

Trial Examination 2023

VCE General Mathematics Units 3&4

Written Examination 1

Multiple-choice Question Booklet

Reading time: 15 minutes

Writing time: 1 hour 30 minutes

Student's Name: _____

Teacher's Name: _____

Structure of booklet

<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
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 booklet of 22 pages

Formula sheet

Answer sheet for multiple-choice questions

Working space is provided throughout the booklet.

Instructions

Write your **name** and your **teacher's name** in the space provided above on this page, and on the answer sheet for multiple-choice questions.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

At the end of the examination

You may keep this question booklet and the formula sheet.

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

Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2023 VCE General Mathematics Units 3&4 Written Examination 1.

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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 booklet are **not** drawn to scale.

DATA ANALYSIS**Question 1**

A company wanted to compare the efficiency of two methods of producing a chemical to maximise the final product. Each method is completed 20 times, and the mass of the final product is recorded in the two-way frequency table shown below.

Mass of final product (g)	Frequency	
	Method 1	Method 2
0.5	4	5
1.5	6	6
2.5	7	5
3.5	3	4

The method with the higher mean mass of the final product is more efficient.

Using the mean mass of the final product for both methods as the determining factor, which one of the following statements is correct?

- A. Both methods are equally efficient because the mean for both is 5 g.
- B. Method 1 is less efficient because the mean is greater than method 2.
- C. Method 2 is less efficient because the mean is less than 1.5 g.
- D. Method 1 is more efficient because the mean is 0.05 g larger than method 2.
- E. Method 2 is more efficient because the mean is 0.05 g smaller than method 1.

Question 2

A study was conducted in which data about the following variables was collected for a family of six people.

- eye colour
- height
- weight
- age (in years)
- favourite TV series

The number of continuous numerical variables in the study is

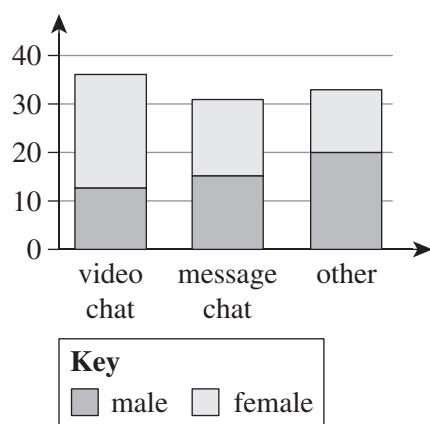
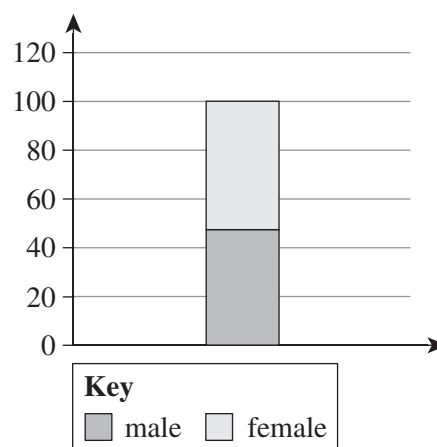
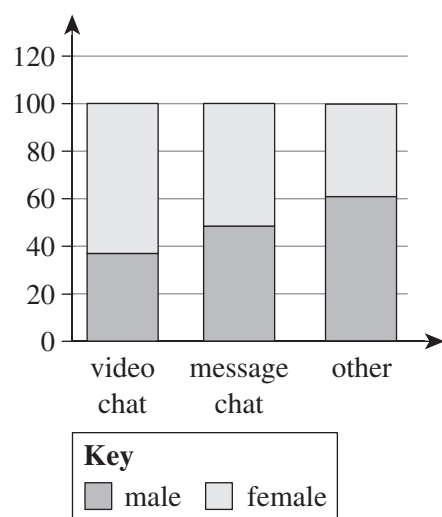
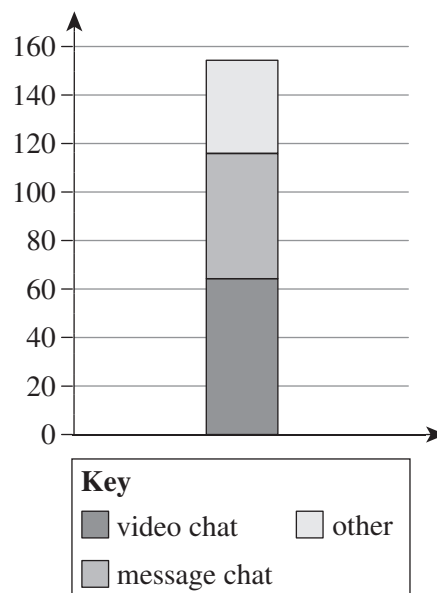
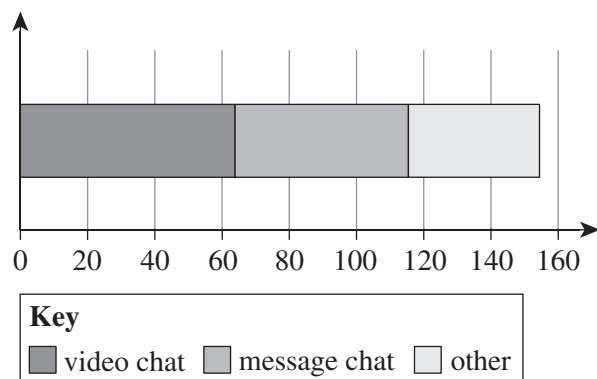
- A. 1
- B. 2
- C. 3
- D. 4
- E. 5

