



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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0606/12

February/March 2021

2 hours

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.

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*

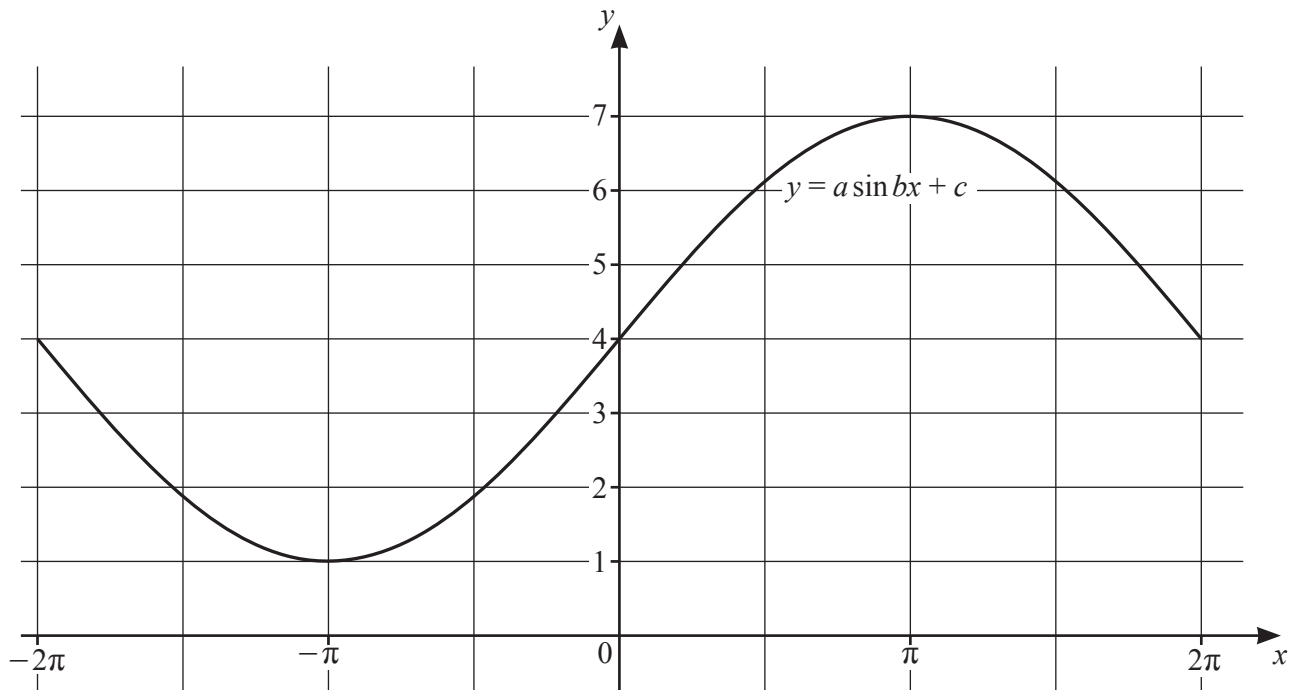
$$\begin{aligned}\sin^2 A + \cos^2 A &= 1 \\ \sec^2 A &= 1 + \tan^2 A \\ \operatorname{cosec}^2 A &= 1 + \cot^2 A\end{aligned}$$

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 Find the exact solutions of the equation $3(\ln 5x)^2 + 2 \ln 5x - 1 = 0$. [4]

2



The diagram shows the graph of $y = a \sin bx + c$ where x is in radians and $-2\pi \leq x \leq 2\pi$, where a , b and c are positive constants. Find the value of each of a , b and c . [3]

