2022
VCE
Further Mathematics

Trial Examination 1

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Kilbaha Education **PO Box 2227** **Kew Vic 3101** **Australia**	**Tel: (03) 9018 5376** kilbaha@gmail.com https://kilbaha.com.au

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Kilbaha Education (Est. 1978) (ABN 47 065 111 373) **PO Box 2227** **Kew Vic 3101** **Australia**	**Tel: +613 9018 5376** **Email:** kilbaha@gmail.com **Web:** https://kilbaha.com.au

VICTORIAN CERTIFICATE OF EDUCATION
2022

FURTHER MATHEMATICS

Trial Written Examination 1

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

MULTIPLE-CHOICE QUESTION BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of modules*	*Number of modules to be answered*	*Number of marks*
A - Core	24	24			24
B - Modules	32	16	4	2	16
					Total 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 43 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.

SECTION A - Core

Instructions for Section A
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 group of students are asked whether they prefer grapes or bananas. The two-way frequency table below shows the *age* (under 12 years, 12 years and over) of the students and their *preferred fruit* (grapes, bananas).

	Age	
Preferred fruit	**Under 12**	**12 and over**
grapes	66	72
bananas	44	88

Question 1

The variables *preferred fruit* (grapes, bananas) and *age* (under 12 years, 12 years and over) are

A. a numerical variable and a nominal variable respectively.

B. both numerical variables.

C. a nominal variable and an ordinal variable respectively.

D. both ordinal variables.

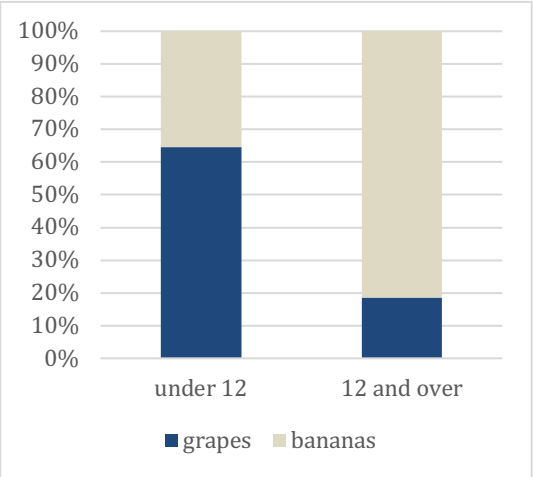
E. a continuous variable and an ordinal variable respectively.

Question 2

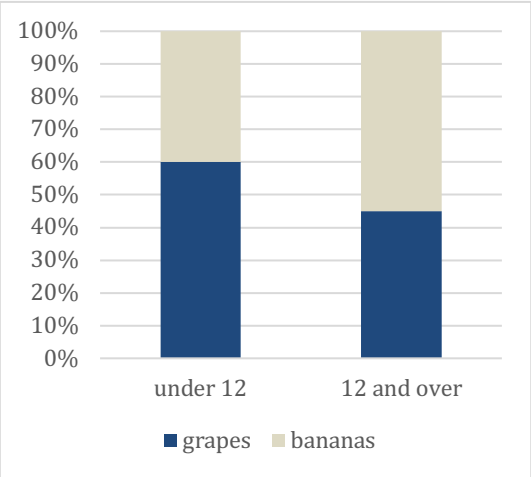
A percentaged segmented bar chart could also be used to summarise the data.

Which one of the following percentaged segmented bar charts could match the two-way frequency table?

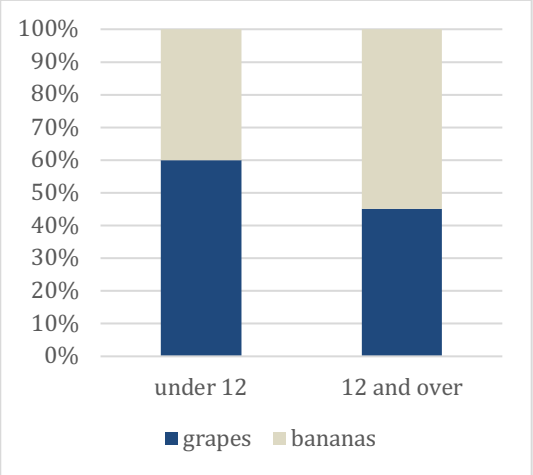
A.



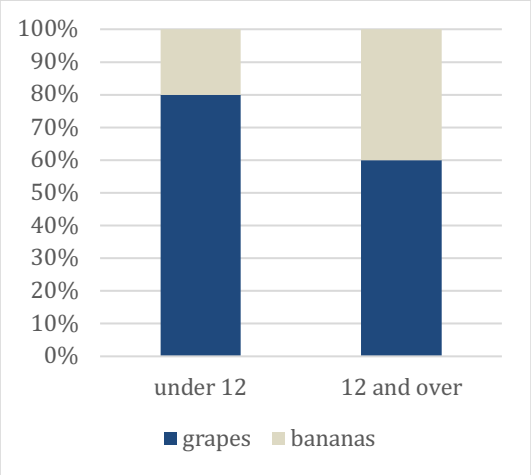
B.



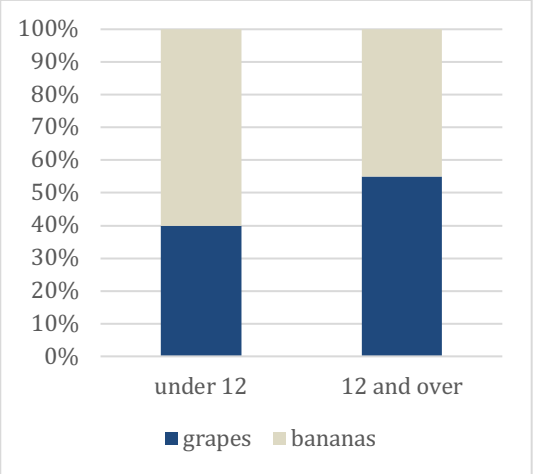
C.



D.

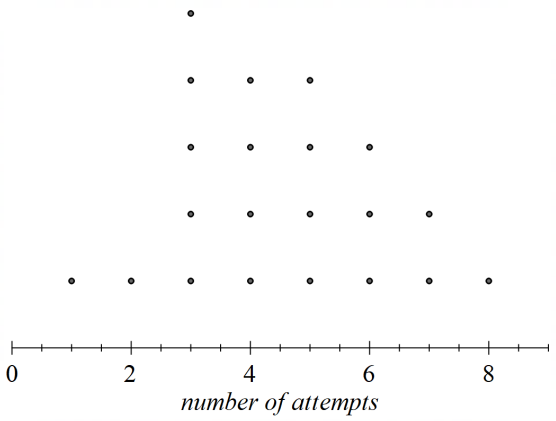


E.



Use the following information to answer questions 3 and 4.

Lang solves a different word puzzle every day for 21 days. The *number of attempts* she takes to solve each puzzle is displayed in the dot plot below.



