LUI | | | | | | | | | | | School code | | | | |

School name

Given name/s

Family name

Attach your barcode ID label here

Book of books used

External assessment 2024

Question and response book

Mathematical Methods

Paper 1 — Technology-free

Time allowed

- Perusal time — 5 minutes
- Working time — 90 minutes

General instructions

- Answer all questions in this question and response book.
- Calculators are **not** permitted.
- QCAA formula book provided.
- Planning paper will not be marked.

Section 1 (10 marks)

- 10 multiple choice questions

Section 2 (45 marks)

- 9 short response questions

Clear zone — margin trimmed off after completion of assessment

Queensland Government | QCAA Queensland Curriculum & Assessment Authority

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Section 1

Instructions

- This section has 10 questions and is worth 10 marks.
- Use a 2B pencil to fill in the A, B, C or D answer bubble completely.
- Choose the best answer for Questions 1–10.
- If you change your mind or make a mistake, use an eraser to remove your response and fill in the new answer bubble completely.

	A	B	C	D
Example:	●	○	○	○

	A	B	C	D
1.	○	○	○	○
2.	○	○	○	○
3.	○	○	○	○
4.	○	○	○	○
5.	○	○	○	○
6.	○	○	○	○
7.	○	○	○	○
8.	○	○	○	○
9.	○	○	○	○
10.	○	○	○	○

Ensure you have filled an answer bubble for each question.

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Section 2

Instructions

- Write using black or blue pen.
- Questions worth more than one mark require mathematical reasoning and/or working to be shown to support answers.
- If you need more space for a response, use the additional pages at the back of this book.
  - On the additional pages, write the question number you are responding to.
  - Cancel any incorrect response by ruling a single diagonal line through your work.
  - Write the page number of your alternative/additional response, i.e. See page …
  - If you do not do this, your original response will be marked.
- This section has nine questions and is worth 45 marks.

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QUESTION 11 (6 marks)

a) Determine the second derivative of $y = x^3 - 3x^2$. *[2 marks]*

b) Use your result from Question 11a) to calculate the value of the second derivative when $x = -1$. *[1 mark]*

c) Determine the x- and y-coordinates of the point on the graph of $y = x^3 - 3x^2$ for which the rate of change of the first derivative is zero. *[3 marks]*

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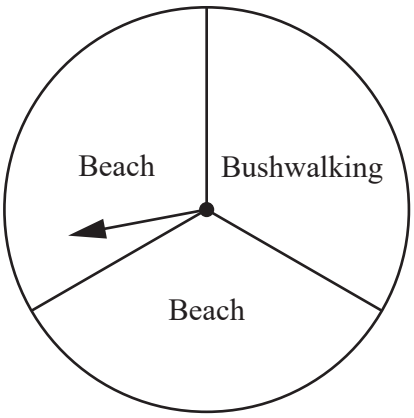
QUESTION 12 (6 marks)

Each day over a three-day long weekend, a family spins a pointer on a circular board to decide whether they will spend the day at the beach or bushwalking. The circular board consists of three equal sections.



a) Determine the probability that the family will spend all three days bushwalking. *[1 mark]*

b) Determine the following binomial probabilities, expressed as fully simplified fractions.

i. Exactly two days will be spent at the beach. *[2 marks]*

ii. Fewer than three days will be spent at the beach. *[3 marks]*

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QUESTION 13 (6 marks)

a) $F(x) = \int \left(4e^{2x} + \sin(2x)\right) dx$. Use integration to determine $F(x)$, if $F(0) = 5$. *[3 marks]*

b) If $\frac{dy}{dx} = \left(\frac{3x^7 - 2x}{x^4}\right)^2$, determine y. *[3 marks]*

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QUESTION 14 (5 marks)

