2026 NHT

SUPERVISOR TO ATTACH
PROCESSING LABEL HERE

Write your **student number** in the boxes above. **Letter**

General Mathematics
Examination 2

Question and Answer Book

VCE (NHT) Examination – Friday 22 May 2026

- Reading time is **15 minutes**: 10.30 am to 10.45 am
- Writing time is **1 hour 30 minutes**: 10.45 am to 12.15 pm

Approved materials

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

Materials supplied

- Question and Answer Book of 24 pages
- Formula Sheet

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 the spaces provided.
- Write your responses in English.
- 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 book are **not** drawn to scale.

Data analysis

Question 1 (7 marks)

The table below displays the typical *body weight*, in kilograms, for a sample of 19 different mammals.

Mammal	***Body weight* (kg)**
okapi	250
gorilla	210
pig	190
Brazilian tapir	160
jaguar	100
grey seal	85
giant armadillo	60
sheep	56
chimpanzee	52
kangaroo	35
goat	28
roedeer	15
baboon	11
rhesus monkey	6.8
raccoon	4.3
red fox	4.2
cat	3.3
echidna	3.0
rabbit	2.5

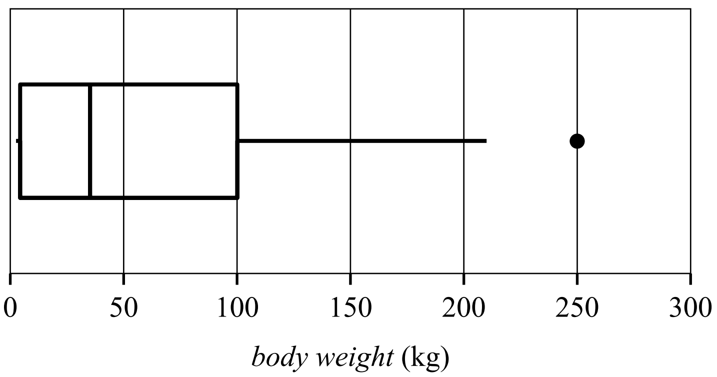
Data: Adapted from T Allison and DV Cicchetti, 'Sleep in mammals: ecological and constitutional correlates', *Science*, vol. 194, no. 4266, 12 November 1976, pp. 732–734 <lib.stat.cmu.edu/datasets/sleep>

a. Is the variable *mammal* an ordinal variable or a nominal variable? 1 mark

b. Complete the five-number summary in the table below for the variable *body weight*, in kilograms, by writing in the values for the minimum and the median. 2 marks

Minimum	Q1	Median	Q3	Maximum
	4.3		100	250

The boxplot below displays the distribution of *body weight*.



c. Describe the shape of this distribution. 1 mark

d. The mean *body weight* is 67 kg, rounded to the nearest whole number.

Explain why the median is a better measure of the centre of the *body weight* data than the mean. 1 mark

e. The *body weight* of the okapi is removed from the data set. A new *mammal* with a typical *body weight* of 240 kg is added to the data set.

Explain whether or not the typical *body weight* value of the new *mammal* is an outlier. Include a relevant calculation in your answer. 2 marks

Question 2 (6 marks)

The association between *life expectancy*, in years, and typical *brain weight*, in grams, for 12 different mammals was investigated. The *life expectancy* and *brain weight* values are shown in the table below.

***Life expectancy* (years)**	***Brain weight* (g)**
7.0	81
9.8	50
16	56
16	120
17	98
20	120
27	180
30	170
39	410
40	420
41	320
50	440

Data: Adapted from T Allison and DV Cicchetti,
'Sleep in mammals: ecological and constitutional correlates',
Science, vol. 194, no. 4266, 12 November 1976, pp. 732–734
<lib.stat.cmu.edu/datasets/sleep>

a. A least squares line with *life expectancy* as the response variable is fitted to this data.

Use the data in the table above to find the equation of this least squares line in terms of the variables *brain weight* and *life expectancy*.

