2023
VCE
General Mathematics
Units 3 and 4
Trial Examination 1

Kilbaha Education

Quality educational content

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VICTORIAN CERTIFICATE OF EDUCATION
2023

GENERAL MATHEMATICS

Trial Written Examination 1

Reading time: 15 minutes
Total writing time: 1 hour 30 minutes

MULTIPLE-CHOICE QUESTION BOOK

Structure of book

Number of questions	*Number of questions to be answered*	*Number of marks*
40	40	40

- Students are permitted to bring into the exam 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 book of 30 pages.
- Formula sheet
- Answer sheet for multiple-choice questions.
- Working space is provided throughout the book.

Instructions

- Check that your **name and student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

At the end of the examination

- You may keep this question book and formula sheet.

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

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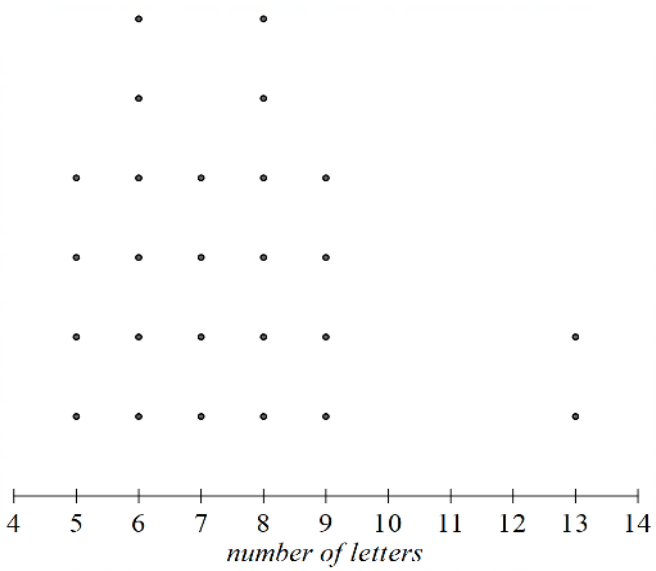
Instructions

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
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.

A certain crossword puzzle has a total of 26 solutions. The dot plot below shows the distribution of the *number of letters* in each solution.



Question 1

The median *number of letters* is

A. 6

B. 6.5

C. 7

D. 7.5

E. 8

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Data analysis

Question 2

13 is an outlier because it is greater than the upper fence. A correct calculation to find the upper fence is

A. $7 + 1.5 \times 6 - 6$

B. $6 - 1.5 \times (8 - 7)$

C. $6 + 1.5 \times (8 - 6)$

D. $8 + 1.5 \times (8 - 6)$

E. $8 + 1.5 \times 7 - 5.5$

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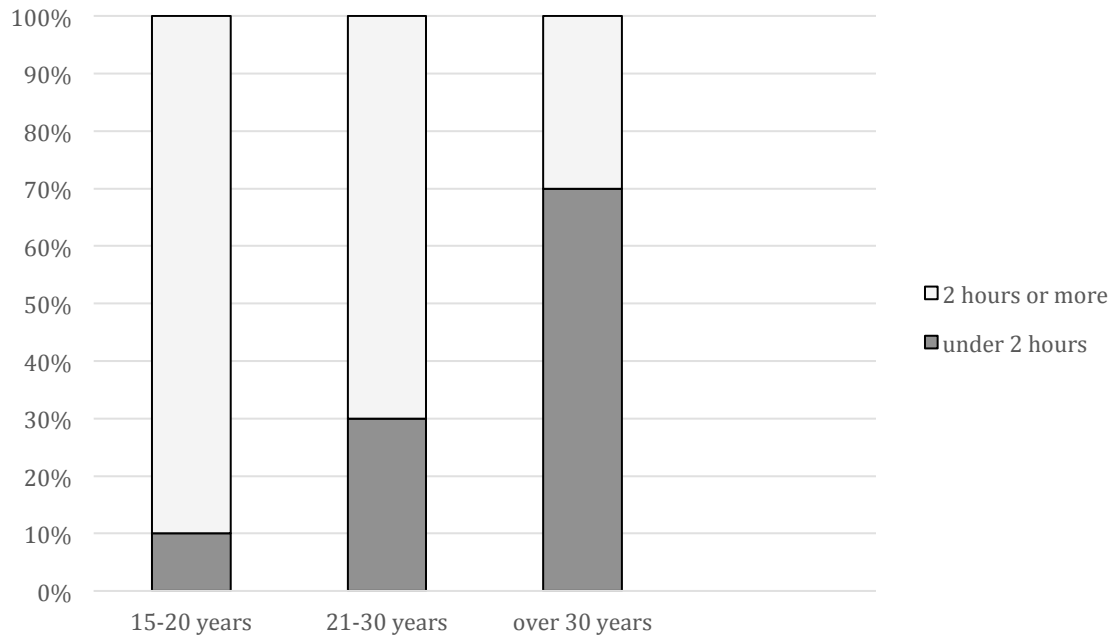
Data analysis

Use the following information to answer questions 3 and 4.

