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ADDITIONAL MATHEMATICS

0606/21

Paper 2

October/November 2023

2 hours

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Any blank pages are indicated.

Mathematical Formulae**1. ALGEBRA***Quadratic Equation*

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \dots + \binom{n}{r}a^{n-r}b^r + \dots + b^n$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

Arithmetic series $u_n = a + (n-1)d$

$$S_n = \frac{1}{2}n(a+l) = \frac{1}{2}n\{2a + (n-1)d\}$$

Geometric series $u_n = ar^{n-1}$

$$S_n = \frac{a(1-r^n)}{1-r} \quad (r \neq 1)$$

$$S_\infty = \frac{a}{1-r} \quad (|r| < 1)$$

2. TRIGONOMETRY*Identities*

$$\begin{aligned}\sin^2 A + \cos^2 A &= 1 \\ \sec^2 A &= 1 + \tan^2 A \\ \operatorname{cosec}^2 A &= 1 + \cot^2 A\end{aligned}$$

Formulae for $\triangle ABC$

$$\begin{aligned}\frac{a}{\sin A} &= \frac{b}{\sin B} = \frac{c}{\sin C} \\ a^2 &= b^2 + c^2 - 2bc \cos A \\ \Delta &= \frac{1}{2}bc \sin A\end{aligned}$$

1 (a) Write $19 - 12x - 3x^2$ in the form $a(x + b)^2 + c$ where a , b and c are integers. [4]

(b) Hence find the maximum value of $19 - 12x - 3x^2$ and the value of x at which this maximum occurs. [2]

(c) Use your answer to **part (a)** to solve the equation $19 - 12\sqrt{u} - 3u = 0$. [3]

2 Solve the following simultaneous equations.

$$5x - 3 \ln y = 2$$

$$x + \ln y = 1$$

[4]

3 (a) Find $\int \left(4x + 5 - \frac{1}{2x+3}\right) dx$. [3]

(b) Hence find the exact value of $\int_1^3 \left(4x + 5 - \frac{1}{2x+3}\right) dx$, simplifying your answer. [3]

4 In this question a and b are integers.

Three terms in the expansion of $(2 + ax)^5(1 + bx)$ are $32 + 112x - 240x^2$. Find the values of a and b .
[7]

5 In this question p and q are constants.

The normal to the curve $y = \frac{p}{x^2} + 5x - 2$, at the point where $x = 1$, has equation $y = -x + q$.

Find the values of p and q .

[6]

- 6 Find the value of the constant a for which the line $y = (2a + 1)x - 10$ is a tangent to the curve $y = ax^2 - 5x + 2$. [6]

7 A particle moves in a straight line. At time t seconds after passing through a fixed point O , its velocity, $v \text{ ms}^{-1}$, is given by $v = 10 \sin 2t - 6 \cos 2t$.

(a) Find an expression for the acceleration of the particle. [2]

(b) Find the acceleration when $t = \frac{\pi}{4}$. [1]

(c) Find the first time at which the acceleration is zero. [3]

(d) Find the displacement of the particle between $t = \frac{\pi}{4}$ and $t = \frac{\pi}{2}$. [4]

8 DO NOT USE A CALCULATOR IN THIS QUESTION.

Solve the equation $(2 - \sqrt{10})x^2 + x + (2 + \sqrt{10}) = 0$, giving your answers in the form $a + b\sqrt{10}$, where a and b are rational. [7]

9 The functions f and g are defined as follows, for all real values of x .

$$f(x) = 2x^2 - 1$$

$$g(x) = e^x + 1$$

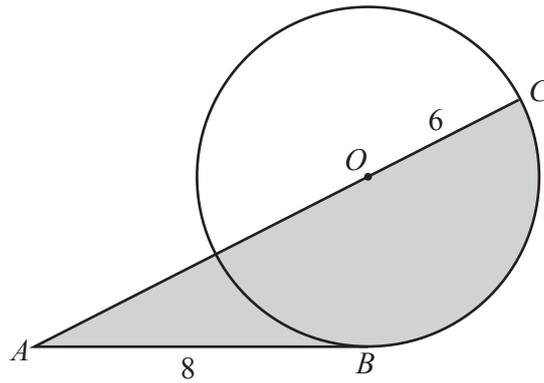
(a) Solve the equation $fg(x) = 8$.

[3]

(b) For each of the functions f and g , either explain why the inverse function does not exist or find the inverse function, stating its domain.

[4]

10 In this question all lengths are in centimetres.



The diagram shows a circle centre O with radius 6 . The line AB is a tangent to the circle at the point B . The point C lies on the circle such that AOC is a straight line. $AB = 8$.

(a) Find the perimeter of the shaded region.

[6]

(b) Find the area of the shaded region.

[3]

11 (a) Show that $\frac{1}{\sec x - \operatorname{cosec} x} + \frac{1}{\sec x + \operatorname{cosec} x} = \frac{2 \cos x}{1 - \cot^2 x}$. [5]

(b) Solve the equation $3 \tan^2\left(y + \frac{\pi}{4}\right) = 1$ for $-2\pi < y < 0$.

[4]

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