Question 3

The percentage of days on which she solved the puzzle in under 6 attempts is closest to

A. 24

B. 33

C. 52

D. 47

E. 71

Question 4

The range and interquartile range for the variable *number of attempts* are

A. 8 and 4.5 respectively.

B. 7 and 3 respectively.

C. both 5.

D. both 7.

E. 7 and 3.5 respectively.

Question 5

A study is done on a group of students to see if there is a relationship between sleep patterns and effectiveness of solving a word puzzle.
The relationship between *amount of sleep* (less than 8 hours, 8 hours or more) and *number of attempts* to solve a word puzzle would be best displayed using

A. a scatterplot.

B. a back-to-back stem plot.

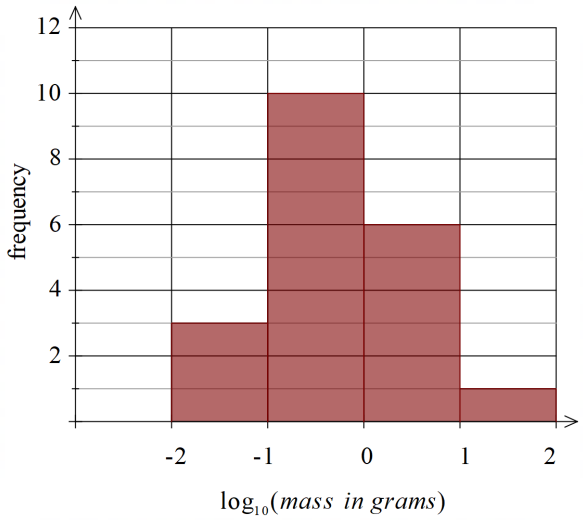
C. a histogram.

D. a time-series plot.

E. a segmented bar graph.

Question 6

The histogram below shows the mass in grams of several insects found in a garden, plotted on a $\log_{10}$ scale.



Based on this histogram, the median *mass in grams* of these insects could be

A. 0.78

B. 1.52

C. 0.02

D. -0.32

E. 0.09

Use the following information to answer questions 7 and 8.

The number of matches contained in boxes of Lite Rites is normally distributed with a mean of 50 and a standard deviation of 2.

Question 7

A box of Lite Rites is rejected if it contains less than 46 matches.
In a batch of 640 boxes, the number of boxes expected to be rejected is closest to

A. 3

B. 10

C. 16

D. 34

E. 86

Question 8

The percentage of boxes of Lite Rites expected to contain between 48 and 54 matches is closest to

A. 50%

B. 81.5%

C. 34%

D. 16%

E. 47.5%

Question 9

The *height*, in cm, and *weight*, in kg, of several people in a group are measured.
The equation of a least squares line is determined to enable *weight* to be predicted from *height*.
The following summary statistics were used to find the equation.

	Height (cm)	*Weight* (kg)
Mean	182.6	65.43
Standard deviation	8.241	7.426
Correlation coefficient (r)	0.7062	

On average, for each additional centimetre in *height*, the *weight* is expected to

A. increase by 0.64 kg.

B. decrease by 50.1 kg.

C. increase by 0.71 kg.

D. decrease by 0.78 kg.

E. increase by 77.6 kg.

Use the following information to answer questions 10 and 11.

A least squares regression line is used to model the relationship between the *success rate* (%) of a netball Goal Shooter and their *distance*, in cm, from the goal ring.

The equation of the least squares line is found to be

$$success\ rate = 84.2 - 0.327 \times distance$$

Question 10

The coefficient of determination is calculated to be 0.87329
The value of the correlation coefficient, rounded to 3 decimal places is

A. 0.874

B. 0.934

C. -0.327

D. -0.934

E. 0.873

Question 11

In a particular training session, the Goal Shooter shoots for goal several times from a distance of 150 cm with a success rate of 42.30 %.
The residual value for this data is closest to

A. -4.23

B. 5.65

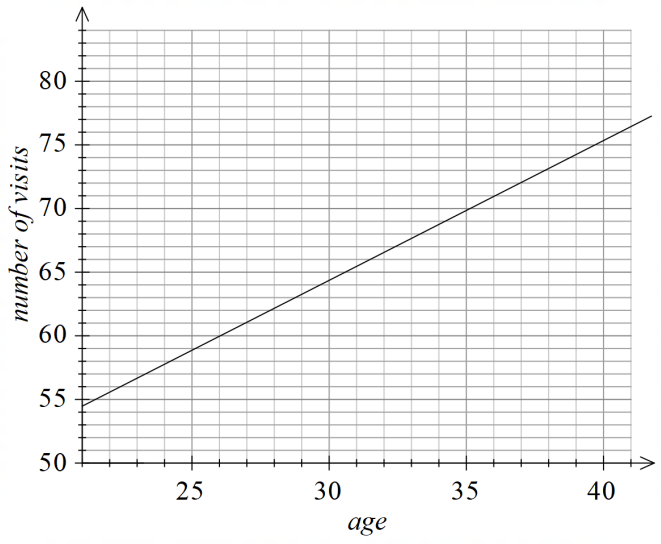
C. -7.15

D. 4.23

E. 7.15

Question 12

The *number of visits* in a five-year period to a doctor, and the *age*, in years, of several patients is recorded. The least squares line generated from the data is shown on the graph below.



With *age* as the explanatory variable, the equation of the least squares regression line is closest to

A. $number\ of\ visits = 54.5 + 0.2 \times age$

B. $number\ of\ visits = 31.5 + 1.1 \times age$

C. $number\ of\ visits = 54.5 + 2.4 \times age$

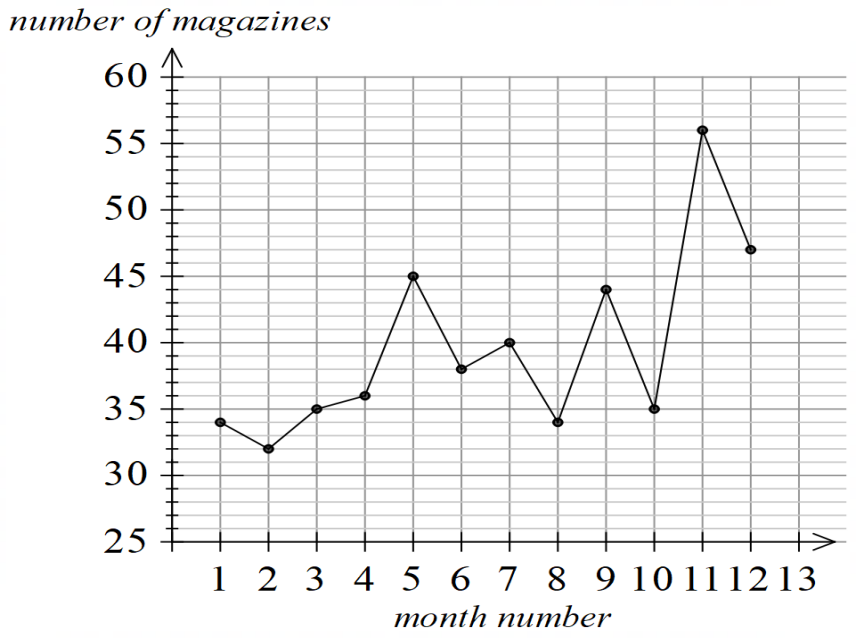
D. $age = 38.5 - 1.1 \times number\ of\ visits$

E. $number\ of\ visits = 55.2 - 1.1 \times age$

Use the following information to answer questions 13 and 14.

The table and time series plot below shows the number of specialist magazines sold by a newsagency each month over a twelve-month period.

