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ADDITIONAL MATHEMATICS

0606/11

Paper 1

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 [].

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 $u_n = ar^{n-1}$

$$S_n = \frac{a(1-r^n)}{1-r} \quad (r \neq 1)$$

$$S_\infty = \frac{a}{1-r} \quad (|r| < 1)$$

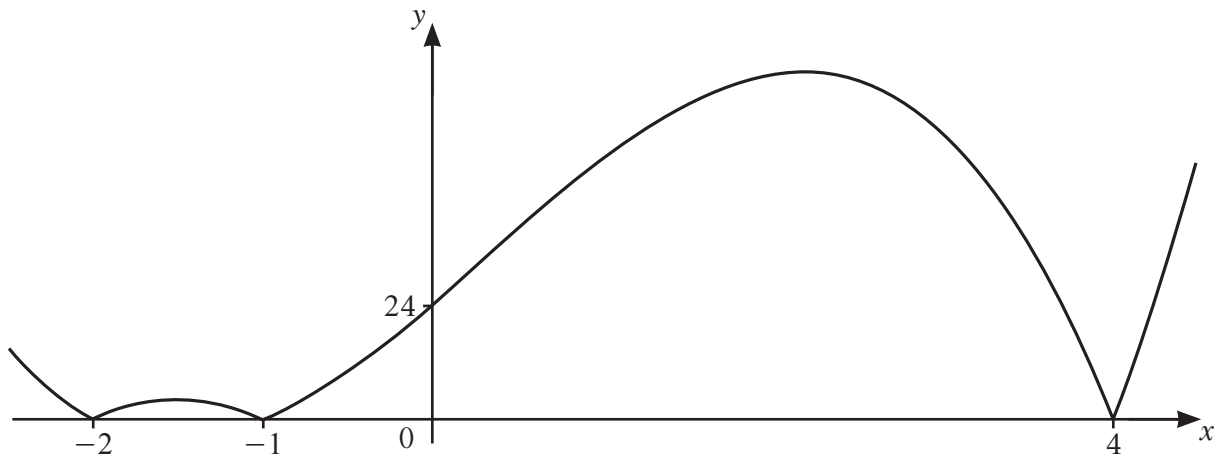
2. TRIGONOMETRY*Identities*

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

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

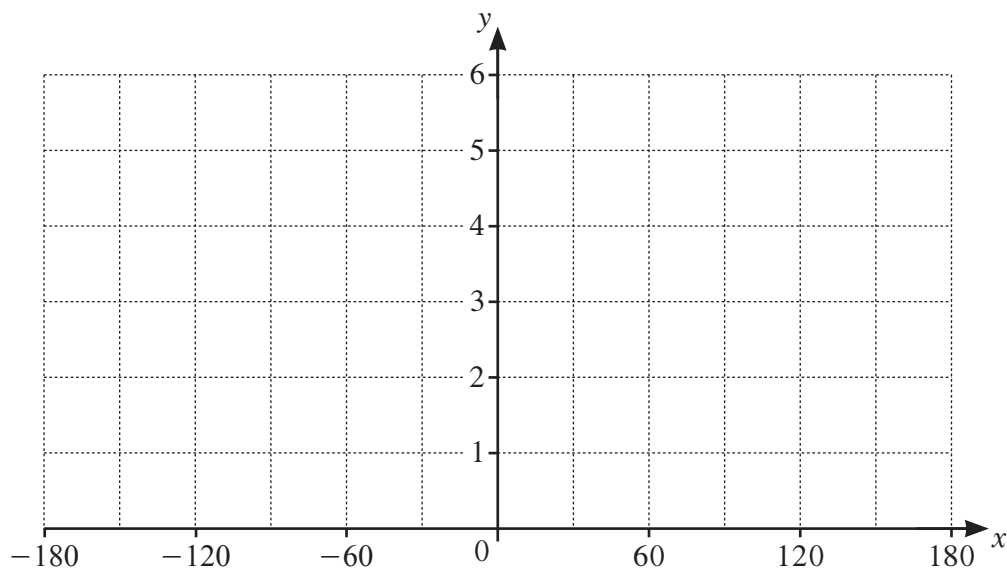


The diagram shows the graph of $y = |p(x)|$, where $p(x)$ is a cubic function. Find the two possible expressions for $p(x)$. [3]

