OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI) 4752

Concepts for Advanced Mathematics (C2)

QUESTION PAPER

Candidates answer on the Printed Answer Book

OCR Supplied Materials:
- Printed Answer Book 4752
- MEI Examination Formulae and Tables (MF2)

Other Materials Required:
- Scientific or graphical calculator

Thursday 27 May 2010
Morning

Duration: 1 hour 30 minutes

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.** Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).
- 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 permitted to use a graphical 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 **8** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or destroyed.

Section A (36 marks)

1 You are given that

$$u_1 = 1,$$
$$u_{n+1} = \frac{u_n}{1 + u_n}.$$

Find the values of u_2, u_3 and u_4. Give your answers as fractions. **[2]**

2 **(i)** Evaluate $\displaystyle\sum_{r=2}^{5} \frac{1}{r-1}$. **[2]**

(ii) Express the series $2 \times 3 + 3 \times 4 + 4 \times 5 + 5 \times 6 + 6 \times 7$ in the form $\displaystyle\sum_{r=2}^{a} \mathrm{f}(r)$ where $\mathrm{f}(r)$ and a are to be determined. **[2]**

3 **(i)** Differentiate $x^3 - 6x^2 - 15x + 50$. **[2]**

(ii) Hence find the x-coordinates of the stationary points on the curve $y = x^3 - 6x^2 - 15x + 50$. **[3]**

4 In this question, $\mathrm{f}(x) = x^2 - 5x$. Fig. 4 shows a sketch of the graph of $y = \mathrm{f}(x)$.

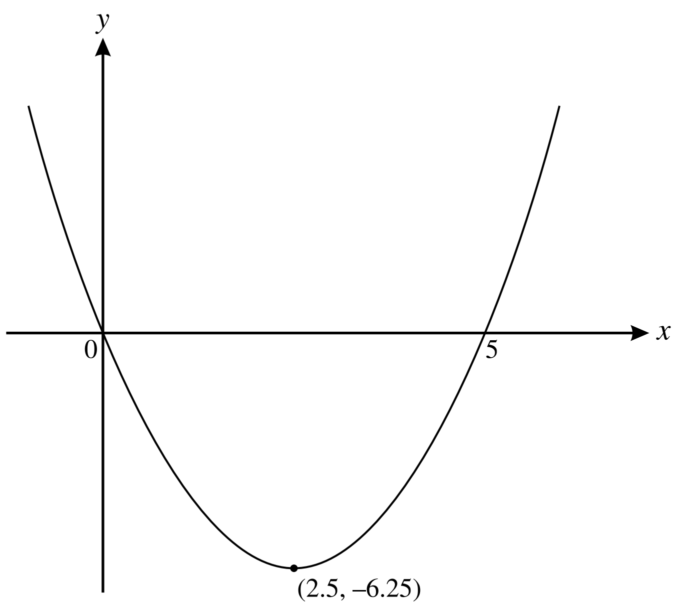

Fig. 4

On separate diagrams, sketch the curves $y = \mathrm{f}(2x)$ and $y = 3\mathrm{f}(x)$, labelling the coordinates of their intersections with the axes and their turning points. **[4]**

5 Find $\int_2^5 \left(1 - \frac{6}{x^3}\right) \mathrm{d}x$. **[4]**

6 The gradient of a curve is $6x^2 + 12x^{\frac{1}{2}}$. The curve passes through the point (4, 10). Find the equation of the curve. **[5]**

7 Express $\log_a x^3 + \log_a \sqrt{x}$ in the form $k \log_a x$. **[2]**

8 Showing your method clearly, solve the equation $4\sin^2\theta = 3 + \cos^2\theta$, for values of θ between $0°$ and $360°$. **[5]**

9 The points (2, 6) and (3, 18) lie on the curve $y = ax^n$.

Use logarithms to find the values of a and n, giving your answers correct to 2 decimal places. **[5]**

Section B (36 marks)

10 **(i)** Find the equation of the tangent to the curve $y = x^4$ at the point where $x = 2$. Give your answer in the form $y = mx + c$. **[4]**

(ii) Calculate the gradient of the chord joining the points on the curve $y = x^4$ where $x = 2$ and $x = 2.1$. **[2]**

(iii) (A) Expand $(2 + h)^4$. **[3]**

(B) Simplify $\frac{(2+h)^4 - 2^4}{h}$. **[2]**

(C) Show how your result in part **(iii)** (B) can be used to find the gradient of $y = x^4$ at the point where $x = 2$. **[2]**

11 (a)

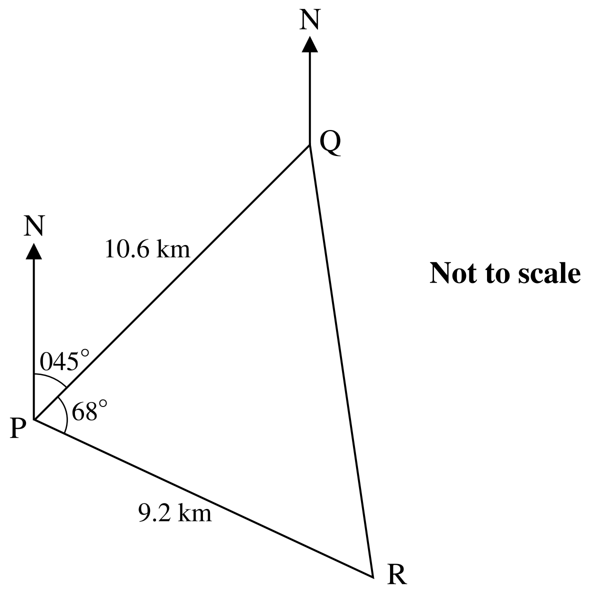

Fig. 11.1

A boat travels from P to Q and then to R. As shown in Fig. 11.1, Q is 10.6 km from P on a bearing of 045°. R is 9.2 km from P on a bearing of 113°, so that angle QPR is 68°.

