LUI | | | | | | | | | | |

School code | | | | |

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Attach your barcode ID label here

Book | | of | | books used

External assessment 2026

Question and response book

Specialist Mathematics

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.
- Calculators are permitted.
- QCAA formula book provided.
- Planning paper will not be marked.

Section 1 (10 marks)

- 10 multiple choice questions

Section 2 (50 marks)

- 9 short response questions
- Predicted paper written by Tangent Tuition. Not QCAA material.

Clear zone — margin trimmed off after completion of assessment

THIS PAGE WILL NOT BE MARKED

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.
- Unless otherwise instructed, give answers to the same degree of accuracy as the values provided in the question.
- 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 50 marks.

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QUESTION 11 (7 marks)

The manufacturer of a brand of LED light globe states that the lifetime of these globes is normally distributed with a mean of 12 000 hours and a standard deviation of 900 hours.

A consumer group tests a random sample of 45 of these globes.

a) Assuming the manufacturer's statement is true, determine the probability that the mean lifetime of the sample is less than 11 650 hours. *[2 marks]*

The sample of 45 globes has a mean lifetime of 11 650 hours and a sample standard deviation of 950 hours.

b) Determine an approximate 95% confidence interval for the population mean lifetime of these globes. *[2 marks]*

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c) State the margin of error of the interval in Question 11b). *[1 mark]*

The consumer group claims that the mean lifetime of these globes is less than the manufacturer states.

d) Use your result from Question 11b) to evaluate the reasonableness of the consumer group's claim. *[2 marks]*

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QUESTION 12 (5 marks)

A model aircraft flies from a point O towards a survey point P, where $\overrightarrow{OP} = 600\hat{\boldsymbol{i}} + 800\hat{\boldsymbol{j}} + 100\hat{\boldsymbol{k}}$ (displacements in metres).

In still air, the velocity ($\mathrm{m\,s^{-1}}$) of the aircraft would be $\boldsymbol{v}_\mathrm{a} = 6\hat{\boldsymbol{i}} + 8\hat{\boldsymbol{j}} + \hat{\boldsymbol{k}}$. The velocity ($\mathrm{m\,s^{-1}}$) of the wind is $\boldsymbol{v}_\mathrm{w} = 1.5\hat{\boldsymbol{i}} - 2\hat{\boldsymbol{j}}$, so the velocity of the aircraft is $\boldsymbol{v} = \boldsymbol{v}_\mathrm{a} + \boldsymbol{v}_\mathrm{w}$.

a) Determine $\boldsymbol{v}$. *[1 mark]*

b) Use your result from Question 12a) to determine the scalar projection of $\boldsymbol{v}$ on $\overrightarrow{OP}$. *[2 marks]*

c) Determine the magnitude of the component of $\boldsymbol{v}$ that is perpendicular to $\overrightarrow{OP}$. *[2 marks]*

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QUESTION 13 (4 marks)

The position vector of a particle at time t is given by

$$\boldsymbol{r}(t) = (2+4\cos(t))\,\hat{\boldsymbol{\imath}} + (3\sin(t)-1)\,\hat{\boldsymbol{\jmath}}, \quad t \geq 0$$

a) Show that the particle moves along the ellipse $\dfrac{(x-2)^2}{16} + \dfrac{(y+1)^2}{9} = 1$. *[2 marks]*

b) Determine the velocity of the particle at time t. *[1 mark]*

c) Determine the speed of the particle when $t = 2$. *[1 mark]*

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QUESTION 14 (6 marks)

A wildlife sanctuary monitors the female population of a species of quoll. The table shows the initial female population and the rates for each age group.

Age (years)	0–1	1–2	2–3
Female population	400	250	150
Birth (breeding) rate	0	1.5	1.2
Survival rate	0.4	0.6	0

a) Determine the Leslie matrix for this population. *[1 mark]*

b) Determine the total female population after one year. *[1 mark]*

c) Use your result from Question 14a) to determine the number of females in each age group after five years. *[2 marks]*

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A ranger notes that the total female population increased during the first year, and claims that the total female population will continue to increase in the long term.

d) Evaluate the reasonableness of the ranger's claim. *[2 marks]*

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QUESTION 15 (4 marks)

The volume of a sphere is increasing at a constant rate of 40 $cm^3\ s^{-1}$.

a) Show that the radius of the sphere is 4.924 cm, rounded to three decimal places, at the instant when the volume of the sphere is 500 cm^3. *[1 mark]*

b) Determine the rate at which the radius of the sphere is increasing at this instant. *[2 marks]*

c) Determine the rate at which the surface area of the sphere is increasing at this instant. *[1 mark]*

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QUESTION 16 (6 marks)

Consider the system of linear equations

$$x+y+z=2$$
$$2x-y+3z=1$$
$$5x-y+\lambda z=p$$

where $\lambda, p \in R$.

a) Use a Gaussian technique to determine the values of λ and p for which the system has infinitely many solutions. *[3 marks]*

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b) Use your result from Question 16a) to determine the solutions of the system. Express your answer in the form of a vector equation of a line. *[2 marks]*

c) Describe the geometric interpretation of the system when $\lambda = 7$ and $p \neq 4$. *[1 mark]*

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QUESTION 17 (6 marks)

The temperature, T °C, of a cup of coffee t minutes after it is poured can be modelled by the differential equation

$$\frac{dT}{dt} = -k(T - A)$$

where k is a positive constant and A °C is the constant temperature of the room.

The coffee is poured at a temperature of 88 °C. Its temperature is 72 °C four minutes later and 60 °C eight minutes after it is poured.

a) Use a calculus approach to show that the temperature of the room is 24 °C. *[4 marks]*

b) Determine the time taken for the coffee to cool to 40 °C. *[2 marks]*

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QUESTION 18 (6 marks)

The mass of mangoes grown on a farm is normally distributed. A random sample of mangoes from the farm was used to calculate an approximate 95% confidence interval for the population mean mass of mangoes on the farm. This interval was $(414.5, 435.5)$ grams.

The sample mean and sample standard deviation of the same sample were used to estimate that approximately 95% of all mangoes on the farm have a mass between 362 grams and 488 grams.

The farm manager claims that if 64 more mangoes had been added to the original sample, and the sample mean and sample standard deviation were unchanged, the approximate 99% confidence interval for the population mean mass would not contain 415 grams.

Evaluate the reasonableness of this claim.

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QUESTION 19 (6 marks)

Two objects, A and B, move on a horizontal surface. The velocity (m s^{-1}) of Object A at time t (s) is given by

$$\boldsymbol{v}_{\text{A}} = 0.7\hat{\boldsymbol{i}} + 2.2\cos(0.4t)\hat{\boldsymbol{j}}, \quad t \geq 0$$

At $t = 0$, the position (m) of Object A relative to the origin, O, is $6.9\hat{\boldsymbol{i}} + 2.3\hat{\boldsymbol{j}}$.

At $t = 0$, Object B is at O and is moving directly towards Object A with a speed of $2.4\ \text{m s}^{-1}$. Object B moves with a constant acceleration of magnitude $1.35\ \text{m s}^{-2}$.

Given that the two objects collide, use vector calculus to determine the acceleration of Object B. Express your answer in Cartesian form, giving each component to two decimal places.

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ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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