



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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4037/14

May/June 2021

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.

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 $u_n = ar^{n-1}$

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

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

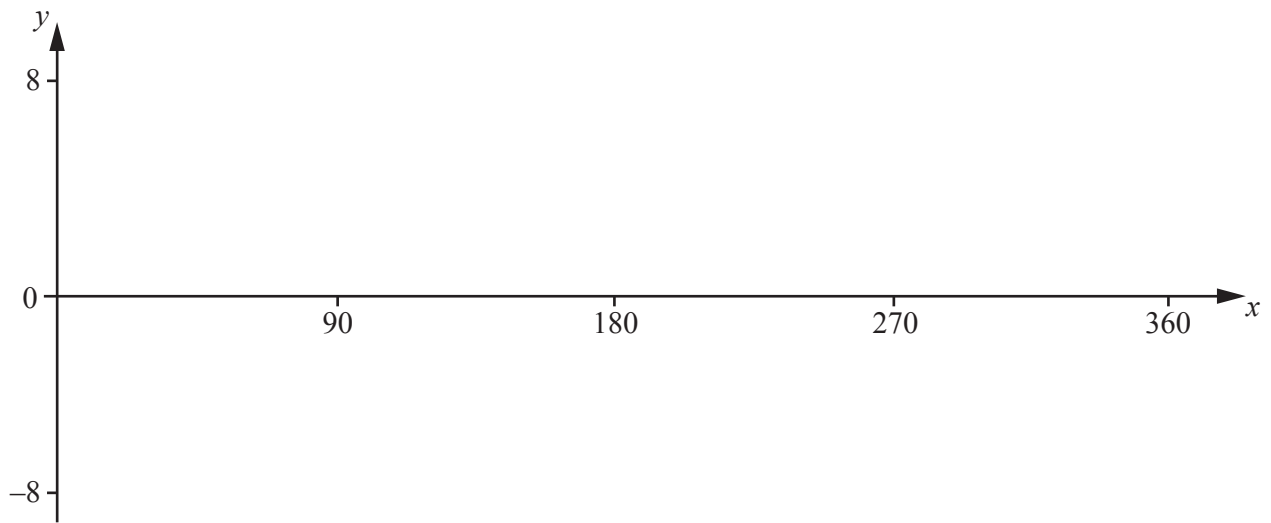
2. TRIGONOMETRY*Identities*

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

Formulae for $\triangle ABC$

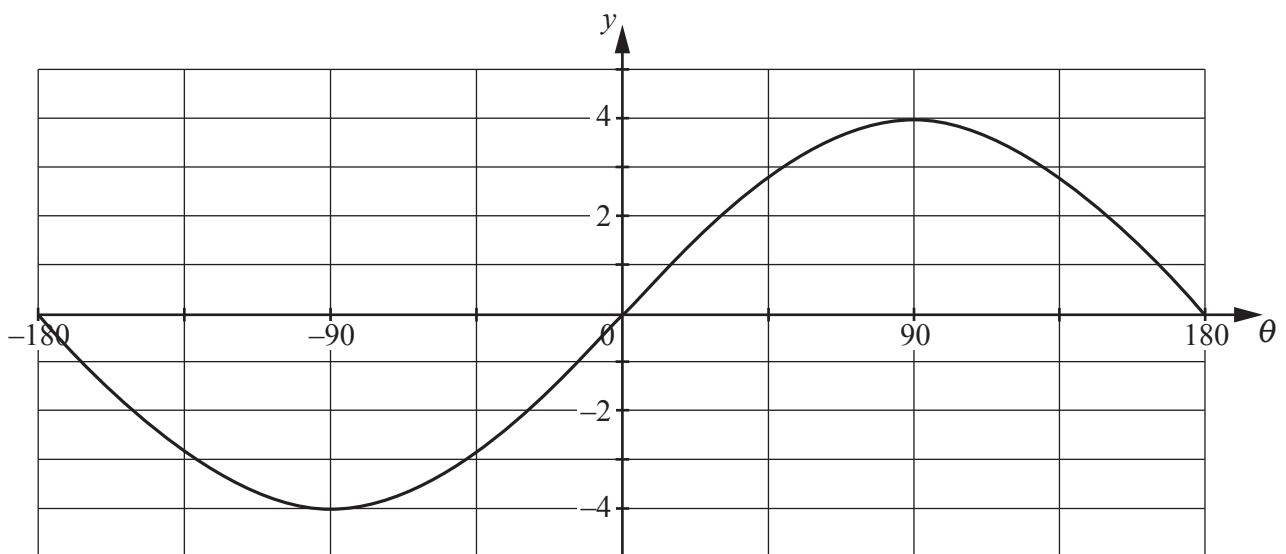
$$\begin{aligned}\frac{a}{\sin A} &= \frac{b}{\sin B} = \frac{c}{\sin C} \\ a^2 &= b^2 + c^2 - 2bc \cos A \\ \Delta &= \frac{1}{2}bc \sin A\end{aligned}$$

