2025
NHT

General Mathematics Examination 1

Multiple-Choice Question Book

VCE (NHT) Examination – Thursday 22 May 2025

VCE Examination

- Reading time is **15 minutes:** 2.00 pm to 2.15 pm
- Writing time is **1 hour 30 minutes:** 2.15 pm to 3.45 pm

Approved materials

- One bound reference that may be annotated
- One approved CAS calculator or CAS software, and one scientific calculator

Materials supplied

- Multiple-Choice Question Book of 28 pages
- Formula Sheet
- Multiple-Choice Answer Sheet

Instructions

- Follow the instructions on your Multiple-Choice Answer Sheet.
- You may keep this Multiple-Choice Question Book.

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

Contents

VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY
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Instructions

- Answer **all** questions in pencil on the Multiple-Choice Answer Sheet.
- Choose the response that is **correct** for the question.
- A correct answer scores 1; an incorrect answer scores 0.
- Marks will **not** be deducted for incorrect answers.
- No marks will be given if more than one answer is completed for any question.
- Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Data analysis

Question 1

The table below shows the rainfall in millimetres (mm) recorded at a weather station in Melbourne during the month of January for the years 2016 to 2024.

Year	Rainfall (mm)
2016	53.4
2017	33.2
2018	73.6
2019	12.6
2020	129.4
2021	93.6
2022	72.3
2023	22.3
2024	117.7

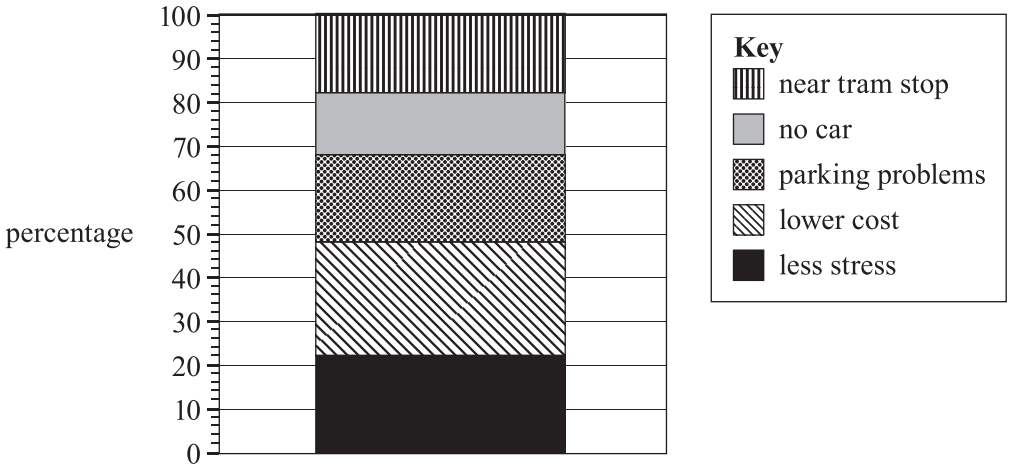
Source: Bureau of Meteorology, Australia
<http://www.bom.gov.au/climate/data/index.shtml>

The median rainfall, in mm, during January for the years 2016 to 2024 was

A. 67.6
B. 72.3
C. 73.6
D. 129.4

Question 2

Passengers on a tram were surveyed for reasons why they travelled by tram. Each reason, along with the percentage of surveyed passengers who gave that reason, is displayed in the segmented bar chart below.



The combined percentage of surveyed passengers who gave the reason ‘lower cost’ or ‘no car’ is closest to

A. 14%

B. 26%

C. 40%

D. 66%

Question 3

The investment returns, as percentages, of seven superannuation funds for the year 2022 are shown in the table below.

Investment returns						
–3.7%	–2.0%	–2.6%	–3.4%	–4.1%	1.7%	–2.2%

Source: www.propertiesandpathways.com.au

The range of these investment returns was

A. –2.4%

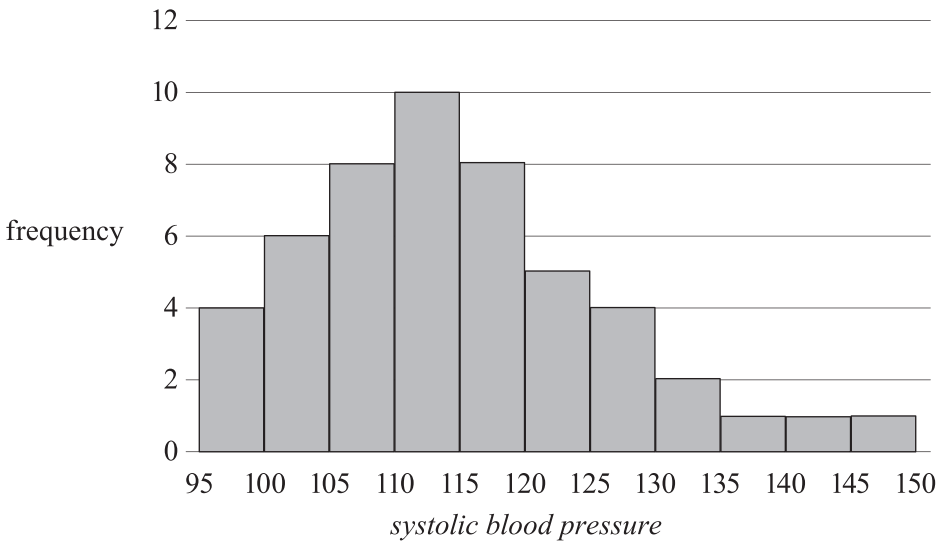
B. –1.5%

C. 2.4%

D. 5.8%

Use the following information to answer Questions 4 and 5.

The *systolic blood pressure* of 50 people was recorded. The results are summarised in the histogram below.