Question 3

A sample of 100 people were asked whether they preferred to communicate online using video chat, message chat or other messaging services. The following table shows the results of the survey.

	Video chat	Message chat	Other	Total
Male	13	15	20	48
Female	23	16	13	52
Total	36	31	33	100

Which one of the following graphs is a percentage segmented bar chart for the results of the survey?

A.**B.****C.****D.****E.**

Question 4

Consider the following data set.

2 2 4 7 10 10 12 15 20

The five-number summary for the data set is 2, 3, 10, 13.5, 20.

It is discovered that the value of 20 was incorrectly recorded and should have been 12.

Which values in the five-number summary will change when the data set is updated?

- A. none of the values
- B. Q_3 and maximum
- C. median, Q_3 and maximum
- D. IQR, Q_3 and maximum
- E. all of the values

Use the following information to answer Questions 5 and 6.

Examining a range of ride share apps shows that there is a bivariate relationship between the cost of the trip, C , and the duration of the trip, t . It is found that the correlation coefficient, r , is 0.7, the mean duration of a trip is 20 minutes with a standard deviation of 10 minutes, and the mean cost of a trip is \$35 with a standard deviation of \$15.

Question 5

The linear association between C and t is given by the equation

- A. $C = 1.5 + 5t$
- B. $C = 14 + 1.05t$
- C. $t = 5 + 1.5C$
- D. $C = \frac{t-5}{1.05}$
- E. $t = 14 + 1.05C$

Question 6

It can be concluded that

- A. 49% of the change in C is due to the change in t .
- B. 49% of the change in t is due to the change in C .
- C. 70% of the change in C is due to the change in t .
- D. 70% of the change in t is due to the change in C .
- E. no cause and effect can be determined because the correlation coefficient is positive.

Use the following information to answer Questions 7 and 8.

A Year 12 Mathematics class was surveyed about what type of social media they use. The following two-way table shows the results of the survey.

	Uses video chat	Does not use video chat	Total
Uses message chat	5	13	18
Does not use message chat	2	4	6
Total	7	17	24

