

Trial Examination 2023

## VCE General Mathematics Units 3&4

Written Examination 2

### Question and Answer Booklet

Reading time: 15 minutes

Writing time: 1 hour 30 minutes

Student's Name: \_\_\_\_\_

Teacher's Name: \_\_\_\_\_

#### Structure of booklet

| <i>Number of questions</i> | <i>Number of questions to be answered</i> | <i>Number of marks</i> |
|----------------------------|-------------------------------------------|------------------------|
| 12                         | 12                                        | 60                     |

Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, one bound reference, one approved technology (calculator or software) and, if desired, one scientific calculator. Calculator memory DOES NOT need to be cleared. For approved computer-based CAS, full functionality may be used.

Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

#### Materials supplied

Question and answer booklet of 18 pages

Formula sheet

Working space is provided throughout the booklet.

#### Instructions

Write your **name** and your **teacher's name** in the space provided above on this page.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

All written responses must be in English.

#### At the end of the examination

You may keep the formula sheet.

**Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.**

Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2023 VCE General Mathematics Units 3&4 Written Examination 2.

Neap<sup>®</sup> Education (Neap) Trial Exams are licensed to be photocopied or placed on the school intranet and used only within the confines of the school purchasing them, for the purpose of examining that school's students only for a period of 12 months from the date of receiving them. They may not be otherwise reproduced or distributed. The copyright of Neap Trial Exams remains with Neap. No Neap Trial Exam or any part thereof is to be issued or passed on by any person to any party inclusive of other schools, non-practising teachers, coaching colleges, tutors, parents, students, publishing agencies or websites without the express written consent of Neap.

**Instructions**

Answer **all** questions in the spaces provided.

In all questions where a numerical answer is required, you should only round your answer when instructed to do so.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

**DATA ANALYSIS****Question 1** (4 marks)

After the Year 12 graduation at Matilda Secondary College, parents of the graduating Year 12 students were asked to complete a survey about how well student achievements were celebrated. The survey included 10 statements and respondents were asked to rate how they felt about each statement using the following scale.

|                           |                 |                |              |                        |
|---------------------------|-----------------|----------------|--------------|------------------------|
| Strongly disagree<br>(SD) | Disagree<br>(D) | Neutral<br>(N) | Agree<br>(A) | Strongly agree<br>(SA) |
|---------------------------|-----------------|----------------|--------------|------------------------|

- a. What type of categorical data will be found using this survey? 1 mark

---

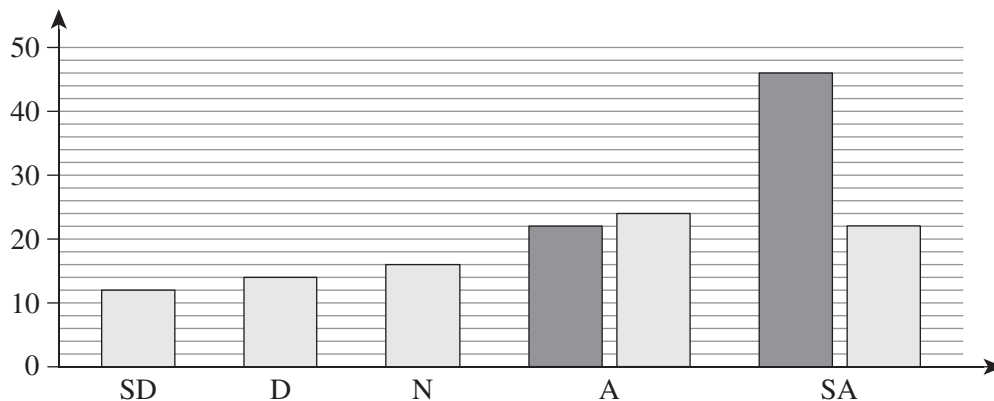


---

- b. Statement 1 in the survey was:

‘The evening was an excellent way for my child to celebrate the year with friends and family.’

The responses to statement 1 are shown in the bar chart below.

**Key**

- parents of award winners
- parents of non-award winners

- i. Use the bar chart on page 2 to complete the frequency table below. 1 mark

|                              | Responses |   |   |   |    |
|------------------------------|-----------|---|---|---|----|
|                              | SD        | D | N | A | SA |
| Parents of award winners     |           |   |   |   |    |
| Parents of non-award winners |           |   |   |   |    |

- ii. How many parents completed the survey? 1 mark

---

---

- iii. What percentage of the parents who completed the survey were parents of students that won an award?  
Round your answer to the nearest whole number. 1 mark

---

---

**Question 2** (10 marks)

The principal of Matilda Secondary College wanted to know more about the community's opinion of the school and commissioned a survey of 200 homes within a 5 km radius of the school.