Question 4

For this group of people, the distribution of their *systolic blood pressure* is best described as

A. symmetric.

B. bell-shaped.

C. positively skewed.

D. negatively skewed.

Question 5

The percentage of these people with a *systolic blood pressure* less than 120 is closest to

A. 36%

B. 41%

C. 72%

D. 82%

Question 6

The distribution of the weights of eggs produced at a chicken farm is assumed to be normally distributed.

Analysis of 2000 eggs showed that:

- 16% of the eggs had a weight more than 96 grams
- 97.5% of the eggs had a weight more than 51 grams.

Using the 68–95–99.7% rule, the mean and standard deviation of the weights of these eggs are respectively

A. 45 and 6

B. 62.25 and 11.25

C. 73.5 and 11.25

D. 81 and 15

Question 7

The *price* of one share in a particular company is measured on the first trading day of each month.

A reciprocal transformation is applied to *price* and the equation of the least squares line relating *price* and *month* is $\frac{1}{price} = 13.2 - 0.74 \times month$.

On the first trading day of month 15, the *price* of one share predicted by the model is closest to

A. 0.08

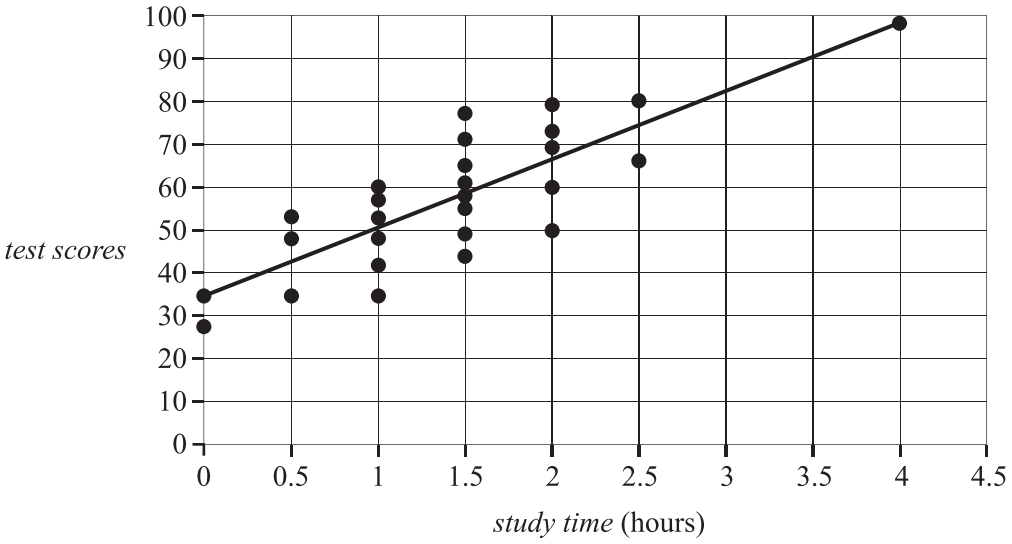
B. 0.48

C. 2.10

D. 13.17

Use the following information to answer Questions 8 and 9.

The scatterplot below shows the *test scores* and the *study time* in hours for students in a class. A least squares line has been added to the scatterplot.



Question 8

The slope of the least squares line is closest to

A. 16

B. 20

C. 25

D. 36

Question 9

From the scatterplot, it can be concluded that a

A. longer time spent studying causes a higher test score.

B. longer time spent studying is associated with a higher test score.

C. shorter time spent studying is associated with a higher test score.

D. shorter time spent studying causes a higher test score.

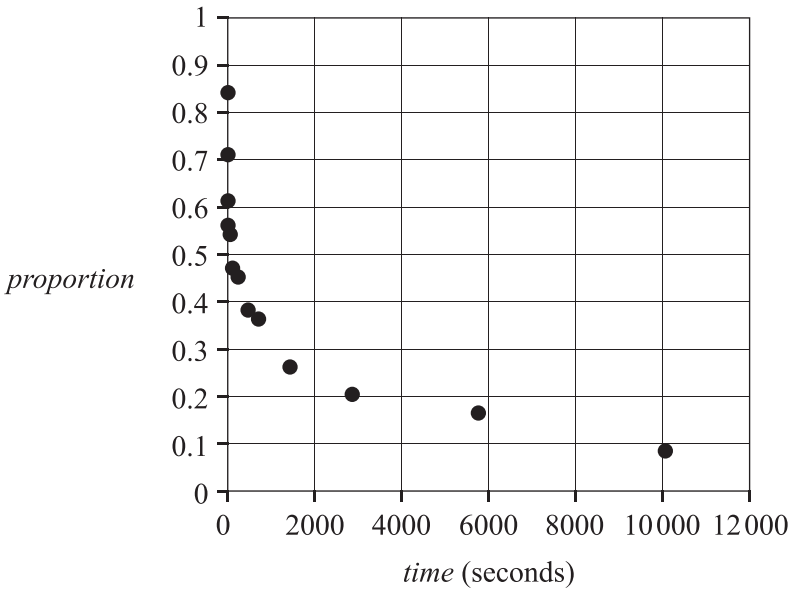
Question 10

A group of people are shown a list of words.

The table below gives the proportion of these words that people in the group could remember, *proportion*, at different times, *time* (in seconds), after the list is removed.

A scatterplot of the data is also shown.

time	*proportion*
1	0.84
5	0.71
15	0.61
30	0.56
60	0.54
120	0.47
240	0.45
480	0.38
720	0.36
1440	0.26
2880	0.2
5760	0.16
10 080	0.08



The scatterplot is non-linear.

A logarithmic (base 10) transformation applied to the variable *time* can be used to linearise the scatterplot.

