

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI)

Concepts for Advanced Mathematics (C2)

4752

Candidates answer on the Answer Booklet

OCR Supplied Materials:

- 8 page Answer Booklet
- Insert for Question 10 (inserted)
- MEI Examination Formulae and Tables (MF2)

Other Materials Required:

None

Friday 22 May 2009

Morning

Duration: 1 hour 30 minutes



INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- 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.
- There is an **insert** for use in Question 10.
- 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

- 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.
- The total number of marks for this paper is **72**.
- This document consists of **4** pages. Any blank pages are indicated.

Section A (36 marks)

- 1 Use an isosceles right-angled triangle to show that $\cos 45^\circ = \frac{1}{\sqrt{2}}$. [2]
- 2 Find $\int_1^2 (12x^5 + 5) \, dx$. [4]
- 3 (i) Find $\sum_{k=3}^8 (k^2 - 1)$. [2]
- (ii) State whether the sequence with k th term $k^2 - 1$ is convergent or divergent, giving a reason for your answer. [1]
- 4 A sector of a circle of radius 18.0 cm has arc length 43.2 cm.
- (i) Find in radians the angle of the sector. [2]
- (ii) Find this angle in degrees, giving your answer to the nearest degree. [2]
- 5 (i) On the same axes, sketch the graphs of $y = \cos x$ and $y = \cos 2x$ for values of x from 0 to 2π . [3]
- (ii) Describe the transformation which maps the graph of $y = \cos x$ onto the graph of $y = 3 \cos x$. [2]
- 6 Use calculus to find the x -coordinates of the turning points of the curve $y = x^3 - 6x^2 - 15x$.
Hence find the set of values of x for which $x^3 - 6x^2 - 15x$ is an increasing function. [5]
- 7 Show that the equation $4 \cos^2 \theta = 4 - \sin \theta$ may be written in the form
 $4 \sin^2 \theta - \sin \theta = 0$.
Hence solve the equation $4 \cos^2 \theta = 4 - \sin \theta$ for $0^\circ \leq \theta \leq 180^\circ$. [5]
- 8 The gradient of a curve is $3\sqrt{x} - 5$. The curve passes through the point (4, 6). Find the equation of the curve. [5]
- 9 Simplify
- (i) $10 - 3 \log_a a$, [1]
- (ii) $\frac{\log_{10} a^5 + \log_{10} \sqrt{a}}{\log_{10} a}$. [2]

Section B (36 marks)

10 Answer part (i) of this question on the insert provided.

Ash trees grow quickly for the first years of their life, then more slowly. This table shows the height of a tree at various ages.

Age (t years)	4	7	10	15	20	40
Height (h m)	4	9	12	17	19	26

The height, h m, of an ash tree when it is t years old may be modelled by an equation of the form

$$h = a \log_{10} t + b.$$

- (i) **On the insert**, complete the table and plot h against $\log_{10} t$, drawing by eye a line of best fit. [3]
- (ii) Use your graph to find an equation for h in terms of $\log_{10} t$ for this model. [3]
- (iii) Find the height of the tree at age 100 years, as predicted by this model. [1]
- (iv) Find the age of the tree when it reaches a height of 29 m, according to this model. [3]
- (v) Comment on the suitability of the model when the tree is very young. [2]
- 11 (i) In a 'Make Ten' quiz game, contestants get £10 for answering the first question correctly, then a further £20 for the second question, then a further £30 for the third, and so on, until they get a question wrong and are out of the game.
- (A) Haroon answers six questions correctly. Show that he receives a total of £210. [1]
- (B) State, in a simple form, a formula for the total amount received by a contestant who answers n questions correctly.
- Hence find the value of n for a contestant who receives £10 350 from this game. [4]
- (ii) In a 'Double Your Money' quiz game, contestants get £5 for answering the first question correctly, then a further £10 for the second question, then a further £20 for the third, and so on doubling the amount for each question until they get a question wrong and are out of the game.
- (A) Gary received £75 from the game. How many questions did he get right? [1]
- (B) Bethan answered 9 questions correctly. How much did she receive from the game? [2]
- (C) State a formula for the total amount received by a contestant who answers n questions correctly.
- Hence find the value of n for a contestant in this game who receives £2 621 435. [4]

[Question 12 is printed overleaf.]

- 12 (i) Calculate the gradient of the chord joining the points on the curve $y = x^2 - 7$ for which $x = 3$ and $x = 3.1$. [2]
- (ii) Given that $f(x) = x^2 - 7$, find and simplify $\frac{f(3+h) - f(3)}{h}$. [3]
- (iii) Use your result in part (ii) to find the gradient of $y = x^2 - 7$ at the point where $x = 3$, showing your reasoning. [2]
- (iv) Find the equation of the tangent to the curve $y = x^2 - 7$ at the point where $x = 3$. [2]
- (v) This tangent crosses the x -axis at the point P. The curve crosses the positive x -axis at the point Q. Find the distance PQ, giving your answer correct to 3 decimal places. [3]

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