Question 7

The percentage of students in the class who use video chat is closest to

- A. 5%
- B. 7%
- C. 21%
- D. 29%
- E. 71%

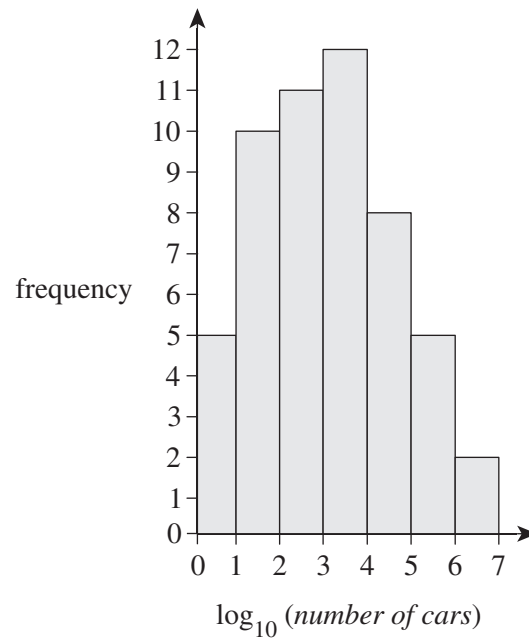
Question 8

Of the students who use message chat, the percentage of students who also use video chat is closest to

- A. 5%
- B. 13%
- C. 28%
- D. 29%
- E. 75%

Question 9

The histogram below shows the *number of cars* sold in 53 countries over one month.



The percentage of countries where fewer than 1000 cars were sold is closest to

- A. 20%
- B. 26%
- C. 49%
- D. 51%
- E. 100%

Question 10

A three-point moving mean is to be calculated for the following data set.

Distance (m)	1	2	3	4	5	6
Time (seconds)	14	22	32	44	50	67

The three-point moving mean centred on 44 seconds is

- A. 38.2
- B. 42
- C. 43
- D. 44
- E. 53.7

Question 11

After a log transformation is applied to the x variable, a data set has a coefficient of determination, r^2 , of 0.64, a gradient of -4.1 and a y -intercept of 32.

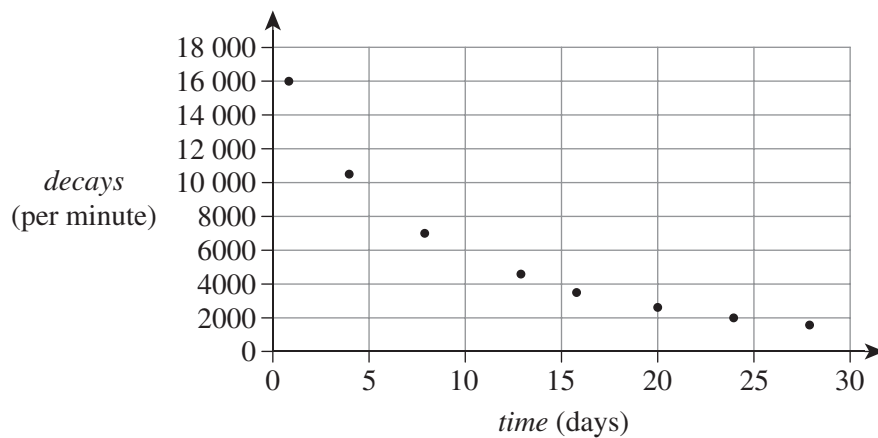
The equation of the least squares line of the original data is

- A. $y = 32 - 4.1x$
- B. $y = 32 - \frac{4.1}{\log_{10}(x)}$
- C. $y = 0.64 - 4.1 \times \log_{10}(x)$
- D. $y = 32 - 0.8 \times \log_{10}(x)$
- E. $y = 32 - 4.1 \times \log_{10}(x)$

Question 12

The number of decays per minute over time, in days, for a radioactive isotope is shown in the table and graph below.

<i>Time (days)</i>	<i>Decays (per minute)</i>
1	16 000
4	10 500
8	7000
12	4700
16	3500
20	2800
24	2000
28	1800