The equation of the least squares line fitted to the linearised data is closest to

A. $proportion = 0.53 - 0.00006 \times \log_{10}(time)$

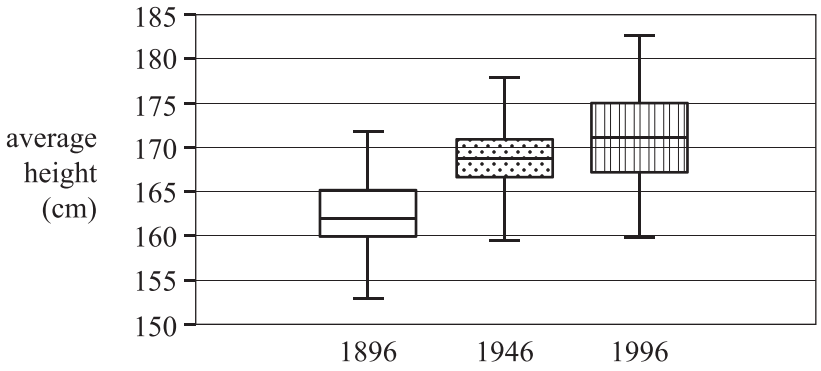
B. $proportion = -0.29 - 0.00009 \times \log_{10}(time)$

C. $proportion = 0.06 - 0.22 \times \log_{10}(time)$

D. $proportion = 0.85 - 0.18 \times \log_{10}(time)$

Question 11

The graph below shows parallel boxplots for the average heights of adult males, in centimetres, in 208 countries in 1896, 1946 and 1996.



Data: adapted from Our World in Data website, 2024
<https://ourworldindata.org/grapher/average-height-of-men>

Which one of the following statements can be concluded from the boxplots?

A. The range of the average heights for males in the 208 countries was greater in 1946 than in 1996.

B. The average adult male height was greater than 170 cm in 1996 for more than 100 of the countries observed.

C. The largest average adult male height observed in 1896 was less than the median of the average male heights observed in 1996.

D. No countries out of any of the 208 countries observed had an average adult male height less than 155 cm in 1896.

Question 12

A least squares line, $y = a + bx$, is fitted to data for an explanatory variable x and a response variable y.

- The standard deviation of the explanatory variable data is twice that of the response variable data.
- 81% of the variation in the response variable can be explained by the variation in the explanatory variable.
- The correlation between x and y is negative.
- The residual associated with the data point (2, 5) is 0.5

What is the residual associated with the data point (3, 4)?

A. –0.05

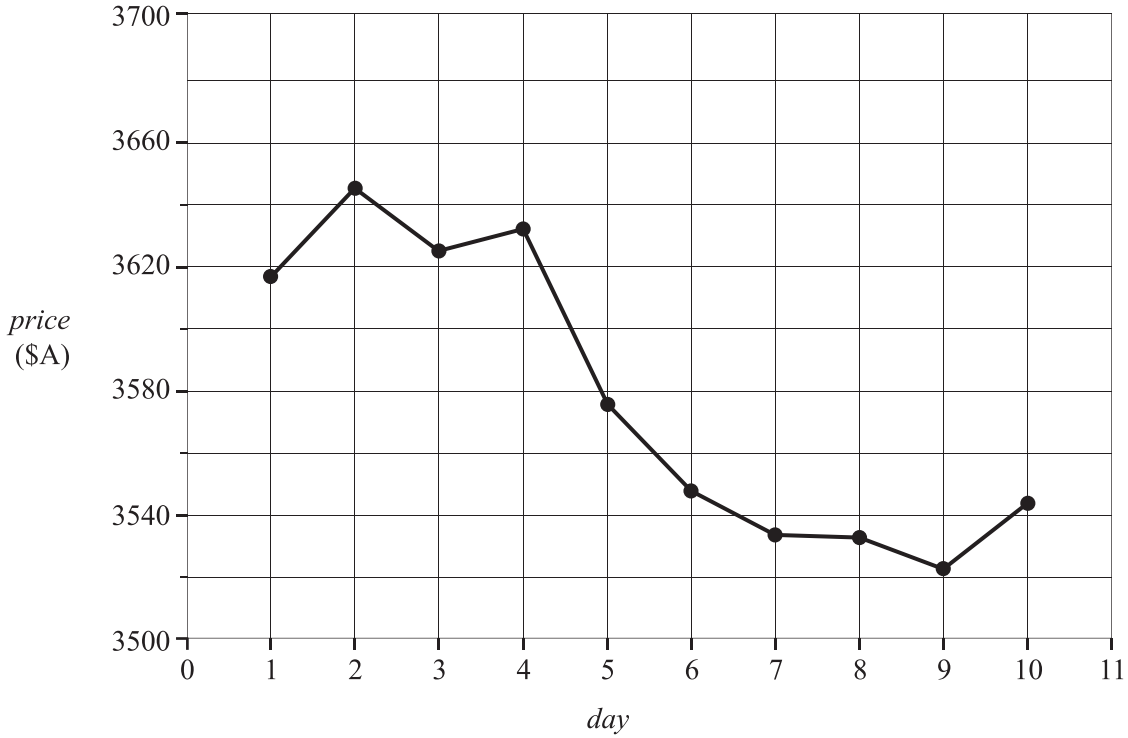
B. –1.05

C. 0.30

D. 1.30

Question 13

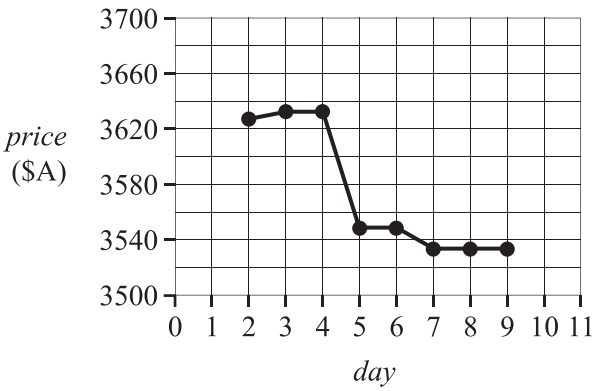
The time series plot below shows the price of gold, per unit, in Australian dollars ($A) for 10 days in May 2024.



