



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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4037/22

October/November 2020

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. 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 inequality $(x - 8)(x - 10) > 35$.

[4]

- 2 Find the value of x such that $\frac{4^{x+1}}{2^{x-1}} = 32^{\frac{x}{3}} \times 8^{\frac{1}{3}}$.

[4]

- 3 (a) Find the equation of the perpendicular bisector of the line joining the points (12, 1) and (4, 3), giving your answer in the form $y = mx + c$. [5]

- (b) The perpendicular bisector cuts the axes at points A and B . Find the length of AB . [3]

- 4 Solve the simultaneous equations.

$$\log_3(x+y) = 2$$

$$2\log_3(x+1) = \log_3(y+2)$$

[6]

5 DO NOT USE A CALCULATOR IN THIS QUESTION.

- (a) Find the equation of the tangent to the curve $y = x^3 - 6x^2 + 3x + 10$ at the point where $x = 1$. [4]

- (b) Find the coordinates of the point where this tangent meets the curve again. [5]

6 Find the exact value of $\int_2^4 \frac{(x+1)^2}{x^2} dx$.

[6]

7 A geometric progression has a first term of 3 and a second term of 2.4. For this progression, find

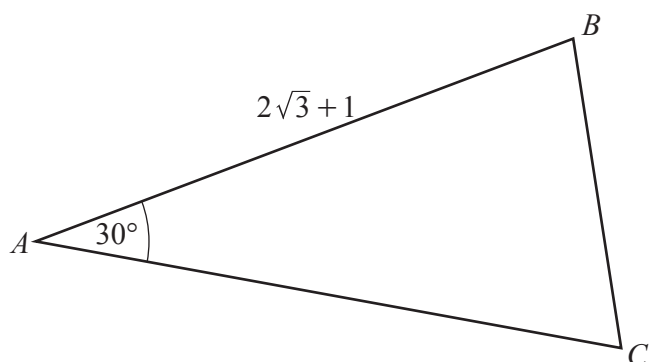
(a) the sum of the first 8 terms, [3]

(b) the sum to infinity, [1]

(c) the least number of terms for which the sum is greater than 95% of the sum to infinity. [4]

8 DO NOT USE A CALCULATOR IN THIS QUESTION.

In this question lengths are in centimetres.



You may use the following trigonometric ratios.

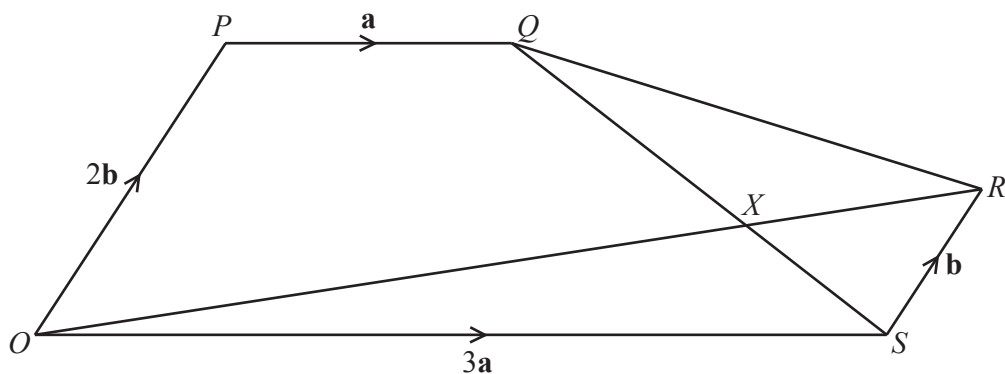
$$\sin 30^\circ = \frac{1}{2}$$

$$\cos 30^\circ = \frac{\sqrt{3}}{2}$$

$$\tan 30^\circ = \frac{1}{\sqrt{3}}$$

- (a) Given that the area of the triangle ABC is 5.5 cm^2 , find the exact length of AC . Write your answer in the form $a + b\sqrt{3}$, where a and b are integers. [4]

- (b) Show that $BC^2 = c + d\sqrt{3}$, where c and d are integers to be found. [4]



In the diagram $\vec{OP} = 2\mathbf{b}$, $\vec{OS} = 3\mathbf{a}$, $\vec{SR} = \mathbf{b}$ and $\vec{PQ} = \mathbf{a}$. The lines OR and QS intersect at X .

(a) Find $\vec{OQ}$ in terms of $\mathbf{a}$ and $\mathbf{b}$. [1]

(b) Find $\vec{QS}$ in terms of $\mathbf{a}$ and $\mathbf{b}$. [1]

(c) Given that $\vec{QX} = \mu\vec{QS}$, find $\vec{OX}$ in terms of $\mathbf{a}$, $\mathbf{b}$ and μ . [1]

(d) Given that $\vec{OX} = \lambda\vec{OR}$, find $\vec{OX}$ in terms of $\mathbf{a}$, $\mathbf{b}$ and λ . [1]

(e) Find the value of λ and of μ .

[3]

(f) Find the value of $\frac{OX}{XS}$.

[1]

(g) Find the value of $\frac{OR}{OX}$.

[1]

- 10** The number, b , of bacteria in a sample is given by $b = P + Qe^{2t}$, where P and Q are constants and t is time in weeks. Initially there are 500 bacteria which increase to 600 after 1 week.

(a) Find the value of P and of Q . [4]

(b) Find the number of bacteria present after 2 weeks.

[1]

(c) Find the first week in which the number of bacteria is greater than 1 000 000.

[3]

11 (a) Show that $\frac{\sin x \tan x}{1 - \cos x} = 1 + \sec x$.

[4]

- (b) Solve the equation $5 \tan x - 3 \cot x = 2 \sec x$ for $0^\circ \leq x \leq 360^\circ$. [6]

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