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YEAR 12 *Trial Exam Paper*

2023

GENERAL MATHEMATICS

Written examination 1

STUDENT NAME:

Reading time: 15 minutes

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

Materials supplied

- Question book of 27 pages
- Formula sheet
- Answer sheet for multiple-choice questions
- Working space is provided throughout the book.

Instructions

- Write your **name** in the space provided above and on the multiple-choice answer sheet.
- 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 the formula sheet.

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

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.

The stem plot shows the number of points scored by the Geckos football team in each of their 18 matches of the season.

Key 3 | 2 = 32 points $n = 18$

0	
1	7 8
2	3 4 6 8
3	4 7 9 9 9
4	1 3 5 8
5	3 7
6	
7	
8	4

Question 1

The range is

A. 10

B. 17

C. 40

D. 67

E. 84

Question 2

The score of 39 is the

A. mean.

B. median.

C. IQR.

D. standard deviation.

E. maximum score.

Question 3

A café collected data to investigate the association between the *amount of money spent,* in dollars, and the time of each *shift*: morning (8–11 am), lunch (11 am–2 pm) and afternoon (2–5 pm).

Which of the following is the most appropriate graph to use to represent this association?

A. segmented bar chart

B. scatterplot

C. parallel boxplots

D. back-to-back stem plot

E. dot plot

Question 4

Which of the following best suggests a positively skewed distribution?

A. a mean of 27.1 and a median of 48.5

B. a mean of 55.8 and a median of 55.8

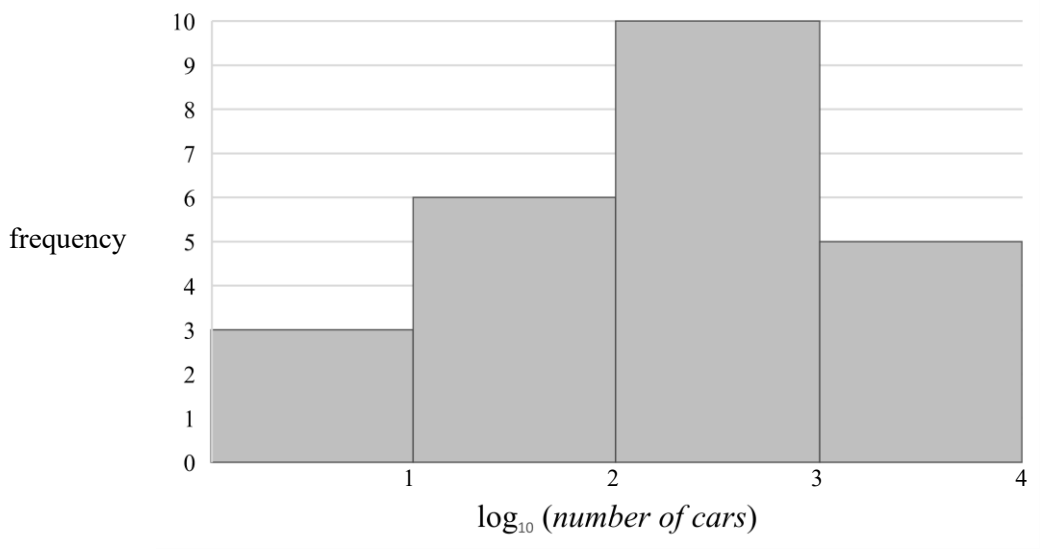
C. a mean of 63.8 and a median of 53.7

D. a mean of 83.4 and a median of 98.9

E. a mean of 23.8 and a median of 38.4

Use the following information to answer Questions 5 and 6.

The histogram below shows the *number of cars* parked in a public car park, recorded each hour for 24 hours. The histogram has been plotted on a $\log_{10}$ scale.



Question 5

The percentage of hours during which the number of cars was between 10 and 100 is

A. 6

B. 10

C. 25

D. 36

E. 60

Question 6

The maximum number of cars parked in the car park could be

A. 8

B. 95

C. 165

D. 6200

E. 12 000

Question 7

The grades for an English test are normally distributed with a mean of 62. Anna receives a grade of 54, placing her in the bottom 2.5% of the class. Using the 68–95–99.7% rule, the standard deviation is