Write your answers in the appropriate boxes provided below. Round the numbers representing the intercept and slope to three significant figures. 2 marks

life expectancy = [ ] + [ ] × *brain weight*

b. The coefficient of determination is 88.9%, rounded to one decimal place.

Using this value, find the value of Pearson's correlation coefficient, r, as a decimal number rounded to three decimal places. 1 mark

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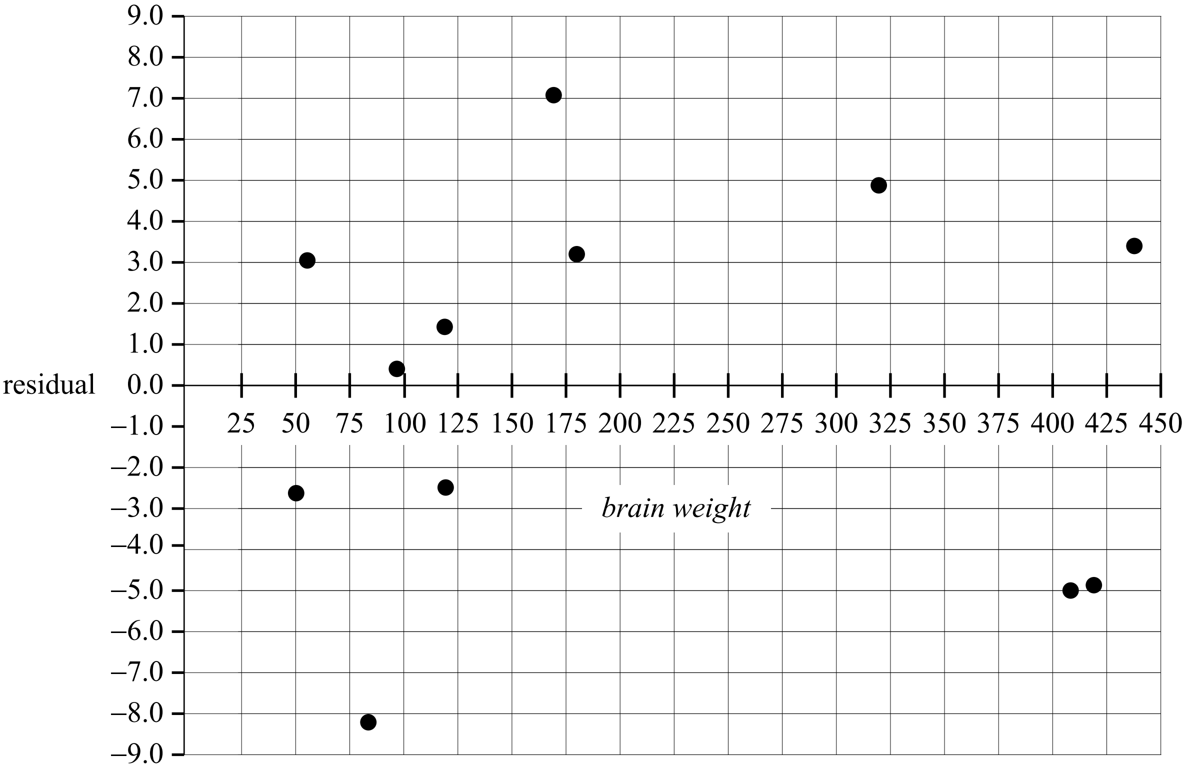
c. Write down the direction of the association between *brain weight* and *life expectancy*. 1 mark

Use the following information to answer part d and part e.

The residual plot associated with fitting a least squares line to this data is shown below.

