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

School name

Given name/s

Family name

Attach your barcode ID label here

Book of books used

External assessment 2025

Question and response book

Mathematical Methods

Paper 2 — Technology-active

Time allowed

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

General instructions

- Answer all questions in this question and response book.
- QCAA-approved calculator **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.

Do not write outside this box.

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 equation of $f(x)$ if $f'(x) = \cos(x) - 4\sin(2x + \pi)$ and $f(\pi) = 2$. *[4 marks]*

b) Use your result from Question 11a) to determine the value of x where $f(x) = 4.8$, for $2 \leq x \leq 4$. *[1 mark]*

c) Use your result from Question 11a) to determine the minimum value of $f(x)$, for $2 \leq x \leq 4$. *[1 mark]*

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QUESTION 12 (7 marks)

A cockroach population is modelled by the function $P(t) = P_0 e^{kt}$, where P is the population after t weeks and k is a population constant. Initially, 100 cockroaches were counted. After three weeks, there were 120.

a) Determine the constant k. *[2 marks]*

b) Determine the function $P'(t)$. *[1 mark]*

c) Determine when the rate of population growth would reach 10 cockroaches per week. *[1 mark]*

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To decrease the growth rate of the cockroach population, a pest control treatment was trialled.

The new function to model the cockroach population t weeks after using the treatment is

$$I(t) = c\ln(t+8)+172,$$

where c is a constant.

Three weeks after using the treatment, the rate of population growth was five cockroaches per week.

d) Determine the value of c. *[2 marks]*

e) Determine the cockroach population when the treatment began. *[1 mark]*

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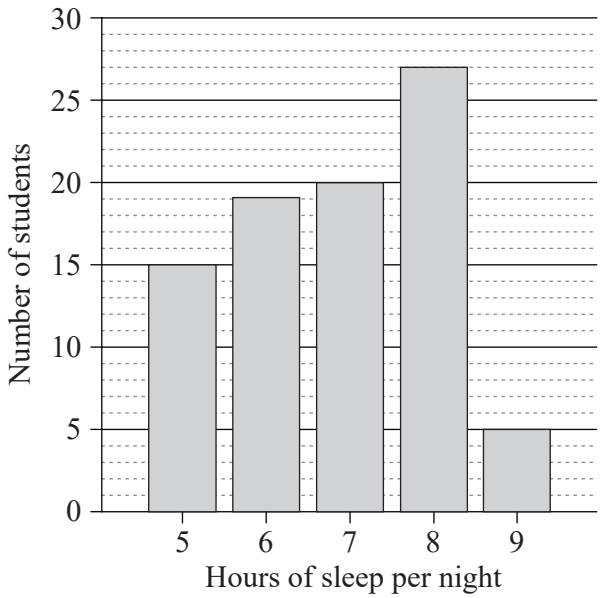
QUESTION 13 (4 marks)

A school investigated how many hours students sleep per night. To obtain data, a random sample of students was surveyed. The results are shown.



a) Use the data to determine the sample proportion of students who had seven or more hours of sleep per night. *[3 marks]*

b) Use your result from Question 13a) to determine an 80% approximate confidence interval for the proportion of students who get seven or more hours of sleep per night. *[1 mark]*

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QUESTION 14 (6 marks)

The number of tourists visiting a country at any given time is modelled by

$$N(t) = 18000 \sin\left(\frac{\pi}{6}t + 6\right) + 22000,\ 0 \le t \le 12,$$

where t is the time (months) from the start of the year.

a) Determine when the number of tourists first reaches 36 000. Provide your response as a decimal number. *[1 mark]*

b) Determine the equation of the second derivative of $N(t)$. *[2 marks]*

c) Determine the value of the second derivative when the number of tourists is a minimum. *[2 marks]*

d) Use your result from Question 14c) to explain how the value of the second derivative is consistent with the number of tourists being a minimum. *[1 mark]*

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QUESTION 15 (3 marks)

A tour operator offers day cruises off the Queensland coast. They advertise that on any given day, customers have a 65% probability of seeing at least one whale.

The tour operator conducts cruises for 40 consecutive days.

Let X be the binomial random variable representing the outcome — success or failure — over the 40 days. A success is customers seeing at least one whale.

Calculate the probability that the number of days with a success will be within one standard deviation of the mean for X.

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QUESTION 16 (4 marks)

A species of fish is being raised in a fish pond. The number of fish, M, in the pond can be modelled by a function $M = 100b^t$, where t is the time (days) since the fish were initially introduced into the pond and b is a constant to be determined.

After seven days, there are 150 fish in the pond.

Find the rate of population growth when the pond contains five times the initial number of fish.

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QUESTION 17 (4 marks)

The probability density function approximates the time (s) that people spend viewing a particular photo on a social media page.

$$p(t) = \begin{cases} k e^{-\frac{7t}{50}}, & 0 \le t \le 20 \\ 0 \quad , & \text{otherwise} \end{cases}$$

Determine the mean time people spend viewing the photo.

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QUESTION 18 (5 marks)

The results of an employee satisfaction survey of 500 employees at a large company are presented to board members.

The results include a 95% confidence interval for the proportion of satisfied employees. The lower end of the confidence interval is 0.648.

A board member would like to use the survey results to make the claim that the proportion of the satisfied employees in the entire company is larger than 75%.

Evaluate the reasonableness of the claim.

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QUESTION 19 (6 marks)

A scientist is gathering data on two species of horned beetle, species A and B. Horn length is a method of distinguishing the species.

Species A horn lengths are normally distributed with a mean of 20 mm and a standard deviation of 2 mm.

It is known that 14.6% of species B beetles have horns shorter than 18 mm.

In the particular population the scientist is studying, 30% of the beetles are species B and 70% are species A.

The scientist captures a beetle with a horn length shorter than 18 mm.

Determine the probability that the beetle is from species A.

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ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

Do not write outside this box.

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Write the question number you are responding to.

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