

# General Mathematics Examination 1

## Multiple-Choice Question Book

VCE Examination – Friday 31 October 2025

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- 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.

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Contents	pages
40 questions (40 marks)	2–24

## Instructions

- Answer **all** questions in pencil on your 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.

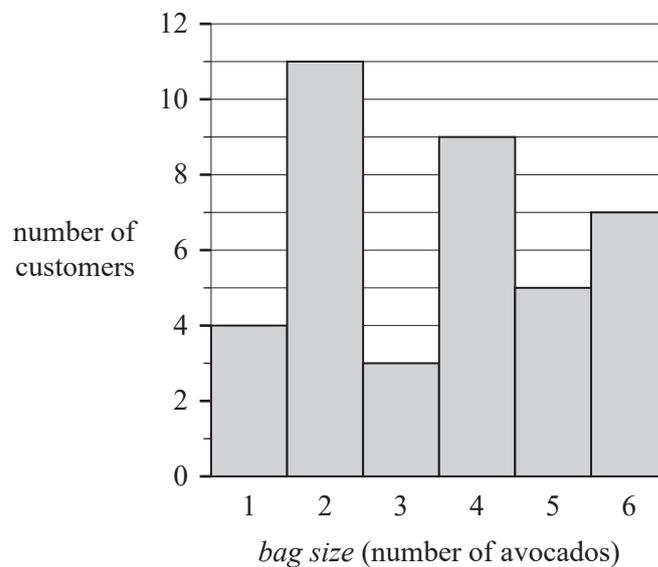
## Data analysis

Use the following information to answer Questions 1 and 2.

At a fruit shop, customers can buy avocados in bags.

The *bag size* ranges from one to six avocados per bag.

The histogram below shows the number of customers who bought each *bag size* on a particular day.



### Question 1

The median *bag size* bought by customers on the day was

- A. 2
- B. 3
- C. 3.5
- D. 4

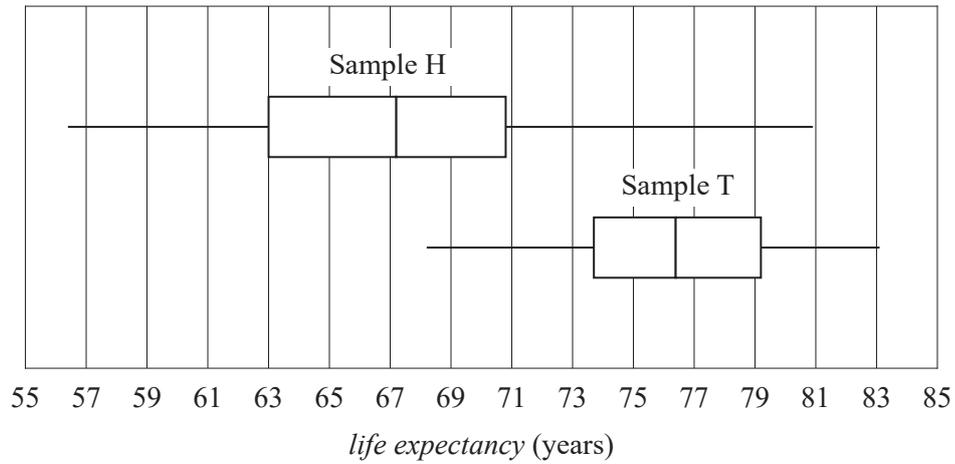
### Question 2

The total number of avocados sold in bags was

- A. 39
- B. 134
- C. 136
- D. 138

**Question 3**

The boxplots below show the *life expectancy*, in years, for a sample of countries from two different continents (Sample H and Sample T).



Data: [www.cia.gov/the-world-factbook/field/life-expectancy-at-birth/country-comparison](http://www.cia.gov/the-world-factbook/field/life-expectancy-at-birth/country-comparison)

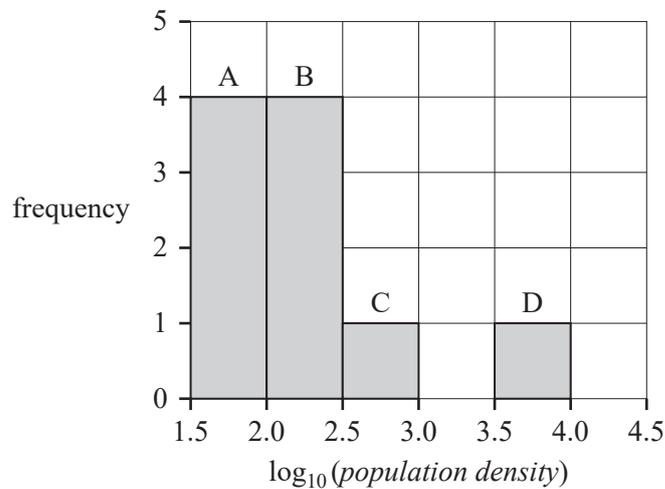
Which one of the following statements is correct?

- A. The interquartile range for Sample T is greater than the interquartile range for Sample H.
- B. The median for Sample T is more than 10 years greater than the median for Sample H.
- C. The third quartile for Sample H is greater than the first quartile for Sample T.
- D. Life expectancy in all Sample T countries exceeds the median life expectancy in Sample H.