A crossword solving competition is held to find who can complete the puzzle in the shortest time. The percentage segmented bar chart below shows the *age* (15-20 years, 21-30 years, over 30 years) of competitors, segmented by *completion time* (under 2 hours, 2 hours or more).



Question 3

The data displayed in the percentage bar chart supports the contention that there is an association between *completion time* and *age* because

A. 30% of competitors in the 20-30 age group completed the puzzle in under 2 hours.

B. 10% of 15-20 year old competitors completed the puzzle in under 2 hours, compared with 30% of 21-30 year old competitors, and 70% of those over 30 years.

C. a greater percentage of competitors completed the puzzle in under 2 hours.

D. 70% of competitors are over the age of 30.

E. 30% of competitors in the 21-30 age group completed the puzzle in under 2 hours compared with 90% of the 15-20 age group.

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Data analysis

Question 4
The original raw data was summarised in a two-way frequency table.
Which one of the following could match the percentaged segmented bar chart given above?

A.

	Age		
Completion time	**15-20 years**	**21-30 years**	**Over 30 years**
Under 2 hours	10	70	70
2 hours of more	90	30	30
Total	100	100	100

B.

	Age		
Completion time	**15-20 years**	**21-30 years**	**Over 30 years**
Under 2 hours	6	12	77
2 hours of more	54	28	33
Total	60	40	110

C.

	Age		
Completion time	**15-20 years**	**21-30 years**	**Over 30 years**
Under 2 hours	10	30	56
2 hours of more	110	70	24
Total	120	100	80

D.

	Age		
Completion time	**15-20 years**	**21-30 years**	**Over 30 years**
Under 2 hours	15	33	75
2 hours of more	95	67	25
Total	100	100	100

E.

	Age		
Completion time	**15-20 years**	**21-30 years**	**Over 30 years**
Under 2 hours	5	24	60
2 hours of more	45	56	30
Total	50	80	90

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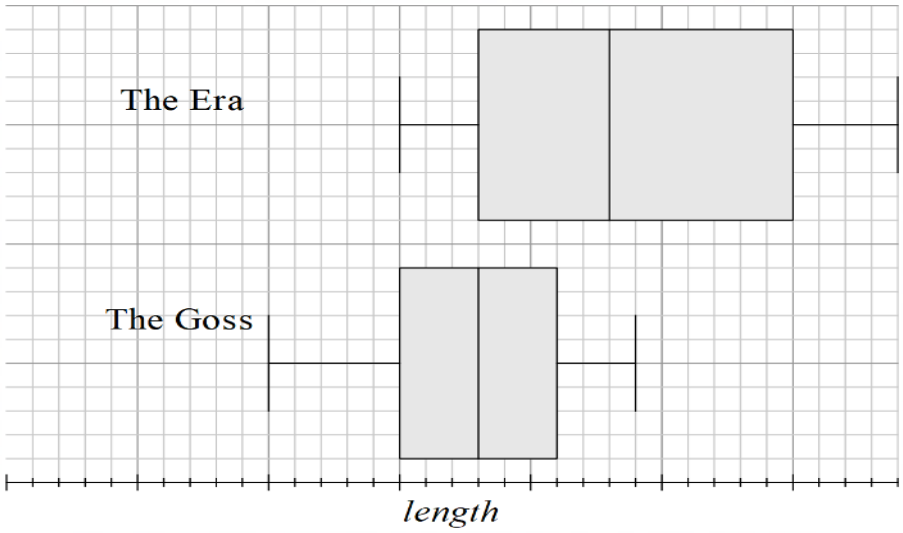
Data analysis

Question 5

The boxplots below show the distribution of the length, in words, of the articles appearing in two different newspapers, The Era and The Goss.



Based on the boxplots above, it can be said that

A. 25% of articles in The Goss are shorter than all the articles in The Era.

B. 50% of articles in The Era are longer than all the articles in The Goss.

C. 25% of articles in The Era are the same length as 50% of the articles in The Goss.

D. The interquartile range for *length* is the same for both The Goss and The Era.

E. The median *length* of articles in The Goss is the same as the upper quartile *length* of articles in the Era.

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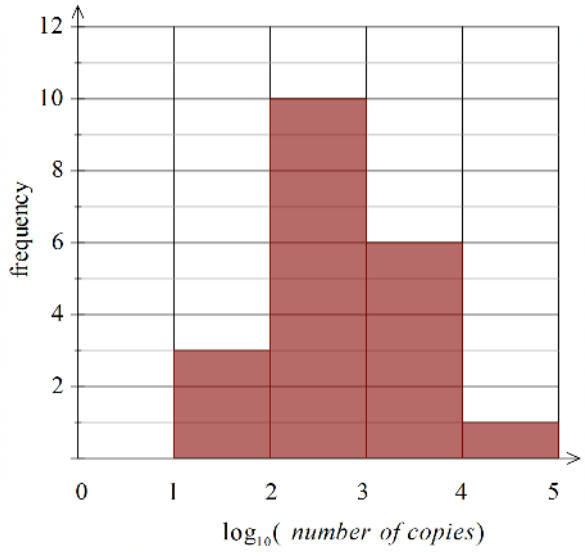
Data analysis