Month number	1	2	3	4	5	6	7	8	9	10	11	12
Number of magazines	34	32	35	36	45	38	40	34	44	35	56	47



Question 13

The plot is to be smoothed using five-point median smoothing.
The smoothed number of magazines for month number 5 is closest to

A. 45

B. 39

C. 36

D. 38

E. 40

Question 14

A least squares line is to be fitted to the **unsmoothed** time series plot.
The equation of this least squares line, with *month number* as the explanatory variable, is closest to

A. $number\ of\ magazines = 6.75 \times month\ number - 0.334$

B. $month\ number = 1.29 \times number\ of\ magazines - 31.3$

C. $month\ number = 0.334 \times number\ of\ magazines - 6.75$

D. $number\ of\ magazines = 1.29 \times month\ number + 31.3$

E. $number\ of\ magazines = 0.334 \times month\ number - 6.75$

Use the following information to answer questions 15 and 16.

The table below shows the long-term average maximum daily temperatures for summer, autumn, winter, and spring. The seasonal indices for summer and winter are missing.

	summer	autumn	winter	spring
Long-term average maximum daily temperature (°C)	27.2	19.9	12.6	21.5
Seasonal index		0.98		1.06

Question 15

The seasonal index for winter is closest to

A. 0.84

B. 1.26

C. 0.62

D. 0.58

E. 1.47

Question 16

In 2021, the deseasonalised average maximum daily temperature in autumn was 22.2 °C.
The actual average maximum daily temperature (in °C) for autumn that year was closest to

A. 21.8

B. 23.5

C. 26.4

D. 20.6

E. 19.8

Recursion and financial modelling

Use the following information to answer questions 17 and 18.

A photocopier is purchased for $24000 and is to be depreciated using the unit cost method at a rate of $0.03 per copy.
The recurrence relation that models the value, in dollars, of the machine at the end of each year, V_n, is given by

$$V_0 = 24000, \qquad V_{n+1} = V_n - 960$$

Question 17

The number of copies made per year is

A. 7200

B. 960

C. 4300

D. 32000

E. 23040

Question 18

The recurrence relation could also represent the value of the machine if flat rate depreciation was used. The annual flat rate of depreciation represented would be

A. 3%

B. 4%

C. 6.5%

D. 7%

E. 8.2%

Question 19

A sequence is generated by the recurrence relation

$$T_0 = 5, \quad T_{n+1} = 2T_n + 5$$

The value of $T_4 - T_3$ is

A. 40

B. 80

C. 60

D. 25

E. 75

Question 20

The number of followers that Jim has on his website after n months, F_n, can be modelled by the recurrence relation

$$F_0 = 32000, \quad F_{n+1} = 0.97F_n + 200$$

The situation could best be described as, each month Jim

A. loses 960 followers and gains 200 new ones.

B. gains 1160 followers.

C. increases his number of followers by 0.97%.

D. increases his number of followers by 103%.

E. loses 3% of the followers from last month and gains 200 new ones.

Use the following information to answer questions 21 and 22.

The first three lines of an amortisation table for a reducing balance loan at a fixed interest rate with monthly repayments are shown below.

Payment number	Payment ($)	Interest ($)	Principal reduction ($)	Balance ($)
0	0.00	0.00	0.00	750000.00
1	3200.00	2187.50	1012.50	748987.50
2		2184.55	1115.45	747872.05

Interest is calculated immediately before each payment.

Question 21

The amount of payment number 2 is closest to

A. $3300.00

B. $1115.45

C. $3200.00

D. $3512.50

E. $2187.50

Question 22

The nominal interest rate, per annum, of this loan is

A. 2.75%

B. 3.00%

C. 3.50%

D. 3.75%

E. 4.00%

Question 23

Aimee invests her savings into an account that earns compound interest.

Which of the following combinations of interest rate and compounding period has the largest effective interest rate?

A. 4.2% per annum, compounding quarterly

B. 4.2% per annum, compounding monthly

C. 4.25% per annum, compounding weekly

D. 4.3% per annum, compounding monthly

E. 4.3% per annum, compounding quarterly

Question 24

Mahila borrowed $32000 and was charged interest at a rate of 8.5% compounding monthly.
For the first year of the loan, she made monthly repayments of $658.
For the second year of the loan, she made monthly repayments of $700.

The total amount of interest that Mahila paid over this two-year period is closest to

A. $3542

B. $5265

C. $4531

D. $4765

E. $3987

END OF SECTION A

SECTION B - Module

Instructions for Section B

Select **two** modules and answer **all** questions within the modules selected in pencil on the answer sheet provided for multiple-choice questions.
Show the modules you are answering by shading the matching boxes on your multiple-choice answer sheet **and** writing the name of the module in the box provided.
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 sale.

Contents **Page**

Module 1: Matrices

Before answering these questions you **must** shade the 'Matrices' box on the answer sheet for multiple-choice questions and write the name of the module in the box provided.

Question 1

The matrix $\begin{bmatrix} 4 & 0 & 2 \\ 0 & 1 & 5 \\ 2 & 5 & 9 \end{bmatrix}$ is an example of a

A. triangular matrix

B. unit matrix

C. symmetric matrix

D. binary matrix

E. column matrix

Question 2

A is a matrix such that $3 \times \begin{bmatrix} 2 & 3 \\ 0 & -1 \end{bmatrix} + A = \begin{bmatrix} 9 & 7 \\ 1 & 1 \end{bmatrix}$

The matrix A is

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

B. $\begin{bmatrix} 7 & 4 \\ 1 & 2 \end{bmatrix}$

C. $\begin{bmatrix} 3 & -2 \\ 0 & 3 \end{bmatrix}$

D. $\begin{bmatrix} 3 \\ 7 \\ -2 \\ 1 \end{bmatrix}$

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

Module 1: Matrices

Question 3

A permutation matrix is used to rearrange the word AGENT as shown in the matrix product below.

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix} \times \begin{bmatrix} A \\ G \\ E \\ N \\ T \end{bmatrix}$$

The resulting arrangement is

A. TANGE

B. GENTA

C. GANTE

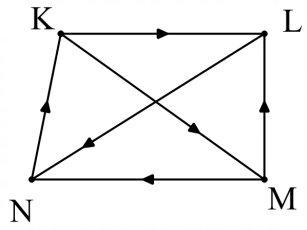
D. TEGAN

E. NEGAT

Module 1: Matrices

Question 4

In a round robin table tennis tournament, Kira (K), Lang (L), Mahila (M) and Nazeem (N) each play each other only once.
The diagram below shows the results of the games.
The arrows in the diagram indicate the winner of each game.
For example, the arrow from N to K indicates that Nazeem defeats Kira.



The matrix showing two-step dominance is

A.

$$\begin{array}{cc} & \text{loser} \\ & \begin{array}{cccc} K & L & M & N \end{array} \\ \text{winner} \begin{array}{c} K \\ L \\ M \\ N \end{array} & \begin{bmatrix} 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

B.

$$\begin{array}{cc} & \text{loser} \\ & \begin{array}{cccc} K & L & M & N \end{array} \\ \text{winner} \begin{array}{c} K \\ L \\ M \\ N \end{array} & \begin{bmatrix} 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 2 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix} \end{array}$$

C.

$$\begin{array}{cc} & \text{loser} \\ & \begin{array}{cccc} K & L & M & N \end{array} \\ \text{winner} \begin{array}{c} K \\ L \\ M \\ N \end{array} & \begin{bmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 2 & 0 \end{bmatrix} \end{array}$$

D.

$$\begin{array}{cc} & \text{loser} \\ & \begin{array}{cccc} K & L & M & N \end{array} \\ \text{winner} \begin{array}{c} K \\ L \\ M \\ N \end{array} & \begin{bmatrix} 0 & 1 & 0 & 2 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 \end{bmatrix} \end{array}$$

E.