**Question 4**

The Association of Southeast Asian Nations (ASEAN) has 10 member nations.

The *population density*, in people per  $\text{km}^2$ , for each of these nations in 2024 is displayed in the histogram below. The histogram has a logarithmic (base 10) scale.



Data: <[www.cia.gov/the-world-factbook/field/area/](http://www.cia.gov/the-world-factbook/field/area/)>; <[www.cia.gov/the-world-factbook/field/population/](http://www.cia.gov/the-world-factbook/field/population/)>

Singapore is a member of ASEAN.

In 2024, Singapore's population was 6 028 460 and its total area was 720  $\text{km}^2$ .

In which labelled column does the value of  $\log_{10}(\text{population density})$  for Singapore lie?

- A. A
- B. B
- C. C
- D. D

**Question 5**

The heights of females aged between 16 and 18 years within a population are normally distributed.

Analysis of the heights of this group of females showed that:

- 2.5% of the heights were greater than 178.9 cm
- 16% of the heights were less than 157.6 cm.

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

- A. 150.5 and 21.3
- B. 154.9 and 7.1
- C. 164.7 and 7.1
- D. 171.8 and 14.2

**Question 6**

The following information relating to life expectancy comes from a sample of nations in the Oceania region.

- The first quartile is 74.9 years.
- The third quartile is 78.5 years.
- The lowest five values recorded are 68.5, 68.6, 69.0, 70.1 and 74.8 years.

Data: [www.cia.gov/the-world-factbook/field/life-expectancy-at-birth/country-comparison](http://www.cia.gov/the-world-factbook/field/life-expectancy-at-birth/country-comparison)

How many outliers would be displayed at the lower end of a boxplot showing this sample of Oceania data?

- A. 1  
 B. 2  
 C. 3  
 D. 4

Use the following information to answer Questions 7 and 8.

The data in the table below shows the *preferred car colour* for a sample of female and male car buyers.

		<i>Preferred car colour</i>		
		<b>Black</b>	<b>Silver</b>	<b>White</b>
<b>Female</b>		28	42	35
<b>Male</b>		55	32	42

**Question 7**

From this table, the percentage of female car buyers whose *preferred car colour* is silver is closest to

- A. 33%  
 B. 40%  
 C. 42%  
 D. 57%

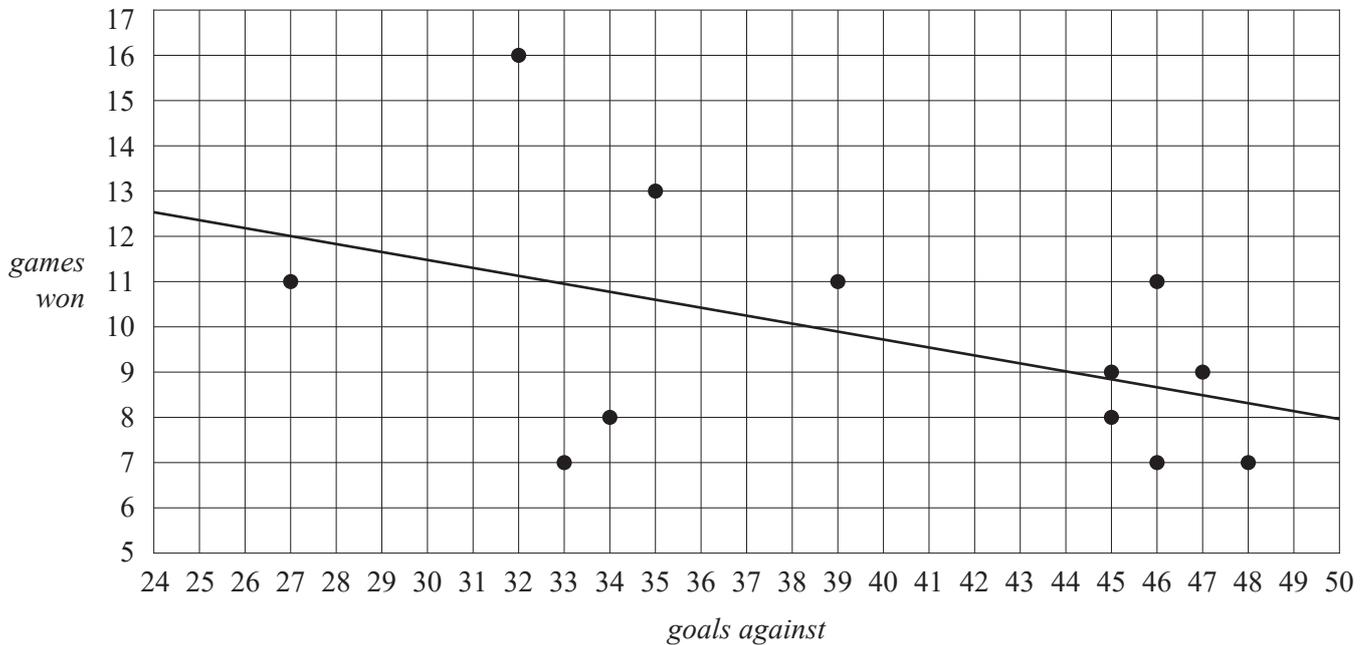
**Question 8**

Which one of the following is the most appropriate way to graphically display the data shown in the table above?