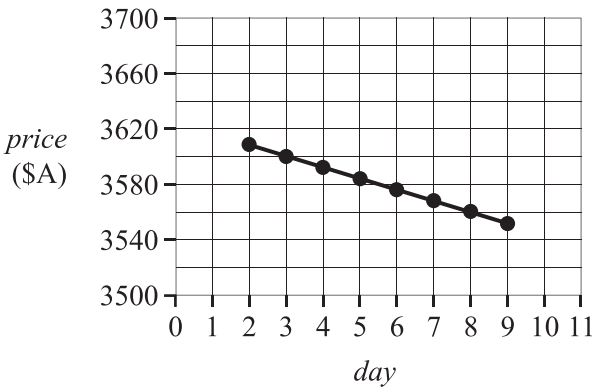
Source: ABC Bullion, Sydney, 2024 <https://abcbullion.com.au/products-pricing/gold>

When smoothed, using three-median smoothing, the time series plot will look most like

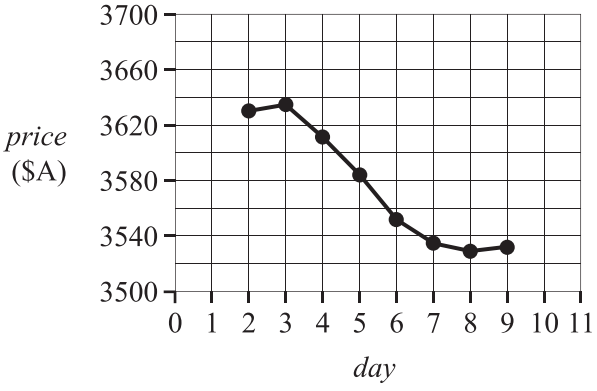
A.



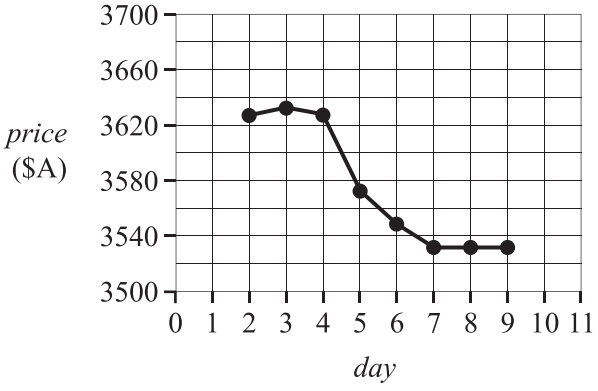
B.



C.



D.



Use the following information to answer Questions 14 and 15.

Umbrella sales for 2022–2023 and seasonal indices are shown in the table below.

	Summer	Autumn	Winter	Spring
Number of umbrellas sold	8143	9469	14 276	11 478
Seasonal index	0.75		1.28	1.10

Question 14

The seasonal index for summer is 0.75

This tells us that, on average, the number of umbrellas sold during summer is

A. 25% less than the seasonal average.

B. 75% less than the seasonal average.

C. 25% more than the seasonal average.

D. 75% more than the seasonal average.

Question 15

The deseasonalised value of the number of umbrellas sold in autumn is closest to

A. 7575

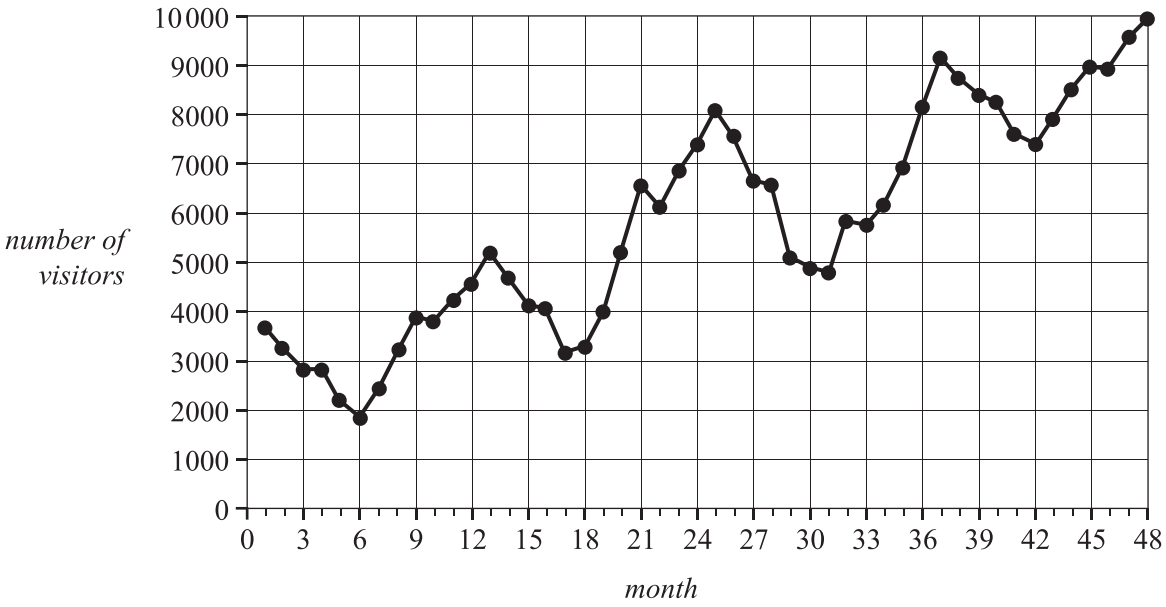
B. 8238

C. 10 100

D. 10 884

Question 16

The time series plot below shows the monthly *number of visitors* to a pool recorded over four years.