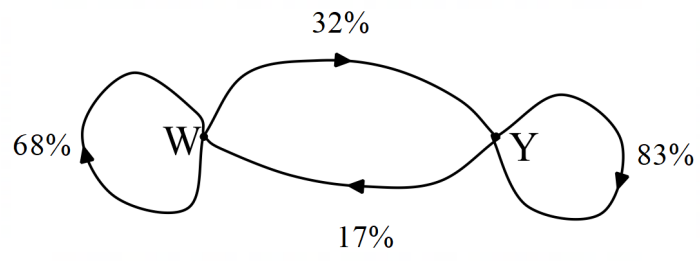
$$\begin{array}{cc} & \text{loser} \\ & \begin{array}{cccc} K & L & M & N \end{array} \\ \text{winner} \begin{array}{c} K \\ L \\ M \\ N \end{array} & \begin{bmatrix} 0 & 0 & 1 & 0 \\ 2 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

Module 1: Matrices

Question 5

The Ranges Film Club shows one film each month at both Warburn (W) and Yarragrove (Y) cinemas. Club members can choose the cinema in which they will watch the film.

The transition diagram below shows how club members change the cinema they attend from one month to the next.



The transition matrix that provides the same information as the transition diagram is

A.

$$T = \begin{array}{c} \\ \text{W} \\ \text{Y} \end{array} \begin{array}{c} \begin{array}{cc} \text{W} & \text{Y} \end{array} \\ \begin{bmatrix} 0.32 & 0.17 \\ 0.68 & 0.83 \end{bmatrix} \end{array} \begin{array}{l} \\ \text{W} \\ \text{Y} \end{array} \quad \begin{array}{l} \text{This month} \\ \\ \text{Next month} \end{array}$$

B.

$$T = \begin{array}{c} \\ \text{W} \\ \text{Y} \end{array} \begin{array}{c} \begin{array}{cc} \text{W} & \text{Y} \end{array} \\ \begin{bmatrix} 0.32 & 0.83 \\ 0.68 & 0.17 \end{bmatrix} \end{array} \begin{array}{l} \\ \text{W} \\ \text{Y} \end{array} \quad \begin{array}{l} \text{This month} \\ \\ \text{Next month} \end{array}$$

C.

$$T = \begin{array}{c} \\ \text{W} \\ \text{Y} \end{array} \begin{array}{c} \begin{array}{cc} \text{W} & \text{Y} \end{array} \\ \begin{bmatrix} 0.17 & 0.68 \\ 0.32 & 0.83 \end{bmatrix} \end{array} \begin{array}{l} \\ \text{W} \\ \text{Y} \end{array} \quad \begin{array}{l} \text{This month} \\ \\ \text{Next month} \end{array}$$

D.

$$T = \begin{array}{c} \\ \text{W} \\ \text{Y} \end{array} \begin{array}{c} \begin{array}{cc} \text{W} & \text{Y} \end{array} \\ \begin{bmatrix} 0.68 & 0.32 \\ 0.17 & 0.83 \end{bmatrix} \end{array} \begin{array}{l} \\ \text{W} \\ \text{Y} \end{array} \quad \begin{array}{l} \text{This month} \\ \\ \text{Next month} \end{array}$$

E.

$$T = \begin{array}{c} \\ \text{W} \\ \text{Y} \end{array} \begin{array}{c} \begin{array}{cc} \text{W} & \text{Y} \end{array} \\ \begin{bmatrix} 0.68 & 0.17 \\ 0.32 & 0.83 \end{bmatrix} \end{array} \begin{array}{l} \\ \text{W} \\ \text{Y} \end{array} \quad \begin{array}{l} \text{This month} \\ \\ \text{Next month} \end{array}$$

Module 1: Matrices

Question 6

The element in row i and column j of matrix N is n_{ij}. The elements in matrix N are determined using the rule $n_{ij} = 3i - j$

Matrix N could not be

A.

$$\begin{bmatrix} 2 & 1 \\ 5 & 4 \end{bmatrix}$$

B.

$$\begin{bmatrix} 2 \\ 1 \\ 5 \\ 4 \end{bmatrix}$$

C.

$$[2]$$

D.

$$\begin{bmatrix} 2 & 1 & 0 \\ 5 & 4 & 3 \\ 8 & 7 & 6 \end{bmatrix}$$

E.

$$[2 \quad 1 \quad 0]$$

Module 1: Matrices

Question 7

A study of filmgoers in a municipality has shown that the filmgoers regularly move between three cinemas, Warburn (W), Xantha (X) and Yarragrove (Y).

Let F_n be the state matrix that shows the number of filmgoers at each cinema n weeks after the study began. The expected number of filmgoers at each cinema can be determined by the matrix recurrence rule

$$F_{n+1} = TF_n - B$$

where

this week

$$T = \begin{array}{c} \begin{matrix} \text{W} & \text{X} & \text{Y} \end{matrix} \\ \begin{bmatrix} 0.3 & 0.2 & 0.5 \\ 0.6 & 0.4 & 0.3 \\ 0.1 & 0.4 & 0.2 \end{bmatrix} \end{array} \begin{matrix} \text{W} \\ \text{X} \\ \text{Y} \end{matrix} \quad \text{next week}$$

and

$$B = \begin{bmatrix} 5 \\ 2 \\ 7 \end{bmatrix} \begin{matrix} \text{W} \\ \text{X} \\ \text{Y} \end{matrix}$$

The state matrix, F_3, below shows the number of filmgoers at each cinema three weeks after the study began.

$$F_3 = \begin{bmatrix} 77 \\ 110 \\ 59 \end{bmatrix} \begin{matrix} \text{W} \\ \text{X} \\ \text{Y} \end{matrix}$$

The number of filmgoers at Xantha cinema two weeks after the study began, as found in the matrix F_2 is closest to

A. 66

B. 109

C. 105

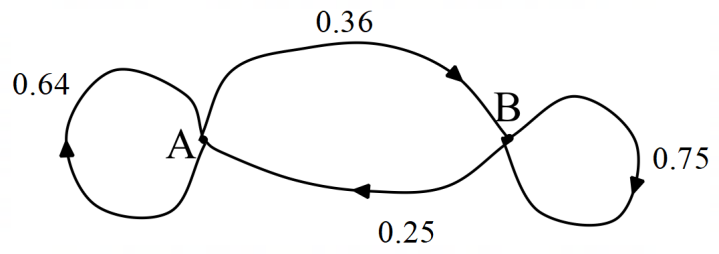
D. 77

E. 74

Module 1: Matrices

Question 8

At a mathematics conference, participants move between two lecture rooms, A and B.
The transition diagram below shows the change in room location of the participants from session to session.



Room A always contains x participants.
Room B always contains y participants.
Of the participants in room B for session two, 27 had been in room A for session one.

The number of participants is

A. 70

B. 125

C. 183

D. 118

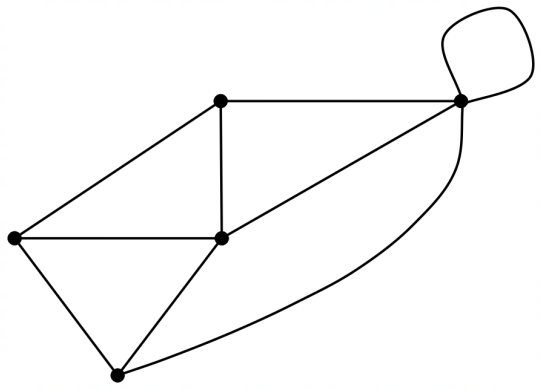
E. 94

End of Module 1

Module 2: Networks and decision mathematics

Before answering these questions you **must** shade the 'Networks and decision mathematics' box on the answer sheet for multiple-choice questions and write the name of the module in the box provided.