- 1 (a) On the axes below, sketch the graph of $y = 6 \cos 2x - 1$ for $0^\circ \leq x \leq 360^\circ$.



[3]

- (b) The graph of $y = a + b \sin c\theta$ for $-180^\circ \leq \theta \leq 180^\circ$ is shown below.

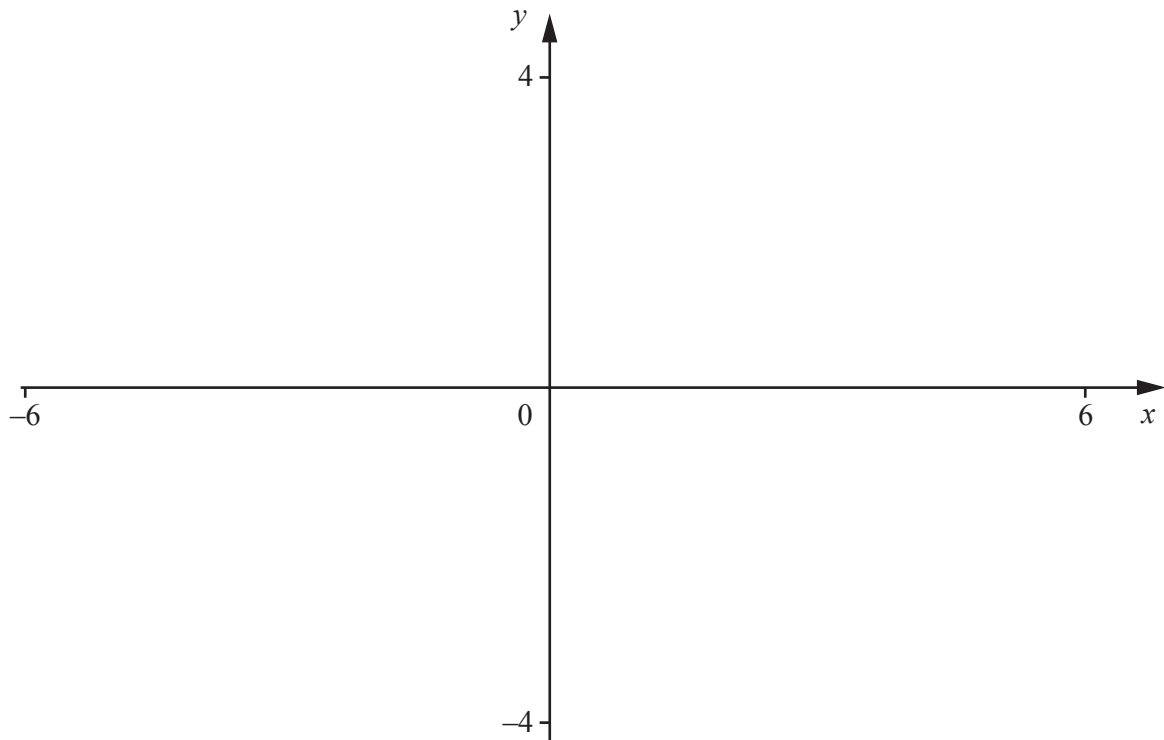


Write down the value of each of the constants a , b and c .

