

Name: _____ ()

Class: _____

PRELIMINARY EXAMINATION
GENERAL CERTIFICATE OF EDUCATION ORDINARY LEVEL

ADDITIONAL MATHEMATICS**4049/02**

Paper 2

24 August 2021
2 hours 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces at the top of this page.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

Answer **all** the questions.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

The use of an approved scientific calculator is expected, where appropriate.

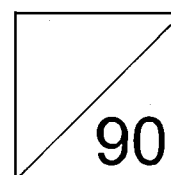
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is **90**.**FOR EXAMINER'S USE**

Q1		Q4		Q7		Q10	
Q2		Q5		Q8		Q11	
Q3		Q6		Q9			

This document consists of **19** printed pages and **1** blank page.

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[Turn over

Mathematical Formulae**1. ALGEBRA***Quadratic Equation*

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial expansion

$$(a+b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \dots + \binom{n}{r}a^{n-r}b^r + \dots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!} = \frac{n(n-1)\dots(n-r+1)}{r!}$

2. TRIGONOMETRY*Identities*

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$$

$$\sin 2A = 2 \sin A \cos A$$

$$\cos 2A = \cos^2 A - \sin^2 A = 2 \cos^2 A - 1 = 1 - 2 \sin^2 A$$

$$\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

Formulae for $\triangle ABC$

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

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

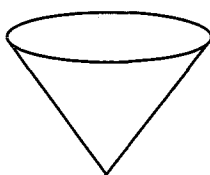
$$\Delta = \frac{1}{2}bc \sin A$$

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- 1 Show that $5^n + 5^{n+1} + 5^{n+2}$ is odd for all positive integer values of n . [3]

- 2 Express $\frac{2x^3+10x-9}{(2-x)(1+2x^2)}$ in partial fractions. [5]

- 3 A viscous liquid is poured into an empty inverted right circular cone.



The volume of the viscous liquid in the cone is increasing at a steady rate of $2\pi \text{ cm}^3/\text{s}$. Given that the dimensions of the cone is such that the height of the cone is always 3 times the radius, find

- (i) the radius of the viscous liquid 4 seconds after the pouring has commenced, [3]

- (ii) the rate of the increase of the radius at that instant. [4]

- 4 Given that $y = x^2\sqrt{2x-1}$, where $x > \frac{1}{2}$, express $\frac{dy}{dx}$ in the form $\frac{x(Ax+B)}{\sqrt{2x-1}}$, where A and B are integers.

Hence evaluate $\int_1^4 \frac{5x^2 - 2x - 2}{\sqrt{2x-1}} dx$. [7]

5 Solve the equation

(i) $5^{2x+1} = 39 - 2(5^x),$ [4]

(ii) $\log_4 \sqrt{x-5} - 1 = \log_{16}(1-2x).$ [5]

- 6 (a) The equation of a curve is $y = 3x^2 - x - 16$.
Find the set of values of x for which $y + 2 < 0$. Represent this set on a number line. [3]

- (b) A curve has equation $y = px^2 - mx + 12m$ and a line has equation $y = -3mx$,
where m and p are positive constants.

- (i) Find, in terms of m and p , the condition for which the curve and the line intersect. [4]

(ii) In the case when the line is a tangent to the curve at point A ,

(a) state the value of $\frac{m}{p}$, [2]

(b) find the x -coordinate of point A . [2]

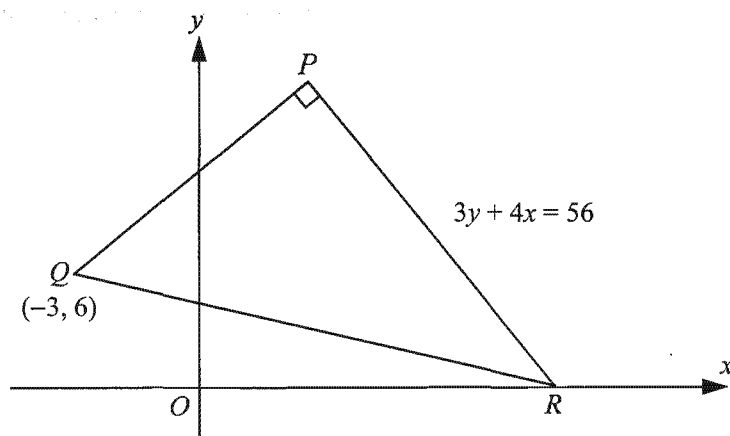
7 The expression $5 \cos \theta - \sin \theta$ is defined for $0 \leq \theta \leq \pi$.

