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ADDITIONAL MATHEMATICS

0606/21

Paper 2

October/November 2022

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 ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\Delta = \frac{1}{2}bc \sin A$$

- 1 Solve the following simultaneous equations, giving your answers in the form $a+b\sqrt{7}$ where a and b are integers.

$$x+3y = 11$$

$$x-\sqrt{7}y = 7$$

[5]

2 DO NOT USE A CALCULATOR IN THIS QUESTION.

Find the x -coordinates of the points where the line $y = 3x - 8$ cuts the curve $y = 2x^3 + 3x^2 - 26x + 22$. [5]

3 (a) Find the coordinates of the point on the curve $y = \sqrt{1 + 3x}$ where the gradient of the normal is $-\frac{8}{3}$. [5]

(b) Find the equation of the normal to the curve $y = \sqrt{1 + 3x}$ at the point (8, 5) in the form $y = mx + c$. [3]

4 Solve the following equations, giving your answers to 3 significant figures.

(a) $2^{3x+1} = 5^{x-2}$ [3]

(b) $e^{2y+1} = 1 + \frac{6}{e^{2y+1}}$ [4]

5 You are given that $y = \frac{1}{\cos 2x}$.

(a) Show that $\frac{dy}{dx} = \frac{k \sin 2x}{\cos^2 2x}$ where k is a constant to be found.

[2]

(b) Find the values of x such that $\frac{dy}{dx} = \frac{5}{\sin 2x}$ for $0 < x < \frac{\pi}{2}$.

[4]

6 (a) Write $3x^2 + 15x - 20$ in the form $a(x+b)^2 + c$ where a , b and c are rational numbers. [4]

(b) State the minimum value of $3x^2 + 15x - 20$ and the value of x at which it occurs. [2]

(c) Use your answer to **part (a)** to solve the equation $3y^{\frac{2}{3}} + 15y^{\frac{1}{3}} - 20 = 0$, giving your answers correct to three significant figures. [3]

- 7 The sum of the first three terms of a geometric progression is 17.5 and the sum to infinity is 20.
Find the first term and the common ratio.

[6]

8 The equation of a curve is $y = x \sin x$.

(a) Find $\frac{dy}{dx}$.

[2]

(b) Find the equation of the tangent to the curve at $x = \frac{\pi}{2}$ in the form $y = mx + c$.

[3]

(c) Use your answer to **part (a)** to find $\int x \cos x \, dx$. [3]

(d) Evaluate $\int_0^{\frac{\pi}{4}} x \cos x \, dx$, giving your answer correct to 2 significant figures. [2]

- 9 The functions $f(x)$ and $g(x)$ are defined as follows for $x > -\frac{1}{3}$ by

$$\begin{aligned}f(x) &= x^2 + 1, \\g(x) &= \ln(3x + 2).\end{aligned}$$

- (a) Find $fg(x)$.

[1]

- (b) Solve the equation $fg(x) = 5$ giving your answer in exact form.

[3]

(c) Solve the equation $gg(x) = 1$.

[6]

- 10 The acceleration, $a \text{ ms}^{-2}$, of a particle at time t seconds is given by $a = -\frac{45}{(t+1)^2}$. When $t = 0$ the velocity of the particle is 50 ms^{-1} .

(a) Find an expression for the velocity of the particle in terms of t .

[4]

(b) Find the distance travelled by the particle between $t = 1$ and $t = 10$.

[4]

11 A 5-digit code is to be formed using 5 different numbers selected from 1, 2, 3, 4, 5, 6, 7, 8. Find how many possible codes there are if the code forms

(a) a number less than 60 000 that ends in a multiple of 3,

[3]

(b) an even number less than 60 000.

[3]

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