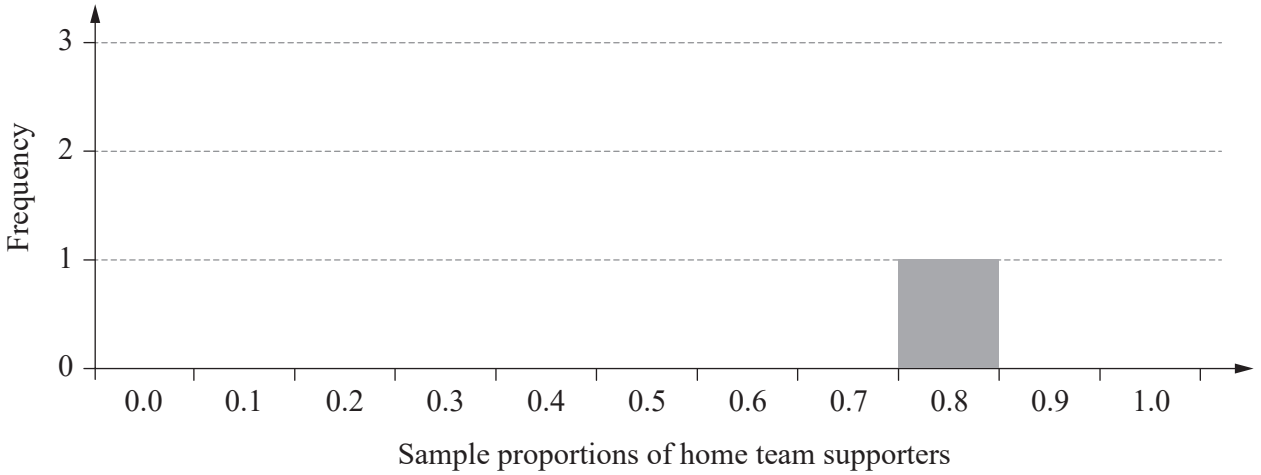
At a particular game at a local sporting venue, 60% of spectators support the home team and the remainder support the away team.

A researcher asked six groups of 10 spectators which team they supported. Each spectator was recorded as either H (supports home team) or A (supports away team). The results were:

Group 1:	H	A	H	H	H	A	H	H	H	H
Group 2:	A	A	H	A	A	H	A	A	A	A
Group 3:	H	A	A	H	H	A	A	A	H	H
Group 4:	H	H	H	H	H	A	H	H	H	H
Group 5:	A	A	H	H	A	H	H	A	H	A
Group 6:	A	H	A	A	A	A	A	H	A	A

a) The researcher would like to see the distribution of the sample proportions of home team supporters obtained by entering the information into a column graph. The sample proportion for group 1 is shown.

Complete the column graph by including the sample proportions for the remaining five groups. *[3 marks]*



Note: If you make a mistake in the diagram, cancel it by ruling a single diagonal line through your work and use the additional response space at the back of this question and response book.

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b) If the researcher had interviewed more groups, each containing 100 spectators, describe two ways the distribution of the resulting sample proportions would be expected to differ from the distribution shown in Question 14a). *[2 marks]*

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QUESTION 15 (4 marks)

A survey was conducted to understand whether people support a new policy.

Using a z-score of 2, the approximate confidence interval for the population proportion of people who support the policy was calculated as $\left(\frac{3}{10}, \frac{7}{10}\right)$.

a) Determine the margin of error. *[1 mark]*

b) Determine the number of people surveyed. *[3 marks]*

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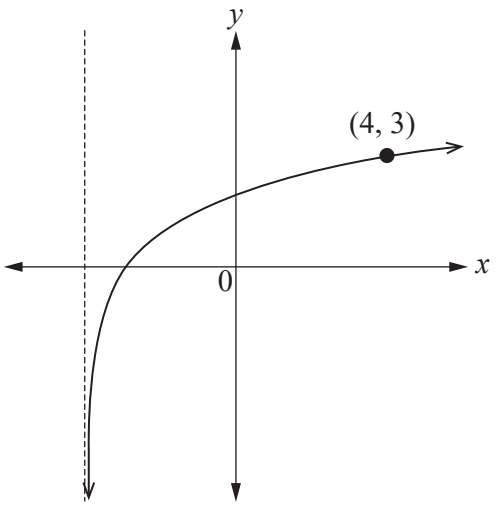
QUESTION 16 (4 marks)

The graph is of the form $y = \log_a(x + b)$. A point on the graph (4, 3) is labelled. The line $x = -4$ is an asymptote.



There is a point $P(x_P, y_P)$ on the graph where y_P is twice the value of the y-intercept of the curve.

Determine the value of x_P.