Question 1



In the graph shown above, the number of vertices with even degree is

A. 0

B. 4

C. 2

D. 3

E. 1

Module 2: Networks and decision mathematics

Question 2

A connected planar graph has 9 vertices and 4 faces.
The number of edges that this graph will have is

A. 7

B. 13

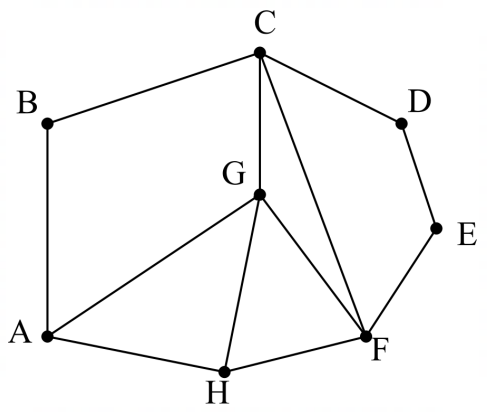
C. 15

D. 11

E. 8

Question 3

Consider the graph below.



Which of the following is **not** an Eulerian trail?

A. HAGHFGCFEDCBA

B. AGCDEFCGABCFH

C. ABCDEFCGFHGAH

D. AGCBAHGFCDEFH

E. ABCGFEDCFHGAH

Module 2: Networks and decision mathematics

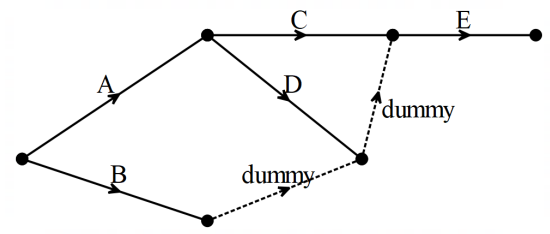
Question 4

A project consists of five tasks. An activity table for the project is shown below.

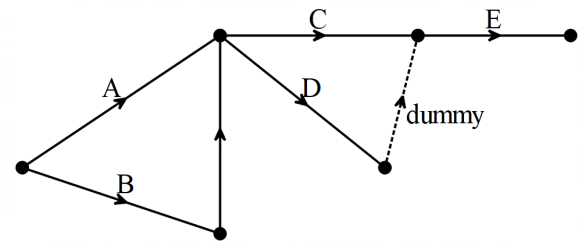
Activity	Immediate predecessor
A	-
B	-
C	A, B
D	A, B
E	C, D

A directed graph for this project could be

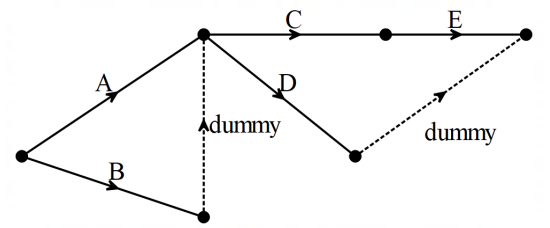
A.



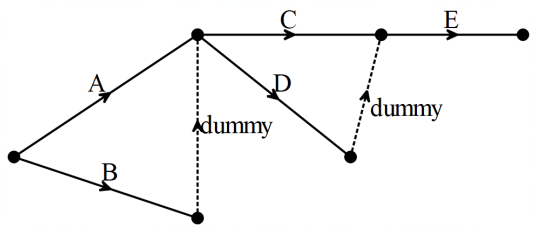
B.



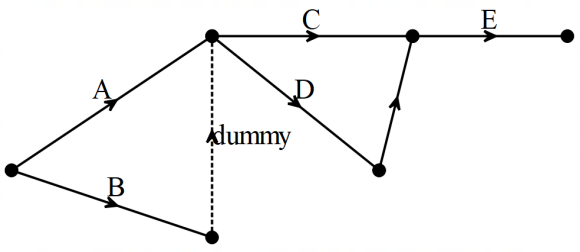
C.



D.



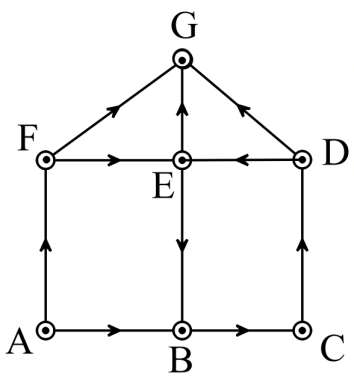
E.



Module 2: Networks and decision mathematics

Question 5

Consider the directed graph below.



The vertices **not** reachable from vertex C are

A. A and F

B. A and B

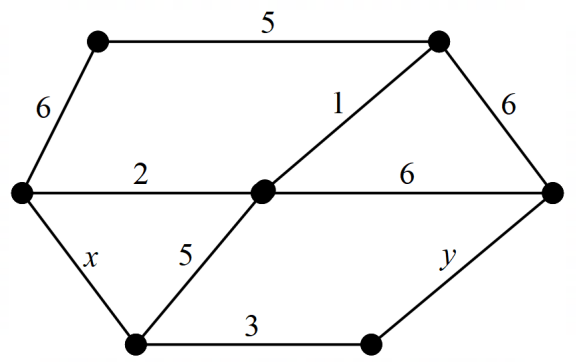
C. A, F and G

D. A only

E. B and G

Module 2: Networks and decision mathematics

Question 6
The minimal spanning tree for the network below includes edges with weightings x and y.



The value of the minimal spanning tree is 19.
The values of x and y could be

A. $x = 4$ and $y = 5$

B. $x = 3$ and $y = 5$

C. $x = 1$ and $y = 7$

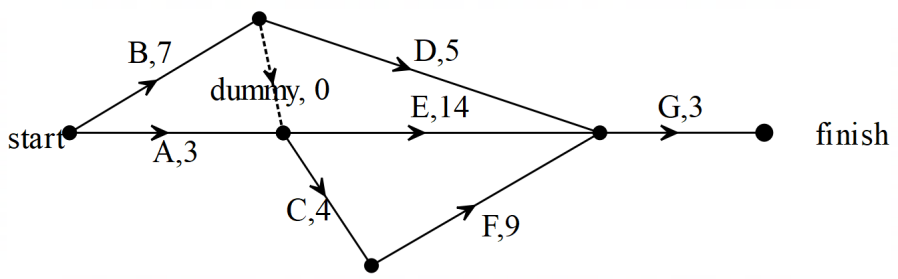
D. $x = 5$ and $y = 6$

E. $x = 2$ and $y = 5$

Module 2: Networks and decision mathematics

Question 7

The activity network below shows the activities along with their duration in hours needed to complete a project.