- a.** The first question in the survey asked respondents to rate their impression of the school on a scale of 1–7, where 1 was the lowest ranking and 7 was the highest ranking. The results are shown in the table below.

| Response | Frequency |
|----------|-----------|
| 1        | 6         |
| 2        | 8         |
| 3        | 24        |
| 4        | 42        |
| 5        | 30        |
| 6        | 84        |
| 7        | 6         |

- i.** Find the five-number summary of the data. 1 mark

---

---

---

- ii.** Describe the shape of the data. 1 mark

---

---

- iii.** Determine, with calculations, whether there are any outliers in the data. 2 marks

---

---

---

---

- b.** One hundred and ninety-five homes responded to the second question in the survey, which asked respondents how many current or past students of Matilda Secondary College lived in the home. The results are shown in the table below.

| Number of current or past students | Frequency |
|------------------------------------|-----------|
| 0                                  | 101       |
| 1                                  | 29        |
| 2                                  | 28        |
| 3                                  | 20        |
| 4                                  | 16        |
| 5                                  | 1         |

- i.** Find the mean number of current or past students.

Round your answer to three decimal places.

1 mark

---

---

- ii.** Find the mean and standard deviation for responses of at least one current or past student.

Round your answers to two decimal places.

2 marks

Mean \_\_\_\_\_

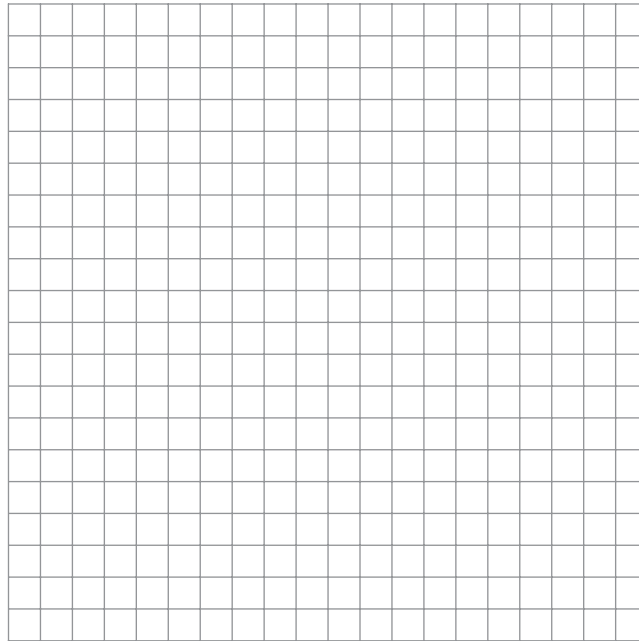
Standard deviation \_\_\_\_\_

To increase community engagement, the principal organises a market to take place on the school grounds on the third Sunday of every month. The attendance over the first nine months of the market is shown in the table below.

| <i>Month</i>      | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| <i>Attendance</i> | 180 | 192 | 205 | 210 | 204 | 230 | 260 | 290 | 380 |

- c. Draw a time series graph on the grid below.

2 marks



- d. Comment on the trend of the time series graph drawn in **part c**.

1 mark

---

---

**Question 3** (7 marks)

The following table shows the attendance at the Matilda Secondary College market and the income generated by the school.