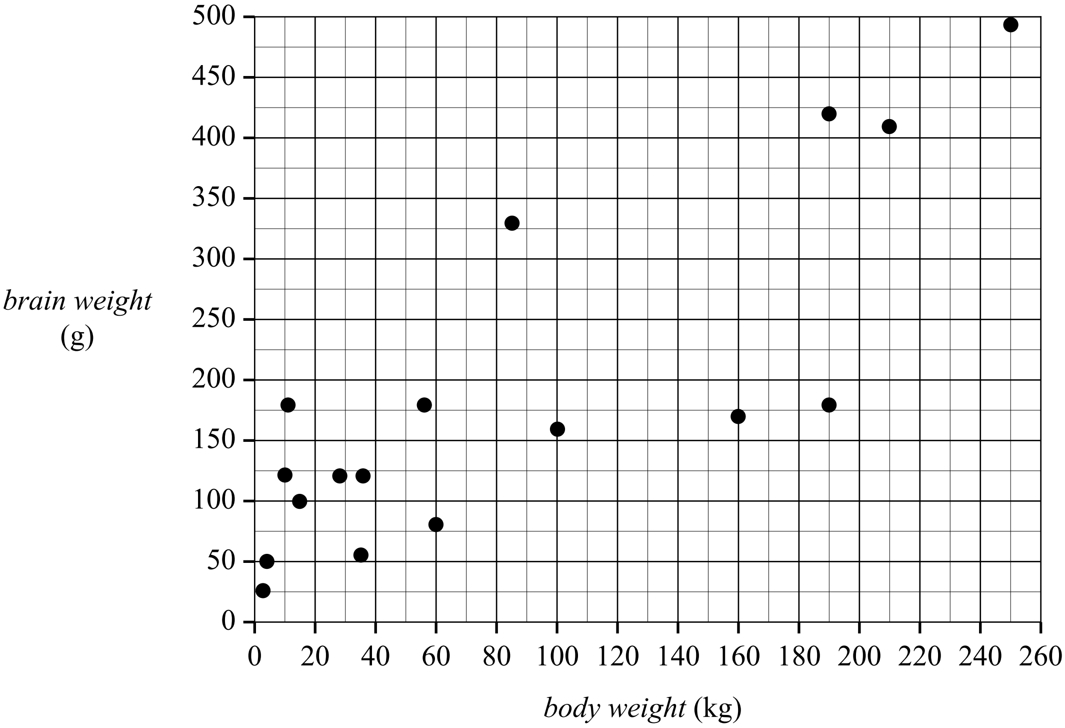


d. Does this residual plot support the assumption of linearity that was made when fitting this line to this data? Briefly explain your answer. 1 mark

e. Based on this residual plot, for the mammal with a *brain weight* of 180 g, was the *life expectancy* value overpredicted or underpredicted by the equation of the least squares line? Briefly explain your answer. 1 mark

Question 3 (7 marks)

The scatterplot below plots the typical *brain weight*, in grams, against the typical *body weight*, in kilograms, for a sample of 17 mammals.



Data: Adapted from T Allison and DV Cicchetti, 'Sleep in mammals: ecological and constitutional correlates', *Science*, vol. 194, no. 4266, 12 November 1976, pp. 732–734 <lib.stat.cmu.edu/datasets/sleep>

A least squares line is fitted to this data set.

The equation of this least squares line is

$$\textit{brain weight} = 69.6 + 1.39 \times \textit{body weight}$$

The coefficient of determination is 0.680

a. Name the explanatory variable in the equation of this least squares line. 1 mark

b. Draw the graph of this least squares line on the scatterplot above. 1 mark

(*Answer on the scatterplot above.*)

c. Interpret the coefficient of determination in terms of *brain weight* and *body weight*. 1 mark

d. Complete the following sentence by filling in the boxes below. 2 marks

The equation of the least squares line predicts that, on average, each 10 kg

increase in *body weight* is associated with a [ ] gram

[ ] in *brain weight*.

