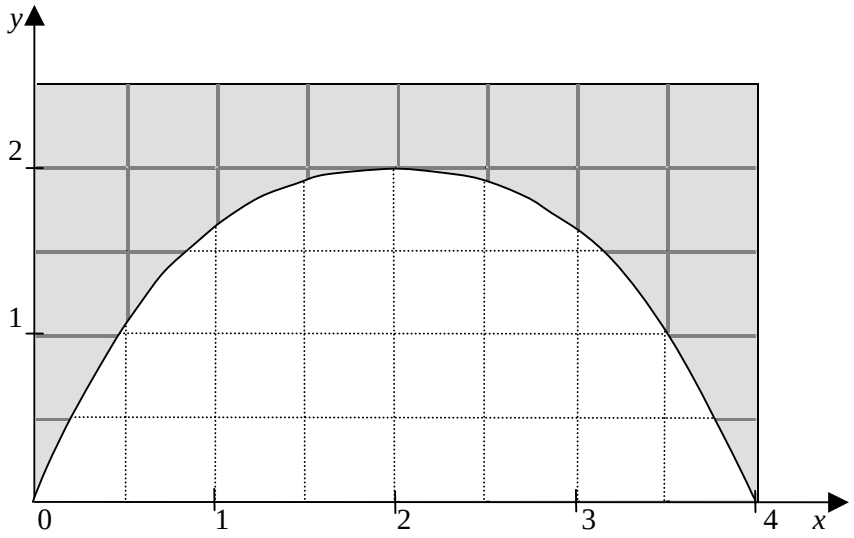
(iii) $(x^{10})^{\frac{1}{2}} = 32$ **[1]**

2 Make x the subject of the equation $ax^2 + b = -x^2 + d$. **[3]**

3 Solve the equation $2x^2 - 5x = 3$. **[3]**

4 Find the term in x^3 in the binomial expansion of $(1-2x)^5$. **[3]**

5 The diagram shows a bridge.
The units are metres.



It is suggested that the curved underside of the bridge can be modelled by the curve $y = \frac{1}{2}x(4-x)$ for $0 \le x \le 4$.

(i) Give two different reasons why this is a good model. **[2]**

(ii) Give also one reason why it is not a perfect model. **[1]**

6 A line *l* passes through the point (-1, 2) and has gradient 3.
Determine whether the point (-100, -294) lies above the line *l*, on it or below it. **[4]**

7 The coordinates of points A, B, C and D are (-2, -1), (2, 1), (5, 4) and (1, 2) respectively.
Prove that ABCD is a parallelogram but not a rhombus. **[4]**

8 The quadratic equation $x^2 + 6x + p = 0$ has equal roots.
State the value of *p* and hence find *x*. **[4]**

9 **(i)** Simplify $(\sqrt{2}+1)(\sqrt{2}-1)$. **[1]**

(ii) Express $\dfrac{\sqrt{2}}{\sqrt{2}+1}$ in the form $a + b\sqrt{2}$, where *a* and *b* are integers to be determined. **[3]**

10 Find the coordinates of the points of intersection of the line $y = 2x + 2$ and the curve $y = x^2 - 4x + 1$, giving your answers as surds. **[5]**

Section B (36 marks)

11

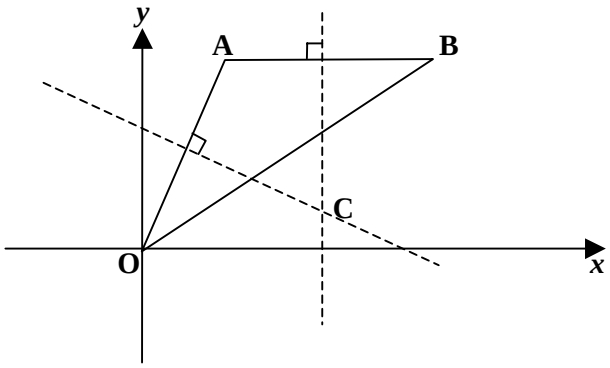


Fig. 1

Fig. 1 shows a triangle with vertices O (0, 0), A (2, 6) and B (12, 6). The perpendicular bisectors of OA and AB meet at C.

(i) Write down the equation of the perpendicular bisector of AB.
Find the equation of the perpendicular bisector of OA.
Hence show that the coordinates of C are (7, 1). **[6]**

(ii) Show that the point C is the centre of the circle which passes through O, A and B.
Find the equation of this circle.
Find the *y*-coordinate of the point other than O where the circle cuts the *y*-axis. **[6]**

12 In this question, $\mathrm{f}(x) = x^3 - 3x^2 - 6x + 8$.

(i) Show that $x - 1$ is a factor of $\mathrm{f}(x)$. **[1]**

(ii) Factorise $\mathrm{f}(x)$ completely and hence sketch the graph of $y = \mathrm{f}(x)$. **[7]**

(iii) On the same axes sketch the graph of $y = -x^3 + 3x^2 + 6x - 8$. **[2]**

(iv) Sketch the graph of $y = \mathrm{f}(x + 2)$, marking the *x*-coordinates of the points where it crosses the *x*-axis. You need not calculate the *y*-intercept. **[2]**

13 **(i)** Express $x^2 - 6x + 10$ in the form $(x + a)^2 + b$ where a and b are constants to be determined.
Hence show that the value of $x^2 - 6x + 10$ is positive for all values of x. **[4]**

(ii) Sketch the graph of $y = x^2 - 6x + 10$.
Mark the axis of symmetry and give its equation.
State the co-ordinates of the lowest point of the curve. **[3]**

(iii) On the same axes sketch the graph of $y = x - 3$.
State, with reasons, what your graph tells you about the solution of the equation
$x^2 - 6x + 10 = x - 3$. **[3]**

(iv) Solve the inequality $x^2 - 6x + 10 < 2$. **[2]**