- A. a histogram  
 B. a back-to-back stem plot  
 C. parallel boxplots  
 D. a segmented bar chart

Use the following information to answer Questions 9 and 10.

In the scatterplot below, the *games won* are plotted against the *goals against* for each of the 12 Australian A-League men's teams after 27 games of the 2022–2023 season. A least squares line has been fitted to the data.



Data: <a href="https://aleagues.com.au/ladders/a-league-men/2022-2023">aleagues.com.au/ladders/a-league-men/2022-2023</a>

### Question 9

The equation for the least squares line is closest to

- A.  $games\ won = 16.8 - 0.178 \times goals\ against$
- B.  $games\ won = 14.3 - 0.193 \times goals\ against$
- C.  $games\ won = 12.5 - 0.165 \times goals\ against$
- D.  $games\ won = 17.4 + 0.173 \times goals\ against$

### Question 10

The correlation coefficient between *games won* and *goals against* is  $r = -0.466$

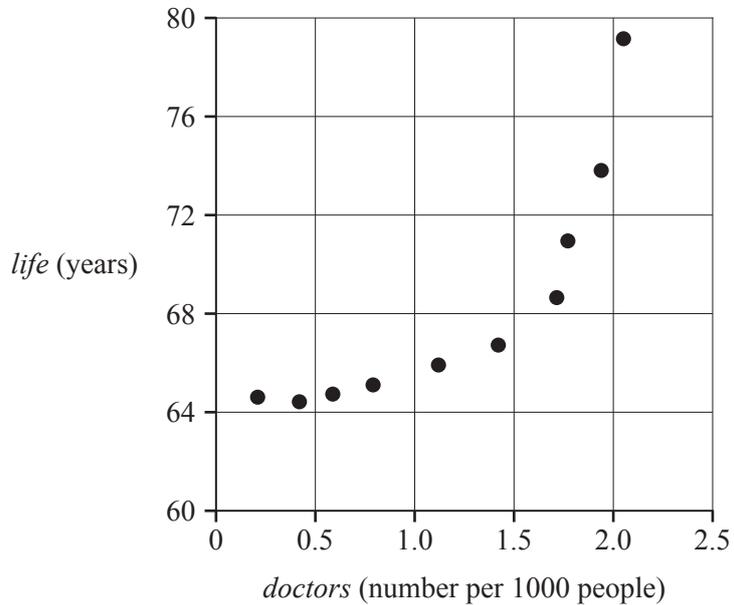
Based on the correlation coefficient, it can be concluded that

- A. fewer goals scored against is associated with a smaller number of wins.
- B. fewer goals scored against causes a smaller number of wins.
- C. more goals scored against causes a smaller number of wins.
- D. more goals scored against is associated with a smaller number of wins.

**Use the following information to answer Questions 11 and 12.**

The table below shows the life expectancy in years, *life*, and the number of doctors per 1000 people, *doctors*, for a sample of 10 countries in 2024. A scatterplot displaying the data is also shown.

<i>Doctors</i>	<i>Life</i>
0.21	64.6
0.42	64.4
0.59	64.7
0.79	65.1
1.12	65.9
1.42	66.7
1.72	68.6
1.77	70.9
1.94	73.8
2.05	79.1



Data: <[www.cia.gov/the-world-factbook/field/life-expectancy-at-birth/country-comparison](http://www.cia.gov/the-world-factbook/field/life-expectancy-at-birth/country-comparison)>;  
<[www.cia.gov/the-world-factbook/field/physician-density](http://www.cia.gov/the-world-factbook/field/physician-density)>

**Question 11**

A logarithmic (base 10) transformation was applied to the variable *life*.

With  $\log_{10}(\textit{life})$  as the response variable, the equation of the least squares line fitted to the transformed data is closest to

- A.  $\log_{10}(\textit{life}) = 1.57 + 0.0123 \times \textit{doctors}$
- B.  $\log_{10}(\textit{life}) = 1.63 + 0.0326 \times \textit{doctors}$
- C.  $\log_{10}(\textit{life}) = 1.79 + 0.0383 \times \textit{doctors}$
- D.  $\log_{10}(\textit{life}) = 1.85 + 0.0403 \times \textit{doctors}$

**Question 12**

A squared transformation was applied to the variable *doctors*.