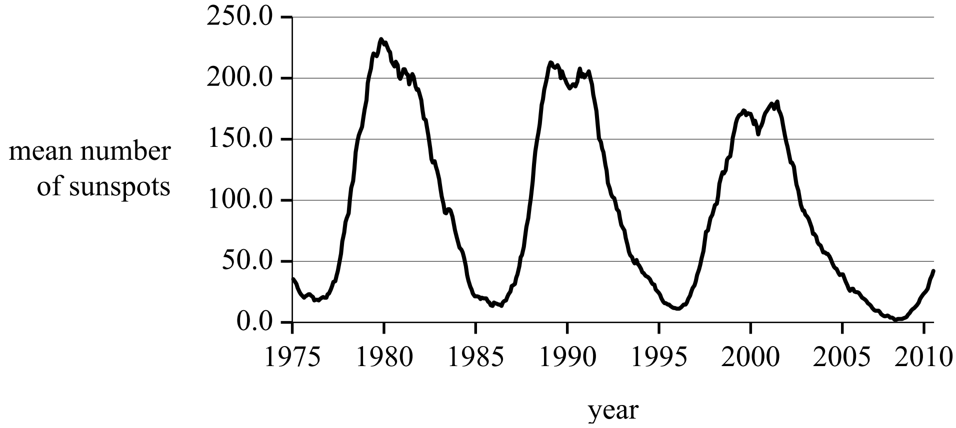
e. A gorilla has a typical *body weight* of 210 kg and a typical *brain weight* of 410 g.

Find the residual, rounded to the nearest whole number, when the least squares line is used to predict the typical *brain weight* of a gorilla. 2 marks

Question 4 (4 marks)

Sunspots are dark areas on the surface of the Sun.

The time series plot below shows mean monthly sunspot numbers for the period from January 1975 to December 2010.



Data: Adapted from Solar Influences Data Analysis Center, 'Sunspot number', WDC-SILSO, Royal Observatory of Belgium, Brussels, www.sidc.be/SILSO/datafiles 1 July 2015; DOI: https://doi.org/10.24414/qnza-ac80; licensed CC-BY-NC

a. The time series plot contains irregular fluctuations.

Identify one other qualitative feature of this time series plot. 1 mark

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b. Astronomers who monitor sunspot numbers use 13-point smoothing to display the underlying trend in the data.

The table below shows the mean monthly sunspot numbers for 18 consecutive months starting in March 1990 for the time series plot displayed on page 8.

In this table, month 1 is March 1990 and month 18 is August 1991.

Month	1	2	3	4	5	6	7	8	9
Number	200.6	198.7	196.1	192.9	191.7	192.7	194.6	195.1	193.3

Month	10	11	12	13	14	15	16	17	18
Number	197.1	203.8	207.6	201.2	203.4	200.3	202.9	203.0	205.7

i. Find the 13-point mean smoothed value, rounded to one decimal place, for month 9 (November 1990). 1 mark

ii. Find the 13-point median smoothed value for month 9 (November 1990). 1 mark

c. How many points would there be in the smoothed plot if 13-point smoothing was applied to the entire data set from January 1975 to December 2010? 1 mark

Do not write in this area.

Recursion and financial modelling

Question 5 (4 marks)

Timmy takes out a reducing balance loan with interest compounding monthly. He intends to fully repay the loan with monthly repayments.

The balance of the loan, V_n, in dollars, after n months is modelled by the recurrence relation

$$V_0 = 600\,000, \qquad V_{n+1} = 1.0048V_n - 4215.93$$

a. What amount does Timmy repay each month? 1 mark

b. Show, using a recursive calculation, that the balance of the loan after one month is \$598 664.07 1 mark

c. Calculate the annual compound interest rate, as a percentage, for this loan. 1 mark

d. The final repayment required by Timmy to fully repay the loan is slightly different from all other repayments.

Determine this final repayment. Round your answer to the nearest dollar. 1 mark

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Question 6 (3 marks)

Timmy's car was valued at \$60 000 when new. The value of the car is depreciated by 35 cents for each kilometre travelled. Assume he travels 25 000 km each year.

a. What will be the value of Timmy's car, in dollars, after two years of driving? 1 mark

b. The value of the car, in dollars, after *n* years, V_n, can be modelled by a recurrence relation.