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

A. The earliest completion time of the project is 24 hours.

B. Activity E has two immediate predecessors.

C. The latest start time for activity F is 11 hours into the project.

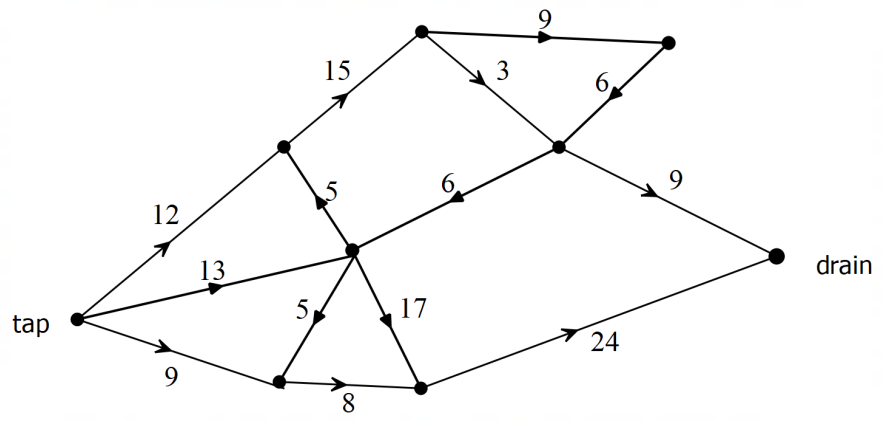
D. The float time for activity D is 9 hours.

E. Reducing the duration of activity E by 1 hour will reduce the completion time by 1 hour.

Module 2: Networks and decision mathematics

Question 8

The diagram below shows the flow of water through pipes in a boiler from the tap to a drain. The arrows show the direction of flow, and the numbers show the flow rate in litres per minute through each pipe.



The maximum flow of water through this system for tap to drain, in litres per minute is

A. 28

B. 30

C. 33

D. 34

E. 26

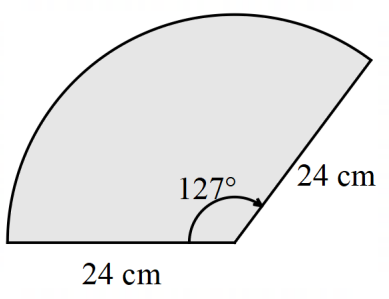
End of Module 2

Module 3: Geometry and measurement

Before answering these questions you **must** shade the 'Geometry and measurement' box on the answer sheet for multiple-choice questions and write the name of the module in the box provided.

Question 1

When fully unfolded, a fan forms the shape of a sector.
The straight edges of the fan have lengths 24 cm and meet at an angle of 127° as shown.



The area of the sector is closest to

A. 452.4 cm^2

B. 531.9 cm^2

C. 638.4 cm^2

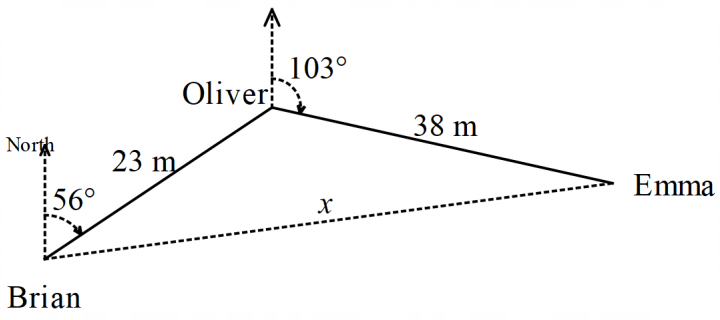
D. 762.6 cm^2

E. 904.8 cm^2

Module 3: Geometry and measurement

Use the following information to answer questions 2 and 3.

In a hockey game, Brian hits the ball to Oliver 23 metres away at a bearing of 056°. Oliver then hits the ball to Emma who is 38 metres away on a bearing of 103°.



Question 2

The bearing of Brian from Oliver is

A. 236°

B. 208°

C. 056°

D. 159°

E. 077°

Question 3

A calculation that can be used to find the distance, x, between Brian and Emma is

A. $x = 61\sin(56°)$

B. $x = \frac{\sin 203°}{\sin 56°} \times 38$

C. $x^2 = 23^2 + 38^2 - 2 \times 23 \times 38\cos(203°)$

D. $x^2 = 23^2 + 38^2 - 2 \times 23 \times 38\cos(133°)$

E. $x = \frac{\sin 133°}{\sin 34°} \times 38$

Module 3: Geometry and measurement

Question 4

Karlstad, Sweden (59.4° N 13.5° E) and Stockholm, Sweden (59.4° N 18.0° E) are in the same time zone.
On April 24, 2022, sunrise in Karlstad, Sweden is at 5:26 am.
On the same day, sunrise in Stockholm, Sweden is expected to be at approximately

A. 5:22 am

B. 5:08 am

C. 4:51 am

D. 5:31 am

E. 4:44 am

Question 5

Laura flies from Melbourne to Los Angeles. Flying time is 14 hours.
She departs Melbourne on Saturday March 26 at 12:50 pm.
If the time in Los Angeles is 18 hours behind Melbourne, the time and date in Los Angeles when she lands will be

A. 6:50 pm on Sunday March 27

B. 3:50 pm on Saturday March 26

C. 9:50 pm on Friday March 25

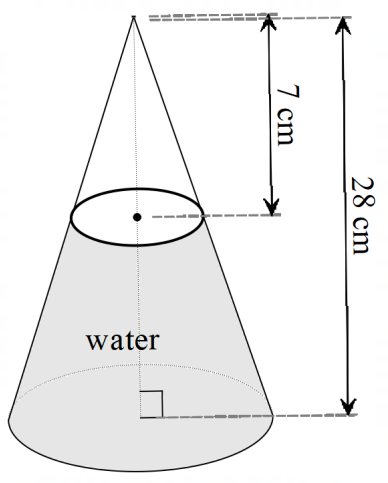
D. 6:50 am on Sunday March 27

E. 8:50 am on Saturday March 26

Module 3: Geometry and measurement

Question 6

A conical water container with a vertical height of 28 cm has a capacity of 1216 cm^3.
It is partially filled with water, leaving a conical air space of height 7 cm as shown.



The volume of water in the container is closest to

A. 912 cm^3

B. 1140 cm^3

C. 1178 cm^3

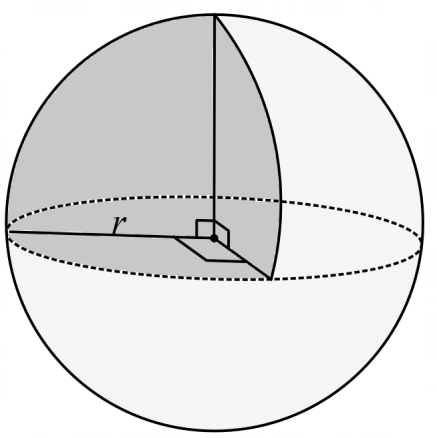
D. 1197 cm^3

E. 1177 cm^3

Module 3: Geometry and measurement

Question 7

Madison makes bronze sculptures of apples.
One such sculpture is a solid sphere of radius r cm, with one eighth of the sphere cut out as shown.