Consider the following four statements relating to the times series plot.

I Seasonality is present.

II An increasing trend is present.

III Irregular fluctuations are present.

IV Structural change is present.

Which of the four statements are correct?

A. I, II and III only

B. I, II, III and IV

C. I and II only

D. II and III only

Recursion and financial modelling

Question 17

A sequence of numbers is generated by the recurrence relation

$$T_0 = 30, \qquad T_{n+1} = 0.5T_n - 5$$

The first negative term in the sequence is

A. T_1

B. T_2

C. T_3

D. T_4

Question 18

Roderick receives a monthly payment after investing $440 000 in a perpetuity at an interest rate of 5% per annum compounding monthly. The monthly payment the perpetuity provides to Roderick in its second year is closest to

A. $1817

B. $1833

C. $1986

D. $2000

Question 19

Aisha took out a reducing balance loan of $500 000 with interest calculated quarterly.

The balance of the loan, in dollars, after n quarters, A_n, can be modelled by the recurrence relation

$$A_0 = 500\,000, \qquad A_{n+1} = 1.015A_n - d$$

With regular quarterly payments, Aisha repays the loan in full in 20 years.

The value of d is closest to

A. $7598.52

B. $9923.26

C. $10 774.16

D. $19 790.92

Question 20

Teresa has office equipment that she purchased for $8000.

She depreciates the value of the equipment using the reducing balance method.

After four years the office equipment is valued at $3000.

The annual reducing balance rate used by Teresa is closest to

A. 15.6%

B. 17.8%

C. 21.7%

D. 27.9%

Question 21

Nina invests $2000 at 9.25% per annum compounding annually.

After how many years will Nina's investment first be more than double its initial value?

A. 8 years

B. 9 years

C. 10 years

D. 11 years

Question 22

Recursive calculations to determine the value, V_n, in dollars, of a reducing balance loan after n time periods begin as follows

$$V_0 = 400\,000$$
$$V_1 = 1.003 \times 400\,000 - 2076.19 = 399\,123.81$$
$$V_2 = 1.003 \times 399\,123.81 - 2076.19 = 398\,244.99$$

All repayments are the same until the final one.

The interest rate charged on the loan does not change.

To ensure the loan is fully repaid to the nearest cent, the last repayment could be

A. $2076.04

B. $2076.19

C. $2076.34

D. $2076.49

Question 23

Yanni took out a loan for $10 000. Yanni makes no repayments in the first year. Compound interest is charged at a fixed interest rate per annum, though the compounding period may vary.

If the interest compounded monthly, then the effective rate of interest for this loan would be 6.4% per annum.

If the interest compounded annually, the amount of interest charged in the first year of the loan would be closest to

A. $622

B. $640

C. $659

D. $666

Question 24

Kenneth borrows $165 000.

He is charged interest at 6% per annum compounding quarterly.

The scheduled repayments are $5515.47 per quarter.

Halfway through the term of the loan, Kenneth pays off the entire remaining balance in one payment.

The amount Kenneth saves in interest by doing this is closest to

A. $10 319

B. $15 616

C. $33 725

D. $40 003

Matrices

Question 25

Matrix A shown below is symmetric.

$$A = \begin{bmatrix} 0 & 1 & 7 & 3 \\ 1 & 0 & 2 & 8 \\ a & b & 0 & 6 \\ 3 & c & 6 & 0 \end{bmatrix}$$

The values of a, b and c are

A. $a = 7 \quad b = 2 \quad c = 8$

B. $a = 7 \quad b = 3 \quad c = 8$

C. $a = 7 \quad b = 8 \quad c = 2$

D. $a = 8 \quad b = 2 \quad c = 7$

Question 26

Matrix K is a square matrix.

Multiplying K by its inverse will result in

A. a row matrix.

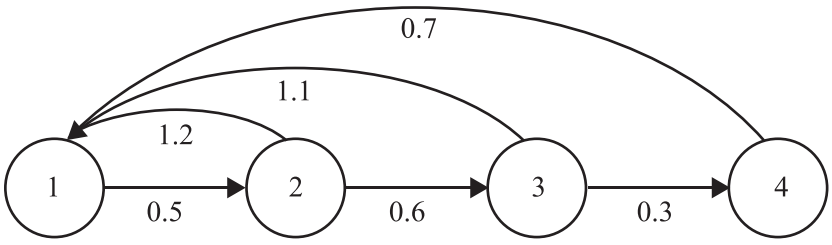
B. a column matrix.

C. the determinant.

D. an identity matrix.

Question 27

The following life-cycle transition diagram shows the life cycle of a female population of a certain size.



Compared with its initial size, in the long term the female population is expected to

A. remain unchanged.

B. decrease.

C. increase by 30%.

D. increase by 50%.

Use the following information to answer Questions 28 and 29.

A shop sells mattresses.

The mattresses come in four sizes, single (S), double (D), queen (Q) and king (K).

The mattresses come in two comfort levels, lush (L) and firm (F).

Matrix B below shows the number of each type of mattress sold in February 2025.

$$B = \begin{matrix} \\ L \\ F \end{matrix} \begin{matrix} \begin{matrix} S & D & Q & K \end{matrix} \\ \begin{bmatrix} 45 & 15 & 87 & 12 \\ 33 & 12 & 69 & 18 \end{bmatrix} \end{matrix}$$

Matrix C gives the predicted number of each type of mattress that will be sold during February 2026.

$$C = \begin{matrix} \\ L \\ F \end{matrix} \begin{matrix} \begin{matrix} S & D & Q & K \end{matrix} \\ \begin{bmatrix} 60 & 20 & 116 & 16 \\ 44 & 16 & 92 & 24 \end{bmatrix} \end{matrix}$$

Question 28

Matrix C could have been calculated using which one of the following equations?