(i) Using $R \cos(\theta + \alpha)$, where $R > 0$ and $0 < \alpha < \frac{\pi}{2}$, solve the equation $5 \cos \theta - \sin \theta = 2$. [4]

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(ii) Using your answer in part (i), solve $5 \cos\left(\frac{\theta}{2}\right) - \sin\left(\frac{\theta}{2}\right) = 2$. [1]

- (iii) State the largest and smallest values of $(10\cos\theta - 2\sin\theta)^2$ and find the corresponding values of θ . [4]



The diagram shows a triangle PQR in which the point Q is $(-3, 6)$, the point R lies on the x -axis and angle QPR is 90° . The equation of PR is $3y + 4x = 56$.

(a) Find the coordinates of P .

[5]

- (b) A circle is drawn passing through the points P , Q and R .
 $x = a$ is a tangent to the circle.
- (i) Find the equation of the circle. [4]

- (ii) Find the exact value(s) of a . [2]

9 Given that $y = e^{-x}(\sin 2x - 2\cos 2x)$,

- (i) Find and simplify an expression for $\frac{dy}{dx}$. [2]

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Hence find

- (ii) the value of x between $\frac{\pi}{2}$ and π for which y is stationary, [3]

- (iii) the y -coordinate of this stationary point and determine its nature.

[3]

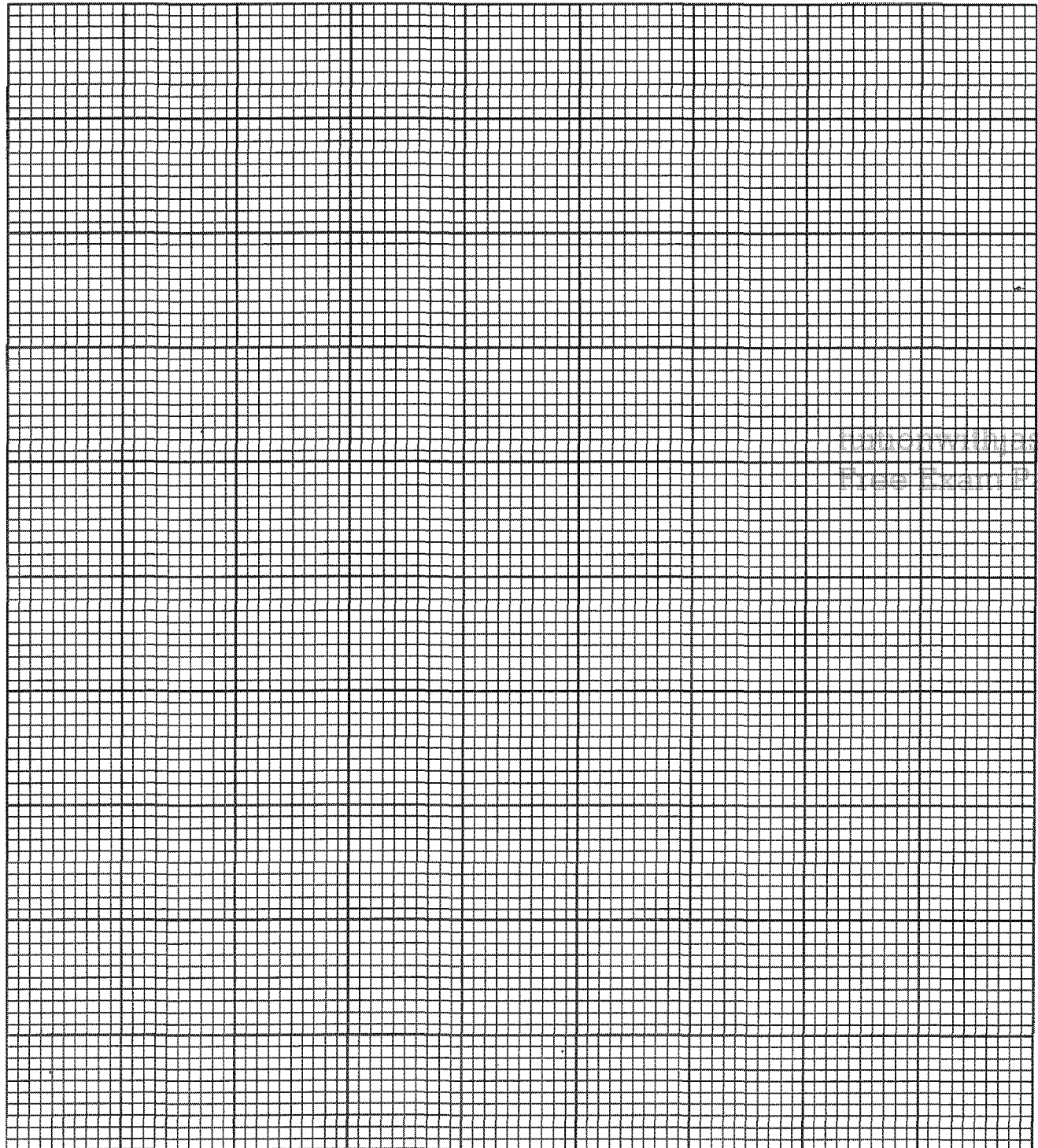
- 10 Recorded values of the volume, v ml, of diffuser perfume in a jar, t hours after observation began are shown in the table below.