Question 6

A small publishing company produces 20 different hobby magazines.
The histogram below shows the *number of copies* sold each month of these 20 magazines plotted on a $\log_{10}$ scale.



The percentage of these magazines that sell between 100 and 10000 copies each month is

A. 60%

B. 50%

C. 80%

D. 40%

E. 70%

Question 7

A local film society wants to know which type of films are more popular.
The relationship between *type of film* (drama, comedy, documentary) and *number of viewers* is best displayed using

A. a time series plot.

B. a scatterplot.

C. a histogram.

D. a parallel boxplot.

E. a back-to-back stem plot.

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Data analysis

Use the following information to answer questions 8 – 10.

Jaqueline writes a daily opinion piece for a newspaper.
The *length*, in number of words, of her pieces is normally distributed with a mean of 800 words and a standard deviation of 13 words.

Question 8

The opinion piece includes a cartoon if the *length* is less than 761 words.
The percentage of pieces that are expected to include a cartoon is

A. 2.5 %

B. 0.35 %

C. 2.35 %

D. 0.15 %

E. 0.25 %

Question 9

Jaqueline writes a total of 600 opinion pieces for the newspaper.
How many of these pieces are expected to have a *length* between 774 and 826 words?

A. 408

B. 489

C. 320

D. 398

E. 570

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Data analysis

Question 10

Jaqueline's opinion piece is placed in the features section of the paper if the standardised length of the piece is greater than 2.4
Three of Jaqueline's pieces and their *length*, in number of words, are given in the table below.

Piece	***Length***
1	832
2	814
3	829

Which one of the following statements is true?

A. Only pieces 1 and 3 are placed in the features section.

B. All three pieces are placed in the features section.

C. None of the pieces is placed in the features section.

D. Only piece 1 is placed in the features section.

E. The standardized length of piece 2 is negative.

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Data analysis

Question 11

Nazeem solves nine crossword puzzles. The *time*, in minutes, that he takes to complete each puzzle and the *number of clues* in each puzzle is shown in the table below.

Number of clues	24	28	25	31	27	25	33	34	30
Time	57	65	60.5	73.5	60.5	54.5	76.5	82	68

A least squares line is fitted to the data to predict *time* from *number of clues*.
Pearson's correlation coefficient is also calculated.

Which one of the following statements is **not** true?

A. On average, the *time* Nazeem takes to complete a puzzle increases by 2.5 minutes for each additional clue.

B. On average, the *time* Nazeem takes to complete a puzzle decreases by five minutes for each additional clue.

C. Approximately 95% of the variation in *time* can be explained by the variation in number of clues.

D. The value of the correlation coefficient is approximately 0.97

E. Using the least squares line to predict Nazeem's *time* to complete a puzzle containing 36 clues is an example of extrapolation.

Question 12

The statistical analysis of a set of bivariate data involving variables *w* and *t* resulted in the information shown in the table below. The value for $\overline{w}$ is missing.

Mean	$\bar{t} = 2.0$	
Standard deviation	$s_t = 0.16$	$s_w = 0.3$
Equation of least squares line	$w = 2.3 + 1.8t$	
Correlation coefficient	$r = 0.96$	

Using this information, the value of the mean of *w*, $\overline{w}$, is closest to

A. 2.3

B. 1.9

C. 0.92

D. 4.16

E. 5.9

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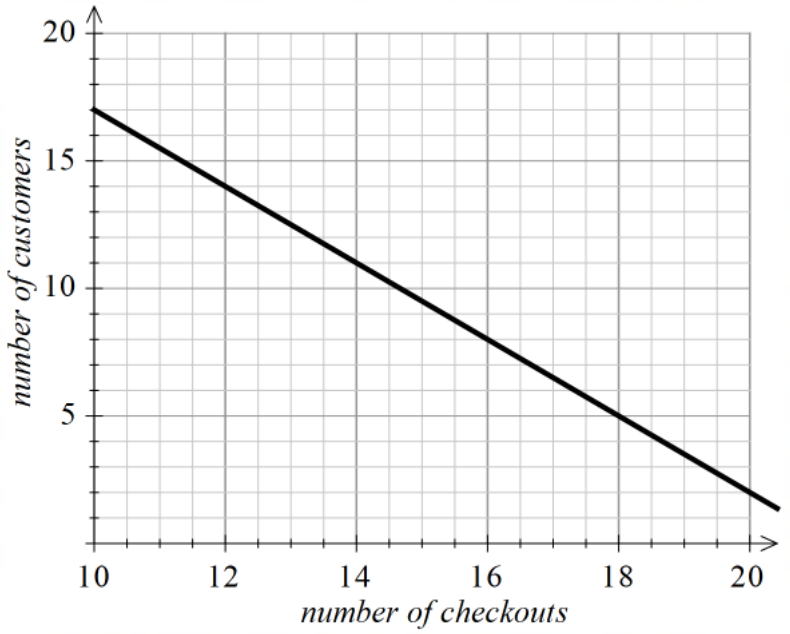
Data analysis