A. $C = \frac{3}{10}B$

B. $C = \frac{1}{3}B$

C. $C = \frac{13}{10}B$

D. $C = \frac{4}{3}B$

Do not write in this area.

Question 29

The matrix product $X(C-B)^T$ gives a row matrix with the total predicted increases in sales for both lush and firm mattresses between February 2025 and February 2026.

Matrix X is

A. $\begin{bmatrix} 1 \\ 1 \end{bmatrix}$

B. $\begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 1 & 1 & 1 \end{bmatrix}$

D. $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

Question 30

Ben is writing multiple-choice tests for his class.

For each test, students are given five multiple-choice questions with options A, B, C, D and E.

The five questions for Test 1 have the following answers:

Question	**1**	**2**	**3**	**4**	**5**
Answer	A	B	E	D	C

This information can be represented by matrix Q.

$$Q = \begin{bmatrix} A & B & E & D & C \end{bmatrix}$$

Ben uses a permutation matrix, P, to decide on the answers for Test 2 onwards according to the rule Test $n = Q \times P^{n-1}$, where n is the test number.

He has noticed that the answers to question 1 and question 4 never change.

The answers to questions 2, 3 and 5 do change.

Which one of the following tests will have the same answers as Test 1?

A. Test 2

B. Test 3

C. Test 4

D. Test 5

Use the following information to answer Questions 31 and 32.

A course requires students to pass two levels of study before they graduate.

Each level of study takes one year.

- Students must pass the first level (*L1*) before they move on to the second level (*L2*).
- Students must pass the second level before they become graduates (*G*).

From one year to the next, it is known that

- 80% of students pass the first level of study and progress to the second level of study
- 60% of students in the second level of study become graduates the following year.

Students who do not pass a level of study repeat it in the following year. No student leaves the course before graduating.

Question 31

What percentage of students are expected to graduate without repeating a level of study?

A. 36%

B. 48%

C. 60%

D. 64%

Question 32

At the start of 2025, the numbers of students enrolled in *L1* and *L2* of the course and who have graduated from the course are given by the recurrence relation

$$S_0 = \begin{bmatrix} 1000 \\ 0 \\ 0 \end{bmatrix} \begin{matrix} L1 \\ L2 \\ G \end{matrix}, \qquad S_{n+1} = TS_n + \begin{bmatrix} k \\ 0 \\ 0 \end{bmatrix}$$

where

- T is the transition matrix showing the expected proportion of students moving between states *L1*, *L2* and *G* from one year to the next
- S_n is the state matrix n years after the start of 2025.

To ensure that there are always students studying the course, new students are enrolled into the first level every year so that the number of students studying the first level remains at 1000.

k is the number of new students enrolled at the first level each year.

At the start of which year will the expected number of students who have graduated from the course first exceed 5000?

A. 2032

B. 2033

C. 2034

D. 2035

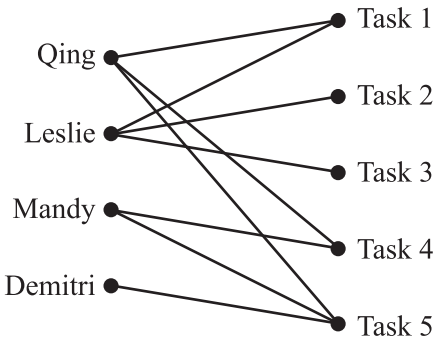
Networks and decision mathematics

Question 33

Four workers at a factory are allocated five tasks, all of which must be completed.

Each worker must complete at least one task, and one worker must complete two tasks.

The bipartite graph shows which tasks can be completed by each worker.



The worker who must complete two tasks is

A. Qing

B. Leslie

C. Mandy

D. Demitri

Question 34

A planar graph has nine edges and six faces.

The number of vertices is

A. 5

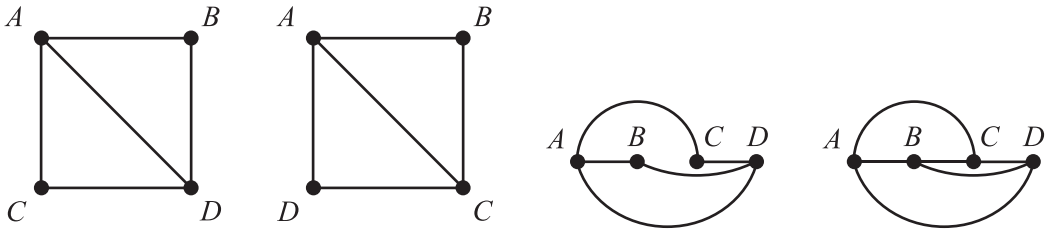
B. 8

C. 11

D. 15

Question 35

Consider the graphs below.



Which two graphs are equivalent?