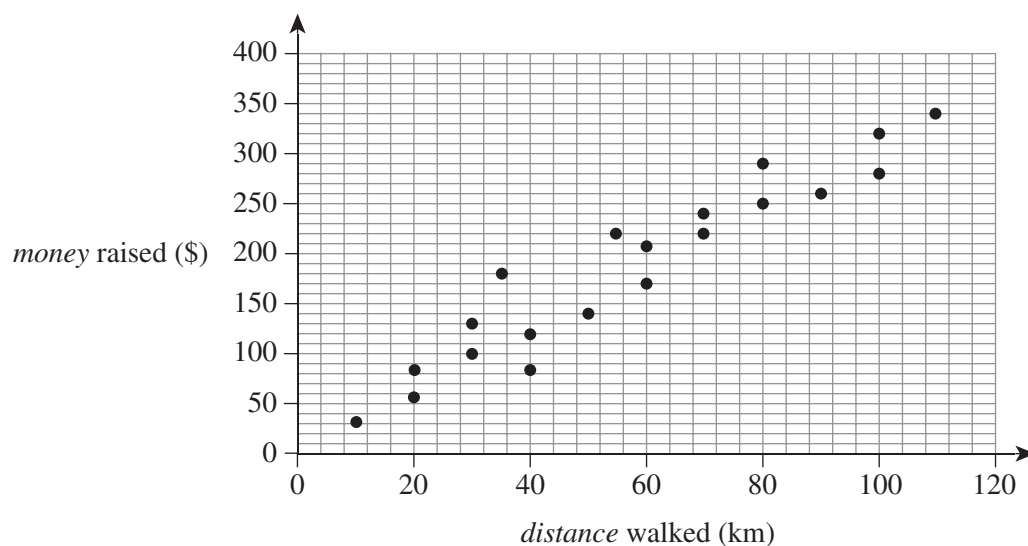


After applying a transformation, the most appropriate line of best fit is

- A. $decays = 16\,000 + 10\,200(\log_{10} \times time)$
- B. $decays = 16\,000 - 10\,200(\log_{10} \times time)$
- C. $decays = 3200 - \frac{14\,000}{time}$
- D. $decays = 10\,000 - 13 \times time^2$
- E. $decays = 10\,000 + 13 \times time^2$

Use the following information to answer Questions 13 and 14.

A group of students enter a charity event where they raise *money*, in dollars, according to the *distance* they walk, in kilometres, during the event. The raw data is shown in the scatterplot below.



Question 13

The residual for the real data point (80, 290) is closest to

- A. -40
- B. -4
- C. 4
- D. 40
- E. 250

Question 14

The equation of the least squares line is closest to

- A. $money = 18 - 3 \times distance$
- B. $money = 18 + 3 \times distance$
- C. $money = 18 + 4 \times distance$
- D. $money = 20 + 2 \times distance$
- E. $money = 40 + 3 \times distance$

Question 15

The number of chocolate bars sold by a supermarket in each season are shown in the table below.

	Summer	Autumn	Winter	Spring	Total	Mean
2020	3000	4500	7400	4300	19 200	4800
2021	3200	5500	9000	5000	22 700	5675
2022	2800	5500	8100	4800	21 200	5300
Total	9000	15 500	24 500	14 100		

The overall seasonal index for the number of chocolate bars sold in winter is closest to

- A. 0.644
- B. 1.528
- C. 1.542
- D. 1.552
- E. 1.586

Question 16

The amount of milk, in litres, sold by a convenience store in each season are shown in the table below.

	Summer	Autumn	Winter	Spring	Total
2021	12 400	10 500	9600	10 400	42 900
2022	13 000	11 200	10 200	12 400	46 800

The deseasonalised amount of milk sold during summer 2022 is closest to

- A. 1.134
- B. 10 725
- C. 10 939
- D. 11 464
- E. 11 700

RECURSION AND FINANCIAL MODELLING**Question 17**

Bernie buys a new car using the finance package offered by the car dealership. After trading in his old car, Bernie needs to take out a \$23 000 loan that will be paid over four years and has an interest rate of 5% per annum.

The monthly repayment is closest to

- A. \$96
- B. \$383
- C. \$479
- D. \$575
- E. \$4600

Question 18

A new air filtration system is installed in an office and costs \$142 800. The value of the air filtration system will decrease by 40% each year for the first three years and by 25% each year after that.

During which year will the value drop below \$10 000 for the first time?

- A. year 3
- B. year 4
- C. year 5
- D. year 6
- E. year 7

Question 19

Heidi is considering opening an investment account. The following recurrence relation models the annual balance of the investment.

$$V_0 = \$50\,000, V_{n+1} = 1.062V_n + 1200$$

Which one of the following statements is correct?