The total surface area of this sculpture, in cm^2, is

A. $\frac{3}{4}\pi r^2$

B. $7\pi r^2$

C. $\frac{13}{4}\pi r^2$

D. $\frac{15}{2}\pi r^2$

E. $\frac{17}{4}\pi r^2$

Module 3: Geometry and measurement

Question 8

Points A and C lie on an east-west line on the shore of a beach.
Summer swims 17 metres from point A on a bearing of 042° to point B. She then turns and swims 15 metres to point C.
The bearing of point C from point B, correct to one decimal place, could be

A. 148.6°

B. 337.4°

C. 212.6°

D. 087.6°

E. 118.1°

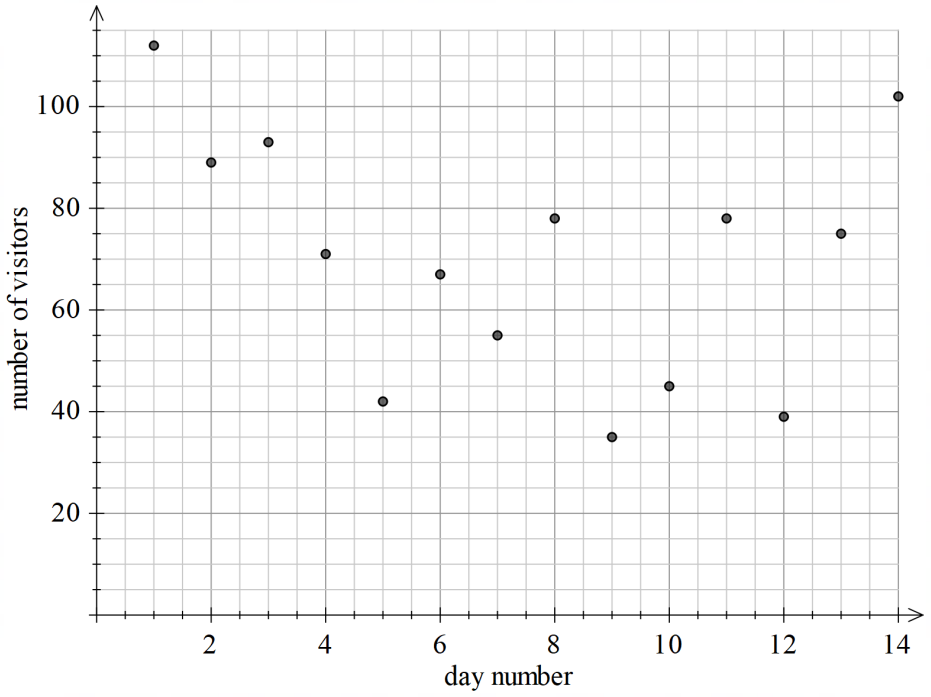
End of Module 3

Module 4: Graphs and relations

Before answering these questions you **must** shade the 'Graphs and relations' box on the answer sheet for multiple-choice questions and write the name of the module in the box provided.

Question 1

The number of visitors each day at an art exhibition over a 14 - day period is shown in the graph below.



The percentage of days on which there was less than 70 visitors is closest to

A. 37

B. 43

C. 46

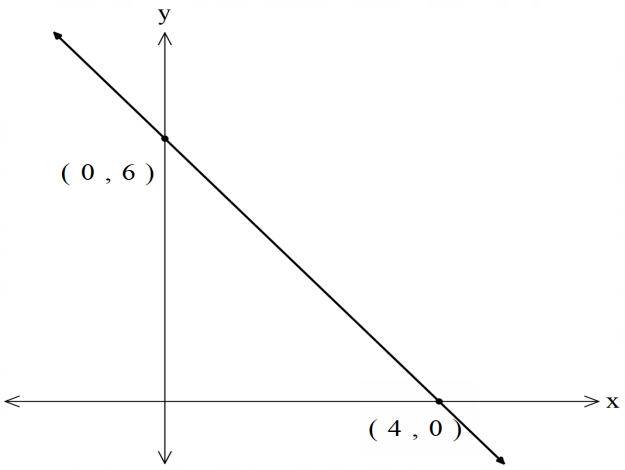
D. 52

E. 57

Module 4: Graphs and relations

Question 2

The graph below shows a line with axial intercepts at (0,6) and (4,0).



The equation of this linear graph is

A. $3x - 2y = 12$

B. $6x + 4y = 12$

C. $x - 4y = 6$

D. $4x + y = 6$

E. $3x + 2y = 12$

Module 4: Graphs and relations

Question 3

At a hardware store, the cost of 5 bolts and 8 washers is $3.50
and the cost of 7 bolts and 14 washers is $5.60

Let x be the cost, in cents, of a bolt.
Let y be the cost, in cents, of a washer.

The set of simultaneous equations that can be solved to find the cost of a bolt and the cost of a washer is

A. $5x + 8y = 350 \; and \; 14x + 8y = 560$

B. $5x + 8y = 3.50 \; and \; 7x + 14y = 5.60$

C. $5x + 8y = 350 \; and \; 7x + 14y = 560$

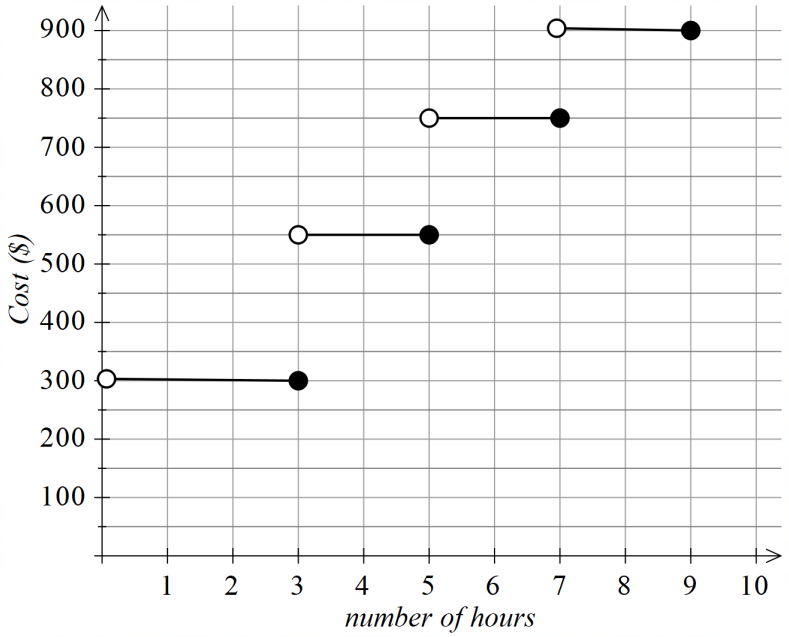
D. $8x + 5y = 3.50 \; and \; 7x + 14y = 5.60$

E. $8x + 5y = 3.50 \; and \; 14x + 7y = 5.60$

Module 4: Graphs and relations

Question 4

The Yarragrove Council hires out its venue.
The daily hire cost, in dollars, will depend upon the number of hours of hire as shown in the graph below.



On a particular weekend, the venue is hired out for 3 hours on Friday, 7 and a half hours on Saturday and 8 hours on Sunday.

The total hire cost collected by the council for the weekend is

A. $1850

B. $1950

C. $1600

D. $2100

E. $2450

Module 4: Graphs and relations

Question 5

Madison makes a small sculpture containing bronze and pewter.
Let b be the number of grams of bronze in the sculpture.
Let p be the number of grams of pewter in the sculpture.
For every 5 grams of bronze, she must use at least 3 grams of pewter.

An inequality representing this constraint is

A. $p \geq \frac{b}{5} + 3$

B. $p \geq \frac{3b}{5}$

C. $p \geq \frac{5b}{3}$

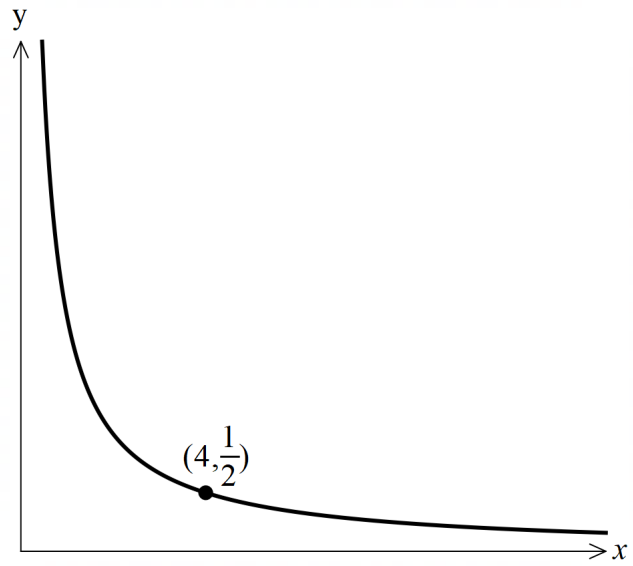
D. $p \leq \frac{3b}{5}$

E. $p \geq \frac{b}{3} + 5$

Module 4: Graphs and relations

Question 6

The graph below shows the relationship between two variables, x and y.



