



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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0606/22

February/March 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*

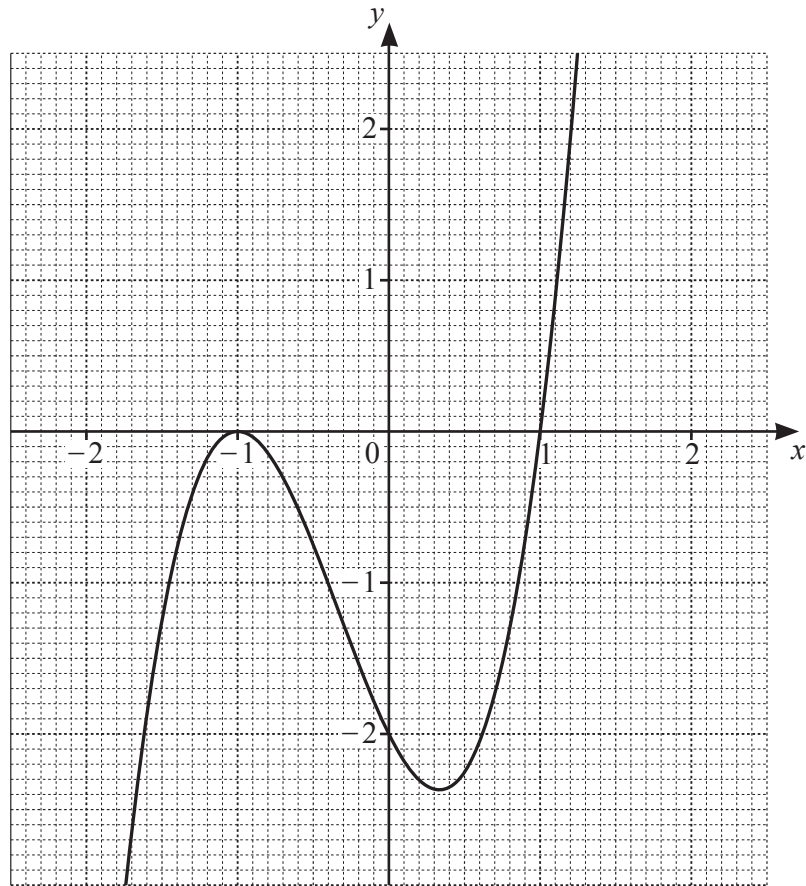
$$\begin{aligned}\sin^2 A + \cos^2 A &= 1 \\ \sec^2 A &= 1 + \tan^2 A \\ \operatorname{cosec}^2 A &= 1 + \cot^2 A\end{aligned}$$

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 Solve the equation $|4x + 9| = |6 - 5x|$. [3]

- 2 Find the values of the constant k for which the equation $kx^2 - 3(k + 1)x + 25 = 0$ has equal roots. [4]



The diagram shows the graph of $y = f(x)$, where $f(x) = a(x+b)^2(x+c)$ and a , b and c are integers.

(a) Find the value of each of a , b and c . [2]

(b) Hence solve the inequality $f(x) \leq -1$. [3]

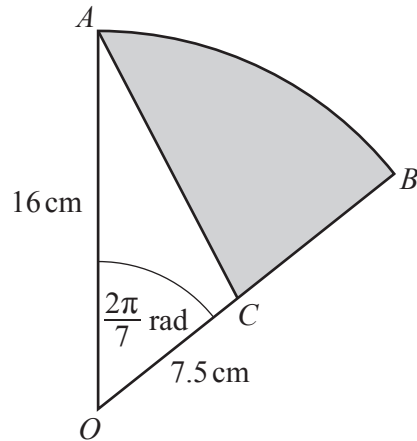
- 4 The curve $\frac{4}{x^2} + \frac{5}{4y^2} = 1$ and the line $x + 2y = 0$ intersect at two points. Find the exact distance between these points. [6]

- 5 A cube of side x cm has surface area S cm². The volume, V cm³, of the cube is increasing at a rate of 480 cm³s⁻¹. Find, at the instant when $V = 512$,

(a) the rate of increase of x , [4]

(b) the rate of increase of S . [2]

6



AOB is a sector of a circle with centre O and radius 16 cm. Angle AOB is $\frac{2\pi}{7}$ radians. The point C lies on OB such that OC is of length 7.5 cm and AC is a straight line.

