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ADDITIONAL MATHEMATICS

0606/11

Paper 1

May/June 2021

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. 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*

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

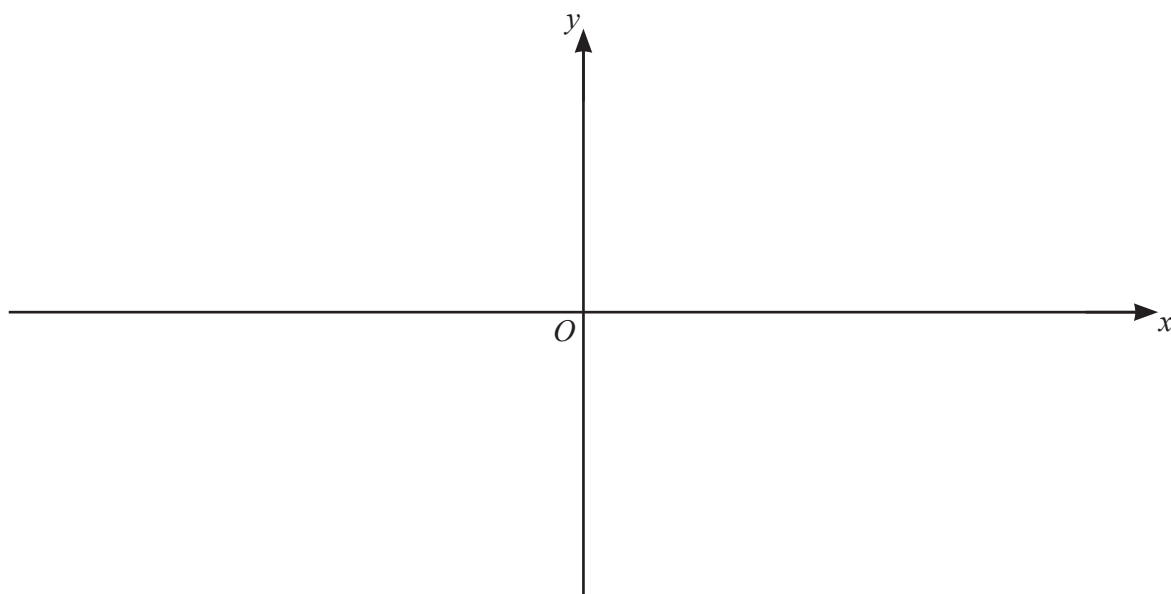
Formulae for $\triangle ABC$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\Delta = \frac{1}{2}bc \sin A$$

- 1 (a) On the axes, sketch the graph of $y = 5(x+1)(3x-2)(x-2)$, stating the intercepts with the coordinate axes. [3]



- (b) Hence find the values of x for which $5(x+1)(3x-2)(x-2) > 0$. [2]

- 2 Find $\int_3^5 \left(\frac{1}{x-1} - \frac{1}{(x-1)^2} \right) dx$, giving your answer in the form $a + \ln b$, where a and b are rational numbers. [5]

3 The polynomial $p(x) = ax^3 - 9x^2 + bx - 6$, where a and b are constants, has a factor of $x - 2$. The polynomial has a remainder of 66 when divided by $x - 3$.

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

(b) Using your values of a and b , show that $p(x) = (x - 2)q(x)$, where $q(x)$ is a quadratic factor to be found. [2]

(c) Hence show that the equation $p(x) = 0$ has only one real solution. [2]

- 4 The first 3 terms in the expansion of $(a+x)^3\left(1-\frac{x}{3}\right)^5$, in ascending powers of x , can be written in the form $27+bx+cx^2$, where a , b and c are integers. Find the values of a , b and c . [8]

