OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI)   **4751**

Introduction to Advanced Mathematics (C1)

QUESTION PAPER

Monday 11 January 2010
Morning

Duration: 1 hour 30 minutes

4751

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

* Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Printed Answer Book.
* **The questions are on the inserted Question Paper.**
* **Write your answer to each question in the space provided in the Printed Answer Book.** If you need more space for an answer use a 4-page answer book; label your answer clearly. Write your Centre Number and Candidate Number on the 4-page answer book and attach it securely to the Printed Answer Book.
* Use black ink. Pencil may be used for graphs and diagrams only.
* Read each question carefully and make sure that you know what you have to do before starting your answer.
* Answer **all** the questions.
* Do **not** write in the bar codes.
* You are **not** permitted to use a calculator in this paper.
* Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.

* The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
* 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.
* The total number of marks for this paper is **72**.
* The Printed Answer Book consists of **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

✗ No calculator can be used for this paper

Turn over

Answer all questions on the Printed Answer Book provided.

Section A (36 marks)

1 Rearrange the formula $c = \sqrt{\dfrac{a+b}{2}}$ to make a the subject. **[3]**

2 Solve the inequality $\dfrac{5x-3}{2} < x + 5$. **[3]**

3 **(i)** Find the coordinates of the point where the line $5x + 2y = 20$ intersects the x-axis. **[1]**

   (ii) Find the coordinates of the point of intersection of the lines $5x + 2y = 20$ and $y = 5 - x$. **[3]**

4 **(i)** Describe fully the transformation which maps the curve $y = x^2$ onto the curve $y = (x+4)^2$. **[2]**

   (ii) Sketch the graph of $y = x^2 - 4$. **[2]**

5 **(i)** Find the value of $144^{-\frac{1}{2}}$. **[2]**

   (ii) Simplify $\dfrac{1}{5 + \sqrt{7}} + \dfrac{4}{5 - \sqrt{7}}$. Give your answer in the form $\dfrac{a + b\sqrt{7}}{c}$. **[3]**

6 You are given that $f(x) = (x+1)^2(2x-5)$.

   (i) Sketch the graph of $y = f(x)$. **[3]**

   (ii) Express $f(x)$ in the form $ax^3 + bx^2 + cx + d$. **[2]**

7 When $x^3 + 2x^2 + 5x + k$ is divided by $(x+3)$, the remainder is 6. Find the value of k. **[3]**

8 Find the binomial expansion of $\left(x + \dfrac{5}{x}\right)^3$, simplifying the terms. **[4]**

9 Prove that the line $y = 3x - 10$ does not intersect the curve $y = x^2 - 5x + 7$. **[5]**
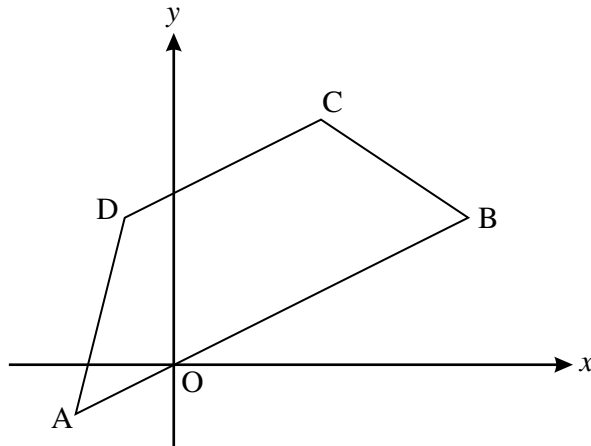
Section B (36 marks)

10

Fig. 10

Fig. 10 shows a trapezium ABCD. The coordinates of its vertices are A $(-2, -1)$, B $(6, 3)$, C $(3, 5)$ and D $(-1, 3)$.

   (i) Verify that the lines AB and DC are parallel. **[3]**

  (ii) Prove that the trapezium is not isosceles. **[3]**

 (iii) The diagonals of the trapezium meet at M. Find the exact coordinates of M. **[4]**

 (iv) Show that neither diagonal of the trapezium bisects the other. **[3]**

11 A circle has equation $(x - 3)^2 + (y + 2)^2 = 25$.

   (i) State the coordinates of the centre of this circle and its radius. **[2]**

  (ii) Verify that the point A with coordinates $(6, -6)$ lies on this circle. Show also that the point B on the circle for which AB is a diameter has coordinates $(0, 2)$. **[3]**

 (iii) Find the equation of the tangent to the circle at A. **[4]**

 (iv) A second circle touches the original circle at A. Its radius is 10 and its centre is at C, where BAC is a straight line. Find the coordinates of C and hence write down the equation of this second circle. **[3]**

[Question 12 is printed overleaf.]

 Turn over

12 The curve with equation $y = \frac{1}{5}x(10 - x)$ is used to model the arch of a bridge over a road, where x and y are distances in metres, with the origin as shown in Fig. 12.1. The x-axis represents the road surface.
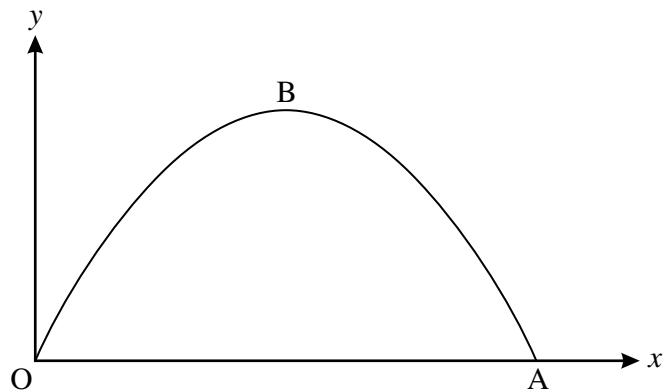

Fig. 12.1

   (i) State the value of x at A, where the arch meets the road. **[1]**

   (ii) Using symmetry, or otherwise, state the value of x at the maximum point B of the graph.

   Hence find the height of the arch. **[2]**

   (iii) Fig. 12.2 shows a lorry which is 4 m high and 3 m wide, with its cross-section modelled as a rectangle. Find the value of d when the lorry is in the centre of the road. Hence show that the lorry can pass through this arch. **[3]**
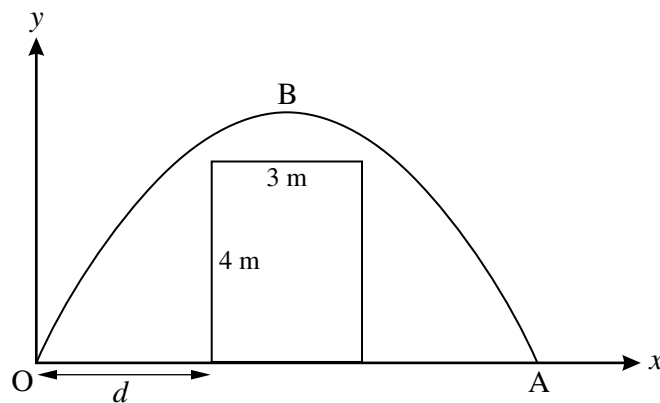
Fig. 12.2

   (iv) Another lorry, also modelled as having a rectangular cross-section, has height 4.5 m and just touches the arch when it is in the centre of the road. Find the width of this lorry, giving your answer in surd form. **[5]**