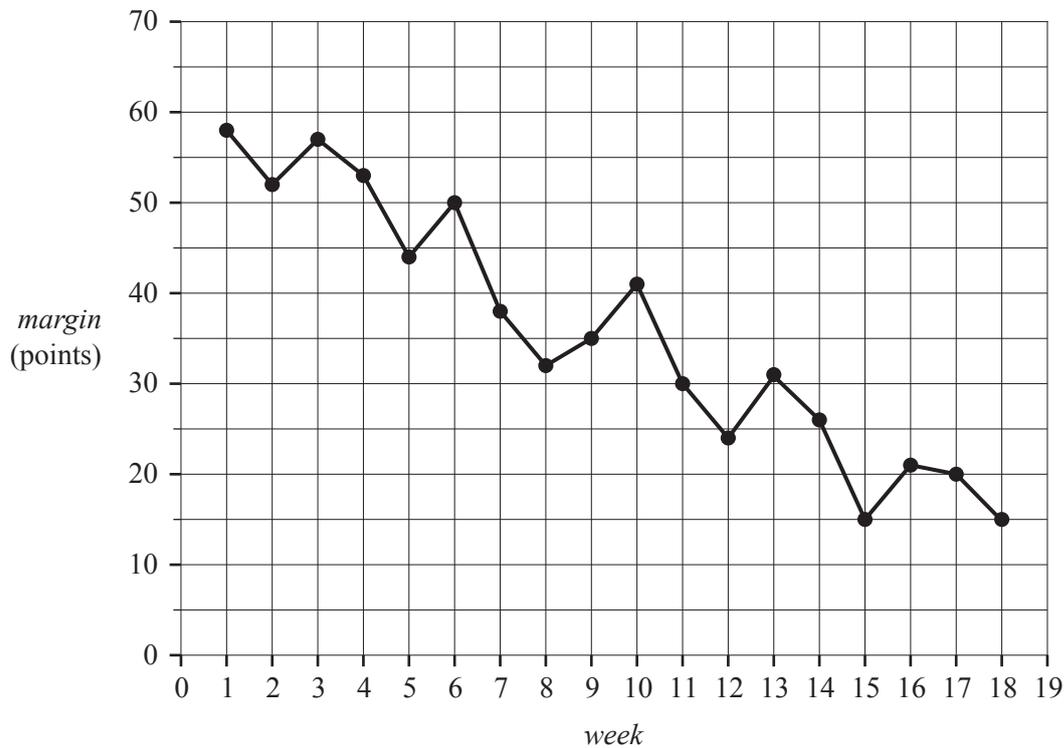
The equation of the least squares line fitted to this transformed data is of the form  $\textit{life} = a + b \times (\textit{doctors})^2$ .

Using this equation, the predicted *life*, in years, for a country with two *doctors* per 1000 people is closest to

- A. 73.6
- B. 74.0
- C. 74.5
- D. 74.9

**Use the following information to answer Questions 13 and 14.**

The following time series graph shows the *margin*, in points, for a team winning all of its games in the first 18 weeks of a season. The team plays one game per week.



**Question 13**

The time series graph is smoothed using five-median smoothing.

The smoothed value for the *margin* in *week 8*, in points, is

- A. 32
- B. 35
- C. 38
- D. 41

**Question 14**

Which one of the following options best describes the qualitative features of the time series graph above?

- A. decreasing trend only
- B. irregular fluctuations only
- C. structural change only
- D. decreasing trend with irregular fluctuations

**Question 15**

The number of drinks sold daily by a juice bar, *drinks*, over a 10-day period is shown in the table below.

<i>Day</i>	1	2	3	4	5	6	7	8	9	10
<i>Drinks</i>	146	98	120	176	145	78	187	106	166	124

The four-mean smoothed number of *drinks*, with centring, sold on *day* 8 is closest to

- A. 134.25
- B. 140.0
- C. 142.75
- D. 145.75

**Question 16**

The seasonal index for the number of meat pie sales in winter is 1.75

To correct for seasonality, the actual number of meat pie sales for winter should be reduced, to the nearest whole percentage, by

- A. 25%
- B. 43%
- C. 57%
- D. 75%

## Recursion and financial modelling

### Question 17

Dani invests \$4000 for three years.

The account earns simple interest at 4% per annum.

The balance in the account after three years can be calculated using

- A.  $4000 \times 1.04^3$
- B.  $3(1.04 \times 4000)$
- C.  $4000 + (0.04 \times 4000)^3$
- D.  $4000 + 3(0.04 \times 4000)$

### Question 18

A recurrence relation is of the form

$$u_0 = a, \quad u_{n+1} = Ru_n + d$$

If  $a > 0$ ,  $R = 0.5$  and  $d = 0$ , the sequence generated will be

- A. arithmetic and increasing.
- B. arithmetic and decreasing.
- C. geometric and increasing.
- D. geometric and decreasing.

### Question 19

The table below compares the value of an asset at various times using the flat rate and reducing balance methods of depreciation.

	Flat rate (\$)	Reducing balance (\$)
Original value	60 000.00	60 000.00
Value after 1 year	56 000.00	55 200.00
Value after 2 years	52 000.00	50 784.00
Value after 3 years	48 000.00	46 721.28

After how many years will the value using flat rate depreciation first be lower than the value using reducing balance depreciation?

- A. 5
- B. 6
- C. 7
- D. 8

**Question 20**

Steve owns gardening equipment that had an initial value of \$12 000.

He will use the unit cost method to depreciate the value of this equipment per hour used.

Steve uses the gardening equipment for 960 hours per year.

The value of the gardening equipment is \$7680 after two years.

By what amount does the gardening equipment depreciate per hour used?