A. –2

B. 1

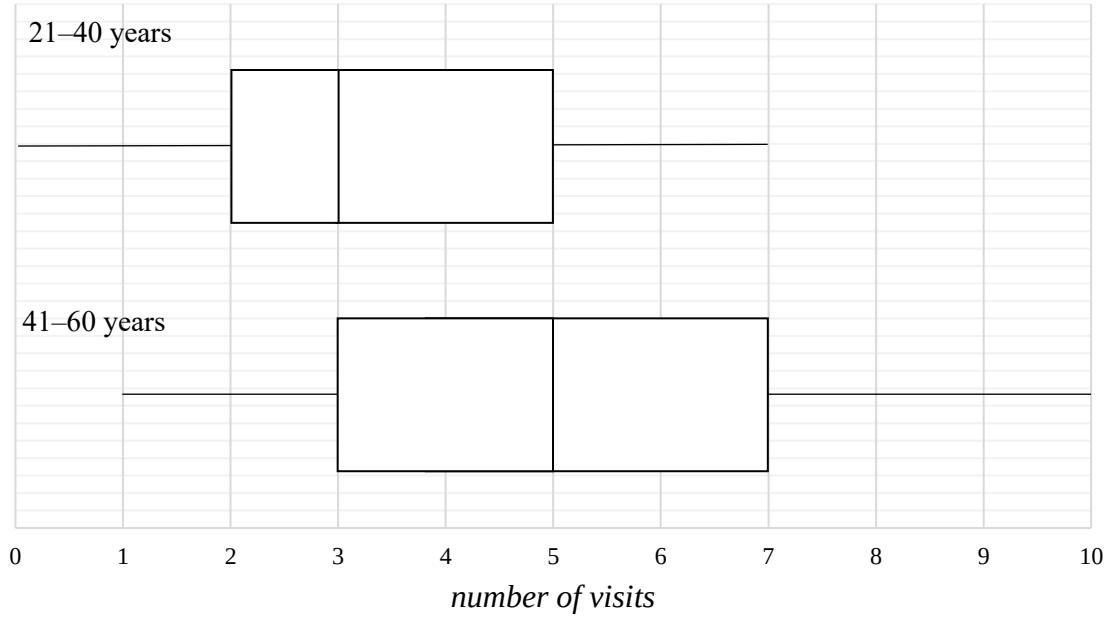
C. 2

D. 4

E. 8

Question 8

The boxplots below represent the number of visits to the general practitioner in one year by a group of people surveyed from two age groups.



Which of the following statements is true?

A. Twice as many 21–40-year-olds make two or fewer visits per year than 21–40-year-olds who make two to three visits.

B. The number of visits per year is more variable for the 21–40-year-old group than the 41–60-year-old group.

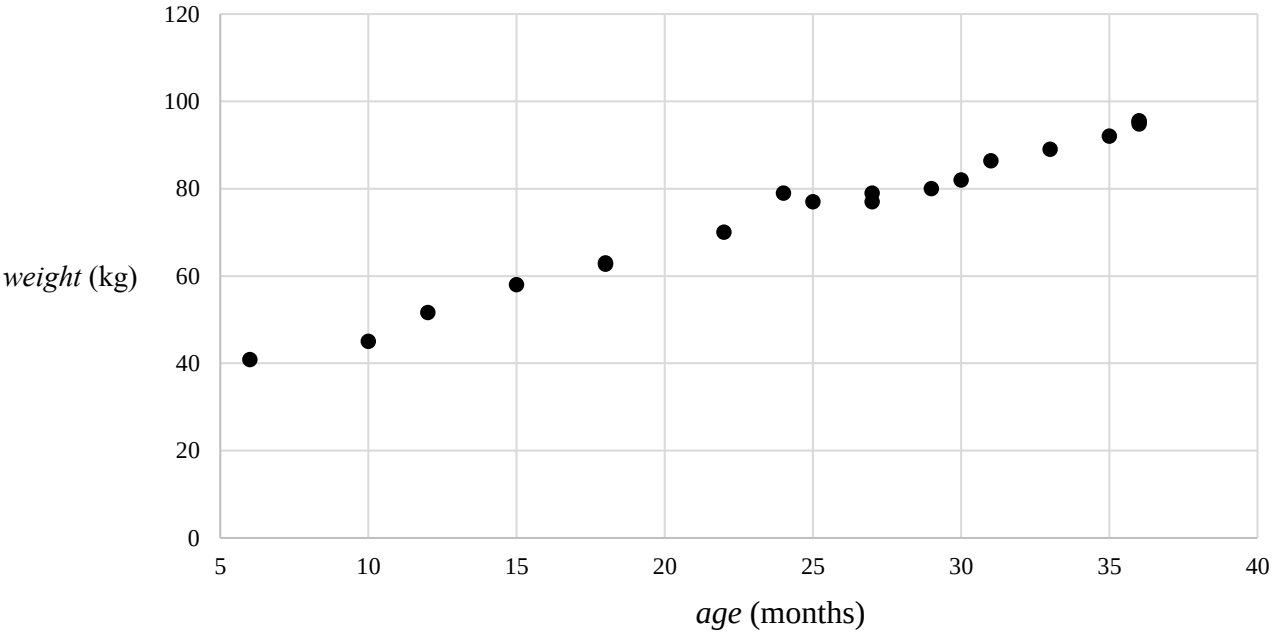
C. 75% of all people surveyed visit the general practitioner five times or more per year.

D. The median number of visits per year is two fewer for the 41–60-year-old group than the 21–40-year-old group.

E. One quarter of both age groups visit the general practitioner between three and five times per year.

Use the following information to answer Questions 9 and 10.

The weight, in kilograms, of an animal was recorded from the ages of 6 to 36 months.



The least squares regression line for the data was obtained:

$$\textit{weight}\ (\text{kg}) = 30.5 + 1.8 \times \textit{age}\ (\text{months})$$

Question 9

The interpretation of the slope, on average, is

A. *weight* increases by 30.5 kg for every one month increase in *age.*

B. *weight* increases by 1.8 kg for every one month increase in *age*.

C. *weight* increases by 1.8 months for every 1 kg increase in *age*.

D. *age* increases by 30.5 months for every 1 kg increase in *weight*.

E. *age* increases by 1.8 months for every 1 kg increase in *weight*.

Question 10

The predicted *weight* of the animal when it is 1.5 years old is

A. 18.0

B. 30.5

C. 33.2

D. 57.5

E. 62.9

Use the following information to answer Questions 11 and 12.

