



Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

A-level MATHEMATICS

Unit Pure Core 3

Wednesday 13 June 2018

Morning

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	



J U N 1 8 M P C 3 0 1

PB/Jun18/E3

MPC3

Answer **all** questions.

Answer each question in the space provided for that question.

1 (a) Find $\frac{dy}{dx}$ when $y = (5 + 3x^2)^{\frac{1}{2}}$.

[2 marks]

(b) Find $\int (1 + \sin 4x) dx$.

[3 marks]

QUESTION
PART
REFERENCE

Answer space for question 1



2 (a) By writing $\cot x$ as $\frac{\cos x}{\sin x}$, use the quotient rule to show that $\frac{d}{dx}(\cot x) = -\operatorname{cosec}^2 x$. **[2 marks]**

(b) The curve with equation $x = \frac{\pi}{12} - y + \cot 3y$ is defined for $0 < y < \frac{\pi}{3}$.

(i) Find $\frac{dx}{dy}$ in terms of y .

[2 marks]

(ii) Hence find the exact equation of the tangent to the curve at the point $\left(1, \frac{\pi}{12}\right)$, giving your answer in the form $y = mx + c$, where m is a rational number.

[4 marks]

QUESTION
PART
REFERENCE

Answer space for question 2



3 (a) (i) Sketch the graph of $y = \ln(2x)$, stating the coordinates of any point where the curve crosses the coordinate axes.

[2 marks]

(ii) Describe a sequence of two geometrical transformations that maps the graph of $y = \ln(2x)$ onto the graph of $y = \ln(3 + 4x)$.

[4 marks]

(b) (i) Use Simpson's rule with five ordinates (four strips) to find an approximate value for $\int_1^3 \ln(3 + 4x) dx$, giving your answer to five significant figures.

[4 marks]

(ii) Given that the value of $\int_1^3 \ln(3 + 4x) dx$ is A ,
show that the value of $\int_1^3 \ln(3e + 4ex) dx$ is $A + 2$.

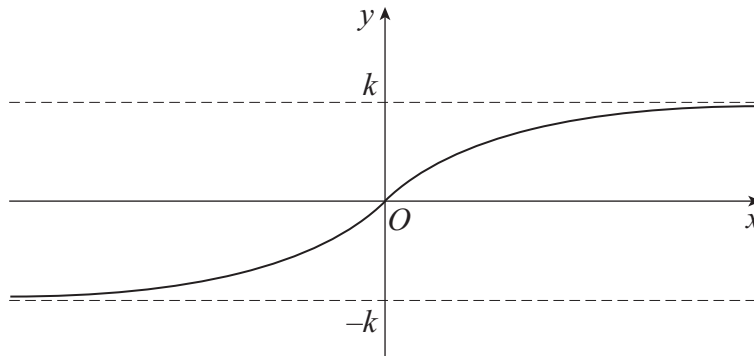
[2 marks]

QUESTION
PART
REFERENCE

Answer space for question 3



- 4 (a) The function f , given by $f(x) = \tan^{-1} x$, is defined for all values of x . The graph of $y = f(x)$ is sketched below.



- (i) The range of f is $-k < f(x) < k$. State the exact value of k . [1 mark]

- (ii) On **Figure 1** below, sketch the graph of $y = |\tan^{-1} x|$. [1 mark]

- (iii) By drawing a suitable straight line on your sketch on **Figure 1**, show that the equation

$$|\tan^{-1} x| - 7x - 3 = 0$$

has exactly one real root.

[2 marks]

- (b) The real root of the equation $|\tan^{-1} x| - 7x - 3 = 0$ is α . Show that α lies between -0.4 and -0.3 .

[2 marks]

- (c) Use the iterative formula

$$x_{n+1} = \frac{1}{7} (|\tan^{-1} x_n| - 3) \text{ with } x_1 = -0.4$$

to find the values of x_2 and x_3 , giving your answers to three decimal places.

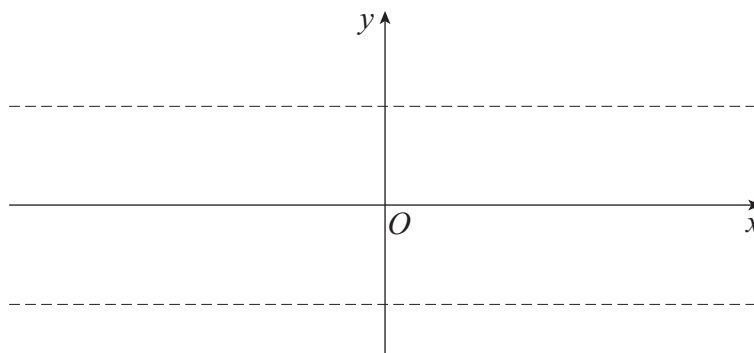
[2 marks]

QUESTION
PART
REFERENCE

Answer space for question 4

- (a)(i) $k = \dots\dots\dots$

Figure 1



5 The functions f and g are defined with their respective domains by

$$f(x) = \sqrt{2x+3} \quad \text{for } x \geq -1$$

$$g(x) = x^2 + 4x \quad \text{for all real values of } x$$

(a) The inverse of f is f^{-1} .

(i) Find $f^{-1}(x)$.

[3 marks]

(ii) State the domain of f^{-1} .

[1 mark]

(b) Find the range of g .

[3 marks]

(c) (i) Find $gf(x)$.

[1 mark]

(ii) Solve the equation $gf(x) = 21$.

[5 marks]

QUESTION
PART
REFERENCE

Answer space for question 5



6 Use the substitution $u = 2 + \ln x$ to show that

$$\int_1^e \frac{\ln x}{x(2 + \ln x)^2} dx = p + \ln q$$

where p and q are rational numbers.

[7 marks]

QUESTION
PART
REFERENCE

Answer space for question 6



8 (a) Show that the expression $\frac{\sec \theta}{\sec \theta - 1} + \frac{\sec \theta}{\sec \theta + 1}$ can be written as $2 \operatorname{cosec}^2 \theta$.

[3 marks]

(b) Hence solve the equation

$$\frac{\sec(2x + 0.4)}{\sec(2x + 0.4) - 1} + \frac{\sec(2x + 0.4)}{\sec(2x + 0.4) + 1} = 8 - \cot(2x + 0.4)$$

giving your answers in radians to three significant figures in the interval $0 < x < \pi$.

[7 marks]

QUESTION
PART
REFERENCE

Answer space for question 8