Question 13

In a supermarket, the *number of customers* waiting and the *number of checkouts* open is recorded. The least squares line generated from the data is shown on the graph below.



With *number of customers* as the response variable, the equation of the least squares regression line is closest to

A. $number\ of\ customers = 32.0 - 1.5 \times number\ of\ checkouts$

B. $number\ of\ customers = 17.0 - 1.5 \times number\ of\ checkouts$

C. $number\ of\ customers = 25.5 - 1.8 \times number\ of\ checkouts$

D. $number\ of\ customers = 32.0 + 2.8 \times number\ of\ checkouts$

E. $number\ of\ customers = 17.0 - 12.8 \times number\ of\ checkouts$

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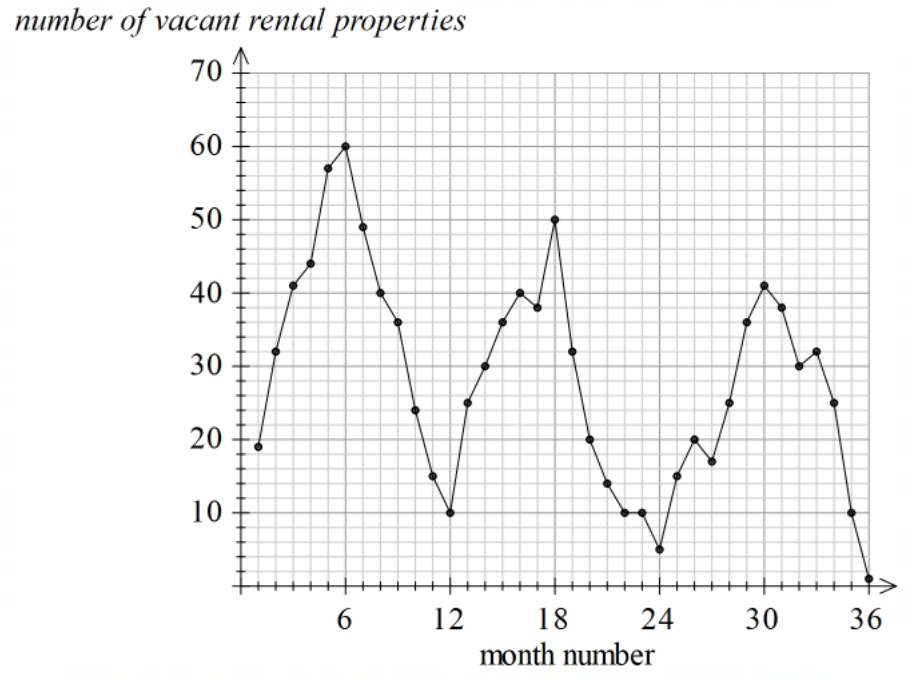
Data analysis

Use the following information to answer questions 14-15

The time series plot below shows the *number of vacant rental properties* in a small holiday town over 36 months.



Question 14

The time series plot is best described as having

A. a decreasing trend with irregular fluctuation only.

B. seasonality only.

C. a decreasing trend with irregular fluctuations and seasonality.

D. seasonality with irregular fluctuations.

E. an increasing trend with seasonality and irregular fluctuations.

Data analysis

Question 15

The seven-median smoothed *number of vacant rental properties* for month number 32 is closest to

A. 31

B. 28

C. 30

D. 39

E. 32

Question 16

The number of rooms rented out by a hotel for each of four seasons in 2022 and 2023 is shown in the table below.