- A. The investment will have an interest rate of 6.2% per annum.
- B. The investment will have an interest rate of 6.2% per annum, compounding monthly.
- C. After five years, the value of the investment will be more than \$80 000.
- D. Each year, the investor will add \$1200 to the investment.
- E. After six years, the value of the investment will be \$81 450.34.

Question 20

Jordan took out a loan of \$5000 and makes monthly payments of \$185. The interest rate of the loan is 3.75% per annum, compounded monthly.

After how many payments will the balance of the loan first fall below \$1000?

- A. 20
- B. 21
- C. 22
- D. 23
- E. 24

Question 21

Consider the following series.

$$10, 9, 8\frac{1}{2}, 8\frac{1}{4}, 8\frac{1}{8}, \dots$$

The series is described by the relation

- A. $t_{n+1} = \frac{t_n}{2} + 4$
- B. $t_0 = 10, t_{n+1} = \frac{t_n}{2} + 4$
- C. $t_1 = 10, t_{n+1} = \frac{t_n}{2} + 4$
- D. $t_1 = 10, t_{n+1} = t_n - 1$
- E. $t_1 = 10, t_{n+1} = 2t_n - 11$

Question 22

Tao deposited \$4000 into an investment account that has an interest rate that compounds monthly. The balance of the investment after n months is given by $t_n = 4000 \times 1.0015n$.

The annual interest rate is closest to

- A. 0.0015%
- B. 0.15%
- C. 1.5%
- D. 1.8%
- E. 6%

Question 23

A new electric vehicle is purchased for \$58 000. It depreciates by 24% in the first year, then by 12% each year for the next 10 years.

The expression for the depreciated value of the electric vehicle after eight years is

- A. $58\,000 \times 1.24 \times 1.12^7$
- B. $58\,000 \times 1.24 \times 1.12^8$
- C. $58\,000 \times 0.76 \times 0.88^7$
- D. $58\,000 \times 0.76 \times 0.88^8$
- E. $58\,000 \times 0.88^8$

Question 24

A viral video is viewed 10 times on the first day it is posted. The number of views increases by an average of 140% each day for the next 20 days.

If $n < 22$, which one of the following recurrence relations describes the scenario?

- A. $t_0 = 10, t_{n+1} = 140t_n + 10$
- B. $t_1 = 10, t_n = 140t_n$
- C. $t_1 = 0, t_{n+1} = 2.40n + 10$
- D. $t_0 = 0, t_{n+1} = 1.40t_n + 10$
- E. $t_0 = 10, t_{n+1} = 2.40t_n$

MATRICES**Question 25**

Consider matrices A and B , where $A = \begin{bmatrix} 1 & 0 \\ a & b \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 2 \\ 1 & 0 \end{bmatrix}$.

Matrix $A - B$ is

A. $\begin{bmatrix} 2 & 2 \\ 2a+b & 2a \end{bmatrix}$

B. $\begin{bmatrix} -1 & -2 \\ a-1 & b \end{bmatrix}$

C. $\begin{bmatrix} 3 & 2 \\ a+1 & b \end{bmatrix}$

D. $\frac{1}{b} \begin{bmatrix} b & 0 \\ -a & 1 \end{bmatrix}$

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

Question 26

Which one of the following matrices has a determinant of -2 ?

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

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

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

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

E. $\begin{bmatrix} 5 & 4 \\ 3 & 2 \end{bmatrix}$

Question 27

Consider matrices A and B , where $A = \begin{bmatrix} 2 & 0 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 0 & 2 \end{bmatrix}$.

What is matrix A^2B ?