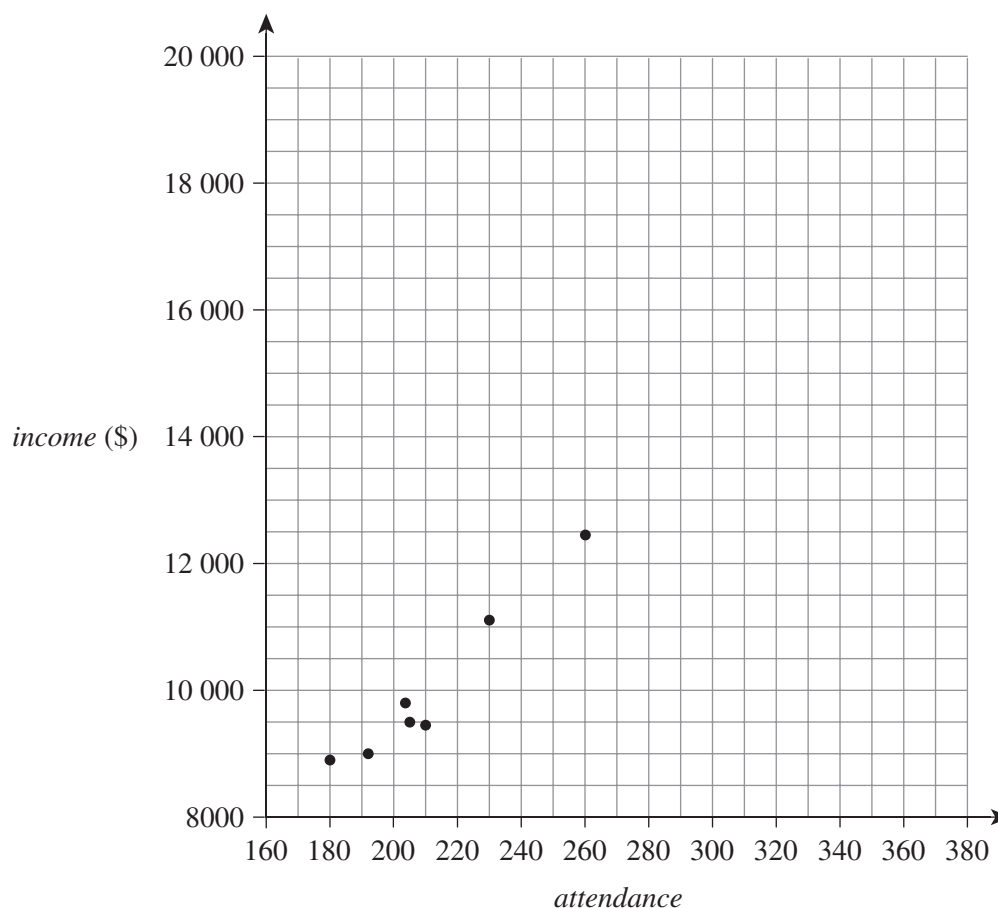
|                    |      |      |      |      |      |        |        |        |        |
|--------------------|------|------|------|------|------|--------|--------|--------|--------|
| <i>Attendance</i>  | 180  | 192  | 205  | 210  | 204  | 230    | 260    | 290    | 380    |
| <i>Income (\$)</i> | 8900 | 9000 | 9500 | 9450 | 9800 | 11 100 | 12 450 | 14 560 | 18 540 |

- a. Which variable is the explanatory variable? Explain your answer. 2 marks

---

---

- b. The following scatterplot of the data is incomplete.



Complete the scatterplot. 1 mark

- c. Comment on the strength and direction of the association shown in the scatterplot in **part b.** 1 mark

---

---

- d.** Find the equation of the least squares line.

Round all values to one decimal place.

1 mark

---

---

- e.** What is the mean amount that an attendee spends at the market?

2 marks

---

---

---

---

**Question 4** (3 marks)

The principal of Matilda Secondary College compares the data from the market with data from other types of community events. The principal finds that the *attendance* at a local carnival is between 500 and 2000 people.

The equation of the least squares line for the carnival's *income* and *attendance* is

$$\text{income} = -1550 + 64 \times \text{attendance}.$$

- a.** On a particular day, the carnival has an *attendance* of 1500 people and generates an *income* of \$84 750.

Calculate the residual.

2 marks

---

---

---

---

- b.** Given that the maximum attendance at the Matilda Secondary College market was 380 people, is the data from the carnival a good comparison for the data from the market? Explain your answer using mathematical terminology.

1 mark

---

---

---

**RECURSION AND FINANCIAL MODELLING****Question 5** (9 marks)

Jai runs a home maintenance service. Jai uses a flat rate of depreciation to depreciate his equipment. The value of the equipment, in dollars, after  $n$  years,  $V_n$ , is modelled by the following recurrence relation.

$$V_0 = 85\,000, V_{n+1} = V_n - 5850$$

- a.** What is the annual depreciation of the equipment? 1 mark

---

- b.** What is the annual flat rate percentage of depreciation?  
Round your answer to two decimal places. 1 mark

---

---

Jai can also depreciate his equipment using the reducing balance method. The value of the equipment after  $n$  years,  $R_n$ , is modelled by the following recurrence relation.

$$R_0 = 85\,000, R_{n+1} = 0.87R_n$$

- c.** What is the annual reducing balance percentage of depreciation? 1 mark

---

---

- d.** Calculate the difference in value between the two methods after two years. 2 marks

---

---

---

---

---

- e. After completing a job, Jai issues an invoice of \$2000 to the customer and gives them 30 days to pay. If the invoice is not paid by the due date, interest is charged at a rate of 0.75% per month on the remaining balance of the invoice, compounding monthly.

Let  $I_n$  be the value of the invoice after  $n$  months.