A. I and II

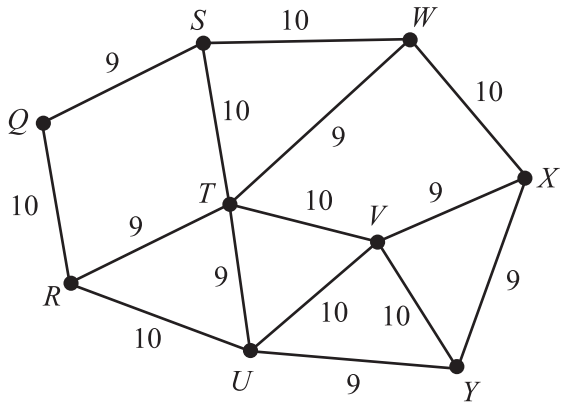
B. I and III

C. II and IV

D. III and IV

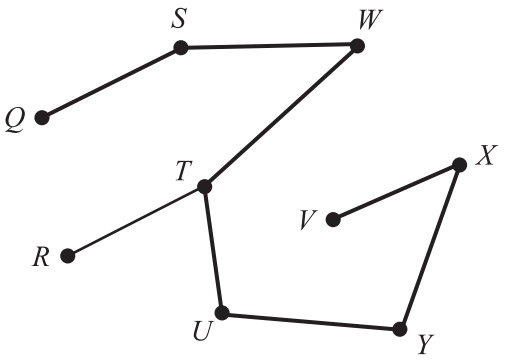
Question 36

Consider the weighted graph below.

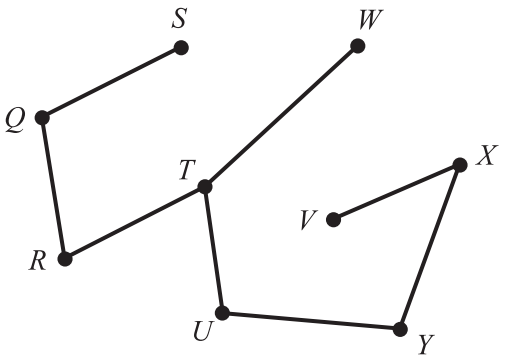


Which one of the following is **not** a minimum spanning tree for this weighted graph?

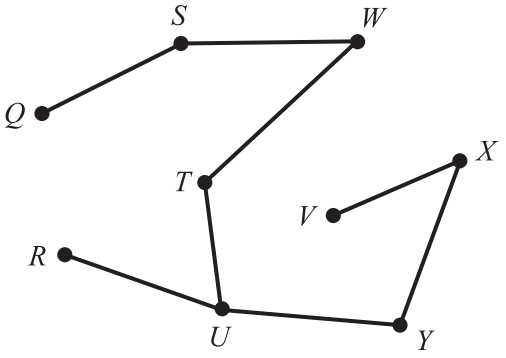
A.



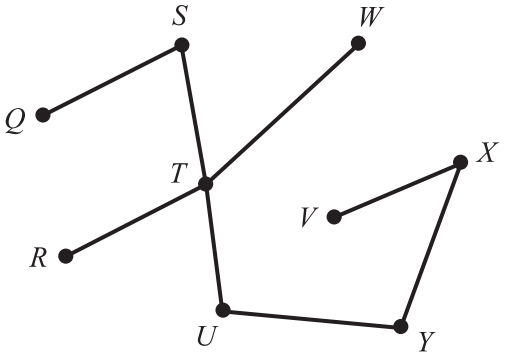
B.



C.



D.



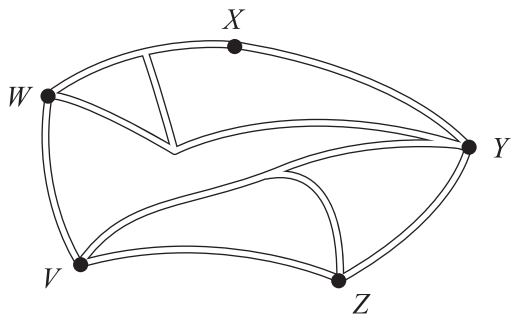
Question 37

The adjacency matrix below shows all the road connections between five towns, V, W, X, Y and Z.

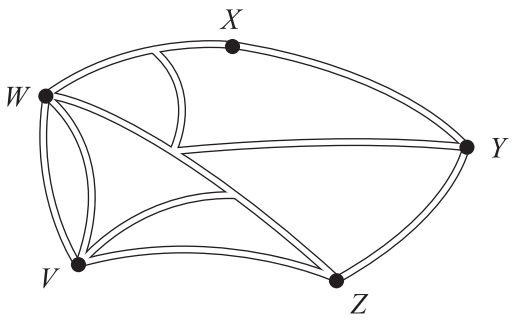
$$\begin{array}{c} \\ V \\ W \\ X \\ Y \\ Z \end{array} \begin{array}{c} \begin{array}{ccccc} V & W & X & Y & Z \end{array} \\ \begin{bmatrix} 0 & 3 & 1 & 1 & 2 \\ 3 & 1 & 2 & 2 & 2 \\ 1 & 2 & 0 & 2 & 1 \\ 1 & 2 & 2 & 0 & 2 \\ 2 & 2 & 1 & 2 & 0 \end{bmatrix} \end{array}$$

The road connections could be represented by which one of the following maps?

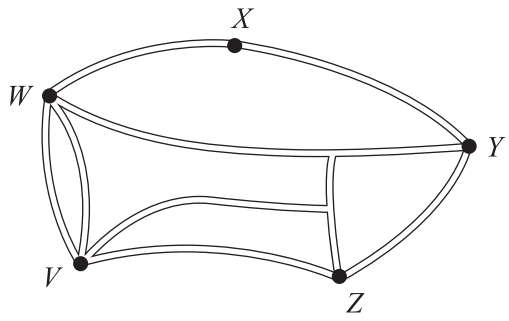
A.



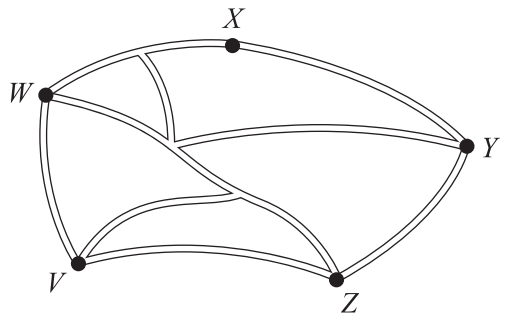
B.