- A. \$2.25
- B. \$4.00
- C. \$4.17
- D. \$4.50

**Question 21**

Donald invests \$250 000 into a perpetuity at an interest rate of 5% per annum.

Donald receives a payment at the end of each year.

When will the sum of all annual payments to Donald first exceed \$250 000?

- A. at the end of year 13
- B. at the end of year 17
- C. at the end of year 21
- D. at the end of year 25

**Question 22**

Rita opens a savings account with an initial deposit of \$4000.

The account earns interest compounding weekly. After the interest is added each week, Rita deposits an additional \$50 into the account.

Assume there are exactly 52 weeks in one year.

The annual interest rate, compounding weekly, that is required to achieve a balance of \$14 000 after three years is closest to

- A. 8.4%
- B. 14.2%
- C. 14.6%
- D. 17.2%

**Question 23**

Virat invested \$5000 into an account that earned interest compounding fortnightly.

The effective annual interest rate for Virat's investment was 4.51%.

Assume that there are exactly 26 fortnights in one year.

After five years, the amount of interest earned by Virat was closest to

- A. \$1128
- B. \$1234
- C. \$1262
- D. \$1264

**Question 24**

Dennis invests \$800 000 in an annuity.

The annuity earns interest at 4.8% per annum, compounding monthly.

After the interest is credited to the annuity, Dennis receives a monthly payment of \$6000.

After some years, the balance of the annuity is \$521 118.96

For the remainder of the annuity, Dennis receives a monthly payment of \$4767.66

The total number of years for which Dennis receives payments is closest to

- A. 19
- B. 20
- C. 21
- D. 22

## Matrices

### Question 25

Consider the matrix  $G$  where

$$G = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$

Which one of the following correctly describes matrix  $G$ ?

- A. a binary matrix
- B. a permutation matrix
- C. an identity matrix
- D. a diagonal matrix

### Question 26

Consider the matrices  $A$ ,  $B$  and  $C$  where

$$A = \begin{bmatrix} 2 & 0 \\ 1 & 6 \end{bmatrix}, B = \begin{bmatrix} 3 \\ 5 \end{bmatrix} \text{ and } C = AB.$$

The calculation that correctly determines element  $c_{21}$  is

- A.  $2 \times 3 + 0 \times 5$
- B.  $2 \times 5 + 3 \times 0$
- C.  $1 \times 3 + 6 \times 5$
- D.  $1 \times 5 + 6 \times 3$

### Question 27

Consider the matrix  $E$  where

$$E = \begin{bmatrix} m & -9 \\ 4 & n \end{bmatrix}$$

For the inverse of  $E$  to exist, the values of  $m$  and  $n$ , respectively, **cannot** be

- A. 3 and 12
- B. 12 and 3
- C. 3 and  $-12$
- D.  $-3$  and  $-12$

**Question 28**

At a fast-food restaurant, team members use headsets to communicate.

There are six different headsets:  $A$ ,  $B$ ,  $C$ ,  $D$ ,  $E$  and  $F$ .

These headsets work on different frequencies, which means some staff members cannot directly communicate with each other.

The matrix below shows which headsets can directly communicate with each other.

		<i>receiver</i>					
		$A$	$B$	$C$	$D$	$E$	$F$
<i>sender</i>	$A$	0	1	0	1	0	1
	$B$	1	0	0	1	0	1
	$C$	0	0	0	0	1	1
	$D$	1	1	0	0	1	0
	$E$	0	0	1	1	0	0
	$F$	1	1	1	0	0	0

In this matrix:

- the '1' in row  $A$ , column  $B$  indicates that headset  $A$  can directly communicate with headset  $B$
- the '0' in row  $A$ , column  $E$  indicates that headset  $A$  cannot directly communicate with headset  $E$ .

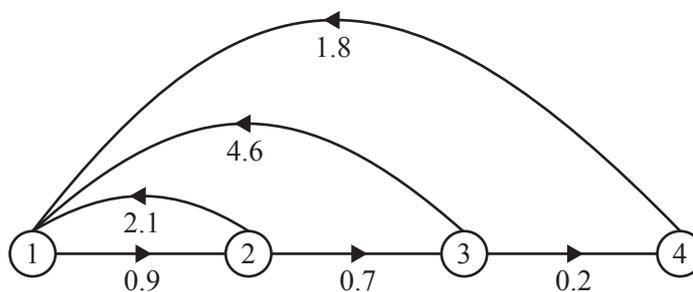
Which one of the following sequences allows a message to be communicated from headset  $A$  to headset  $E$ ?

- A.**  $A - C - E$
- B.**  $A - D - B - E$
- C.**  $A - B - D - E$
- D.**  $A - F - D - E$

**Question 29**

The female population of an animal species has been divided into four age groups (1, 2, 3 and 4), with age group 1 being the youngest.

The age groups, birth rates and survival rates are presented in the life-cycle diagram below.



Which one of the following is a Leslie matrix that corresponds with this life-cycle diagram?