A. $\begin{bmatrix} 4 & 8 & 12 \\ 34 & 36 & 86 \end{bmatrix}$

B. $4 \begin{bmatrix} 1 & 2 & 3 \\ 8 & 9 & 21 \end{bmatrix}$

C. $\begin{bmatrix} 2 & 4 & 6 \\ 7 & 6 & 17 \end{bmatrix}$

D. $\begin{bmatrix} 2 & 7 \\ 4 & 6 \\ 6 & 17 \end{bmatrix}$

E. Matrix A^2B cannot be found because matrices A and B have a different number of columns.

Question 28

Students in a Physical Education class must choose between volleyball and badminton. 60% of students who chose volleyball in the first class will choose volleyball again in the second class, while 50% of students who chose badminton in the first class will choose badminton again in the second class.

Each sport was chosen by 60 students in the first class.

The number of students that choose each sport in their second class is

A. $T = \begin{bmatrix} 0.6 & 0.5 \\ 0.4 & 0.5 \end{bmatrix}$

B. $S_1 = \begin{bmatrix} 0.6 \\ 0.5 \end{bmatrix}$

C. $S_1 = \begin{bmatrix} 60 \\ 60 \end{bmatrix}$

D. $S_1 = \begin{bmatrix} 66 \\ 54 \end{bmatrix}$

E. $S_2 = \begin{bmatrix} 54 \\ 66 \end{bmatrix}$

Question 29

Consider the matrix A , where $A = \begin{bmatrix} 6 & 7 & 0 \\ 5 & 2 & 1 \\ 4 & 8 & 3 \end{bmatrix}$.

Element $a_{3,1}$ is

- A. 0
- B. 2
- C. 3
- D. 4
- E. 6

Question 30

A scientist is studying a bear population in a Canadian national park. The following table shows statistics about the female bears in the population living at the end of the first year of the study.

	Age group		
	0–1 year	1–2 years	2–3 years
Number of individuals	75	45	50
Birth rate of female cubs per individual	0.30	1.25	0.45
Survival rate per individual	0.55	0.81	0

The total population of female bears at the end of the fourth year of the study can be calculated using

- A. $\begin{bmatrix} 0.3 & 1.25 & 0.45 \\ 0.55 & 0 & 0 \\ 0 & 0.81 & 0 \end{bmatrix}^3 \times \begin{bmatrix} 75 \\ 45 \\ 50 \end{bmatrix}$
- B. $\begin{bmatrix} 0.3 & 1.25 & 0.45 \\ 0.55 & 0 & 0 \\ 0 & 0.81 & 0 \end{bmatrix}^4 \times \begin{bmatrix} 75 \\ 45 \\ 50 \end{bmatrix}$
- C. $\begin{bmatrix} 0.3 & 1.25 & 0.45 \\ 0.55 & 0.81 & 0 \\ 1 & 1 & 1 \end{bmatrix}^4 \times \begin{bmatrix} 75 \\ 45 \\ 50 \end{bmatrix}$
- D. $\begin{bmatrix} 0.3 & 0 & 0 \\ 1.25 & 0.55 & 0 \\ 0.45 & 0 & 0.81 \end{bmatrix}^3 \times \begin{bmatrix} 75 \\ 45 \\ 50 \end{bmatrix}$
- E. $\begin{bmatrix} 0.3 & 1.25 & 0.45 \\ 0.55 & 0.81 & 0 \\ 0 & 0 & 0 \end{bmatrix}^3 \times \begin{bmatrix} 75 \\ 45 \\ 50 \end{bmatrix}$

Question 31

The inverse of matrix $\begin{bmatrix} 4 & x \\ y & 5 \end{bmatrix}$ is

- A. $\frac{1}{20} \begin{bmatrix} 5 & -x \\ -y & 4 \end{bmatrix}$
- B. $\frac{1}{20} \begin{bmatrix} 5 & y \\ x & 4 \end{bmatrix}$
- C. $\frac{1}{20-xy} \begin{bmatrix} 4 & y \\ x & 5 \end{bmatrix}$
- D. $\frac{1}{20-xy} \begin{bmatrix} 5 & y \\ x & 4 \end{bmatrix}$
- E. $\frac{1}{20-xy} \begin{bmatrix} 5 & -x \\ -y & 4 \end{bmatrix}$

Question 32

Consider matrix Q , where $Q = \begin{bmatrix} 5 & 2 \\ 1 & x \end{bmatrix}$.

