



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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4037/22

October/November 2022

2 hours

You must answer on the question paper.

No additional materials are needed.

- 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.

- 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 Solve the following simultaneous equations.

$$x + 5y = -4$$

$$3y - xy = 6$$

[5]

- 2 Solve the equation $4e^{2x-3} = 7e^{5-x}$.

[4]

3 In this question a and b are constants.

The normal to the curve $y = \frac{a}{x} + 3x - 2$ at the point where $x = 1$ has equation $y = -\frac{1}{4}x + b$.
Find the values of a and b . [6]

4 Solve the equation $\log_3(11x-8) = 1 + \frac{2}{\log_x 3}$ given that $x > 1$. [5]

5 DO NOT USE A CALCULATOR IN THIS QUESTION.

Find the x -coordinates of the points of intersection of the curves $y = 7x^3 - 7x^2 - 17x - 4$ and $y = x^3 - 2x^2 - 4x - 16$. [5]

- 6** A 4-digit code is to be formed using 4 different numbers selected from 2, 3, 4, 5, 6, 7, 8 and 9. Find how many possible codes there are if the code forms

(a) a number that is odd and greater than 5000, [3]

(b) a number greater than 5000 with a last digit that is prime. [3]

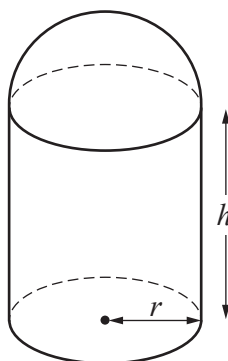
7 (a) Show that $\frac{\sin x}{1 - \cos x} + \frac{1 - \cos x}{\sin x} = 2 \operatorname{cosec} x$. [4]

(b) Hence solve the equation $\frac{\sin x}{1 - \cos x} + \frac{1 - \cos x}{\sin x} = 3 \sin x - 1$ for $0^\circ < x < 360^\circ$. [4]

8 In this question all lengths are in centimetres.

The volume of a cylinder with radius r and height h is $\pi r^2 h$ and its curved surface area is $2\pi r h$.

The volume of a sphere with radius r is $\frac{4}{3}\pi r^3$ and its surface area is $4\pi r^2$.



The diagram shows a solid object in the shape of a cylinder of base radius r and height h , with a hemisphere of radius r on top. The total surface area of the object is 300 cm^2 .

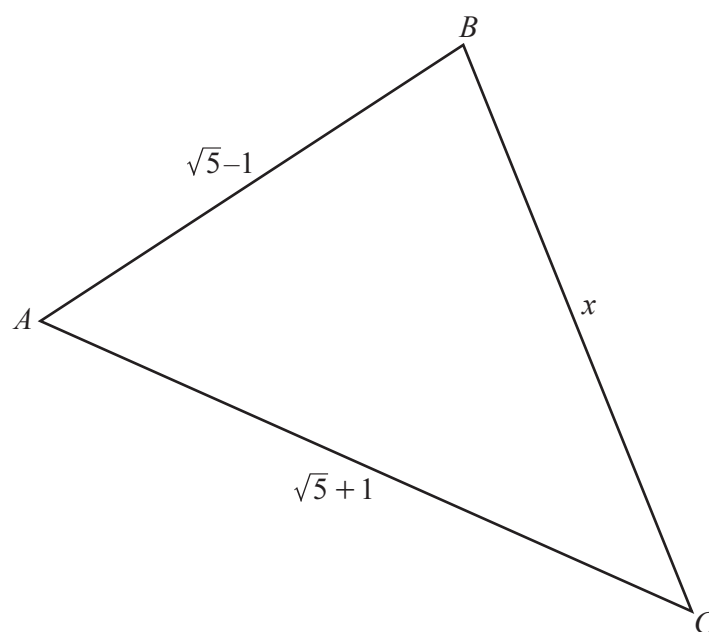
(a) Find an expression for h in terms of r . [2]

(b) Show that the volume, V , of the object is $150r - \frac{5}{6}\pi r^3$. [3]

(c) Find the maximum volume of the object as r varies.

[5]

- 9 In this question all lengths are in centimetres.



The diagram shows triangle ABC which has area $\frac{2\sqrt{5}}{3}\text{cm}^2$. Angle A is acute.

- (a) Find the exact value of $\sin A$.

[3]

(b) Find the exact value of $\cos A$ and hence find the exact value of x .

[5]

(c) Find the exact value of $\sin B$.

[3]

- 10 (a)** A geometric progression has third term 4.5 and sixth term 15.1875. Find the first term and the common ratio. [4]

- (b) Find the sum of ten terms of the progression, starting with the sixteenth term. Give your answer to the nearest integer. [4]

- 11** The coordinates of points A and B are $(-5, 6)$ and $(4, -6)$ respectively. The point C lies on the line AB , between A and B , such that $\frac{AC}{CB} = \frac{1}{2}$.

(a) Find the coordinates of C . [2]

(b) The line CD is perpendicular to AB . Find the equation of CD in the form $y = mx + c$. [4]

- (c) The length of BD is $\sqrt{125}$. Find the coordinates of the two possible positions of point D . [6]

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