2 (a) Write down the amplitude of $1 + 4 \cos\left(\frac{x}{3}\right)$. [1]

(b) Write down the period of $1 + 4 \cos\left(\frac{x}{3}\right)$. [1]

(c) On the axes below, sketch the graph of $y = 1 + 4 \cos\left(\frac{x}{3}\right)$ for $-180^\circ \leq x^\circ \leq 180^\circ$.



[3]

3 (a) Write $\frac{\sqrt{p}(qr^2)^{\frac{1}{3}}}{(q^3p)^{-1}r^3}$ in the form $p^a q^b r^c$, where a , b and c are constants. [3]

(b) Solve $6x^{\frac{2}{3}} - 5x^{\frac{1}{3}} + 1 = 0$. [3]

4 It is given that $y = \frac{\tan 3x}{\sin x}$.

(a) Find the exact value of $\frac{dy}{dx}$ when $x = \frac{\pi}{3}$. [4]

(b) Hence find the approximate change in y as x increases from $\frac{\pi}{3}$ to $\frac{\pi}{3} + h$, where h is small. [1]

(c) Given that x is increasing at the rate of 3 units per second, find the corresponding rate of change in y when $x = \frac{\pi}{3}$, giving your answer in its simplest surd form. [2]

5 (a) (i) Find how many different 4-digit numbers can be formed using the digits 1, 3, 4, 6, 7 and 9. Each digit may be used once only in any 4-digit number. [1]

(ii) How many of these 4-digit numbers are even and greater than 6000? [3]

(b) A committee of 5 people is to be formed from 6 doctors, 4 dentists and 3 nurses. Find the number of different committees that could be formed if

(i) there are no restrictions, [1]

(ii) the committee contains at least one doctor, [2]

(iii) the committee contains all the nurses. [1]

- 6 A particle P is initially at the point with position vector $\begin{pmatrix} 30 \\ 10 \end{pmatrix}$ and moves with a constant speed of 10 ms^{-1} in the same direction as $\begin{pmatrix} -4 \\ 3 \end{pmatrix}$.

(a) Find the position vector of P after t s. [3]

As P starts moving, a particle Q starts to move such that its position vector after t s is given by

$$\begin{pmatrix} -80 \\ 90 \end{pmatrix} + t \begin{pmatrix} 5 \\ 12 \end{pmatrix}.$$

(b) Write down the speed of Q . [1]