Write the recurrence relation in terms of V_0, V_{n+1} and V_n. 1 mark

c. The value of the car, in dollars, after travelling *n* kilometres, W_n, can be modelled by a rule.

Write the rule for W_n in terms of *n*. 1 mark

Question 7 (2 marks)

Timmy took out a further reducing balance loan with interest compounding annually. He makes annual repayments. Two lines of the amortisation table for Timmy's loan are shown below.

Payment number	Payment ($)	Interest ($)	Principal reduction ($)	Balance ($)
0	0.00	0.00	0.00	260 000.00
1	20 598.55	12 610.00	7988.55	252 011.45

After one year, Timmy changes to making interest-only repayments.

Complete the next line in the amortisation table below, rounding all values to the nearest cent.

Payment number	Payment ($)	Interest ($)	Principal reduction ($)	Balance ($)
0	0.00	0.00	0.00	260 000.00
1	20 598.55	12 610.00	7988.55	252 011.45
2				

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Question 8 (3 marks)

a. Timmy makes an annuity investment. The value of the annuity, A_n, after n monthly payments have been made to Timmy can be determined using the recurrence relation shown below.

$$A_0 = 225\,000, \qquad A_{n+1} = 1.0025A_n - 1862.53$$

i. For how many years is Timmy expected to receive a monthly payment? 1 mark

ii. Determine the total interest earned in the first year of the annuity. Round your answer to the nearest cent. 1 mark

b. Timmy's friend Jane invests a principal amount, V_0, in an annuity that provides a quarterly payment of \$7600 for a total of 10 years.

This annuity has an interest rate of 3.2% per annum, compounding quarterly. The value of this annuity, V_n, after n quarters can be described using a recurrence relation.

Write this recurrence relation in terms of V_0, V_{n+1} and V_n, with V_0 rounded to the nearest cent. 1 mark

Matrices

Question 9 (2 marks)

The total number of visitors to a wildlife park each day over a three-week period is shown in matrix V below.

$$V = \begin{matrix} \\ week\ 1 \\ week\ 2 \\ week\ 3 \end{matrix} \begin{matrix} M & Tu & W & Th & F & Sa & Su \\ \left[\begin{matrix} 759 \\ 885 \\ 812 \end{matrix}\right. & \begin{matrix} 965 \\ 843 \\ 896 \end{matrix} & \begin{matrix} 788 \\ 846 \\ 943 \end{matrix} & \begin{matrix} 1035 \\ 1394 \\ 972 \end{matrix} & \begin{matrix} 1172 \\ 1316 \\ 1111 \end{matrix} & \begin{matrix} 1263 \\ 1477 \\ 1494 \end{matrix} & \left.\begin{matrix} 1312 \\ 1236 \\ 1432 \end{matrix}\right] \end{matrix}$$

a. Write down the order of matrix V in the boxes below. 1 mark

$\square \times \square$

b. Matrix S and matrix V are multiplied to form the matrix product SV.

This matrix SV is a row matrix showing the total number of visitors on each day of the week over the three weeks.

Write matrix S below. 1 mark

$S =$

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Question 10 (3 marks)

A merchandise stall sells soft animal toys in three different sizes: Pocket Pal (P), Cuddle (C) and Jumbo (J).

The retail price of each toy, in dollars, is given in matrix M below.

$$M = \begin{bmatrix} 8.50 \\ 18.00 \\ 28.90 \end{bmatrix} \begin{matrix} P \\ C \\ J \end{matrix}$$

Matrix Q, shown below, gives the number of each toy sold at the merchandise stall last Saturday and Sunday.

$$\begin{matrix} & Sa & Su & \\ Q = & \begin{bmatrix} 193 & 158 \\ 176 & 241 \\ 284 & 267 \end{bmatrix} & & \begin{matrix} P \\ C \\ J \end{matrix} \end{matrix}$$

a. Explain why MQ is not defined. 1 mark

b. The manager of the merchandise stall completes a calculation to determine the total revenue, R, in dollars, from the toys sold on each of the two days using the equation below.

$$R = Q^{\mathrm{T}}M$$

Calculate matrix R below. 1 mark

$R =$

c. New customers receive a 12% discount when purchasing from the merchandise stall. Matrix M can be multiplied by a scalar, p, to determine the discounted price of the toys.