Calculate the distance and bearing of R from Q. **[5]**

(b) Fig. 11.2 shows the cross-section, EBC, of the rudder of a boat.

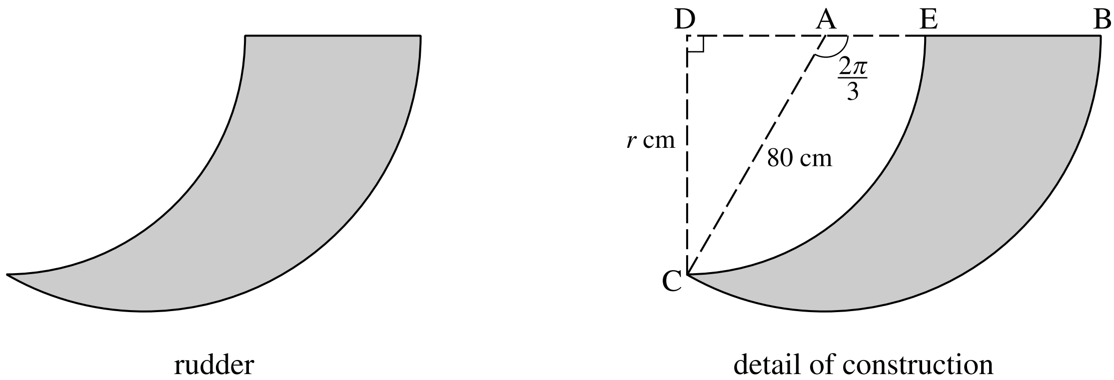

Fig. 11.2

BC is an arc of a circle with centre A and radius 80 cm. Angle CAB = $\frac{2\pi}{3}$ radians.

EC is an arc of a circle with centre D and radius r cm. Angle CDE is a right angle.

(i) Calculate the area of sector ABC. **[2]**

(ii) Show that $r = 40\sqrt{3}$ and calculate the area of triangle CDA. **[3]**

(iii) Hence calculate the area of cross-section of the rudder. **[3]**

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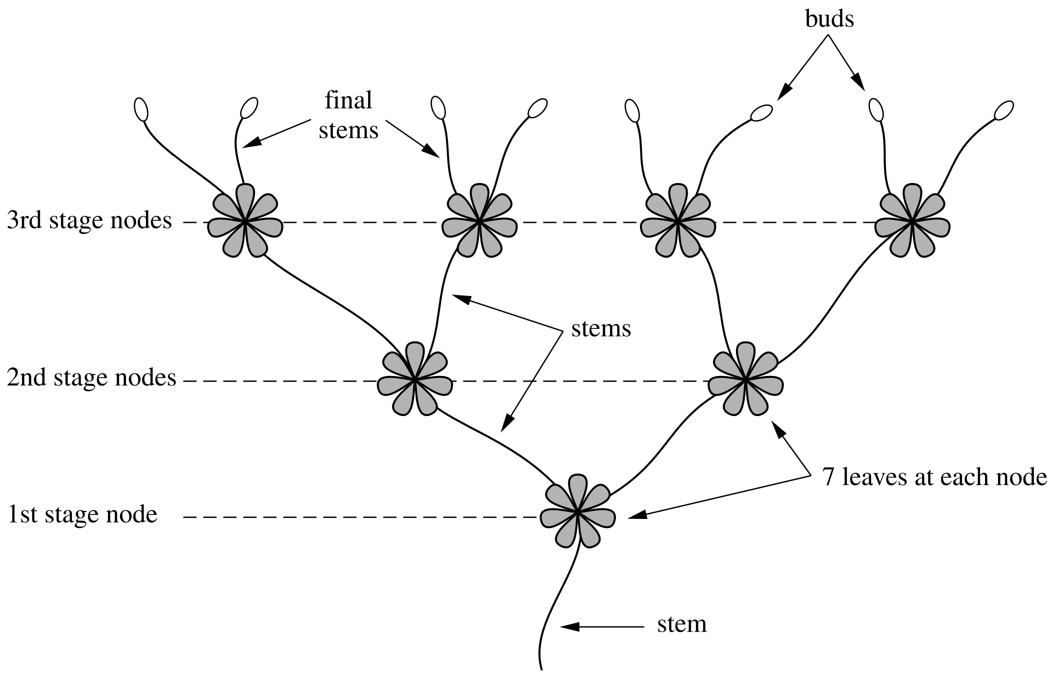

Fig. 12

A branching plant has stems, nodes, leaves and buds.

- There are 7 leaves at each node.
- From each node, 2 new stems grow.
- At the end of each final stem, there is a bud.

Fig. 12 shows one such plant with 3 stages of nodes. It has 15 stems, 7 nodes, 49 leaves and 8 buds.

(i) One of these plants has 10 stages of nodes.

(A) How many buds does it have? **[2]**

(B) How many stems does it have? **[2]**

(ii) (A) Show that the number of leaves on one of these plants with n stages of nodes is

$$7(2^n - 1).$$ **[2]**

(B) One of these plants has n stages of nodes and more than 200 000 leaves. Show that n satisfies the inequality $n > \dfrac{\log_{10} 200\,007 - \log_{10} 7}{\log_{10} 2}$. Hence find the least possible value of n. **[4]**