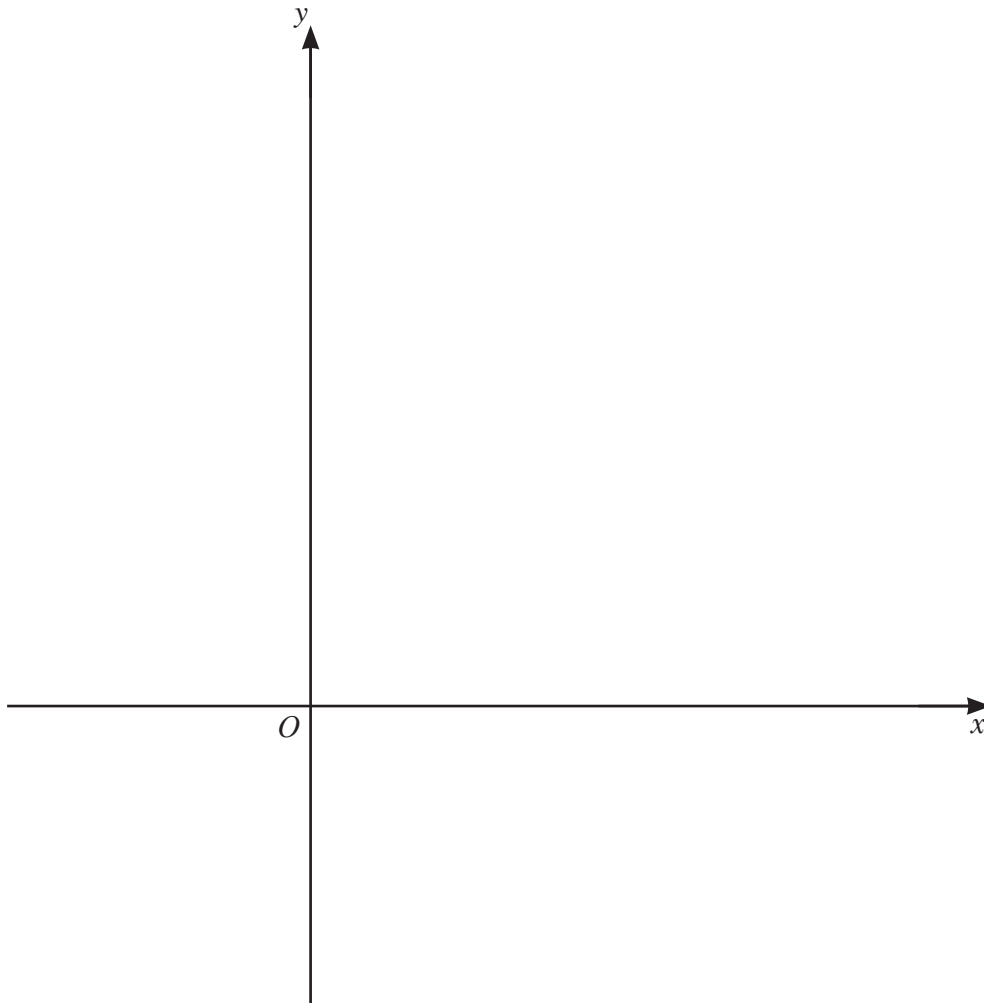
(c) Find the exact distance between P and Q when $t = 10$, giving your answer in its simplest surd form. [3]

7 It is given that $f(x) = 5 \ln(2x+3)$ for $x > -\frac{3}{2}$.

(a) Write down the range of f . [1]

(b) Find f^{-1} and state its domain. [3]

(c) On the axes below, sketch the graph of $y = f(x)$ and the graph of $y = f^{-1}(x)$. Label each curve and state the intercepts on the coordinate axes.



[5]

8 (a) (i) Show that $\frac{1}{(1 + \operatorname{cosec} \theta)(\sin \theta - \sin^2 \theta)} = \sec^2 \theta$. [4]

(ii) Hence solve $(1 + \operatorname{cosec} \theta)(\sin \theta - \sin^2 \theta) = \frac{3}{4}$ for $-180^\circ \leq \theta \leq 180^\circ$. [4]

(b) Solve $\sin\left(3\phi + \frac{2\pi}{3}\right) = \cos\left(3\phi + \frac{2\pi}{3}\right)$ for $0 \leq \phi \leq \frac{2\pi}{3}$ radians, giving your answers in terms of π .
[4]

- 9 (a) Given that $\int_1^a \left(\frac{1}{x} - \frac{1}{2x+3} \right) dx = \ln 3$, where $a > 0$, find the exact value of a , giving your answer in simplest surd form. [6]

- (b) Find the exact value of $\int_0^{\frac{\pi}{3}} \left(\sin\left(2x + \frac{\pi}{3}\right) - 1 + \cos 2x \right) dx$. [5]

- 10 (a) An arithmetic progression has a second term of 8 and a fourth term of 18. Find the least number of terms for which the sum of this progression is greater than 1560. [6]

(b) A geometric progression has a sum to infinity of 72. The sum of the first 3 terms of this progression is $\frac{333}{8}$.

(i) Find the value of the common ratio. [5]

(ii) Hence find the value of the first term. [1]

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