5 The functions f and g are defined as follows.

$$f(x) = x^2 + 4x \quad \text{for } x \in \mathbb{R}$$

$$g(x) = 1 + e^{2x} \quad \text{for } x \in \mathbb{R}$$

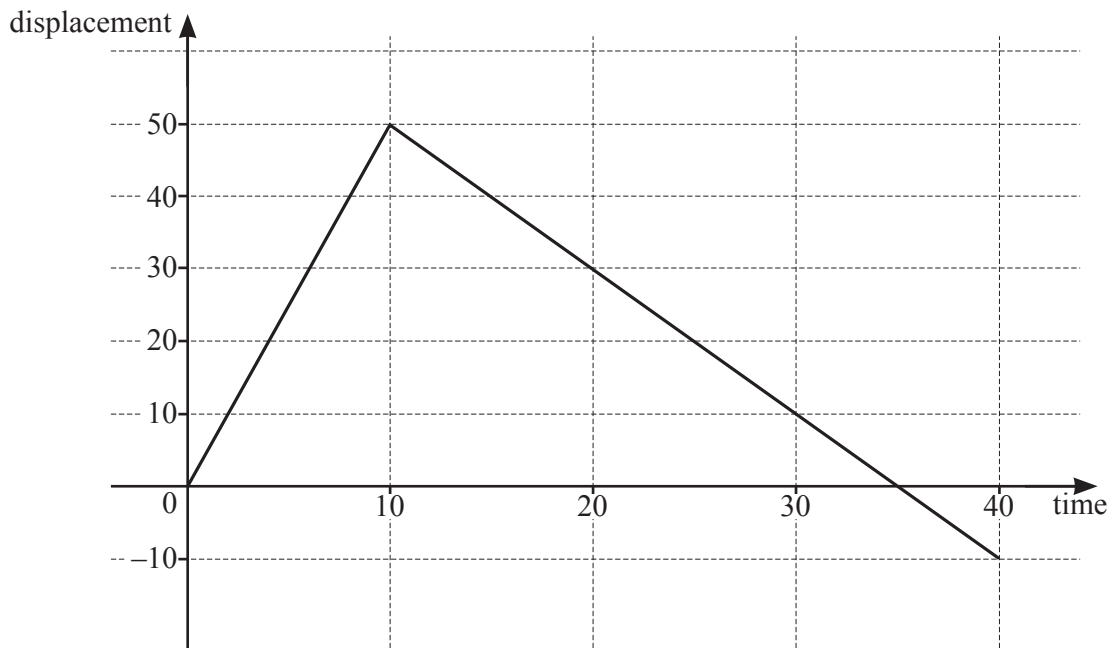
(a) Find the range of f . [2]

(b) Write down the range of g . [1]

(c) Find the exact solution of the equation $fg(x) = 21$, giving your answer as a single logarithm. [4]

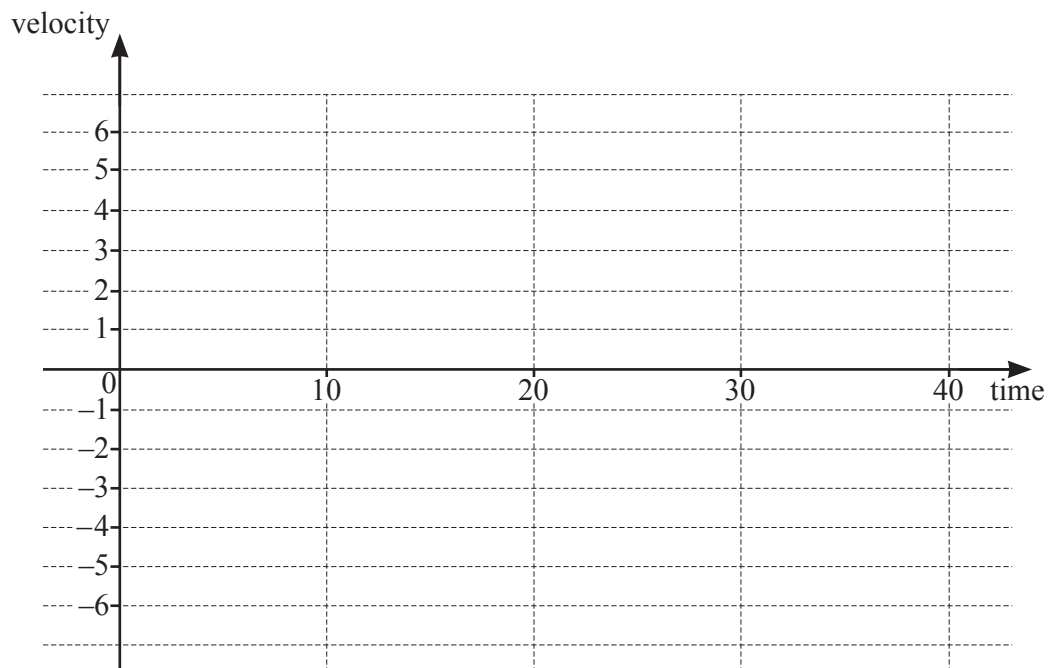
- 6 (a) (i) Find how many different 5-digit numbers can be formed using the digits 1, 3, 5, 6, 8 and 9. No digit may be used more than once in any 5-digit number. [1]
- (ii) How many of these 5-digit numbers are odd? [1]
- (iii) How many of these 5-digit numbers are odd and greater than 60 000? [3]
- (b) Given that $45 \times {}^n C_4 = (n+1) \times {}^{n+1} C_5$, find the value of n . [4]

- 7 (a) In this question, all lengths are in metres and time, t , is in seconds.