Write down the value of the scalar p below. 1 mark

$p =$

Question 11 (4 marks)

The wildlife park is studying the population of female numbats in a national park over a 10-year period for their first, second and third years of life.

A Leslie matrix, L, for the population of female numbats for this study is shown below.

$$L = \begin{bmatrix} 0 & 2 & 1 \\ 0.35 & 0 & 0 \\ 0 & 0.22 & 0 \end{bmatrix}$$

a. Interpret **each of the three elements** in the first row of matrix L. 1 mark

b. What percentage of female numbats in their first year of life are expected to survive to their third year of life? 1 mark

c. One of the criteria for a species to be classified as threatened is significant population decline over time.

The *level of threat* to a species can be described as critically endangered, endangered, vulnerable or least concern. This is determined by the decline in the total female population, as a percentage, over a 10-year period (*population decline*), as shown in the table below.

Level of threat	critically endangered	endangered	vulnerable	least concern
Population decline	greater than 90%	greater than 70% and less than or equal to 90%	greater than 50% and less than or equal to 70%	less than or equal to 50%

Source: Adapted from 'The IUCN red list of threatened species', International Union for Conservation of Nature and Natural Resources <www.iucnredlist.org>

Matrix S_0 represents the initial population of female numbats observed at the start of 2022.

$$S_0 = \begin{bmatrix} 112 \\ 35 \\ 12 \end{bmatrix}$$

Showing relevant calculations, determine the *level of threat* faced by the numbat population 10 years later, at the start of 2032. 2 marks

Question 12 (3 marks)

The wildlife park wishes to track sugar glider movements across three zones: J, K and L.

Let A_n be the state matrix for the number of sugar gliders expected to be in each region at the start of year n.

The matrix recurrence relation shown below can be used to calculate the expected number of sugar gliders in each region from year to year.

$$A_{n+1} = TA_n + B$$

where

$$A_{2025} = \begin{bmatrix} 1330 \\ 590 \\ 280 \end{bmatrix} \begin{matrix} J \\ K \\ L \end{matrix}, \quad T = \begin{matrix} & \textit{this year} & \\ J & K & L \end{matrix} \begin{bmatrix} 0.5 & 0.6 & 0.4 \\ 0.3 & 0.3 & 0.4 \\ 0.2 & 0.1 & 0.2 \end{bmatrix} \begin{matrix} J \\ K \\ L \end{matrix} \textit{ next year} \quad \text{and} \quad B = \begin{bmatrix} 200 \\ -100 \\ -100 \end{bmatrix} \begin{matrix} J \\ K \\ L \end{matrix}$$

a. How many sugar gliders were expected to be in zone J at the start of 2023? 2 marks

b. In the long term, how many sugar gliders in total are expected to be in the wildlife park? 1 mark

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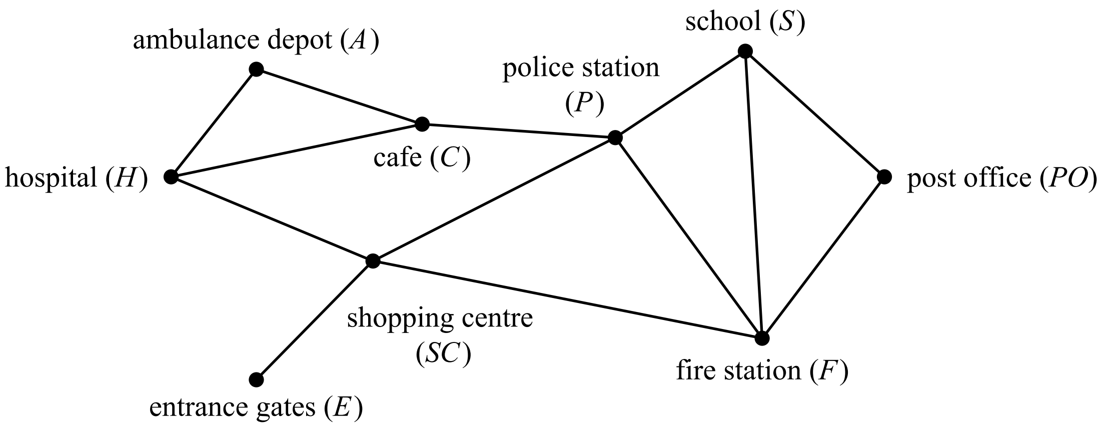
Networks and decision mathematics