- i. Construct a recurrence relation, in terms of  $I_0$ ,  $I_{n+1}$  and  $I_n$ , that models the balance of the invoice.

1 mark

---

---

- ii. If the customer makes no payments on the invoice for six months, what is the balance of the invoice?

1 mark

---

---

- iii. When the job is completed, the customer requests a payment plan. Jai agrees to the customer paying \$700 a month until the invoice is paid in full.

How much is the customer's final payment?

2 marks

---

---

---

---

---

---

**Question 6** (3 marks)

Jai sells his business for \$1 200 000 and sets up an annuity with an interest rate of 4.1% per annum, compounding monthly.

- a.** What is the value of the annuity after five years?

Round your answer to the nearest cent.

1 mark

---

---

After five years, Jai is considering changing the annuity to a perpetuity.

- b.** If Jai changes to a perpetuity, how much could he withdraw each month?

Round your answer to the nearest cent.

1 mark

---

---

- c.** Jai decides to keep the annuity and leaves the investment until it has a value of \$1 600 000. Once the annuity reaches a value of \$1 600 000, Jai decides that he will retire in four years, so he starts making an extra payment of \$250 per month into the annuity.

What is the balance of the annuity when Jai retires?

Round your answer to the nearest cent.

1 mark

---

---

**MATRICES****Question 7** (5 marks)

The best-selling items in the canteen at Mitchell Valley High School are salad rolls ( $S$ ), egg and lettuce sandwiches ( $E$ ) and burritos ( $B$ ).

Matrix  $O$  shows the number of each item sold over a four-week period.

$$O = \begin{array}{ccc|l} S & E & B & \\ \hline 35 & 26 & 34 & \text{week 1} \\ 30 & 22 & 30 & \text{week 2} \\ 22 & 14 & 23 & \text{week 3} \\ 42 & 29 & 36 & \text{week 4} \end{array}$$

- a.** A public holiday occurred during the four-week period.

Which week most likely contained the public holiday? Explain your answer.

1 mark

---



---



---



---

- b.** How many egg and lettuce sandwiches were sold during the four-week period?

1 mark

---



---

- c.** Due to school holidays, sport days and curriculum days, it can be assumed that the three items continue to be sold at the same rate as the four-week period.

How many burritos would the canteen be expected to sell over 30 school weeks?

1 mark

---



---

- d.** A salad roll costs \$4.80, an egg and lettuce sandwich costs \$3.90 and a burrito costs \$4.50.

Find the total income for the four-week period.

2 marks

---



---



---



---

**Question 8** (3 marks)

Students at Mitchell Valley High School are studying for their upcoming English and Mathematics exams. The students have one study period each day to prepare for their exams.

It is found that 60% of students who study Mathematics on the first day will study Mathematics on the second day, and the remainder will study English on the second day. 30% of students who study English on the first day will study English on the second day, and the remainder will study Mathematics on the second day.

On the first day, 80 students studied Mathematics and 30 students studied English.

- a.** Find the transition matrix,  $T$ . 1 mark

---

---

- b.** Determine the number of students who will study Mathematics and the number of students who will study English on the fourth day. 1 mark

---

---

---

---

- c.** Find the steady state matrix. 1 mark

---

---

---

---

---

---

**Question 9** (4 marks)

Mitchell Valley High School ( $M$ ) competed in a debating competition against four other schools ( $I$ ,  $J$ ,  $K$  and  $L$ ). Each school debated against all other schools and there were no draws. The results of the competition are shown in the dominance matrix below.

|               |     | <i>loser</i> |     |     |     |     |
|---------------|-----|--------------|-----|-----|-----|-----|
|               |     | $I$          | $J$ | $K$ | $L$ | $M$ |
| <i>winner</i> | $I$ | 0            | 1   | 1   | 1   | 0   |
|               | $J$ | 0            | 0   | 1   | 0   | 1   |
|               | $K$ | 0            | 0   | 0   | 1   | 1   |
|               | $L$ | 0            | 1   | 0   | 0   | 0   |
|               | $M$ | 1            | 0   | 0   | 1   | 0   |

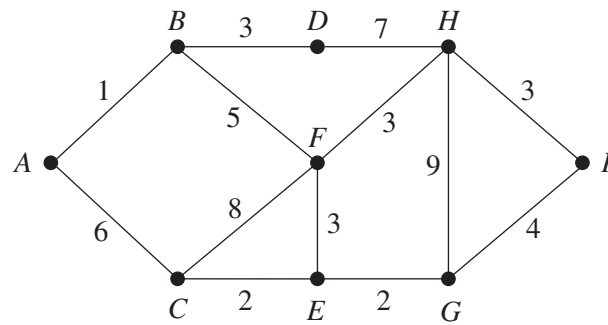
A '1' in the matrix means that the team named in that row defeated the team named in that column.