	Total number of rooms rented out			
Year	**Summer**	**Autumn**	**Winter**	**Spring**
2022	220	210	188	210
2023	210	192	182	220

The seasonal index for **Winter** is closest to

A. 1.06

B. 0.99

C. 1.05

D. 0.91

E. 0.93

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Recursion and financial modelling

Question 17

The first five terms of a sequence are

2, -1, 8, -19, 62

A recurrence relation used to generate this sequence could be

A. $a_0 = 2, \quad a_{n+1} = -a_n + 3$

B. $a_0 = 2, \quad a_{n+1} = 3a_n - 4$

C. $a_0 = 2, \quad a_{n+1} = -3a_n + 5$

D. $a_0 = 2, \quad a_{n+1} = -3a_n - 5$

E. $a_0 = 2, \quad a_{n+1} = 2a_n - 5$

Question 18

The value of a compound interest investment, in dollars, after *n* years, V_n, can be modelled by the recurrence relation

$$V_0 = 25000, \quad V_{n+1} = 1.035V_n$$

The interest rate, per annum, for this investment is

A. 103.5%

B. 3.5%

C. 1.35%

D. 0.135%

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E. 10.35%

Recursion and financial modelling

Question 19

A business purchases a printer for $12000.
The printer's value depreciates at a flat rate of 6% annually.
A calculation to find the value of the printer seven years after purchase could be

A. $7680 - \left(\frac{6}{100} \times 12000\right)$

B. $12000 - \left(\frac{6}{100} \times 11280\right)$

C. $12000 \times (0.94)^7$

D. $12000 - \left(\frac{6}{100} \times 12000\right)$

E. $8400 - (1.06)^6$

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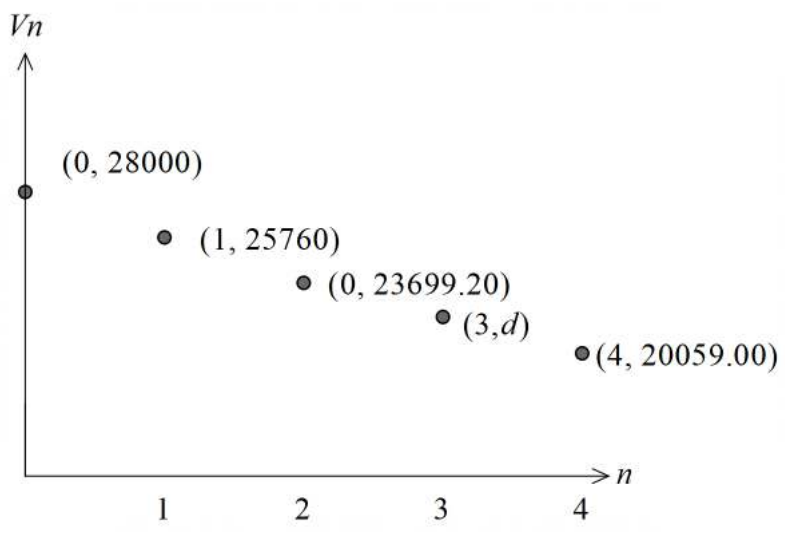
Recursion and financial modelling

Question 20

The graph below shows the value, in dollars, V_n, of an asset using the reducing balance method of depreciation after n years, for a period of four years.



The coordinates of the point where $n = 3$ are $(3,d)$
The value of d is closest to

A. $21280.00

B. $22494.36

C. $21803.26

D. $22299.00

E. $21416.56

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Recursion and financial modelling

Question 21

Five lines of an amortisation table for a reducing balance loan with monthly repayments are shown below.

Repayment number	Repayment ($)	Interest ($)	Principal reduction ($)	Balance ($)
15	3300.00	593.86	2706.14	153571.86
16	3300.00	583.57	2716.43	150855.43
17	3300.00	573.25	2726.75	148128.69
18	3300.00	503.64	2796.16	145332.53
19	3300.00	494.13	2805.87	142526.66

The interest rate for this loan changed immediately before repayment number 18.
The change in interest rate is best described as

A. a decrease of 0.048% per annum.

B. a decrease of 0.48% per annum.

C. an increase of 0.048% per annum.

D. a decrease of 0.0048% per annum.

E. an increase of 0.48% per annum.

Question 22

Quynh invests $250000 into an annuity, paying 4.8% interest per annum, compounding monthly.
Over eight years, she receives a payment of $3142 every month, except for the last month.
The payment Quynh receives in the last month is closest to

A. $3040

B. $2068

C. $2784

D. $3052

E. $3232

Recursion and financial modelling

Question 23

Medika has $85000 to set up a perpetuity for her children. She invests the money in a perpetuity that returns 4.6% per annum compounding quarterly.
A recurrence relation that could determine the value of the perpetuity, in dollars, after *n* quarters, A_n is

A. $A_0 = 85000, \quad A_{n+1} = 1.0115\, A_n - 977.50$

B. $A_0 = 85000, \quad A_{n+1} = 1.046\, A_n - 3910$

C. $A_0 = 85000, \quad A_{n+1} = A_n - 977.50$

D. $A_0 = 85000, \quad A_{n+1} = 1.46\, A_n - 325.85$

E. $A_0 = 85000, \quad A_{n+1} = 1.0115\, A_n - 3910$

Question 24

Frank borrows $500,000 to be fully repaid as a reducing balance loan over 25 years with monthly repayments.
For the first five years, the interest rate is 2.5% per annum.
At the end of five years, the interest rate immediately increases to 5.4% per annum.
The amount by which Frank's monthly repayments must increase if he is to fully repay the loan in the 25 years is closest to

A. $243

B. $724

C. $532

D. $313

E. $645

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Matrices

Question 25

The determinant of the matrix $\begin{bmatrix} 6 & 4 \\ -7 & b \end{bmatrix}$ is 10.

