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ADDITIONAL MATHEMATICS**0606/21**

Paper 2

October/November 2021**2 hours**

You must answer on the question paper.

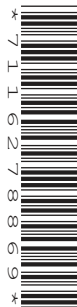
No additional materials are needed.

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 $\triangle ABC$

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

3

1 Solve the inequality $(x + 5)(x - 2) > 3x + 6$.

[3]

2 Solve the following simultaneous equations.

$$xy + x^2 = 15$$

$$y + 3x = 11$$

[5]

4

3 A curve has equation $y = \frac{2 + \sin 3x}{x + 1}$.

(a) Show that the exact value of $\frac{dy}{dx}$ at the point where $x = \frac{\pi}{6}$ can be written as $\frac{k}{\left(\frac{\pi}{6} + 1\right)^2}$, where k is an integer. [5]

(b) Find the equation of the normal to the curve at the point where $x = 0$. [4]

5

- 4** Find rational values a and b such that $\frac{a}{\sqrt{5}+2} + \frac{b}{\sqrt{5}-2} = 1$. [5]

6

5 It is given that $y = 3 \tan^2 x$ for $0^\circ < x < 360^\circ$.

(a) Show that $\frac{dy}{dx} = m \tan x \sec^2 x$ where m is an integer to be found. [2]

(b) Find all values of x such that $\frac{dy}{dx} = 3 \sec x \operatorname{cosec} x$. [5]

7

- 6** Find the values of m for which the line $y = mx - 2$ does not touch or cut the curve $y = (m + 1)x^2 + 8x + 1$.

[6]

8

- 7 (a)** Use logarithms to solve the following equation, giving your answer correct to 1 decimal place.

$$5^{x-2} = 3 \times 2^{2x+3} \quad [4]$$

- (b)** Solve the equation $\log_3(y^2 + 11) - 2 = \log_3(y - 1)$. [5]

9

8 Marc chooses 5 people from 4 men, 4 women and 2 children.

Find the number of ways that Marc can do this

(a) if there are no restrictions, [1]

(b) if at least 2 men are chosen, [3]

(c) if at least 1 man, at least 1 woman and at least 1 child are chosen. [3]

10

- 9** The following functions are defined for $x > 1$.

$$f(x) = \frac{x+3}{x-1} \qquad g(x) = 1+x^2$$

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

[2]

- (b)** Find $g^{-1}(x)$.

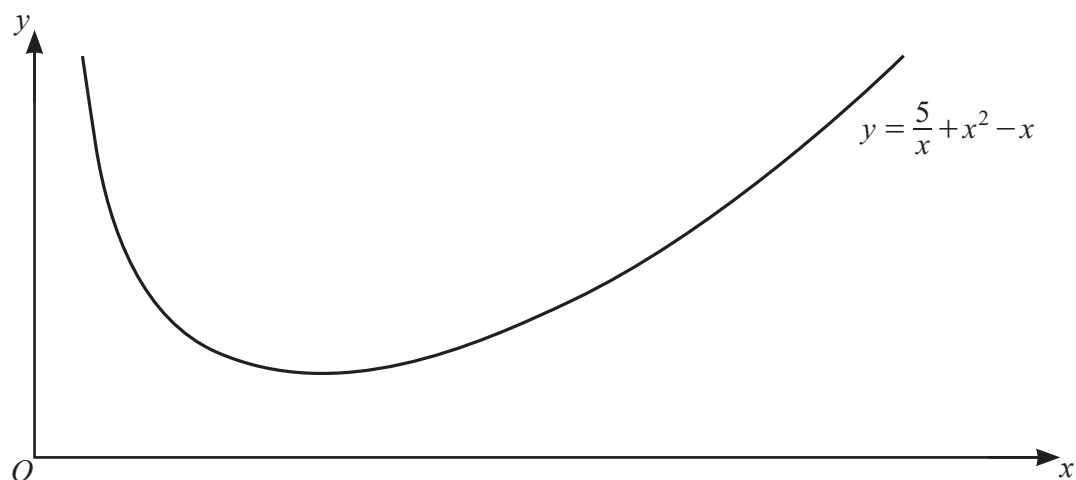
[2]

11**(c) DO NOT USE A CALCULATOR IN THIS PART OF THE QUESTION.**Solve the equation $f(x) = g(x)$.

[5]

12

10



The diagram shows part of the curve $y = \frac{5}{x} + x^2 - x$.

- (a) Find, in the form $y = mx + c$, the equation of the tangent to the curve at the point where $x = 1$.

[5]

13

- (b)** Find the exact area enclosed by the curve, the x -axis, and the lines $x = 1$ and $x = 3$. [4]

14

- 11** The volume, V , of a cone with base radius r and vertical height h is given by $\frac{1}{3}\pi r^2 h$.
The curved surface area of a cone with base radius r and slant height l is given by $\pi r l$.

A cone has base radius r cm, vertical height h cm and volume V cm³. The curved surface area of the cone is 4π cm².

- (a)** Show that $h^2 = \frac{16}{r^2} - r^2$. [4]

- (b)** Show that $V = \frac{\pi}{3}\sqrt{16r^2 - r^6}$. [2]

15

- (c) Given that r can vary and that V has a maximum value, find the value of r that gives the maximum volume. [5]

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