A young footballer decides to start practising their kicking during training. The distances kicked during their training session are shown below.

Kick number	1	2	3	4	5	6	7	8	9	10
***Distance* (m)**	14.5	15.2	14.9	16.2	18.8	19.0	27.6	34.2	45.0	63.1

A $\log_{10}$ transformation of the variable *distance* is applied.

Question 11

The equation of the regression line for the transformed data, when rounded to two significant figures, is

A. $\log_{10}(distance) = 0.98 + 0.07 \times kick\ number$

B. $\log_{10}(distance) = 0.98 + 0.070 \times kick\ number$

C. $\log_{10}(distance) = 0.99 + 0.07 \times kick\ number$

D. $\log_{10}(distance) = 0.99 + 0.070 \times kick\ number$

E. $\log_{10}(distance) = 1.0 + 0.07 \times kick\ number$

Question 12

In reference to the comparison of the original data to the transformed data, which one of the following statements is **not** correct?

A. The residual plot no longer shows a clear pattern: it is random.

B. The correlation coefficient has increased from 0.88 to 0.94.

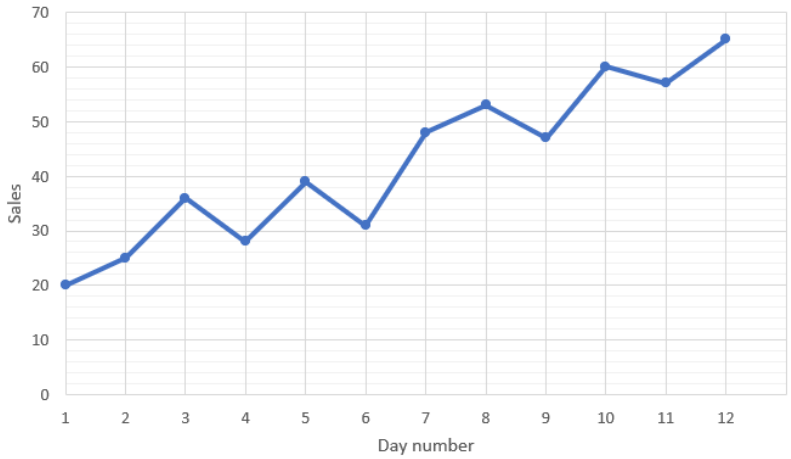
C. The coefficient of determination has increased from 0.772 to 0.883.

D. The variation in the kicking distance that is not attributed to the variation in the kick number has decreased from 23% to 12%.

E. The value of the y-intercept has increased but the slope has decreased.

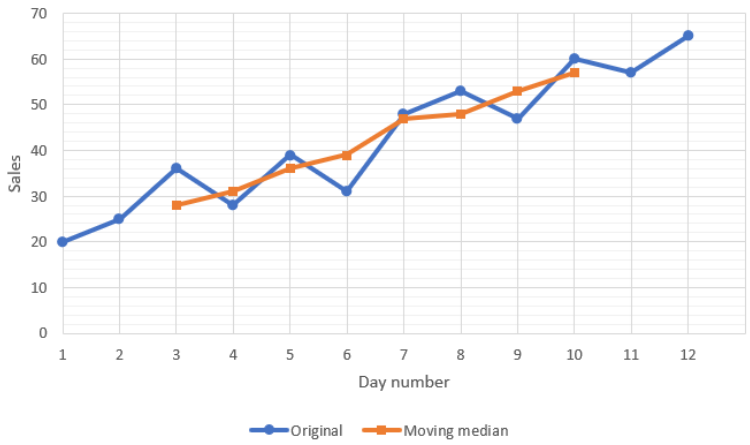
Question 13

The time series plot below shows the number of sales over a 12 day period.

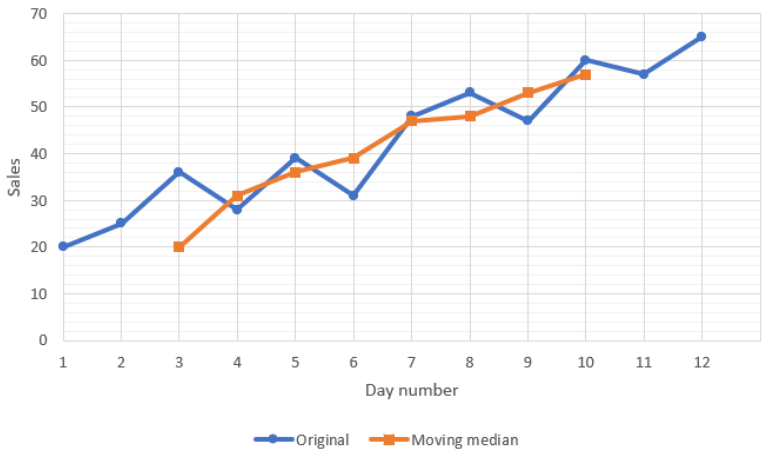


Which one of the following shows the five-median smoothing for the time series plot above?