A. 
$$\begin{bmatrix} 0 & 2.1 & 4.6 & 1.8 \\ 0.9 & 0 & 0 & 0 \\ 0 & 0.7 & 0 & 0 \\ 0 & 0 & 0.2 & 0 \end{bmatrix}$$

B. 
$$\begin{bmatrix} 0 & 0.9 & 0.7 & 0.2 \\ 2.1 & 0 & 0 & 0 \\ 0 & 4.6 & 0 & 0 \\ 0 & 0 & 1.8 & 0 \end{bmatrix}$$

C. 
$$\begin{bmatrix} 2.1 & 4.6 & 1.8 & 0 \\ 0.9 & 0 & 0 & 0 \\ 0 & 0.7 & 0 & 0 \\ 0 & 0 & 0.2 & 0 \end{bmatrix}$$

D. 
$$\begin{bmatrix} 2.1 & 4.6 & 1.8 & 0.8 \\ 0 & 0.9 & 0 & 0 \\ 0 & 0 & 0.7 & 0 \\ 0 & 0 & 0 & 0.2 \end{bmatrix}$$

**Question 30**

$F$  is a  $4 \times 4$  matrix.

The element in row  $i$  and column  $j$  of  $F$  is  $f_{ij}$ .

The elements are determined by the rule  $f_{ij} = i^2 - j$ .

How many of the elements in  $F$  will be negative?

- A. 2
- B. 3
- C. 5
- D. 16

**Question 31**

Consider the following four matrices.

$$A = \begin{bmatrix} 4 & 6 \\ -2 & -3 \end{bmatrix} \quad B = \begin{bmatrix} 4 \\ 2 \\ 8 \end{bmatrix} \quad C = \begin{bmatrix} 5 & 0 \\ 2 & 5 \\ 3 & 1 \end{bmatrix} \quad D = [3 \quad -2 \quad 5]$$

Which one of the following computations is defined?

- A.  $D(A + B)$
- B.  $C^TBD$
- C.  $C + BD$
- D.  $(DA)^T + D$

**Question 32**

Kyle ( $K$ ), Lian ( $L$ ), Maggie ( $M$ ), Neil ( $N$ ) and Ophelia ( $O$ ) took part in a round-robin chess tournament in which each person played each of the others once. In each game there was a winner and a loser.

The winner of the tournament was determined by  $T = D + D^2$  where  $D$  and  $D^2$  are, respectively, the one-step and two-step dominance matrices.

Some of the individual match results were not recorded.

An incomplete matrix  $D$  is shown below.

The '1' in row  $K$ , column  $M$  indicates that Kyle defeated Maggie.

$$D = \begin{matrix} & K & L & M & N & O \\ \begin{matrix} K \\ L \\ M \\ N \\ O \end{matrix} & \begin{bmatrix} 0 & \dots & 1 & \dots & 0 \\ \dots & 0 & 0 & \dots & 0 \\ 0 & 1 & 0 & 1 & 1 \\ \dots & \dots & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 \end{bmatrix} \end{matrix}$$

The following information is known.

- Maggie and Ophelia each won three of their four games.
- Kyle won two of his four games.
- Lian and Neil each won one of their four games.
- Kyle defeated Neil.

Which one of the following is matrix  $T$ ?

**A.**

$$\begin{matrix} & K & L & M & N & O \\ \begin{matrix} K \\ L \\ M \\ N \\ O \end{matrix} & \begin{bmatrix} 0 & 2 & 1 & 2 & 1 \\ 1 & 0 & 0 & 1 & 0 \\ 2 & 2 & 0 & 3 & 1 \\ 1 & 1 & 1 & 0 & 0 \\ 2 & 2 & 1 & 2 & 0 \end{bmatrix} \end{matrix}$$

**B.**

$$\begin{matrix} & K & L & M & N & O \\ \begin{matrix} K \\ L \\ M \\ N \\ O \end{matrix} & \begin{bmatrix} 0 & 2 & 1 & 2 & 1 \\ 1 & 0 & 1 & 1 & 0 \\ 2 & 3 & 0 & 2 & 1 \\ 1 & 1 & 0 & 0 & 0 \\ 2 & 2 & 1 & 2 & 0 \end{bmatrix} \end{matrix}$$

**C.**

$$\begin{matrix} & K & L & M & N & O \\ \begin{matrix} K \\ L \\ M \\ N \\ O \end{matrix} & \begin{bmatrix} 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 \end{bmatrix} \end{matrix}$$

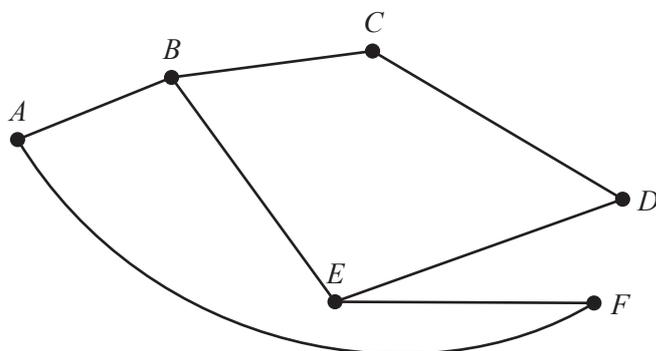
**D.**

$$\begin{matrix} & K & L & M & N & O \\ \begin{matrix} K \\ L \\ M \\ N \\ O \end{matrix} & \begin{bmatrix} 0 & 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 \end{bmatrix} \end{matrix}$$

## Networks and decision mathematics

### Question 33

Consider the following graph.