Question 13 (4 marks)

In the network shown below, the vertices A, C, E, F, H, P, S, PO and SC represent the key locations in an estate and the edges represent the roads between them.



a. What is the degree of vertex S? 1 mark

b. Jed wishes to visit each location in the estate exactly once, starting at the fire station and ending at a different location.

i. What route could Jed take? 1 mark

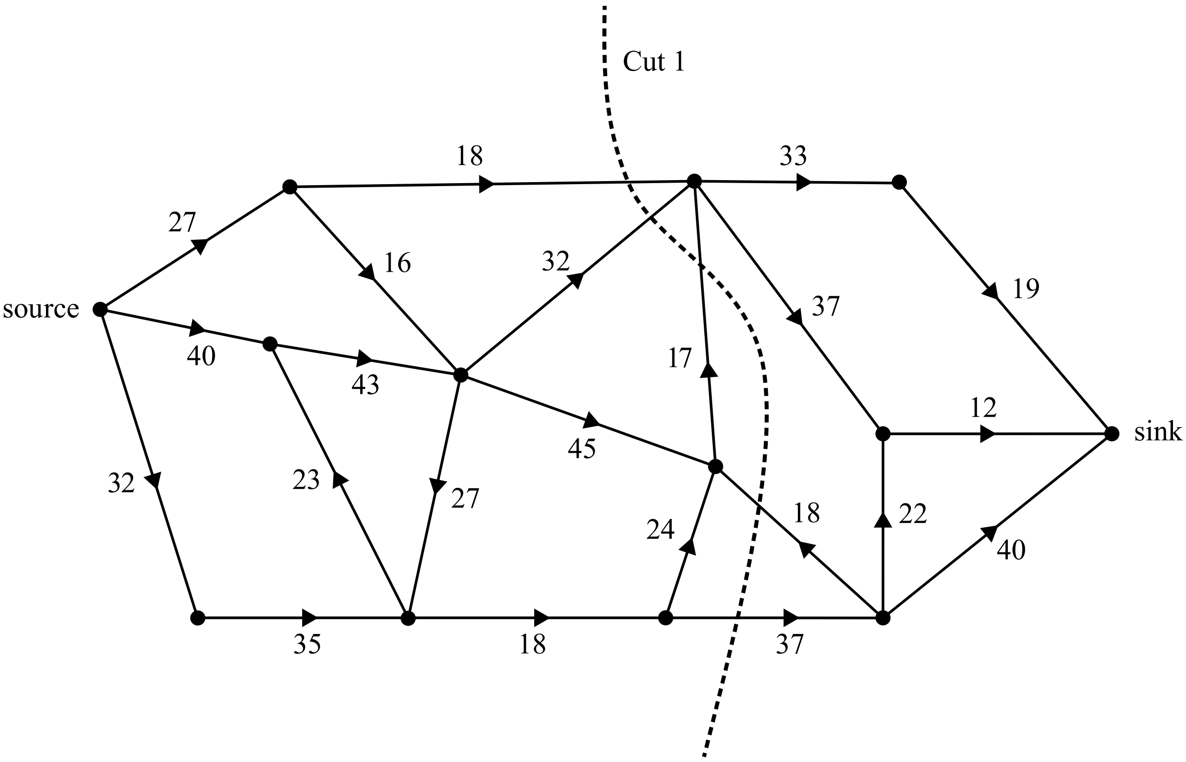
ii. What is the mathematical name for the journey taken by Jed? 1 mark

c. Payton also wishes to visit each location exactly once, starting and ending her journey at different locations.