The value of b is

A. 2

B. -6

C. 4

D. $\frac{19}{3}$

E. -3

Question 26

D is a matrix such that $D \times \begin{bmatrix} 3 \\ 9 \\ 4 \end{bmatrix} = \begin{bmatrix} 10 \\ 13 \end{bmatrix}$

A possible matrix for D is

A. $\begin{bmatrix} 2 & 1 \\ 0 & 1 \end{bmatrix}$

B. $\begin{bmatrix} 1 & 2 & 0 \\ 0 & 1 & 1 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 2 \\ 1 & 1 \\ 0 & 0 \end{bmatrix}$

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

E. $\begin{bmatrix} 2 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$

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Matrices

Question 27

P is a 3 x 3 matrix and Q is a 3 x 2 matrix.
R is a matrix such that PQ = R

$p_{21}\times q_{11} + p_{22}\times q_{21} + p_{23}\times q_{31}$ gives

A. r_{21}

B. r_{32}

C. r_{12}

D. r_{22}

E. r_{23}

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Matrices

Question 28

Members of the Warburn Gourmet Society meet for dinner every week at one of two places: the hotel, H, or the restaurant, R.

Of the members who eat at the hotel one week, 32% will eat at the hotel the next week.
Of the members eat at the restaurant one week, 49% will eat at the restaurant the next week.

A transition matrix that can be used to describe this situation is

A.

This week

	H	R
H	0.32	0.68
R	0.51	0.49

Next week

B.

This week

	H	R
H	0.32	0.51
R	0.78	0.49

Next week

C.

This week

	H	R
H	0.32	0.51
R	0.68	0.49

Next week

D.

This week

	H	R
H	0.51	0.68
R	0.49	0.32

Next week

E.

This week

	H	R
H	0.32	0.51
R	0.49	0.68

Next week

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Matrices

Use the following information to answer questions 29 and 30.

Every day during an election campaign, a group of 700 voters are asked which of the three political parties, Action Party (A), Basic Party (B) or Capital Party (C) they prefer.
The transition matrix T shows how the voters change their preference from day to day.

$$T = \begin{array}{c} \\ \text{A} \\ \text{B} \\ \text{C} \end{array} \begin{array}{c} \textit{this day} \\ \begin{array}{ccc} \text{A} & \text{B} & \text{C} \end{array} \\ \begin{bmatrix} 0.8 & 0.4 & 0.2 \\ 0.1 & 0.1 & 0.2 \\ 0.1 & 0.5 & 0.6 \end{bmatrix} \end{array} \begin{array}{l} \\ \text{A} \\ \text{B} \\ \text{C} \end{array} \quad \textit{next day}$$

The initial state matrix $\begin{bmatrix} 100 \\ 200 \\ 400 \end{bmatrix} \begin{array}{l} \text{A} \\ \text{B} \\ \text{C} \end{array}$ shows the voters' preferences on the first day.

Question 29

The number of these voters who prefer Basic Party (B) in the long term is closest to

A. 99

B. 94

C. 91

D. 89

E. 85

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Matrices

Question 30

During the same campaign, a different group of voters are asked their preferences.
The change in preference of these voters from day to day is shown in the matrix D below.

$$D = \begin{array}{c} \\ \\ \\ \end{array} \begin{array}{c} \begin{array}{ccc} \text{A} & \text{B} & \text{C} \end{array} \\ \begin{bmatrix} 0.3 & 0.2 & 0.4 \\ 0.5 & 0.6 & 0.3 \\ 0.2 & 0.2 & 0.3 \end{bmatrix} \end{array} \begin{array}{l} \\ \text{A} \\ \text{B} \\ \text{C} \end{array}$$

this day (columns) / *next day* (rows)

In the long term, 209 of these voters are expected to prefer A.
In the long term, the number of these voters expected to prefer C is closest to

A. 162

B. 390

C. 257

D. 171

E. 283

Matrices

Question 31

Which one of the following is an example of a Leslie matrix?