(a) Find the perimeter of the shaded region. [3]

(b) Find the area of the shaded region. [3]

7 A curve has equation $y = p(x)$, where $p(x) = x^3 - 4x^2 + 6x - 1$.

- (a) Find the equation of the tangent to the curve at the point $(3, 8)$. Give your answer in the form $y = mx + c$. [5]

- (b) (i) Given that p^{-1} exists, write down the gradient of the tangent to the curve $y = p^{-1}(x)$ at the point $(8, 3)$. [1]

- (ii) Find the coordinates of the point of intersection of these two tangents. [2]

8 A photographer takes 12 different photographs. There are 3 of sunsets, 4 of oceans, and 5 of mountains.

(a) The photographs are arranged in a line on a wall.

(i) How many possible arrangements are there if there are no restrictions? [1]

(ii) How many possible arrangements are there if the first photograph is of a sunset and the last photograph is of an ocean? [2]

(iii) How many possible arrangements are there if all the photographs of mountains are next to each other? [2]

(b) Three of the photographs are to be selected for a competition.

(i) Find the number of different possible selections if no photograph of a sunset is chosen. [2]

(ii) Find the number of different possible selections if one photograph of each type (sunset, ocean, mountain) is chosen. [2]

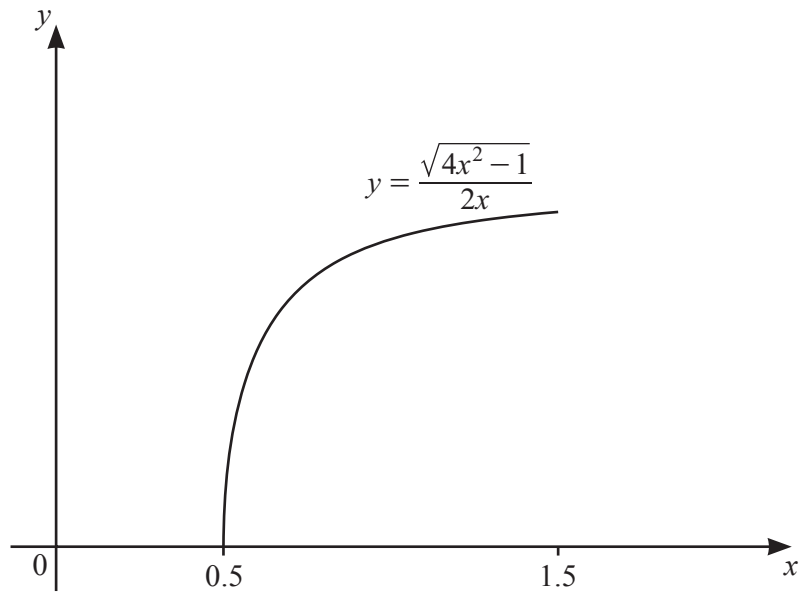
- 9 (a) In the expansion of $\left(2k - \frac{x}{k}\right)^5$, where k is a constant, the coefficient of x^2 is 160. Find the value of k . [3]

- (b) (i) Find, in ascending powers of x , the first 3 terms in the expansion of $(1 + 3x)^6$, simplifying the coefficient of each term. [2]

- (ii) When $(1 + 3x)^6(a + x)^2$ is written in ascending powers of x , the first three terms are $4 + 68x + bx^2$, where a and b are constants. Find the value of a and of b . [3]

- 10** The function f is defined by $f(x) = \frac{\sqrt{4x^2 - 1}}{2x}$ for $0.5 \leq x \leq 1.5$.

The diagram shows a sketch of $y = f(x)$.



- (a) (i)** It is given that f^{-1} exists. Find the domain and range of f^{-1} .

[3]

(ii) Find an expression for $f^{-1}(x)$.

[3]

(b) The function g is defined by $g(x) = e^{x^2}$ for all real x . Show that $gf(x) = e^{\left(1 - \frac{a}{bx^2}\right)}$, where a and b are integers. [2]

11 (a) (i) Find $\int \frac{1}{(10x-1)^6} dx$. [2]

(ii) Find $\int \frac{(2x^3+5)^2}{x} dx$. [3]

(b) (i) Differentiate $y = \tan(3x + 1)$ with respect to x . [2]

(ii) Hence find $\int_{\frac{\pi}{12}}^{\frac{\pi}{10}} \left(\frac{\sec^2(3x + 1)}{2} - \sin x \right) dx$. [4]

Question 12 is printed on the next page.

- 12 A particle P travels in a straight line so that, t seconds after passing through a fixed point O , its velocity, $v \text{ ms}^{-1}$, is given by

$$v = \frac{t}{2e} \quad \text{for } 0 \leq t \leq 2,$$

$$v = e^{-\frac{t}{2}} \quad \text{for } t > 2.$$

Given that, after leaving O , particle P is never at rest, find the distance it travels between $t = 1$ and $t = 3$. [6]

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