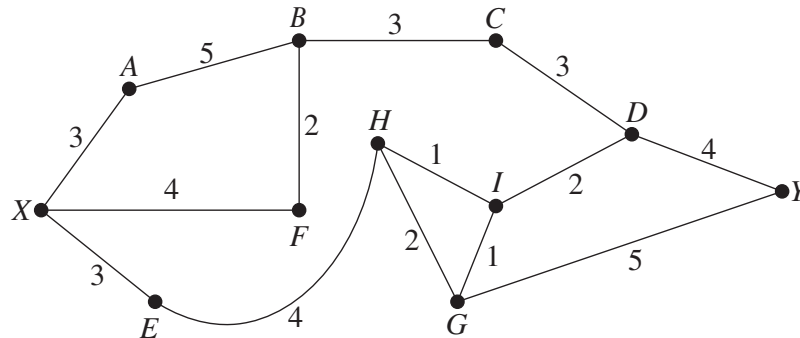
If $PQ = Q$, it is known that matrix P is

- A. $\begin{bmatrix} 1 \end{bmatrix}$
- B. $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$
- C. $\begin{bmatrix} x & -2 \\ -1 & 5 \end{bmatrix}$
- D. $\frac{1}{5x-2} \begin{bmatrix} x & -2 \\ -1 & 5 \end{bmatrix}$
- E. a permutation matrix.

NETWORKS AND DECISION MATHEMATICS

Question 33

Consider the following network diagram.



The length of the shortest path between X and Y is

- A. 1
- B. 12
- C. 14
- D. 16
- E. 22

Question 34

Which one of the following describes a planar graph?

- A. 4 faces, 6 vertices and 7 edges
- B. 4 faces, 0 vertices and 2 edges
- C. 4 faces, 1 vertex and 3 edges
- D. 4 faces, 4 vertices and 4 edges
- E. 4 faces, 6 vertices and 6 edges

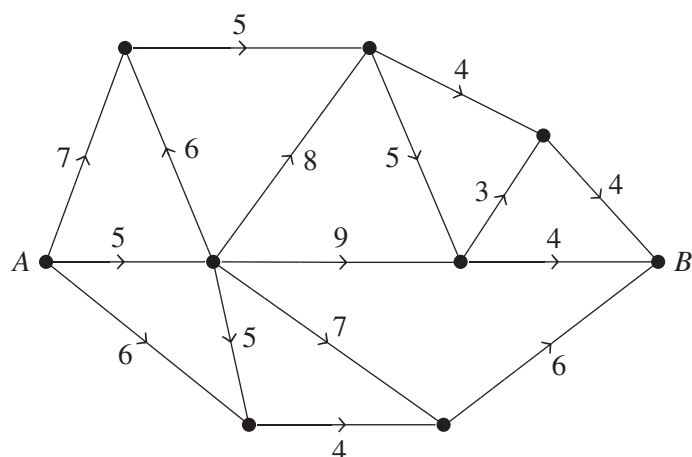
Question 35

Which one of the following statements is correct?

- A. Reducing the duration of an activity on the critical path by three days will reduce the duration of the project by three days.
- B. A network only has an Eulerian trail when the degrees of all vertices are even.
- C. The critical path always contains the longest activity.
- D. An isolated vertex cannot have an Eulerian trail.
- E. A planar graph has no vertices with an odd degree.

Question 36

Consider the following graph.

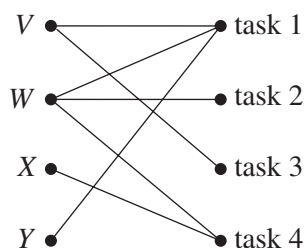


The maximum flow from A to B is

- A. 14
- B. 16
- C. 18
- D. 27
- E. 33

Question 37

A bipartite graph is shown below.

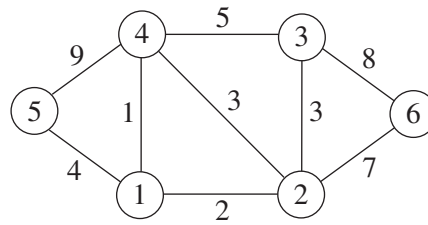


Which one of the following shows the optimum assignment of tasks?