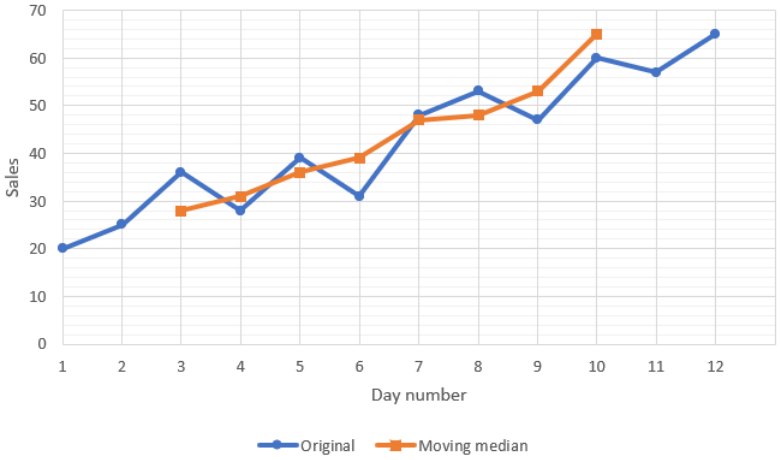
A.



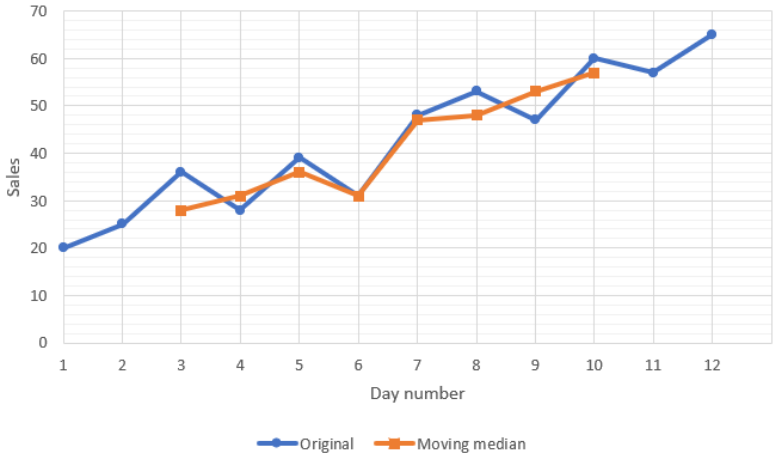
B.



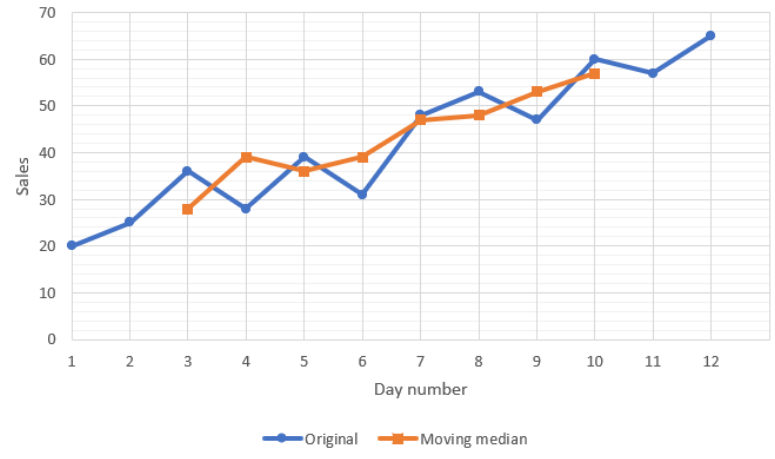
C.



D.



E.



Question 14

The sales for a bakery have been recorded for a year, with the seasonal index and deseasonalised sales figures shown below.

Quarter number	1	2	3	4
Seasonal index	0.867	*a*	1.157	1.044
2022 sales ($)	54 000	58 000	*b*	65 000
2022 deseasonalised sales ($)	*c*	62 366	62 069	62 500

Using the table above, which of the following is the best estimate of the missing values?

A. $a = 0.93$, $b = 72\,000$, $c = 47\,000$

B. $a = 0.93$, $b = 72\,000$, $c = 62\,000$

C. $a = 1.08$, $b = 54\,000$, $c = 62\,000$

D. $a = 0.93$, $b = 54\,000$, $c = 47\,000$

E. $a = 1.08$, $b = 72\,000$, $c = 62\,000$

Question 15

Data are deseasonalised for the quarters in 2015 and 2016.

Quarter	summer	autumn	winter	spring
2015	32	28	33	38
2016	41	42	51	48
Seasonal index	1.05	0.98	0.96	1.01

A least squares regression line is fitted to the deseasonalised data. The equation of the least squares line is shown below, where summer in 2015 = quarter 1, autumn in 2015 = quarter 2 etc.

$$\textit{deseasonalised value} = 25.4 + 3.06 \times \textit{quarter number}$$

The actual value predicted for quarter 2 in 2018 is closest to

A. 31.5

B. 54.9

C. 56.0

D. 66.9

E. 68.2

Question 16

The average number of regular customers at a coffee shop each month for two years is shown below.