[2]

$a = \dots\dots\dots$ $b = \dots\dots\dots$ $c = \dots\dots\dots$

- 2 (a) On the axes below, sketch the graphs of $y = |x - 3|$ and $y = \left|\frac{2}{5}x\right|$, giving the coordinates of the points where the graphs meet the axes. [3]



- (b) Solve the equation $\left|\frac{2}{5}x\right| = |x - 3|$. [2]

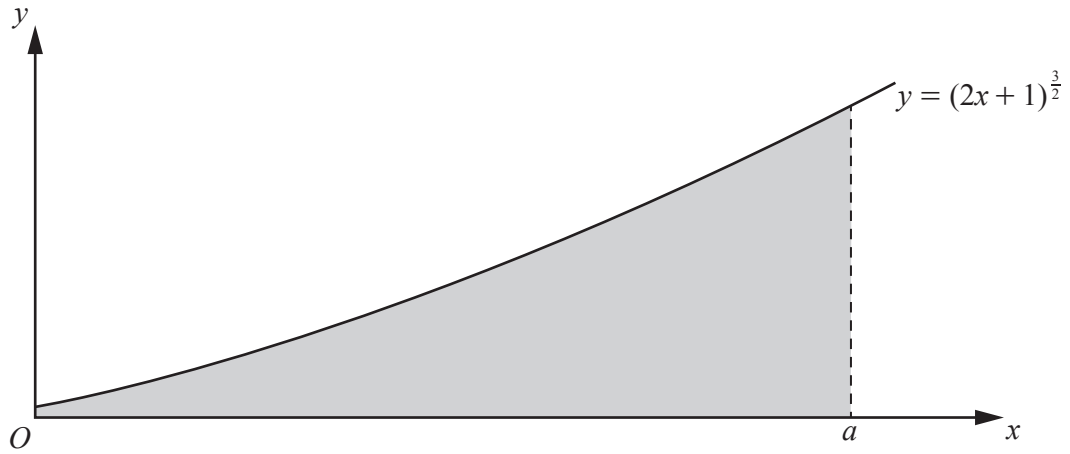
- 3 (a) Find the first 3 terms in the expansion, in ascending powers of x , of $(a-3x)^{10}$, where a is a constant. [3]

- (b) Given that a is positive and that the three terms found in **part (a)** can also be written as $p + qx + \frac{405}{256}x^2$, find the value of each of the constants a , p and q . [3]

4 (a) Find $\frac{d}{dx}(2x+1)^{\frac{5}{2}}$. [2]

(b) Hence find $\int (2x+1)^{\frac{3}{2}} dx$. [2]

(c)



The diagram shows the graph of the curve $y = (2x + 1)^{\frac{3}{2}}$ for $x \geq 0$. The shaded region enclosed by the curve, the axes and the line $x = a$ is equal to 48.4 square units. Find the value of a , showing all your working. [3]

- 5 (a)** A 5-digit number is to be formed from the digits 2, 5, 6, 7 and 9. Each digit may only be used once.
- (i)** Find the number of different 5-digit numbers that can be formed. [1]
- (ii)** Find the percentage of these numbers that are odd. [2]
- (b)** 12 people are placed at random in 3 groups of 4 people each. Find the number of ways that this can be done. [3]

- 6 (a) Solve the simultaneous equations

$$\log_a(x+y) = 0,$$

$$\log_a(x+1) = 2\log_a y.$$

[4]

- (b) Given that $\log_p q^2 \times \log_q p^3 = A$, find the value of the constant A .

[3]

- 7 A curve is such that $\frac{d^2y}{dx^2} = 8 \sin 2x$. The curve has a gradient of 6 at the point $\left(\frac{\pi}{2}, 4\pi\right)$.

