



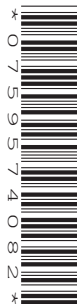
Cambridge International AS & A Level

CANDIDATE
NAME
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**MATHEMATICS****9709/31**

Paper 3 Pure Mathematics 3

October/November 2024**1 hour 50 minutes**

You must answer on the question paper.

You will need: List of formulae (MF19)

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.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- 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 75.
- The number of marks for each question or part question is shown in brackets [].

This document has **20** pages. Any blank pages are indicated.

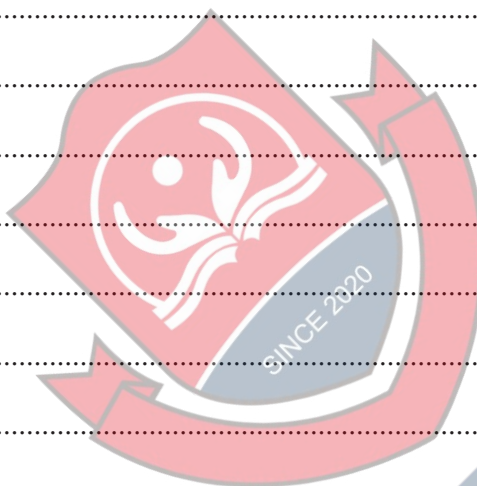




- 1 The polynomial $4x^3 + ax^2 + 5x + b$, where a and b are constants, is denoted by $p(x)$. It is given that $(2x + 1)$ is a factor of $p(x)$. When $p(x)$ is divided by $(x - 4)$ the remainder is equal to 3 times the remainder when $p(x)$ is divided by $(x - 2)$.

Find the values of a and b .

[5]



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Find the gradient of the curve at the point $(1, 0)$.



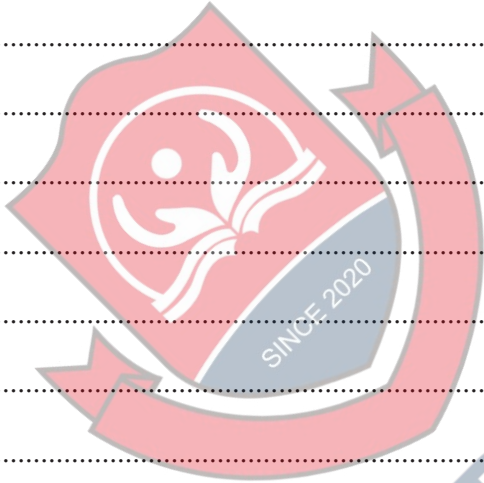
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[3]



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- on that this root lies between 7 and 9.

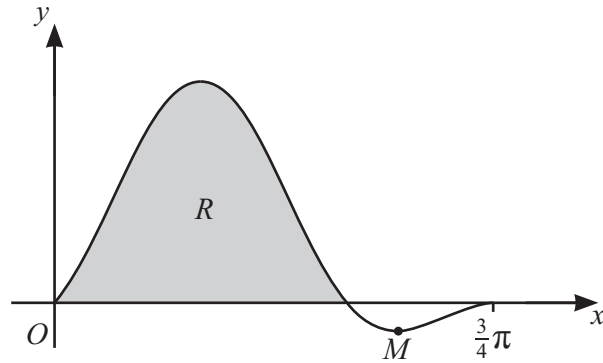
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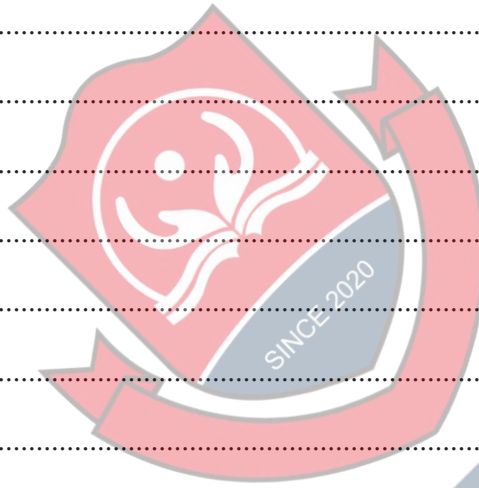
to determine the root correct to 2 decimal places. Give the result of each iteration to 4 decimal places.

[3]



The diagram shows the curve $y = \sin 2x(1 + \sin 2x)$, for $0 \leq x \leq \frac{3}{4}\pi$, and its minimum point M . The shaded region bounded by the curve that lies above the x -axis and the x -axis itself is denoted by R .

- (a) Given that the x -coordinate of M lies in the interval $\frac{1}{2}\pi < x < \frac{3}{4}\pi$, find the exact coordinates of M . [4]



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[4]



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$$\text{Let } f(x) = \frac{5x^2 + 8x + 5}{(1 + 2x)(2 + x^2)}.$$

[5]





[4]



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- (c) On a single Argand diagram, sketch the loci given by the equations $\operatorname{Re}(z) = 1$ and $\left|z - \frac{1}{2}\right| = \frac{1}{2}$, where z is a complex number. [3]



- (d) The complex number z is such that $\operatorname{Re}(z) = 1$. Use your answer to part (b) to give a geometrical description of the locus of $\frac{1}{z}$. [1]



- (a) State a vector equation for l .