	Jan.	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**
2010	45	48	52	57	43	40	49	51	58	61	63	64
2011	66	57	54	48	49	52	55	56	61	62	69	71

The four-mean smoothed value, with centring, for December 2010 is

A. 62

B. 62.5

C. 63

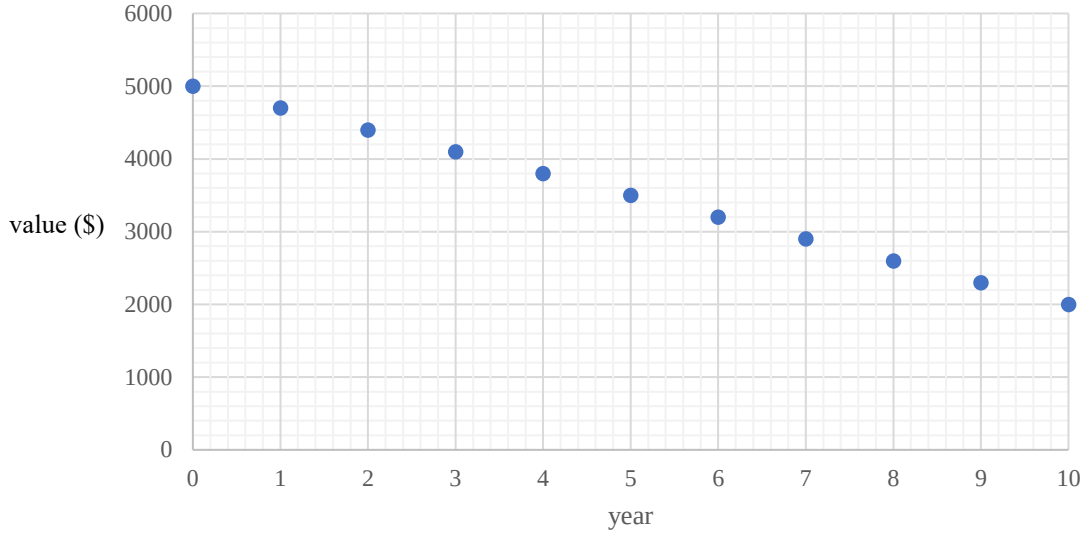
D. 63.5

E. 64

Recursion and financial modelling

Use the following information to answer Questions 17 and 18.

The graph below shows the decrease in value each year, over a period of 10 years, for a suite of office furniture.



Question 17

The total amount of depreciation over 10 years is

A. $300

B. $1500

C. $2000

D. $3000

E. $5000

Question 18

The graph above shows a decrease in value best modelled by

A. an annuity.

B. a perpetuity.

C. reducing balance depreciation.

D. unit cost depreciation.

E. flat rate depreciation.

Question 19

Gigi invests $1600, earning interest at 3.1% per annum, compounding monthly.

She wants the balance to grow to $10 000 within two years.

In order for her investment to reach this balance, the amount that she will need to deposit as an additional payment each month is closest to

A. $191.36

B. $335.58

C. $473.26

D. $480.14

E. $512.11

Question 20

Five options are offered by a bank for a home loan.

Option	Nominal annual interest rate	Compounding
1	4.9%	fortnightly
2	4.9%	weekly
3	5.1%	monthly
4	5.1%	daily
5	5.1%	quarterly

When the effective interest rate of each is determined, how many options round to 5.02%?

A. one

B. two

C. three

D. four

E. five

Question 21

Tomas invests $3000 and needs it to grow to at least $5000 after 5 years.

Which one of the following recurrence relations could represent the investment of his money, where V_n is the value of the investment after n years?

A. $V_0 = 3000, V_{n+1} = V_n + 250$

B. $V_0 = 3000, V_{n+1} = 0.94V_n$

C. $V_0 = 3000, V_{n+1} = 1.06V_n$

D. $V_0 = 3000, V_{n+1} = 1.04V_n + 250$

E. $V_0 = 3000, V_{n+1} = 0.91V_n + 200$

Question 22

A loan of $520 000 is withdrawn, with the recurrence relation below representing the balance after n months.

$$V_0 = 520\,000 \qquad V_{n+1} = 1.004V_n - 2980$$

The final repayment is expected to be a smaller amount.

The final payment is closest to

A. $240.35

B. $2728.74

C. $2739.65

D. $2955.65

E. $2980.00

Question 23

Ursula has $5000 invested in an annuity for a term of one year, earning 4.0% per annum, compounding quarterly. The withdrawals are $1285 per quarter.

The interest earned in the third quarter is closest to

A. $25

B. $32

C. $35

D. $38

E. $40

Question 24

Emerson purchased a car for $45 000 and sold it 8 years later. It depreciated on a reducing balance basis.

Over the same period of time he invested $4000, and with interest compounding monthly it grew to $5684.

The annual rate of interest for the investment was the same as the car's annual rate of depreciation.

For how much did Emerson sell the car?

A. $31 400

B. $32 200

C. $37 800

D. $37 900

E. $39 500

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Matrices

Question 25

The number of books sold in a day at a bookstore is shown in the matrix below.

The books are recorded as either fiction (F) or non-fiction (N), and as written by Australian (A) or international (I) authors.

$$\begin{matrix} & A & I \\ N & \\ F & \end{matrix}\begin{bmatrix} 13 & 23 \\ 43 & 81 \end{bmatrix}$$

The number of fiction books by an Australian author that were sold is

A. 13

B. 23

C. 43

D. 56

E. 81

Question 26

$$D=\begin{bmatrix} 2 & -1 \\ 7 & 3 \end{bmatrix} \qquad E=\begin{bmatrix} 4 & 0 \\ -2 & 3 \\ 11 & 6 \end{bmatrix} \qquad F=\begin{bmatrix} 8 & 9 & 2 \\ 4 & -4 & 3 \\ 7 & 9 & 1 \end{bmatrix} \qquad G=\begin{bmatrix} -9 & 3 & 1 \\ 2 & -2 & 7 \end{bmatrix}$$

Which one of the following matrix products results in a square matrix?