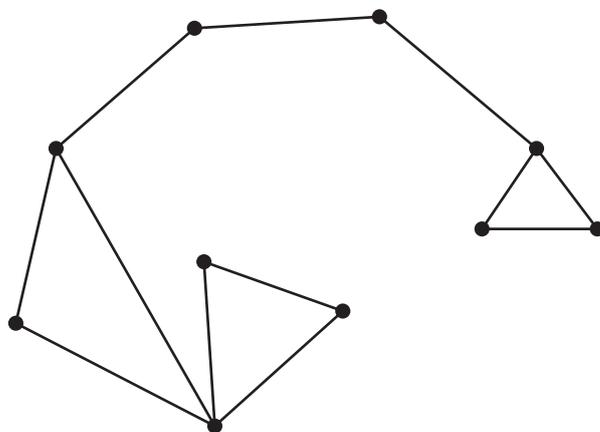


The number of Hamiltonian cycles in this graph, starting from  $E$ , is

- A. 0
- B. 2
- C. 4
- D. 6

### Question 34

Consider the following graph.

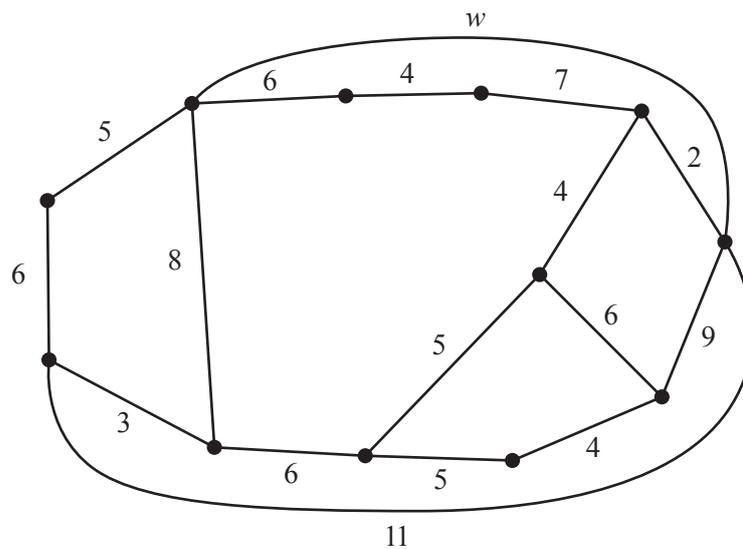


The number of bridges in this graph is

- A. 1
- B. 2
- C. 3
- D. 4

**Question 35**

Consider the following weighted graph.



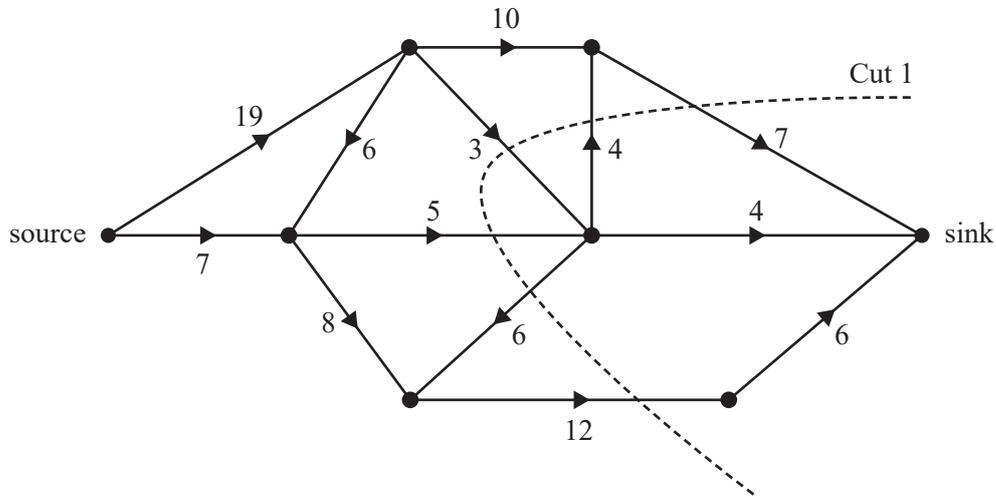
The minimum spanning tree for this graph contains the edge with weight  $w$ .

The length of this minimum spanning tree is

- A.  $37 + w$
- B.  $44 + w$
- C.  $48 + w$
- D.  $49 + w$

Use the following information to answer Questions 36 and 37.

The network below shows the flow of water, in litres per minute, in a system of pipes connecting the source to the sink.



**Question 36**

What is the capacity of Cut 1?