3 The line AB is such that the points A and B have coordinates $(-4, 6)$ and $(2, 14)$ respectively.

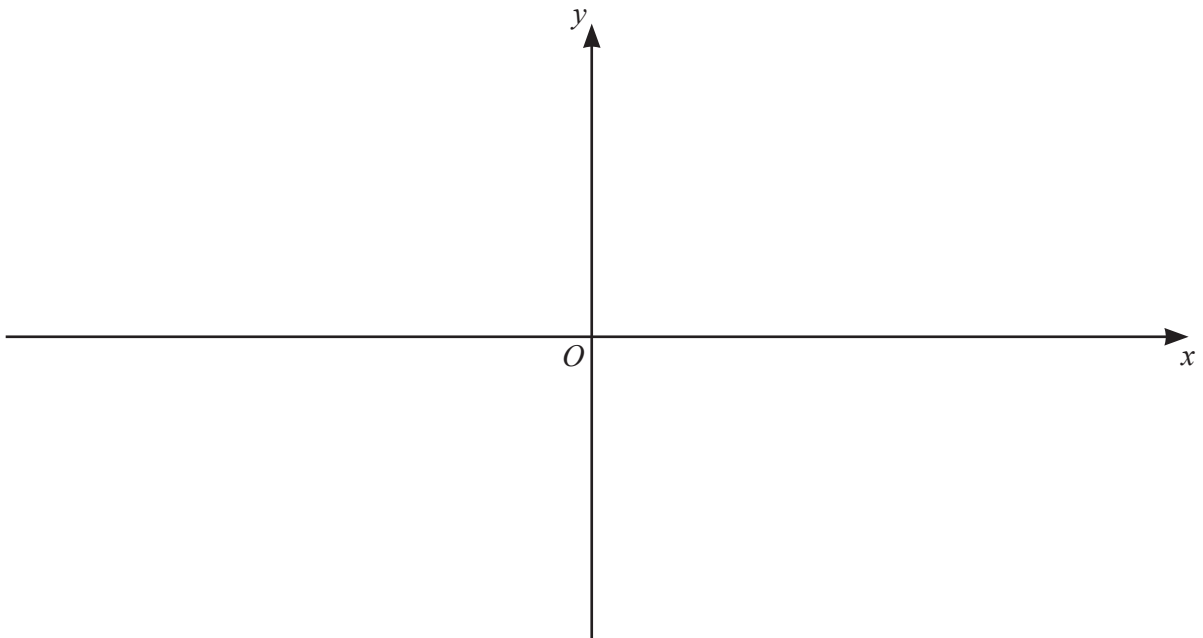
(a) The point C , with coordinates $(7, a)$ lies on the perpendicular bisector of AB . Find the value of a .
[4]

(b) Given that the point D also lies on the perpendicular bisector of AB , find the coordinates of D such that the line AB bisects the line CD .
[2]

- 4 (a) Show that $2x^2 + 5x - 3$ can be written in the form $a(x+b)^2 + c$, where a , b and c are constants. [3]

- (b) Hence write down the coordinates of the stationary point on the curve with equation $y = 2x^2 + 5x - 3$. [2]

- (c) On the axes below, sketch the graph of $y = |2x^2 + 5x - 3|$, stating the coordinates of the intercepts with the axes. [3]



- (d) Write down the value of k for which the equation $|2x^2 + 5x - 3| = k$ has exactly 3 distinct solutions. [1]

5 In this question all lengths are in kilometres and time is in hours.

Boat A sails, with constant velocity, from a point O with position vector $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$. After 3 hours A is at the point with position vector $\begin{pmatrix} -12 \\ 9 \end{pmatrix}$.

(a) Find the position vector, $\overrightarrow{OP}$, of A at time t . [1]

At the same time as A sails from O , boat B sails from a point with position vector $\begin{pmatrix} 12 \\ 6 \end{pmatrix}$, with constant velocity $\begin{pmatrix} -5 \\ 8 \end{pmatrix}$.

(b) Find the position vector, $\overrightarrow{OQ}$, of B at time t . [1]

(c) Show that at time t $|\overrightarrow{PQ}|^2 = 26t^2 + 36t + 180$. [3]

(d) Hence show that A and B do not collide. [2]

6 (a) A geometric progression has first term 10 and sum to infinity 6.

(i) Find the common ratio of this progression.

[2]

(ii) Hence find the sum of the first 7 terms, giving your answer correct to 2 decimal places. [2]

(b) The first three terms of an arithmetic progression are $\log_x 3$, $\log_x(3^2)$, $\log_x(3^3)$.

(i) Find the common difference of this progression. [1]

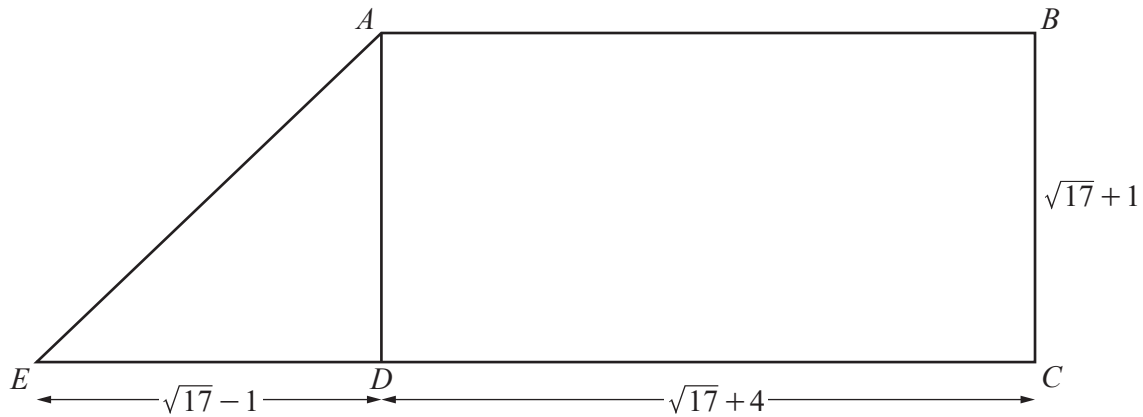
(ii) Find, in terms of n and $\log_x 3$, the sum to n terms of this progression. Simplify your answer. [2]

(iii) Given that the sum to n terms is $3081 \log_x 3$, find the value of n . [2]

(iv) Hence, given that the sum to n terms is also equal to 1027, find the value of x . [2]

7 DO NOT USE A CALCULATOR IN THIS QUESTION

In this question all lengths are in centimetres.