The diagram shows the displacement–time graph for a runner, for $0 \leq t \leq 40$.

- (i) Find the distance the runner has travelled when $t = 40$. [1]
- (ii) On the axes, draw the corresponding velocity–time graph for the runner, for $0 \leq t \leq 40$. [2]



(b) A particle, P , moves in a straight line such that its displacement from a fixed point at time t is s .

The acceleration of P is given by $(2t+4)^{-\frac{1}{2}}$, for $t > 0$.

(i) Given that P has a velocity of 9 when $t = 6$, find the velocity of P at time t . [3]

(ii) Given that $s = \frac{1}{3}$ when $t = 6$, find the displacement of P at time t . [3]

8 DO NOT USE A CALCULATOR IN THIS QUESTION.

A curve has equation $y = (2 - \sqrt{3})x^2 + x - 1$. The x -coordinate of a point A on the curve is $\frac{\sqrt{3} + 1}{2 - \sqrt{3}}$.

- (a) Show that the coordinates of A can be written in the form $(p + q\sqrt{3}, r + s\sqrt{3})$, where p , q , r and s are integers. [5]

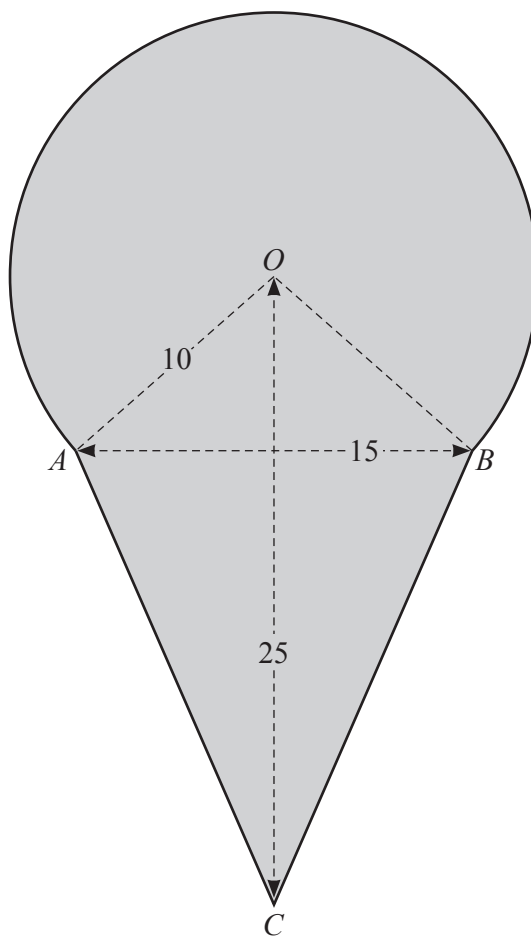
- (b) Find the x -coordinate of the stationary point on the curve, giving your answer in the form $a + b\sqrt{3}$, where a and b are rational numbers. [3]

9 (a) (i) Write $6xy + 3y + 4x + 2$ in the form $(ax + b)(cy + d)$, where a , b , c and d are positive integers. [1]

(ii) Hence solve the equation $6 \sin \theta \cos \theta + 3 \cos \theta + 4 \sin \theta + 2 = 0$ for $0^\circ < \theta < 360^\circ$. [4]

- (b) Solve the equation $\frac{1}{2}\sec\left(2\phi + \frac{\pi}{4}\right) = \frac{1}{\sqrt{3}}$ for $-\pi < \phi < \pi$, where ϕ is in radians. Give your answers in terms of π . [5]

10 In this question all lengths are in centimetres.



The diagram shows a shaded shape. The arc AB is the major arc of a circle, centre O , radius 10 . The line AB is of length 15 , the line OC is of length 25 and the lengths of AC and BC are equal.

(a) Show that the angle AOB is 1.70 radians correct to 2 decimal places. [2]

(b) Find the perimeter of the shaded shape. [4]

(c) Find the area of the shaded shape.

[5]

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