- a.** Which schools did Mitchell Valley High School defeat? 1 mark

- b.** Using the one- and two-step dominance method, rank the performances of each school from strongest to weakest. Show your working in the space below. 3 marks

**NETWORKS AND DECISION MATHEMATICS****Question 10** (3 marks)

A construction company is contracted to complete a project to connect nine locations,  $A$ – $I$ , with high-speed internet cables. The cable costs \$22 500 per kilometre. The distances between the locations, in kilometres, are shown in the graph below.



- a.** Draw the minimum spanning tree and calculate the minimum length.

2 marks

---

---

- b.** Find the minimum cost of the project.

1 mark

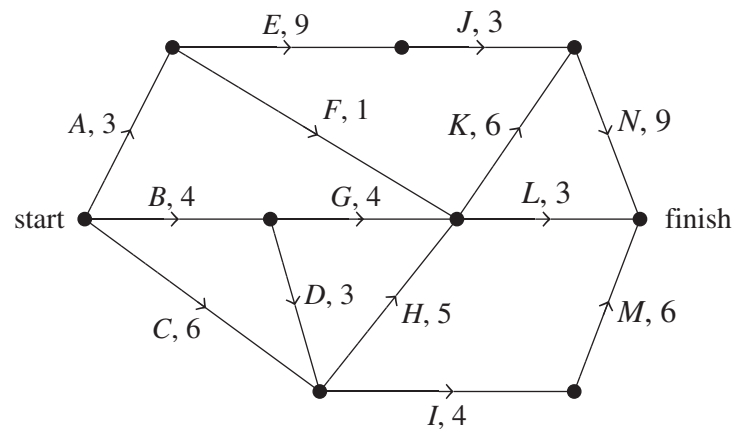
---

---



**Question 12** (5 marks)

The graph below shows the tasks in a building project. The times for each task are given in days.



- a. What are the immediate predecessors of task *L*? 1 mark

---

---

- b. How long will the project take to complete? 1 mark

---

---

- c. Identify the critical path. 1 mark

---

---

- d. What is the float time of task *J*? 1 mark

---

---

- e. More workers are employed, which reduces the length of task *H* to two days.  
What effect will this have on the length of the project? 1 mark

---

---

**END OF QUESTION AND ANSWER BOOKLET**

Trial Examination 2023

## VCE General Mathematics Units 3&4

Written Examinations 1&2

### Formula Sheet

#### Instructions

This formula sheet is provided for your reference.  
A question and answer booklet is provided with this formula sheet.

**Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.**

**GENERAL MATHEMATICS FORMULAS****Data analysis**

|                                    |                                                                                |
|------------------------------------|--------------------------------------------------------------------------------|
| standardised score                 | $z = \frac{x - \bar{x}}{s_x}$                                                  |
| lower and upper fence in a boxplot | lower $Q_1 - 1.5 \times IQR$ upper $Q_3 + 1.5 \times IQR$                      |
| least squares line of best fit     | $y = a + bx$ ,      where $b = r \frac{s_y}{s_x}$ and $a = \bar{y} - b\bar{x}$ |
| residual value                     | residual value = actual value – predicted value                                |
| seasonal index                     | seasonal index = $\frac{\text{actual figure}}{\text{deseasonalised figure}}$   |

**Recursion and financial modelling**

|                                                                       |                                                                                              |
|-----------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| first-order linear recurrence relation                                | $u_0 = a, \quad u_{n+1} = Ru_n + d$                                                          |
| effective rate of interest for a compound interest loan or investment | $r_{\text{effective}} = \left[ \left( 1 + \frac{r}{100n} \right)^n - 1 \right] \times 100\%$ |

**Matrices**

|                                      |                                                                                                                           |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| determinant of a $2 \times 2$ matrix | $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}, \quad \det A = \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$ |
| inverse of a $2 \times 2$ matrix     | $A^{-1} = \frac{1}{\det A} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}, \quad \text{where } \det A \neq 0$             |
| recurrence relation                  | $S_0 = \text{initial state}, \quad S_{n+1} = TS_n + B$                                                                    |
| Leslie matrix recurrence relation    | $S_0 = \text{initial state}, \quad S_{n+1} = LS_n$                                                                        |

**Networks and decision mathematics**

|                 |                 |
|-----------------|-----------------|
| Euler's formula | $v + f = e + 2$ |
|-----------------|-----------------|

**END OF FORMULA SHEET**