A. GF

B. DG

C. EG

D. FE

E. ED

Question 27

A permutation matrix is used to change $\begin{bmatrix} A \\ C \\ R \\ E \\ S \end{bmatrix}$ to $\begin{bmatrix} S \\ C \\ A \\ R \\ E \end{bmatrix}$. The correct permutation matrix is

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

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

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

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

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

Question 28

Consider the matrix F, where $F = \begin{bmatrix} 4 & 7 & 10 \\ 5 & 8 & 11 \end{bmatrix}$.

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

The elements in matrix F are determined by the rule

A. $f_{ij} = 2i + 2j$

B. $f_{ij} = 3i + j$

C. $f_{ij} = 2i + 3j$

D. $f_{ij} = i + 3j$

E. $f_{ij} = 2i + j$

Question 29

The communication matrix below shows the communication links between five people: Alfie (A), Benny (B), Carly (C), Danni (D) and Ellie (E).

$$\begin{array}{cc} & \textit{receiver} \\ & \begin{array}{ccccc} A & B & C & D & E \end{array} \\ \textit{sender} & \begin{bmatrix} 0 & 1 & 0 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 \end{bmatrix} \begin{array}{c} A \\ B \\ C \\ D \\ E \end{array} \end{array}$$

In this matrix:

- the ‘1’ in row A, column B indicates that Alfie can communicate directly with Benny.
- the ‘0’ in row A, column C indicates that Alfie cannot communicate directly with Carly.

According to this matrix, Danni cannot communicate via one-step or two-step communication with

A. Alfie.

B. Benny.

C. Alfie, Benny and Ellie.

D. Benny and Carly.

E. Alfie and Benny.

Question 30

The age distribution of a population of animals is outlined below.

- The average birth rate for adults (A) is 3.7.
- The average birth rate for seniors (S) is 2.3.
- Juveniles (J) have a survival rate of 65%.
- The survival rate for adults (A) is 35%.
- The survival rate for seniors (S) is 0%.

The Leslie matrix that represents this information is

A.
$$\begin{matrix} J & A & S \end{matrix}$$
$$\begin{bmatrix} 0 & 3.7 & 2.3 \\ 0 & 0.65 & 0 \\ 0 & 0 & 0.35 \end{bmatrix} \begin{matrix} J \\ A \\ S \end{matrix}$$

B.
$$\begin{matrix} J & A & S \end{matrix}$$
$$\begin{bmatrix} 3.7 & 0 & 2.3 \\ 0.65 & 0 & 0 \\ 0 & 0.35 & 0 \end{bmatrix} \begin{matrix} J \\ A \\ S \end{matrix}$$

C.
$$\begin{matrix} J & A & S \end{matrix}$$
$$\begin{bmatrix} 3.7 & 2.3 & 0 \\ 0.65 & 0 & 0 \\ 0 & 0.35 & 0 \end{bmatrix} \begin{matrix} J \\ A \\ S \end{matrix}$$

D.
$$\begin{matrix} J & A & S \end{matrix}$$
$$\begin{bmatrix} 0 & 3.7 & 2.3 \\ 0.65 & 0 & 0 \\ 0 & 0 & 0.35 \end{bmatrix} \begin{matrix} J \\ A \\ S \end{matrix}$$

E.
$$\begin{matrix} J & A & S \end{matrix}$$
$$\begin{bmatrix} 0 & 3.7 & 2.3 \\ 0.65 & 0 & 0 \\ 0 & 0.35 & 0 \end{bmatrix} \begin{matrix} J \\ A \\ S \end{matrix}$$

Use the following information to answer Questions 31 and 32.

The transition matrix, *T*, below shows the expected change in visits each day between three dog parks: Colton Reserve (*C*), Ellery Park (*E*) and Franklin Park (*F*).

$$T = \begin{matrix} \\ C \\ E \\ F \end{matrix} \begin{matrix} \begin{matrix} C & E & F \end{matrix} \\ \begin{bmatrix} 0.6 & 0.1 & 0.1 \\ 0.3 & 0.7 & 0.15 \\ 0.1 & 0.2 & 0.75 \end{bmatrix} \end{matrix}$$

Fifty people visited Colton Reserve on Monday.

Question 31

How many of the 50 people who visited Colton Reserve on Monday are expected to visit Ellery Park on Tuesday and then Franklin Park on Wednesday?

A. 2

B. 3

C. 4

D. 6

E. 9

Question 32

The number of visitors at Ellery Park on Monday was 40.

The number of visitors at Colton Reserve on Tuesday was 38.

So the number of visitors at Franklin Park on Wednesday is closest to

A. 40

B. 43

C. 45

D. 46

E. 51

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Networks and decision mathematics

Question 33

The principal of a high school leaves her office and walks around the school campus, visiting every building once. She then returns to her office.