Find the equation of the curve.

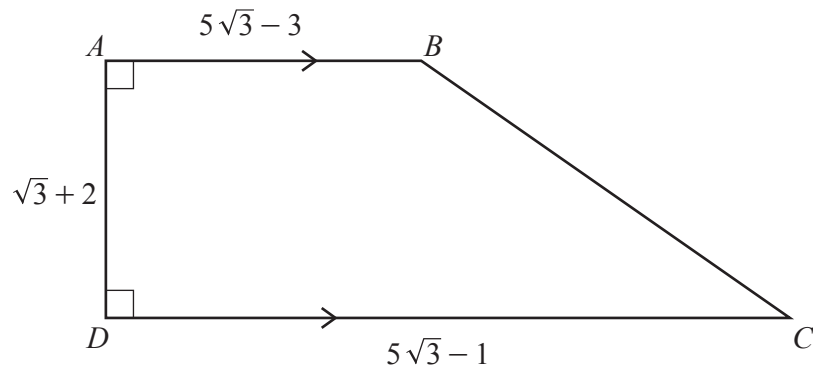
[8]

- 8 The polynomial $p(x)$ is $ax^3 + bx^2 + 7x + 1$, where a and b are integers. It is given that $2x + 1$ is a factor of $p(x)$ and that when $p(x)$ is divided by $x - 3$ there is a remainder of 175.

(a) Find the value of a and of b . [5]

(b) Using your values of a and b from **part (a)**, find the remainder when $p'(x)$ is divided by $x - 1$. [3]

- 9 In this question all lengths are in centimetres.
Do not use a calculator in this question.



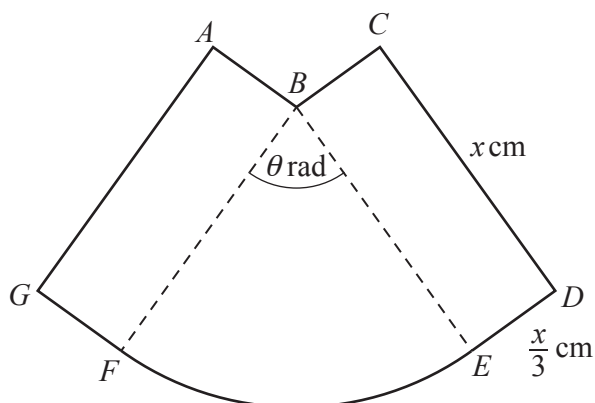
The diagram shows the trapezium $ABCD$, where $AB = 5\sqrt{3} - 3$, $DC = 5\sqrt{3} - 1$ and $AD = \sqrt{3} + 2$.

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

- (b) Given that angle $BCD = \theta$ radians, find the value of $\cot \theta$ in the form $c + d\sqrt{3}$, where c and d are integers. [3]

- (c) Using your answer to **part (b)**, find the value of $\operatorname{cosec}^2 \theta$ in the form $e + f\sqrt{3}$, where e and f are integers. [2]

10



The diagram shows the figure $ABCDEFG$, where $ABFG$ and $BCDE$ are rectangles of length x cm and width $\frac{x}{3}$ cm. The sector BFE of the circle, centre B , radius x cm, has an angle of θ radians. It is given that the area of BFE is 2 cm^2 .

- (a) Show that the perimeter, P cm, of the figure $ABCDEFG$ is given by $P = \frac{10x}{3} + \frac{4}{x}$. [5]

- (b) Given that x can vary, find the minimum value of P in the form $q\sqrt{30}$, where q is a rational number. [4]

- (c) Verify that P is a minimum. [1]

Question 11 is printed on the next page.

- 11 The tangent at the point where $x = 1$ on the curve $y = 6x \ln(x^2 + 1)$ intersects the y -axis at the point P . This tangent also intersects the line $x = 2$ at the point Q . A line through P , parallel to the x -axis, meets the line $x = 2$ at the point R . Find the exact area of triangle PQR . [10]

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