[2]

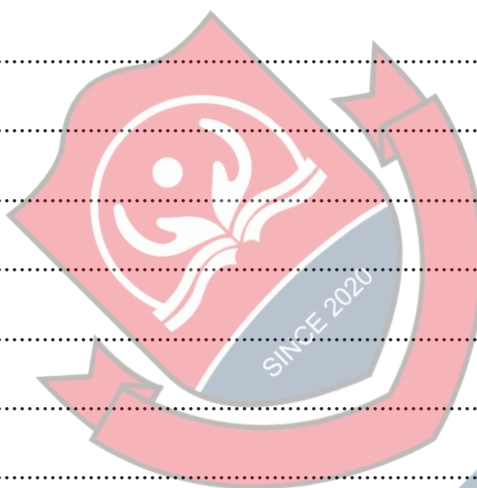
- Find the value of t .

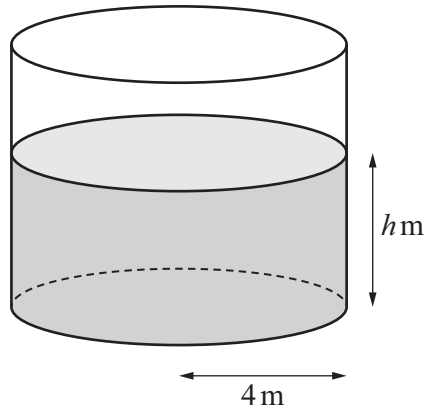
[3]

- (c) The line m has vector equation $\mathbf{r} = 5\mathbf{i} - \mathbf{j} + 2\mathbf{k} + \mu(a\mathbf{i} - \mathbf{j} + 3\mathbf{k})$. The acute angle between the directions of l and m is θ , where $\cos \theta = \frac{1}{\sqrt{6}}$.

Find the possible values of a .

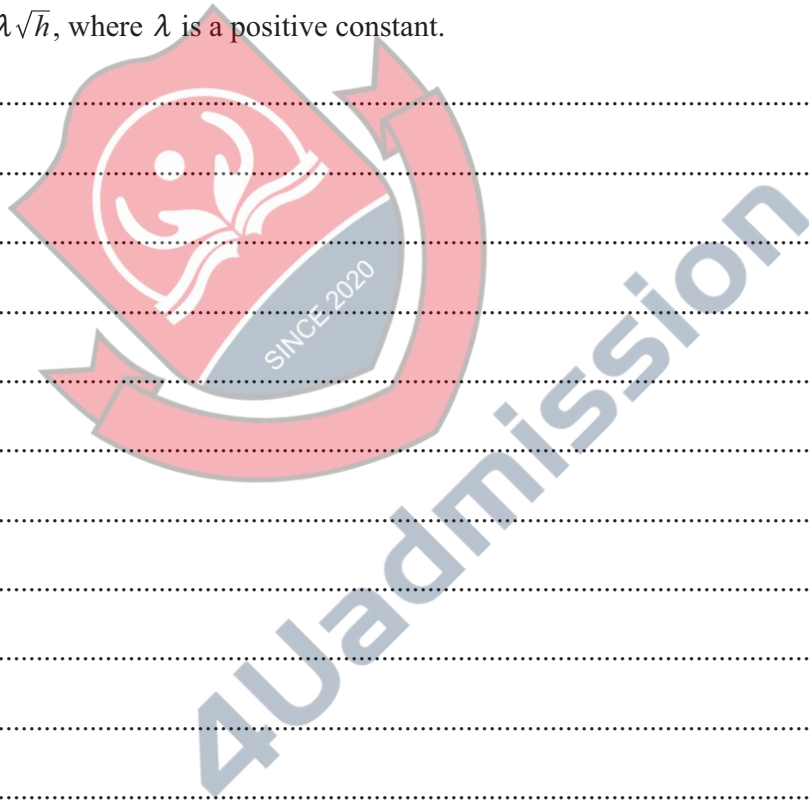
[5]





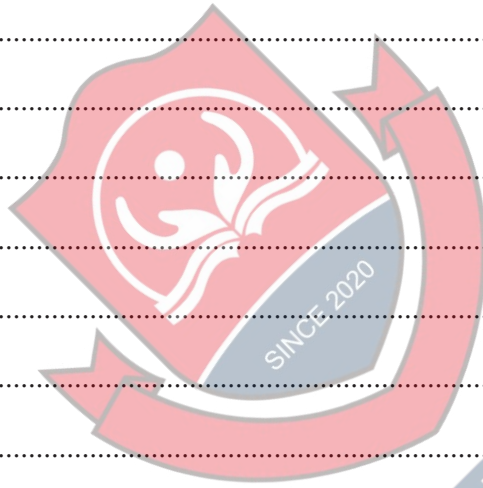
A large cylindrical tank is used to store water. The base of the tank is a circle of radius 4 metres. At time t minutes, the depth of the water in the tank is h metres. There is a tap at the bottom of the tank. When the tap is open, water flows out of the tank at a rate proportional to the square root of the volume of water in the tank.

- (a) Show that $\frac{dh}{dt} = -\lambda\sqrt{h}$, where λ is a positive constant. [4]

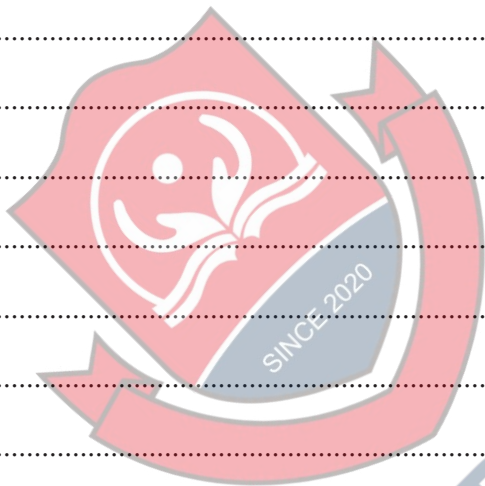




[6]

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