t (hours)	25	50	75	100
v (millilitres)	250	112	36	12

It is known that v and t are related by the equation $v = v_0 10^{-kt}$, where v_0 and k are constants.

- (a) Plot $\lg v$ against t and draw a straight line graph.

[3]

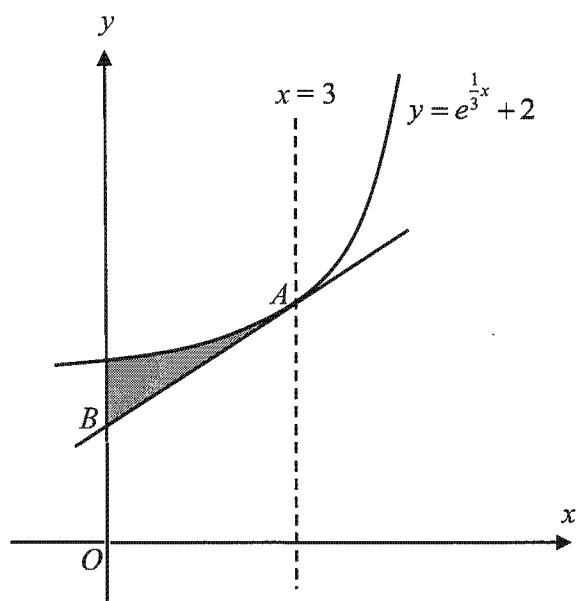


- (b) Use your graph to estimate the volume of perfume, to the nearest ml, at the start of the observation. [3]

- (c) Use your graph to find the value of k . [1]

- (d) Use your graph to find the time taken for the perfume to be 10 percent of its original volume. [2]

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The diagram shows part of the curve $y = e^{\frac{1}{3}x} + 2$. The tangent to the curve at A intersects the y -axis at B .

- (a) Find the exact area of the shaded region bounded by the tangent AB , the curve and the y -axis.

[8]

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- (b) Find the equation of the normal to the curve at $x = 0$.

[3]

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