



VCAA VCE Mathematical Methods Units 3 & 4

Written Examination 1 (Technology-free) 2026

Question and Answer Book

Student Name _____

Teacher Name _____

Reading Time: 15 minutes

Writing Time: 60 minutes

The total number of marks available is 40

Materials Supplied

- Question and Answer Book
- Formula Sheet

Instructions

- Students are **not** permitted to bring any technology (calculators or software), or notes of any kind, into the examination room.
- Students are **not** permitted to bring mobile phones and/or any unauthorised electronic devices into the examination room.

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Instructions

- Answer all questions in the spaces provided.
 - Write your responses in English.
 - In questions where a numerical answer is required, an exact value must be given unless otherwise specified.
 - In questions where more than one mark is available, appropriate working must be shown.
 - Unless otherwise indicated, the diagrams in this book are not drawn to scale.
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Question 1 (11 marks)

Consider function $f(x) = \cos^3(x)$.

- a.** Show that $f'(x) = 3 \sin^3(x) - 3 \sin(x)$.

2 marks

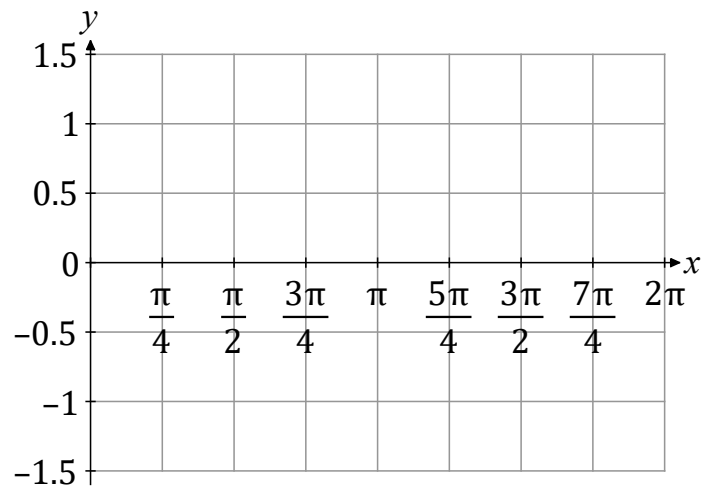
- b.** Hence, find an antiderivative of $\sin^3(x)$.

3 marks

- c. Hence, evaluate $\int_0^{\frac{\pi}{4}} \sin^3(x) dx$, expressing your answer in the form $\frac{a-b\sqrt{c}}{d}$, where $a, b, c, d \in \mathbb{N}$.

3 marks

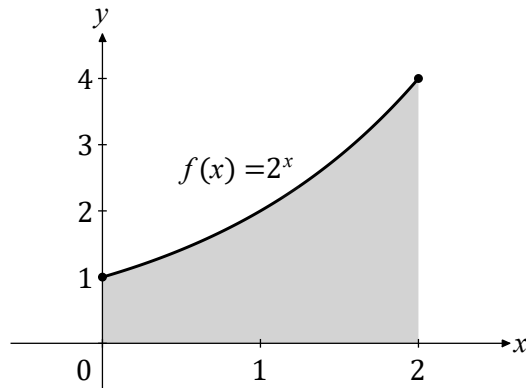
- d. On the set of axes below, sketch the graph of $y = f(x)$ for $0 \leq x \leq 2\pi$, labelling coordinates of all axial intercepts, stationary points, and end points.



3 marks

Question 2 (4 marks)

Consider function $f: [0, 2] \rightarrow \mathbb{R}, f(x) = 2^x$. The graph of $y = f(x)$ is shown in the diagram below. The area bounded by the graph of $y = f(x)$, the x -axis, the line $x = 0$, and the line $x = 2$ is shaded.



- a.** Use two trapeziums to approximate the shaded area.

1 mark

The formula $\int a^x dx = \frac{a^x}{\log_e(a)} + c$, where e is Euler's number, $a \in \mathbb{R}^+ \setminus \{1\}$, and $c \in \mathbb{R}$ is given to you.

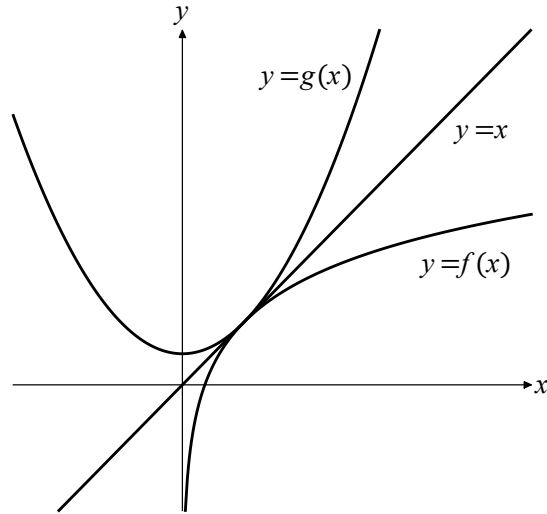
- b.** Find the exact value of the shaded area.

1 mark

c. Using answers from parts a and b, deduce $e < 2\sqrt{2}$.

2 marks

Consider functions $f(x) = e \log_e(x)$ and $g(x) = bx^2 + c$, where $b \in \mathbb{R} \setminus \{0\}$ and $c \in \mathbb{R}$. The graphs of $y = f(x)$, $y = g(x)$, and $y = x$ are shown in the diagram below. The line $y = x$ is a tangent to both graphs of $y = f(x)$ and $y = g(x)$ at their point of intersection.



b. Find the values of b and c .

3 marks

Consider function $f: (0, \infty) \rightarrow \mathbb{R}, f(x) = e \log_e(x)$.

- c. Find the inverse function of f, f^{-1} . Express your answer in function notation.

3 marks