This could best be described as

A. an Euler trail.

B. an Euler circuit.

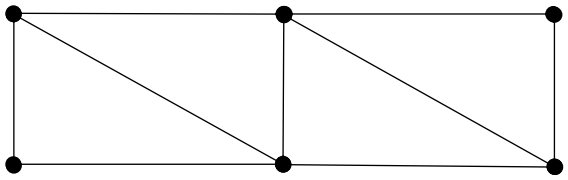
C. an Euler cycle.

D. a Hamilton path.

E. a Hamilton cycle.

Question 34

Consider the graph below.



The number of vertices with an even degree is

A. 2

B. 3

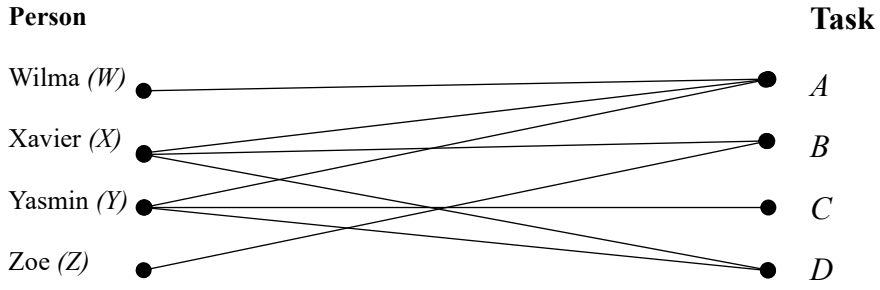
C. 4

D. 5

E. 6

Question 35

The possible allocation of four staff members to four tasks is shown by the bipartite graph below.



If only one person can be allocated to each task, the allocation is

A.

Person	Task
W	*A*
X	*B*
Y	*C*
Z	*D*

B.

Person	Task
W	*A*
X	*D*
Y	*B*
Z	*C*

C.

Person	Task
W	*A*
X	*B*
Y	*D*
Z	*C*

D.

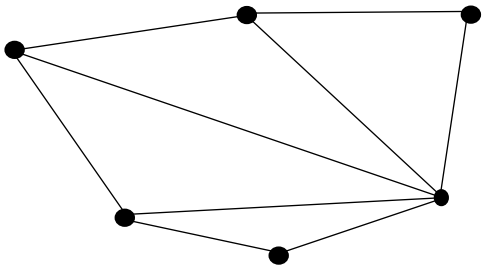
Person	Task
W	*A*
X	*D*
Y	*C*
Z	*B*

E.

Person	Task
W	*A*
X	*C*
Y	*D*
Z	*B*

Question 36

Consider the graph below.



The minimum number of edges needed to be removed to create a tree is

A. 3

B. 4

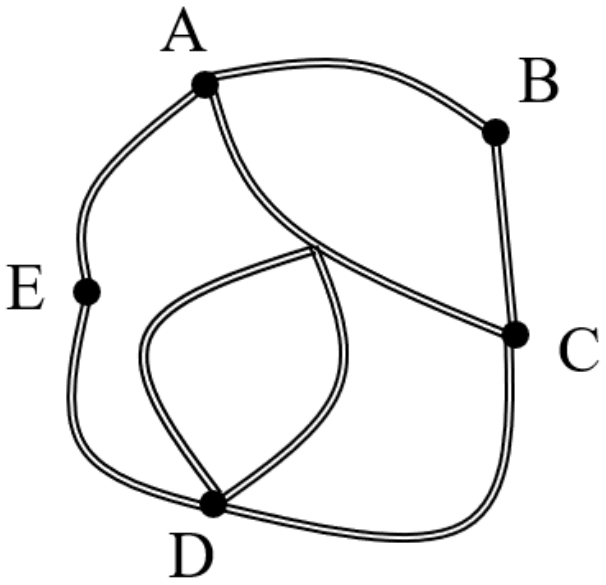
C. 5

D. 6

E. 7

Question 37

The map below shows the tracks between five locations, *A*, *B*, *C*, *D* and *E*.



The adjacency matrix that best represents the connections between the five locations is

A.
$$\begin{array}{c} \\ A \\ B \\ C \\ D \\ E \end{array}\begin{array}{c} \begin{array}{ccccc} A & B & C & D & E \end{array} \\ \begin{bmatrix} 0 & 1 & 1 & 2 & 1 \\ 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 2 & 0 \\ 2 & 0 & 2 & 1 & 1 \\ 1 & 0 & 0 & 1 & 0 \end{bmatrix} \end{array}$$

B.
$$\begin{array}{c} \\ A \\ B \\ C \\ D \\ E \end{array}\begin{array}{c} \begin{array}{ccccc} A & B & C & D & E \end{array} \\ \begin{bmatrix} 0 & 1 & 1 & 2 & 1 \\ 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 2 & 0 \\ 2 & 0 & 2 & 0 & 1 \\ 1 & 0 & 0 & 1 & 0 \end{bmatrix} \end{array}$$

