

Cambridge O Level

CANDIDATE NAME		
CENTRE NUMBER		CANDIDATE NUMBER
ADDITIONAL MATHEMATICS		4037/22
Paper 2		October/November 2020
		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 [].



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

$$\sin^2 A + \cos^2 A = 1$$
$$\sec^2 A = 1 + \tan^2 A$$
$$\csc^2 A = 1 + \cot^2 A$$

Formulae for $\triangle ABC$

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

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1 Solve the inequality (x-8)(x-10) > 35.

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]

[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
$$\int_2^4 \frac{(x+1)^2}{x^2} dx$$
.

7

- 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.

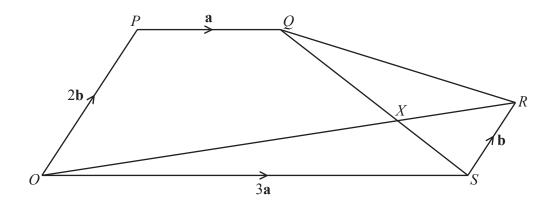
B

$$2\sqrt{3}+1$$

 A
 30°
 C
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 $\overrightarrow{OP} = 2\mathbf{b}$, $\overrightarrow{OS} = 3\mathbf{a}$, $\overrightarrow{SR} = \mathbf{b}$ and $\overrightarrow{PQ} = \mathbf{a}$. The lines *OR* and *QS* intersect at *X*. (a) Find \overrightarrow{OQ} in terms of **a** and **b**. [1]

(b) Find \overrightarrow{QS} in terms of **a** and **b**.

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

[1]

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

(e) Find the value of λ and of μ .

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

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

[1]

[1]

[3]

- 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.

(c) Find the first week in which the number of bacteria is greater than 1 000 000. [3]

[1]

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

[6]

(b) Solve the equation $5 \tan x - 3 \cot x = 2 \sec x$ for $0^{\circ} \le x \le 360^{\circ}$.

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