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QUESTION 17 (3 marks)

A community group that uses social media created a new post on the internet on a day when they had 1000 members. The rate of change in their number of members (members/day) is given by $f'(t) = 3e^{0.5t}$, where t represents days after the new post.

Determine the time it will take for the community group to achieve seven times the initial number of members. Express your answer in the form $a\ln(b)$.

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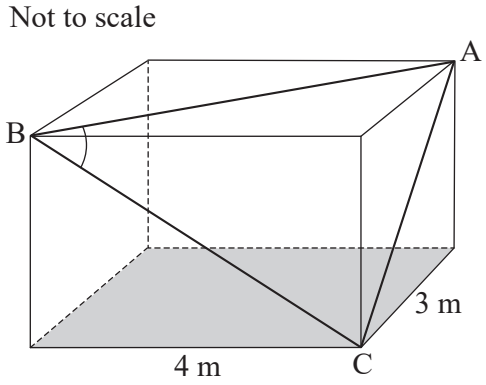
QUESTION 18 (5 marks)

The diagram shows some dimensions of a large storage container that is a rectangular prism. The angle ABC is 60°.

A person requires a container that is at least 4 metres in height.



Make a justified decision about whether this storage container meets the person's requirements.

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QUESTION 19 (6 marks)

A permanent ice glacier is in a valley in New Zealand.

Due to the temperature changes of the seasons each year, the glacier expands for six months and recedes for six months. The changing distance of a point on the front edge of the glacier to a car park can be modelled by a sine function.

During the colder months, when the glacier expands, the front edge of the glacier moves to within 270 m of the car park. However, in the warmer months, when the glacier recedes, the front edge moves to a maximum distance of 280 m away from the car park.

The erosion effects of the glacier on the ground are of most interest to geologists when the absolute value of the acceleration of the front edge is greater than $\frac{5\pi^2\sqrt{3}}{72}$ metres/month^2. During these times, a team of geologists sets up a camp site nearby to perform field work. Whenever the acceleration is less than this, the geologists leave camp.

The following claim is made.

The geologists will spend a total of between seven and eight months at the camp site each calendar year.

Evaluate the reasonableness of this claim.

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ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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Write the question number you are responding to.

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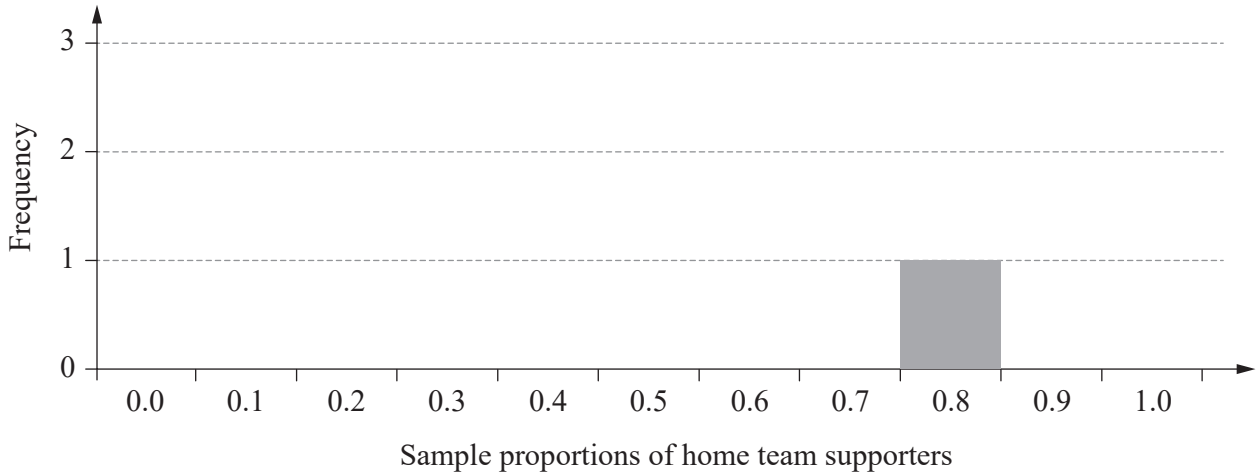
ADDITIONAL RESPONSE SPACE FOR QUESTION 14a)

If you want this diagram to be marked, rule a single diagonal line through your original response.



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