The diagram shows a trapezium $ABCDE$ such that AB is parallel to EC and $ABCD$ is a rectangle. It is given that $BC = \sqrt{17} + 1$, $ED = \sqrt{17} - 1$ and $DC = \sqrt{17} + 4$.

- (a) Find the perimeter of the trapezium, giving your answer in the form $a + b\sqrt{17}$, where a and b are integers. [3]

- (b) Find the area of the trapezium, giving your answer in the form $c + d\sqrt{17}$, where c and d are integers. [2]

- (c) Find $\tan AED$, giving your answer in the form $\frac{e+f\sqrt{17}}{8}$, where e and f are integers. [2]

- (d) Hence show that $\sec^2 AED = \frac{81+9\sqrt{17}}{32}$. [2]

8 (a) (i) Show that $\sin x \tan x + \cos x = \sec x$.

[3]

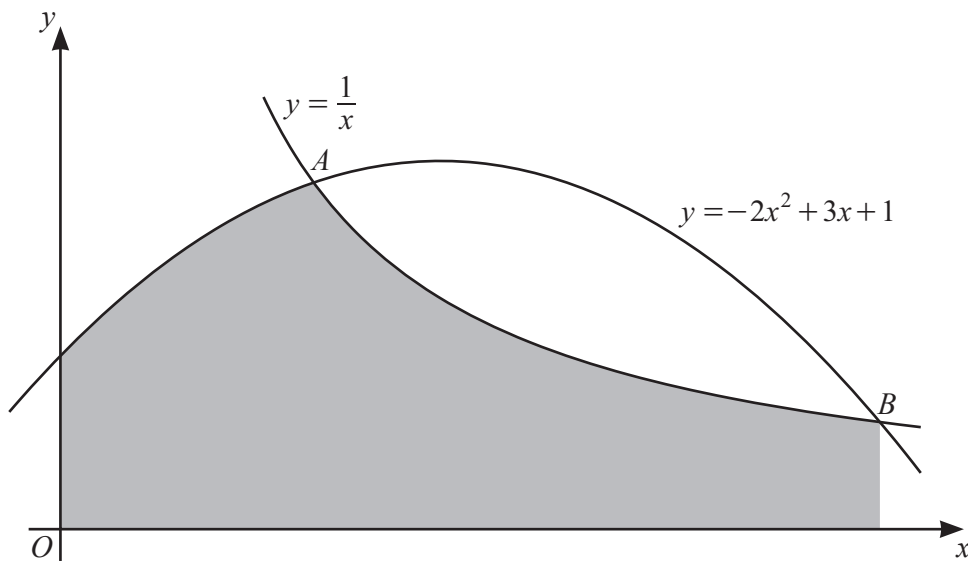
(ii) Hence solve the equation $\sin \frac{\theta}{2} \tan \frac{\theta}{2} + \cos \frac{\theta}{2} = 4$ for $0 \leq \theta \leq 4\pi$, where θ is in radians. [4]

(b) Solve the equation $\cot(y + 38^\circ) = \sqrt{3}$ for $0^\circ \leq y \leq 360^\circ$.

[3]

9 The polynomial $p(x) = 2x^3 - 3x^2 - x + 1$ has a factor $2x - 1$.

(a) Find $p(x)$ in the form $(2x - 1)q(x)$, where $q(x)$ is a quadratic factor. [2]



The diagram shows the graph of $y = \frac{1}{x}$ for $x > 0$, and the graph of $y = -2x^2 + 3x + 1$. The curves intersect at the points A and B.

(b) Using your answer to **part (a)**, find the exact x -coordinate of A and of B. [4]

(c) Find the exact area of the shaded region.

[6]

Question 10 is printed on the next page.

10 A curve has equation $y = \frac{(2x^2 + 10)^{\frac{3}{2}}}{x - 1}$ for $x > 1$.

(a) Show that $\frac{dy}{dx}$ can be written in the form $\frac{(2x^2 + 10)^{\frac{1}{2}}}{(x - 1)^2}(Ax^2 + Bx + C)$, where A , B and C are integers. [5]

(b) Show that, for $x > 1$, the curve has exactly one stationary point. Find the value of x at this stationary point. [4]

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