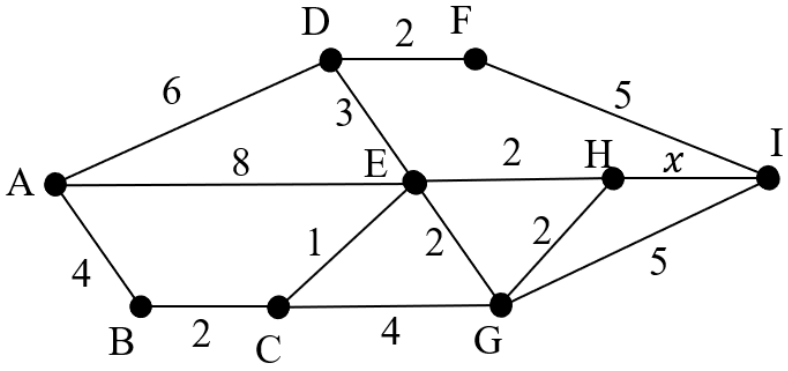
C.
$$\begin{array}{c} \\ A \\ B \\ C \\ D \\ E \end{array}\begin{array}{c} \begin{array}{ccccc} A & B & C & D & E \end{array} \\ \begin{bmatrix} 0 & 1 & 1 & 2 & 1 \\ 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 3 & 0 \\ 2 & 0 & 3 & 1 & 1 \\ 1 & 0 & 0 & 1 & 0 \end{bmatrix} \end{array}$$

D.
$$\begin{array}{c} \\ A \\ B \\ C \\ D \\ E \end{array}\begin{array}{c} \begin{array}{ccccc} A & B & C & D & E \end{array} \\ \begin{bmatrix} 0 & 1 & 1 & 3 & 1 \\ 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 3 & 0 \\ 3 & 0 & 3 & 1 & 1 \\ 1 & 0 & 0 & 1 & 0 \end{bmatrix} \end{array}$$

E.
$$\begin{array}{c} \\ A \\ B \\ C \\ D \\ E \end{array}\begin{array}{c} \begin{array}{ccccc} A & B & C & D & E \end{array} \\ \begin{bmatrix} 0 & 1 & 1 & 2 & 1 \\ 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 2 & 0 \\ 1 & 0 & 2 & 0 & 1 \\ 1 & 0 & 0 & 1 & 0 \end{bmatrix} \end{array}$$

Question 38

The graph below shows the paths between nine landmarks, with the measurements given in kilometres.



The shortest path between A and I is determined to be 12 km.

The value of x is

A. 1

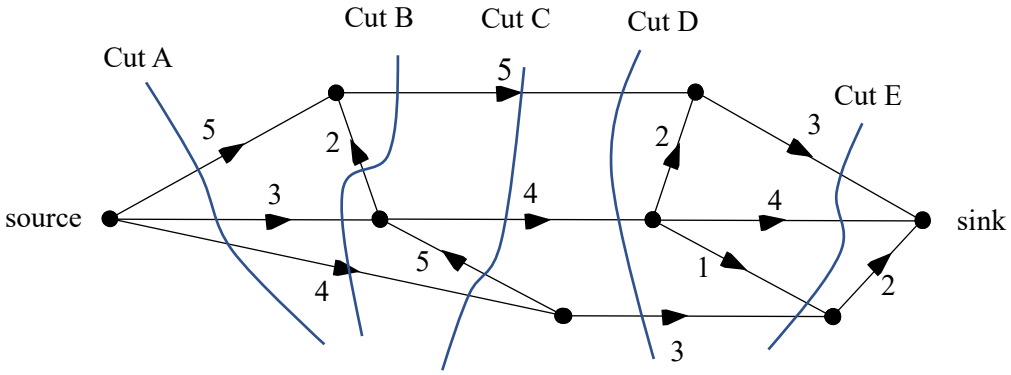
B. 2

C. 3

D. 4

E. 5

Question 39



How many of the cuts shown have a capacity of 12?

A. 1

B. 2

C. 3

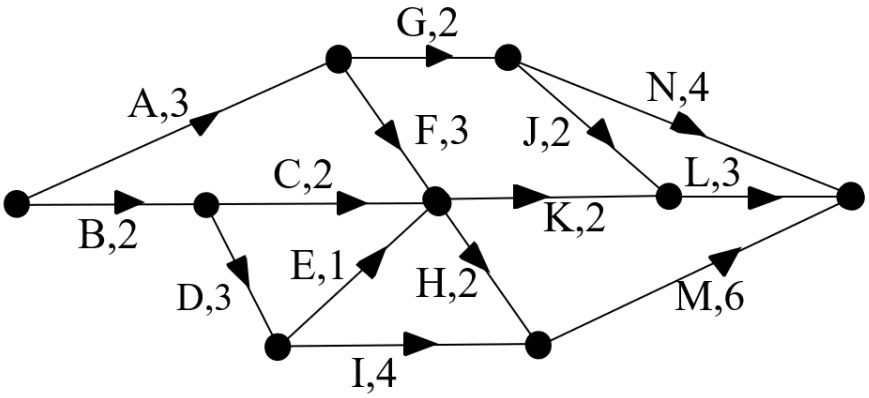
D. 4

E. 5

Question 40

The directed graph below shows the sequence of activities required to complete a project.

The time to complete each activity, in hours, is also shown.



How many of the following statements are true?

- The minimum completion time is 15 hours.
- The critical path is *B–D–I–M*.
- The earliest start time of activity *L* is 8 hours.
- The latest time that activity *I* can finish is 9 hours.
- The float time of activity *K* is 4 hours.

A. 1

B. 2

C. 3

D. 4

E. 5

END OF MULTIPLE-CHOICE QUESTION BOOK