



Tuesday 21 June 2016 – Morning

A2 GCE MATHEMATICS

4723/01 Core Mathematics 3

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:

- Printed Answer Book 4723/01
- List of Formulae (MF1)

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 inside 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.
- Answer all the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Do not write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.

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 reminded of the need for clear presentation in your answers.
- 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.

INSTRUCTION TO EXAMS OFFICER/INVIGILATOR

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Answer all the questions

1 Find the equation of the tangent to the curve

$$y = 3x^2(x+2)^6$$

at the point (-1, 3), giving your answer in the form y = mx + c.

[5]

2 Find

(i)
$$\int \left(2 - \frac{1}{x}\right)^2 \mathrm{d}x,$$

(ii)
$$\int (4x+1)^{\frac{1}{3}} dx$$
.

[5]

3 The mass of a substance is decreasing exponentially. Its mass is *m* grams at time *t* years. The following table shows certain values of *t* and *m*.

| t | 0 | 5 | 10 | 25 |
|---|-----|-----|----|----|
| m | 200 | 160 | | |

(i) Find the values missing from the table.

[2]

(ii) Determine the value of t, correct to the nearest integer, for which the mass is 50 grams.

[4]

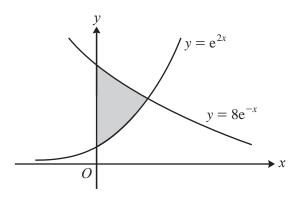
4 It is given that A and B are angles such that

$$\sec^2 A - \tan A = 13$$
 and $\sin B \sec^2 B = 27 \cos B \csc^2 B$.

Find the possible exact values of tan(A - B).

[8]

5



The diagram shows the curves $y = e^{2x}$ and $y = 8e^{-x}$. The shaded region is bounded by the curves and the y-axis. Without using a calculator,

(i) solve an appropriate equation to show that the curves intersect at a point for which $x = \ln 2$, [2]

(ii) find the area of the shaded region, giving your answer in simplified form.

[5]

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6 The curves C_1 and C_2 have equations

$$y = \ln(4x - 7) + 18$$
 and $y = a(x^2 + b)^{\frac{1}{2}}$

respectively, where a and b are positive constants. The point P lies on both curves and has x-coordinate 2. It is given that the gradient of C_1 at P is equal to the gradient of C_2 at P. Find the values of a and b.

- 7 (i) By sketching the curves y = x(2x+5) and $y = \cos^{-1}x$ (where y is in radians) in a single diagram, show that the equation $x(2x+5) = \cos^{-1}x$ has exactly one real root. [3]
 - (ii) Use the iterative formula

$$x_{n+1} = \frac{\cos^{-1} x_n}{2x_n + 5}$$
 with $x_1 = 0.25$

to find the root correct to 3 significant figures. Show the result of each iteration correct to at least 4 significant figures. [4]

(iii) Two new curves are obtained by transforming each of the curves y = x(2x+5) and $y = \cos^{-1}x$ by the pair of transformations:

reflection in the x-axis followed by reflection in the y-axis.

State an equation of each of the new curves and determine the coordinates of their point of intersection, giving each coordinate correct to 3 significant figures. [4]

8 The functions f and g are defined for all real values of x by

$$f(x) = |2x + a| + 3a$$
 and $g(x) = 5x - 4a$,

where a is a positive constant.

- (i) State the range of f and the range of g. [2]
- (ii) State why f has no inverse, and find an expression for $g^{-1}(x)$. [3]
- (iii) Solve for x the equation gf(x) = 31a. [5]
- 9 (i) Show that $\sin 2\theta (\tan \theta + \cot \theta) \equiv 2$. [4]
 - (ii) Hence

(a) find the exact value of
$$\tan \frac{1}{12}\pi + \tan \frac{1}{8}\pi + \cot \frac{1}{12}\pi + \cot \frac{1}{8}\pi$$
, [3]

(b) solve the equation
$$\sin 4\theta (\tan \theta + \cot \theta) = 1$$
 for $0 < \theta < \frac{1}{2}\pi$, [3]

(c) express
$$(1-\cos 2\theta)^2 \left(\tan \frac{1}{2}\theta + \cot \frac{1}{2}\theta\right)^3$$
 in terms of $\sin \theta$. [2]

END OF QUESTION PAPER

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