A.

$$\begin{bmatrix} 0 & 0.4 \\ 0 & 1.2 \\ 0.7 & 0 \\ 1.5 & 0 \end{bmatrix}$$

B.

$$\begin{bmatrix} 0 & 1.4 & 0.8 \\ 0.7 & 0 & 0 \\ 0 & 0.6 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

C.

$$\begin{bmatrix} 0.7 & 1.2 & 0 & 0 \\ 0 & 0.5 & 0 & 0 \\ 1.2 & 0 & 0 & 0 \\ 0 & 0.9 & 0 & 0 \end{bmatrix}$$

D.

$$\begin{bmatrix} 0 & 1.2 & 1.8 & 0.9 \\ 0.7 & 0 & 0 & 0 \\ 0 & 0.5 & 0 & 0 \\ 0 & 0 & 0.2 & 0 \end{bmatrix}$$

E.

$$\begin{bmatrix} 0 & 1.7 & 1.2 & 0.5 \\ 0 & 0 & 0.2 & 0 \\ 0 & 0.5 & 0 & 0 \\ 0.6 & 0 & 0.2 & 0 \end{bmatrix}$$

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Matrices

Question 32

The permutation matrix, P, is shown below.

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

Matrices D and M are column matrices such that $P \times D = M$.
When matrix D is multiplied by matrix P, which one of the following is true?

A. element d_{31} moves to element m_{11}

B. element d_{51} moves to element m_{41}

C. element d_{11} moves to element m_{31}

D. element d_{41} moves to element m_{51}

E. element d_{21} moves to element m_{21}

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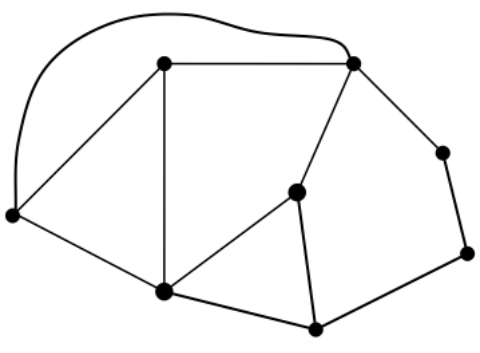
Networks and decision mathematics

Question 33

Consider the graph below.



The sum of the degrees of the odd vertices is

A. 4

B. 7

C. 9

D. 11

E. 12

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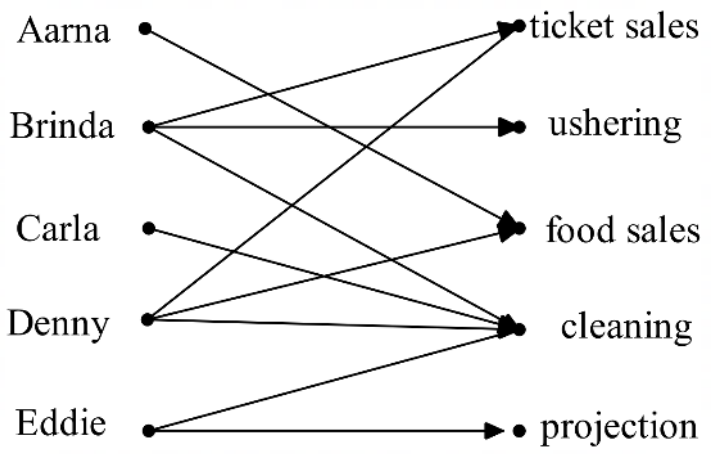
Networks and decision mathematics

Question 34

Aarna, Brinda, Carla, Denny, and Eddie are each given one of five jobs in the local cinema. The bipartite graph below shows which job or jobs each of them can do.



For all five jobs to be done, the job that Brinda must do is

A. ushering

B. projection

C. food sales

D. cleaning

E. ticket sales

Networks and decision mathematics

Question 35

Laura, Robert, Jasper, and Etsi are competing as a team in a skiing event.
The following table shows the shortest times, in seconds, that each of them can ski each event.
Each of the four people will be allocated to one event.

	Downhill	Slalom	Moguls	Super-G
Laura	100.8	82.3	35.7	71.0
Robert	122.4	71.5	25.9	69.6
Jasper	128.3	66.2	34.6	72.0
Esti	87.2	71.5	22.1	62.0

The allocation that will make sure their combined times is a minimum is

A.

Downhill	Slalom	Moguls	Super-G
Laura	Robert	Esti	Jasper

B.

Downhill	Slalom	Moguls	Super-G
Esti	Jasper	Robert	Laura

C.

Downhill	Slalom	Moguls	Super-G
Robert	Jasper	Esti	Laura

D.

Downhill	Slalom	Moguls	Super-G
Jasper	Esti	Robert	Laura

E.

