OCR
RECOGNISING ACHIEVEMENT

# Friday 18 January 2013 – Afternoon

## AS GCE MATHEMATICS (MEI)

**4752/01** Concepts for Advanced Mathematics (C2)

**QUESTION PAPER**



Candidates answer on the Printed Answer Book.

**OCR supplied materials:**
- Printed Answer Book 4752/01
- MEI Examination Formulae and Tables (MF2)

**Other materials required:**
- Scientific or graphical calculator

**Duration:** 1 hour 30 minutes

### INSTRUCTIONS TO CANDIDATES

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

- The Question Paper will be found in the centre of the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **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. HB pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure 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 scientific or 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 recycled. Please contact OCR Copyright should you wish to re-use this document.

**Section A** (36 marks)

**1** Find $\int 30x^{\frac{3}{2}}\,dx$. **[3]**

**2** For each of the following sequences, state with a reason whether it is convergent, periodic or neither. Each sequence continues in the pattern established by the given terms.

**(i)** $3,\ \frac{3}{2},\ \frac{3}{4},\ \frac{3}{8},\ \ldots$ **[1]**

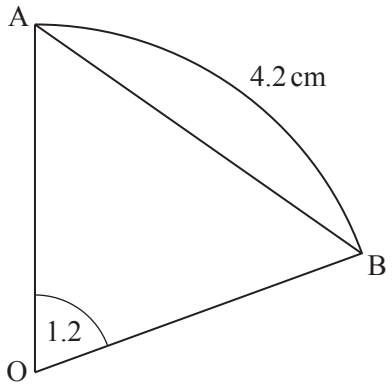
**(ii)** $3,\ 7,\ 11,\ 15,\ \ldots$ **[1]**

**(iii)** $3,\ 5,\ -3,\ -5,\ 3,\ 5,\ -3,\ -5,\ \ldots$ **[1]**

**3** **(i)** The point P (4, –2) lies on the curve $y = \mathrm{f}(x)$. Find the coordinates of the image of P when the curve is transformed to $y = \mathrm{f}(5x)$. **[2]**

**(ii)** Describe fully a single transformation which maps the curve $y = \sin x°$ onto the curve $y = \sin(x - 90)°$. **[2]**

**4**




**Not to scale**

**Fig. 4**

Fig. 4 shows sector OAB with sector angle 1.2 radians and arc length 4.2 cm. It also shows chord AB.

**(i)** Find the radius of this sector. **[2]**

**(ii)** Calculate the perpendicular distance of the chord AB from O. **[2]**

**5** A and B are points on the curve $y = 4\sqrt{x}$. Point A has coordinates (9, 12) and point B has $x$-coordinate 9.5. Find the gradient of the chord AB.

The gradient of AB is an approximation to the gradient of the curve at A. State the $x$-coordinate of a point C on the curve such that the gradient of AC is a closer approximation. **[3]**

**6** Differentiate $2x^3 + 9x^2 - 24x$. Hence find the set of values of $x$ for which the function $f(x) = 2x^3 + 9x^2 - 24x$ is increasing. **[4]**

**7** Fig. 7 shows a sketch of a village green ABC which is bounded by three straight roads. AB = 92 m, BC = 75 m and AC = 105 m.

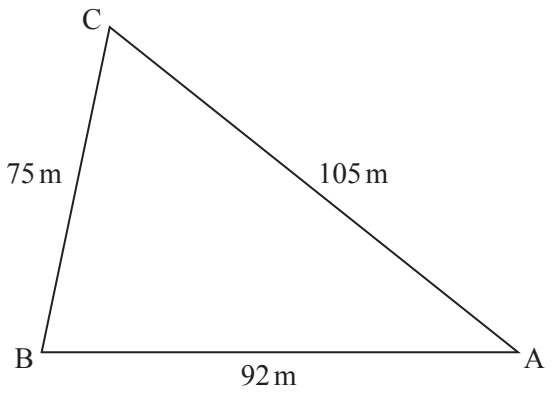



**Fig. 7**

Calculate the area of the village green. **[5]**

**8** **(i)** Sketch the graph of $y = 3^x$. **[2]**

**(ii)** Solve the equation $3^{5x-1} = 500000$. **[3]**

**9** **(i)** Show that the equation $\frac{\tan\theta}{\cos\theta} = 1$ may be rewritten as $\sin\theta = 1 - \sin^2\theta$. **[2]**

**(ii)** Hence solve the equation $\frac{\tan\theta}{\cos\theta} = 1$ for $0° \leqslant \theta \leqslant 360°$. **[3]**

**Section B** (36 marks)

**10** Fig. 10 shows a sketch of the curve $y = x^2 - 4x + 3$. The point A on the curve has $x$-coordinate 4. At point B the curve crosses the $x$-axis.

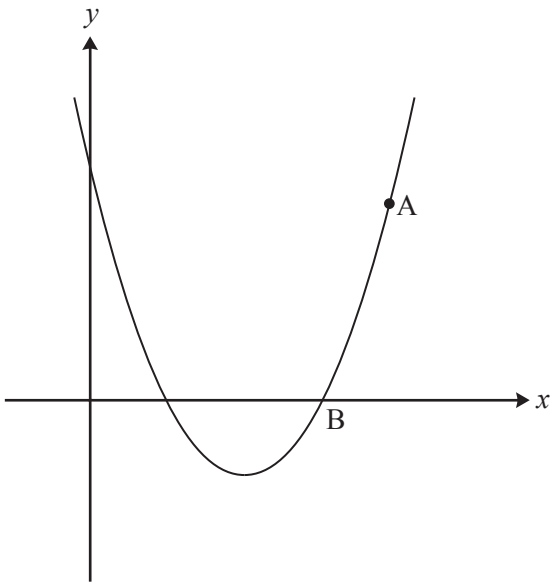



**Fig. 10**

**(i)** Use calculus to find the equation of the normal to the curve at A and show that this normal intersects the $x$-axis at C (16, 0). **[6]**

**(ii)** Find the area of the region ABC bounded by the curve, the normal at A and the $x$-axis. **[5]**

**11** **(i)** An arithmetic progression has first term $A$ and common difference $D$. The sum of its first two terms is 25 and the sum of its first four terms is 250.

($A$) Find the values of $A$ and $D$. **[4]**

($B$) Find the sum of the 21st to 50th terms inclusive of this sequence. **[3]**

**(ii)** A geometric progression has first term $a$ and common ratio $r$, with $r \neq \pm 1$. The sum of its first two terms is 25 and the sum of its first four terms is 250.

Use the formula for the sum of a geometric progression to show that $\frac{r^4 - 1}{r^2 - 1} = 10$ and hence or otherwise find algebraically the possible values of $r$ and the corresponding values of $a$. **[5]**

**12** The table shows population data for a country.

| Year | 1969 | 1979 | 1989 | 1999 | 2009 |
|---|---|---|---|---|---|
| Population in millions ($p$) | 58.81 | 80.35 | 105.27 | 134.79 | 169.71 |

The data may be represented by an exponential model of growth. Using $t$ as the number of years after 1960, a suitable model is $p = a \times 10^{kt}$.

**(i)** Derive an equation for $\log_{10} p$ in terms of $a$, $k$ and $t$. **[2]**

**(ii)** Complete the table and draw the graph of $\log_{10} p$ against $t$, drawing a line of best fit by eye. **[3]**

**(iii)** Use your line of best fit to express $\log_{10} p$ in terms of $t$ and hence find $p$ in terms of $t$. **[4]**

**(iv)** According to the model, what was the population in 1960? **[1]**

**(v)** According to the model, when will the population reach 200 million? **[3]**