	Task 1	Task 2	Task 3	Task 4
A.	Y	W	V	X
B.	V	W	X	Y
C.	Y	X	V	W
D.	V	W	Y	X
E.	V	X	W	Y

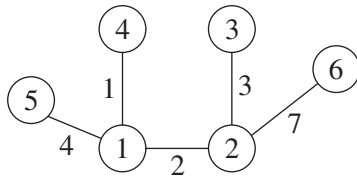
Question 38

Consider the following graph.

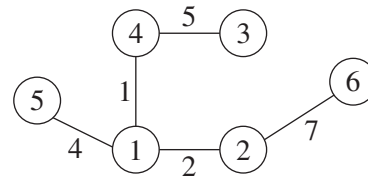


The minimum spanning tree for the graph is

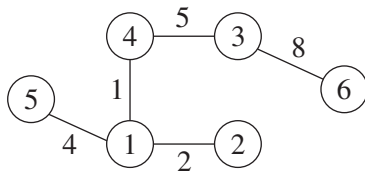
A.



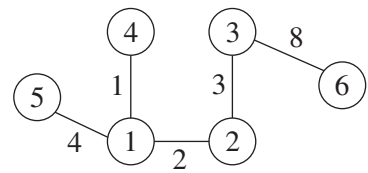
B.



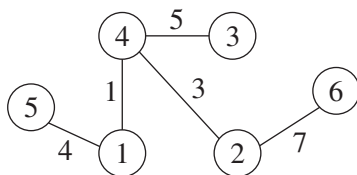
C.



D.



E.



Question 39

Consider the following matrix.

$$\begin{bmatrix} 8 & 6 & 2 & 2 \\ 2 & 0 & 6 & 2 \\ 4 & 2 & 6 & 2 \end{bmatrix}$$

If a row reduction is performed on the matrix, it becomes

A. $\begin{bmatrix} 4 & 3 & 1 & 1 \\ 2 & 1 & 0 & 3 & 1 \\ 2 & 1 & 3 & 1 \end{bmatrix}$

B. $\begin{bmatrix} 6 & 4 & 0 & 0 \\ 0 & 0 & 4 & 0 \\ 2 & 0 & 4 & 0 \end{bmatrix}$

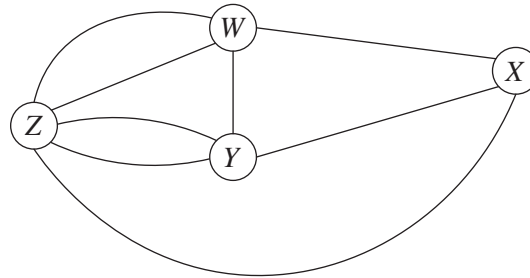
C. $\begin{bmatrix} 6 & 4 & 0 & 0 \\ 2 & 0 & 6 & 2 \\ 2 & 0 & 4 & 0 \end{bmatrix}$

D. $\begin{bmatrix} 6 & 4 & 0 & 0 \\ 2 & 0 & 6 & 2 \\ 2 & 0 & 3 & 0 \end{bmatrix}$

E. $\begin{bmatrix} 4 & 3 & 1 & 1 \\ 1 & 0 & 3 & 1 \\ 2 & 1 & 3 & 1 \end{bmatrix}$

Question 40

Consider the following graph.



Which one of the following is a matrix representation of the graph?

A.
$$\begin{bmatrix} 4 \\ 3 \\ 4 \\ 5 \end{bmatrix}$$

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

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

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

E. $X-Y-W-X-Z-W-Z-Y-Z$

END OF MULTIPLE-CHOICE QUESTION BOOKLET

Trial Examination 2023

VCE General Mathematics Units 3&4

Written Examinations 1&2

Formula Sheet

Instructions

This formula sheet is provided for your reference.
A question and answer booklet 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.

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

Matrices

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

Networks and decision mathematics

Euler's formula	$v + f = e + 2$
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END OF FORMULA SHEET