C.



D.



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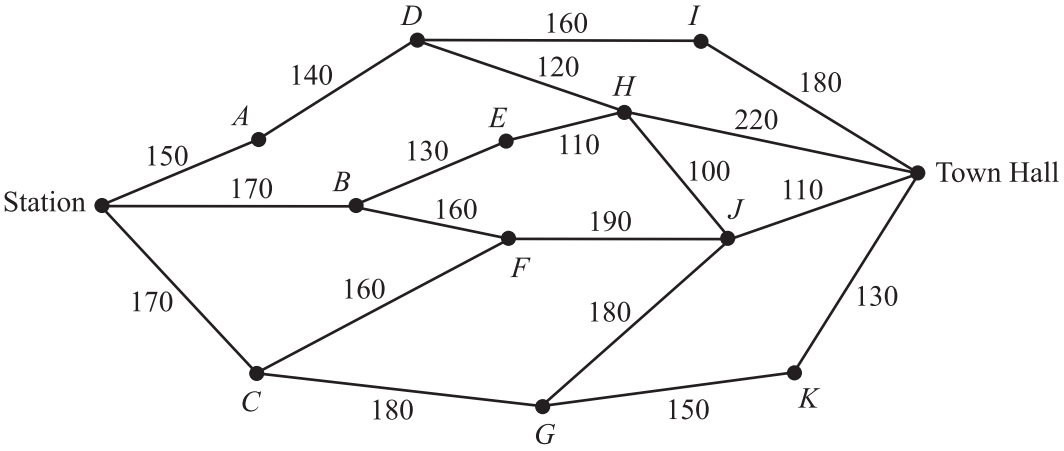
Question 38

Three friends, Alex, Bishnu and Cassie, start from the Station and travel through the city, ending at the Town Hall.

The following network shows the distances, in metres, of the streets they will travel on. The vertices represent city landmarks.



From the Station, Alex will travel towards vertex *A*, Bishnu will travel towards vertex *B*, and Cassie will travel towards vertex *C*. All three journeys end at the Town Hall.

Which one of the following statements is true?

A. Only Alex could have the shortest distance to travel.

B. Only Bishnu could have the shortest distance to travel.

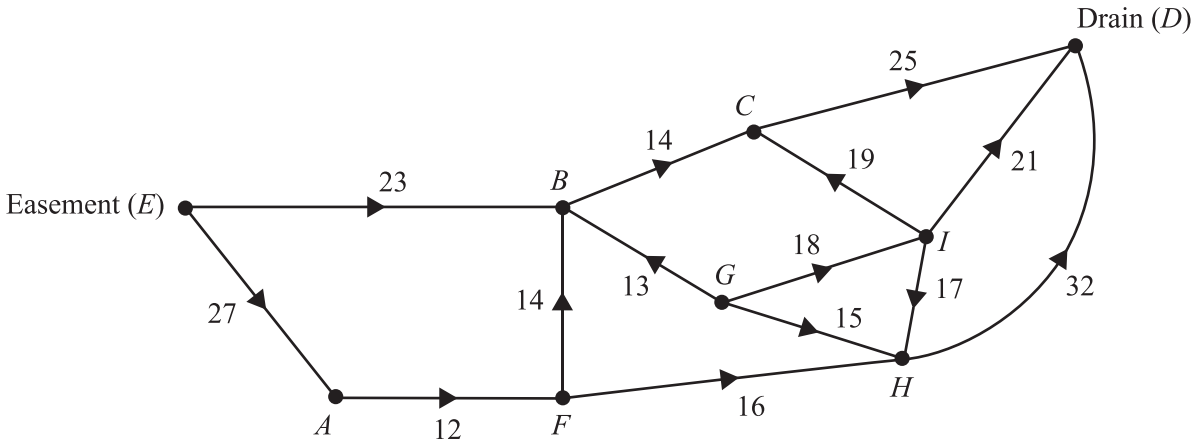
C. Both Cassie and Bishnu could have the shortest distance to travel, but not Alex.

D. Both Alex and Bishnu could have the shortest distance to travel, but not Cassie.

Question 39

The following network represents the flow of water from an Easement (source) to a storm water Drain (sink). The water flows through pipes, represented by edges, beneath a series of houses, represented by vertices.

The numbers on the edges represent the flow of water through the pipes in litres per second.



To increase the flow of water from the Easement to the Drain, the direction of flow of one of the pipes can be reversed.

To achieve the maximum increase, the direction of water flow should be reversed between which two vertices?

A. B and F

B. B and G

C. C and I

D. H and I

Question 40

A project involves 11 activities, A to K.

The duration, in days, and the immediate predecessors of these activities are shown in the table below.

Activity	Duration	Immediate Predecessors
A	7	–
B	9	–
C	13	A
D	6	B
E	8	C, D
F	16	B
G	7	B
H	5	G
I	5	H
J	9	E, F, I
K	12	H

When the project takes place, the duration of activity F is increased by 4 days.

By how many days does this increase the original minimum completion time of the project?

A. 1

B. 2

C. 3

D. 4

End of examination questions

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2025
NHT

General Mathematics Examination 1

2025 Formula Sheet

You may keep this Formula Sheet.

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Data analysis

standardised score	$z = \frac{x - \bar{x}}{s_x}$
lower and upper fence in a boxplot	lower $\text{Q1} - 1.5 \times \text{IQR}$ upper $\text{Q3} + 1.5 \times \text{IQR}$
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	$\text{seasonal index} = \frac{\text{actual figure}}{\text{deseasonalised figure}}$

Recursion and financial modelling

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

Matrices

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

Networks and decision mathematics

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

End of Formula Sheet