Downhill	Slalom	Moguls	Super-G
Laura	Jasper	Robert	Esti

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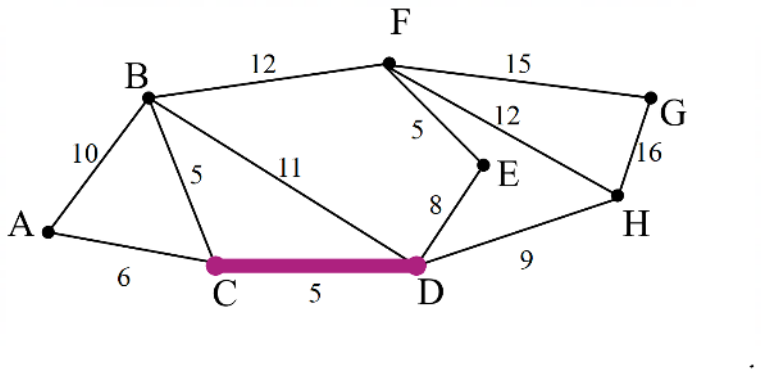
Networks and decision mathematics

Use the following information to answer questions 36 and 37.

Jodie is using Prim's algorithm to find the minimum spanning tree for the network below. She begins with vertex C and selects the edge CD as shown.



Question 36

Using Prim's algorithm, the next edge Jodie will select is

A. AC

B. AB

C. BC

D. DH

E. EF

Question 37

The length of the minimum spanning tree for the network is

A. 58

B. 45

C. 49

D. 51

E. 53

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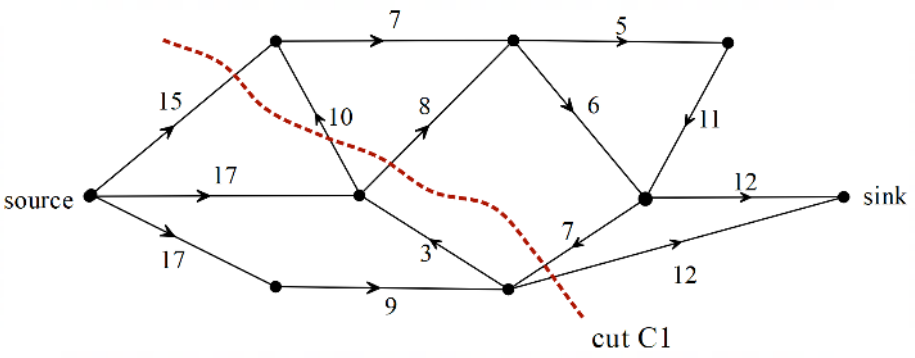
Networks and decision mathematics

Use the following information to answer questions 38 and 39.

The graph below shows the flow of water, in litres per hour, through tubes in a garden watering system. Cut C1 is drawn through the graph as shown.



Question 38

The capacity of cut C1 is

A. 52

B. 35

C. 42

D. 45

E. 48

Question 39

The maximum flow, in litres per hour, of water through the tubes from source to sink is

A. 20

B. 23

C. 32

D. 22

E. 17

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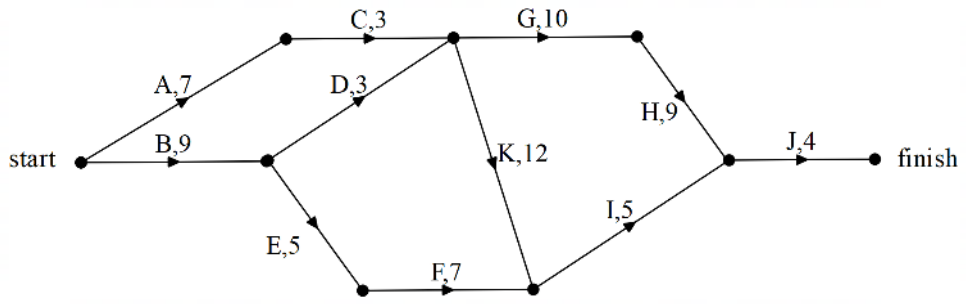
Networks and decision mathematics

Question 40

The activity network below shows the activities along with their duration in minutes needed to complete the preparation of a meal.



Which one of the following statements is correct based on this information?

A. The earliest completion time for the meal preparation is 32 minutes

B. Decreasing the completion time of activity G by 6 minutes will decrease the earliest completion time by 6 minutes.

C. Increasing the time taken for activity F by 1 minute will increase the earliest completion time by 1 minute

D. If the earliest completion time is to be met, the latest start time for activity K is 14 minutes into the preparation.

E. Three of the activities have a float time of 2 minute

END OF MULTIPLE-CHOICE QUESTION BOOK

End of Kilbaha General Mathematics Units 3 and 4
Trial Examination 1

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VCE GENERAL MATHEMATICS

Written examinations 1 and 2

FORMULA SHEET

Instructions

This formula sheet is provided for your reference.

A question and answer book 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.

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

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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:	$A^{-1} = \frac{1}{\det A} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ where $\det A \neq 0$
recurrence relation:	$S_0 =$ initial state, $S_{n+1} = TS_n + B$
Leslie matrix recurrence relation	$S_0 =$ initial state, $S_{n+1} = LS_n$

Networks and decision mathematics

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

END OF FORMULA SHEET

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