List **three** locations where Payton cannot commence her journey. 1 mark

Question 14 (3 marks)

In the estate, water flows through a series of pipes, from source to sink, as shown in the directed network below.



The numbers on each edge represent the capacity, in megalitres per hour, of each section of the pipes being used.

a. Determine the capacity of Cut 1. 1 mark

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b. A cut passing through four edges has a capacity of 109 megalitres per hour.

Draw this cut on the directed network above. Label this cut as Cut 2. 1 mark

(*Answer on the directed network above.*)

c. What is the maximum flow of water through the estate in megalitres per hour? 1 mark

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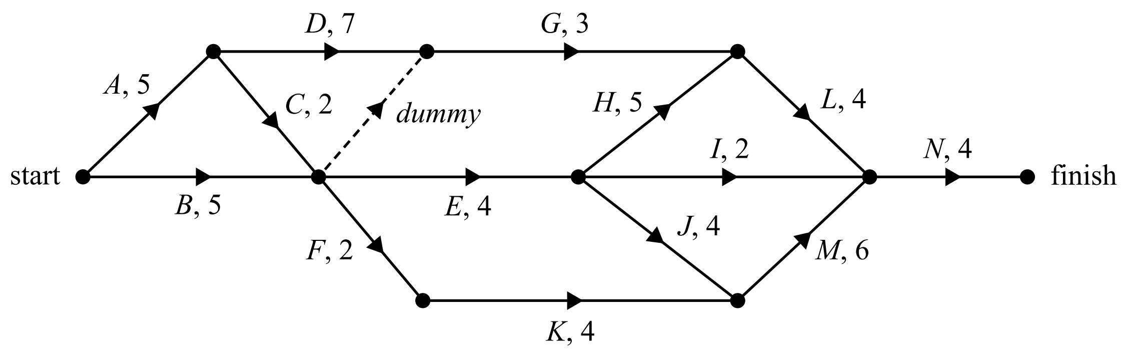
Question 15 (5 marks)

Each morning, before the cafe in the estate can open, a project of 14 activities needs to be completed.

The activity network below shows a project with activities labelled *A* to *N*, along with the completion times, in minutes, for each activity.



a. State the critical path for this project. 1 mark

b. Determine the latest start time of activity *H*. 1 mark

c. State all the activities that have a float time of 2 minutes. 1 mark

d. The owners of the cafe want to reduce the total time taken to complete the project by as much as possible.

They have determined that the time taken to complete each of the activities *A*, *B*, *D*, *H* and *M* may be reduced by either 1 minute or 2 minutes, or left unchanged.

Each minute by which an activity's completion time is reduced has an associated cost of $20.

Determine the new minimum completion time and the minimum associated cost to achieve this time. 2 marks

New minimum completion time

Minimum associated cost

End of examination questions

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End of examination. There are no more questions.

End of examination. There are no more questions.

2026
NHT

General Mathematics Examination 2

2026 Formula Sheet

You may keep this Formula Sheet.

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Data analysis

standardised score	$z = \dfrac{x - \bar{x}}{s_x}$
lower and upper fence in a boxplot	lower $Q1 - 1.5 \times IQR$ upper $Q3 + 1.5 \times IQR$
least squares line of best fit	$y = a + bx$, where $b = r\dfrac{s_y}{s_x}$ and $a = \bar{y} - b\bar{x}$
residual value	residual value = actual value – predicted value
seasonal index	seasonal index = $\dfrac{\text{actual figure}}{\text{deseasonalised figure}}$

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	$r_{\text{effective}} = \left[\left(1 + \dfrac{r}{100n}\right)^n - 1\right] \times 100\%$

Matrices

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

Networks and decision mathematics

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

End of Formula Sheet