- A. 27
- B. 31
- C. 33
- D. 37

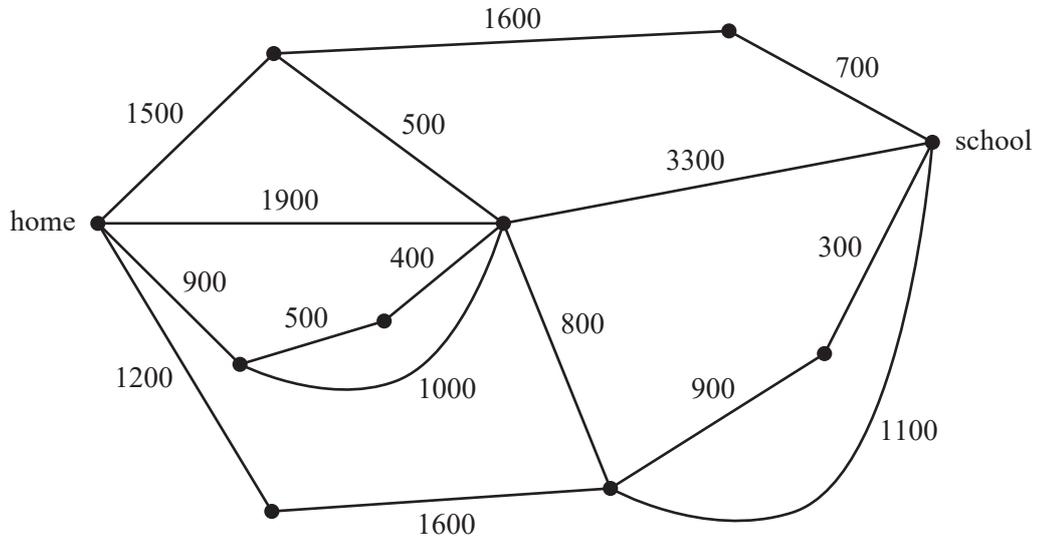
**Question 37**

What is the maximum flow of water, in litres per minute, from source to sink?

- A. 16
- B. 17
- C. 26
- D. 30

**Question 38**

The diagram below shows the network of roads that Sofia can use to travel between home and school. The numbers on the roads show the length, in metres, of each section of road.



Using this network of roads, the shortest distance that Sofia can take to travel from home to school, in metres, is

- A. 3700
- B. 3800
- C. 3900
- D. 5100

Do not write in this area.

**Question 39**

Four contractors, P, Q, R and S, have been hired to complete work at one of four sites.

Each contractor will be allocated to a different site.

The cost for each contractor to complete the works, in dollars (\$), is shown in the table below.

	Site 1	Site 2	Site 3	Site 4
P	15 400	9 600	22 750	18 300
Q	14 500	10 000	25 000	19 450
R	21 000	12 400	29 300	24 600
S	19 438	9 000	23 150	18 000

The Hungarian algorithm is used to determine the minimum cost to complete the works.

Martha, the project manager, completes two steps of the Hungarian algorithm, as follows.

- First, she subtracts the minimum entry in each row from each element in that row to obtain a new table of values.
- Then, using this new table, she subtracts the minimum entry in each column from each element in that column.

Which one of the following tables correctly displays the results after these two steps are completed?

**A.**

	Site 1	Site 2	Site 3	Site 4
P	5800	0	13 150	8700
Q	4500	0	15 000	9450
R	8600	0	16 900	12 200
S	10 438	0	14 150	9000

**B.**

	Site 1	Site 2	Site 3	Site 4
P	1300	0	0	0
Q	0	0	1850	750
R	4100	0	3750	3500
S	5938	0	1000	300

**C.**

	Site 1	Site 2	Site 3	Site 4
P	900	600	0	300
Q	0	1000	2250	1450
R	6500	3400	6550	6600
S	4938	0	400	0

**D.**

	Site 1	Site 2	Site 3	Site 4
P	900	600	0	300
Q	0	1000	2250	1450
R	3100	0	3150	3200
S	4938	0	400	0

**Question 40**

The precedence table below shows the 12 activities required to complete a project. The duration in days and immediate predecessors are shown.

Activity	Duration	Immediate predecessors
<i>A</i>	4	–
<i>B</i>	6	<i>A</i>
<i>C</i>	8	<i>A</i>
<i>D</i>	3	<i>A</i>
<i>E</i>	9	<i>B</i>
<i>F</i>	6	<i>C</i>
<i>G</i>	7	<i>B, D, F</i>
<i>H</i>	12	<i>C</i>
<i>I</i>	6	<i>G, H</i>
<i>J</i>	4	<i>E, I</i>
<i>K</i>	3	<i>G, H</i>
<i>L</i>	9	<i>J</i>

The project is to be completed in minimum time.

The float time, in days, of Activity *B* is

- A. 4
- B. 6
- C. 8
- D. 12

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# General Mathematics Examination 1

## 2025 Formula Sheet

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You may keep this Formula Sheet.

**Data analysis**

standardised score	$z = \frac{x - \bar{x}}{s_x}$
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 $b = r \frac{s_y}{s_x}$ 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	$S_0 = \text{initial state}, \quad S_{n+1} = T S_n + B$
Leslie matrix recurrence relation	$S_0 = \text{initial state}, \quad S_{n+1} = L S_n$

**Networks and decision mathematics**

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