If the rule for this relationship is of the form $y = kx^{-2}$, the value of k is

A. $\frac{1}{8}$

B. $\frac{9}{2}$

C. 4

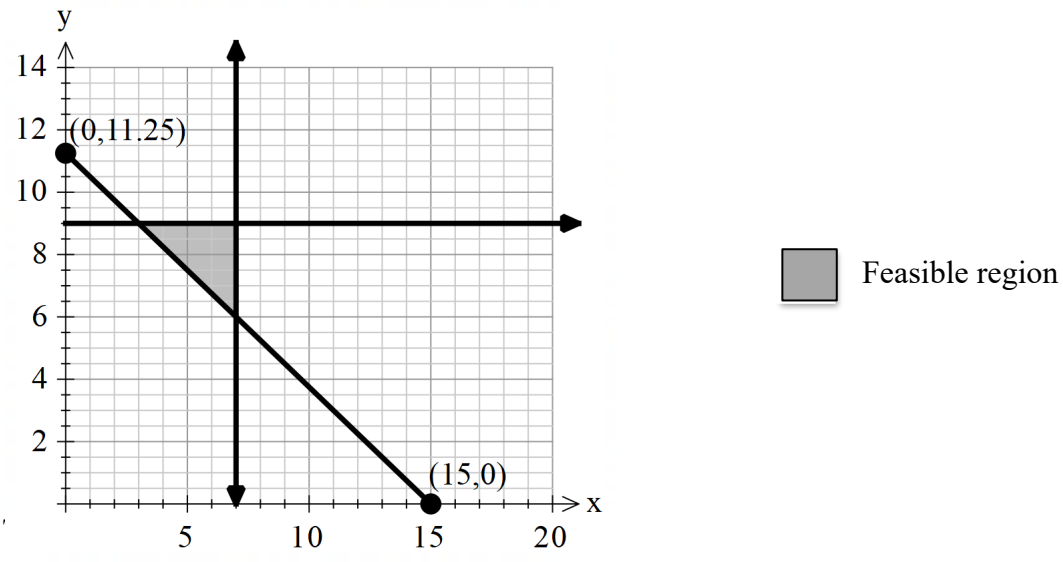
D. 8

E. $\frac{1}{4}$

Module 4: Graphs and relations

Question 7

The feasible region (shaded) for a linear programming problem is shown in the graph below.



This feasible region is defined by

A. $x \leq 7,\ y \leq 9,\ 3x + 4y \geq 45$

B. $x \leq 7,\ y \leq 9,\ 4x + 3y \geq 45$

C. $x \geq 7,\ y \leq 9,\ 3x + 4y \leq 45$

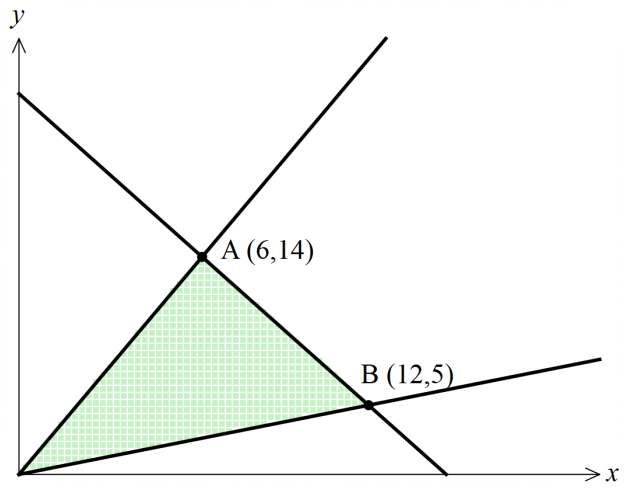
D. $x \geq 7,\ y \geq 9,\ 3x + 4y \leq 45$

E. $x \leq 7,\ y \leq 9,\ 4x + 3y \leq 45$

Module 4: Graphs and relations

Question 8

In the diagram below, the shaded region (with boundaries included) represents the feasible region for a linear programming problem.



The equation of the objective function for this problem is of the form

$$Z = ax + by$$

It is found that this objective function has its value maximized at both points A and B.

The values of a and b could be

A. $a = -6, b = 2$

B. $a = 3, b = 4$

C. $a = 6, b = 4$

D. $a = 6, b = 12$

E. $a = 3, b = -4$

End of Module 4

End of 2022 Further Mathematics Trial Examination 1

Kilbaha Education **PO Box 2227** **Kew Vic 3101** **Australia**	**Tel: (03) 9018 5376** **kilbaha@gmail.com** **https://kilbaha.com.au**

FURTHER MATHEMATICS

Written examinations 1 and 2

FORMULA SHEET

Directions to students

Detach this formula sheet during reading time. This formula sheet is provided for your reference.

Further Mathematics Formulas

Core: 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:	$y = a + bx$ 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$= \frac{\text{actual figure}}{\text{deseasonalised figure}}$

Core: Recursion and financial modelling

first-order linear recurrence relation	$u_0 = a, \quad u_{n+1} = bu_n + c$
effective rate of interest for a compound interest loan or investment	$r_{effective} = \left[\left(1 + \frac{r}{100n}\right)^n - 1\right] \times 100\%$

Module 1: 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, $\quad S_{n+1} = TS_n + B$

Module 2: Networks and decision mathematics

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

Module 3: Geometry and measurement

area of a triangle:	$A = \frac{1}{2}bc\sin(\theta^0)$
Heron's formula:	$A = \sqrt{s(s-a)(s-b)(s-c)}$ where $s = \frac{1}{2}(a+b+c)$
sine rule:	$\frac{a}{\sin(A)} = \frac{b}{\sin(B)} = \frac{c}{\sin(C)}$
cosine rule:	$a^2 = b^2 + c^2 - 2bc\cos(A)$
circumference of a circle:	$2\pi r$
length of an arc:	$r \times \frac{\pi}{180} \times \theta^0$
area of a circle:	πr^2
area of sector	$\pi r^2 \times \frac{\theta^0}{360}$
volume of a sphere:	$\frac{4}{3}\pi r^3$
surface area of a sphere:	$4\pi r^2$
volume of a cone:	$\frac{1}{3}\pi r^2 h$
volume of a prism:	area of base × height
volume of a pyramid:	$\frac{1}{3}$ × area of base × height

Module 4: Graphs and relations

gradient (slope) of a straight line:	$m = \frac{y_2 - y_1}{x_2 - x_1}$
equation of a straight line:	$y = mx + c$

END OF FORMULA SHEET

VCE FURTHER MATHEMATICS 2022
Trial Written Examination 1
ANSWER SHEET

NAME: _____

STUDENT NUMBER _____

SIGNATURE _____

Instructions

- Write your name in the space provided above.
- Write your student number in the space provided above. Sign your name.
- Use a **PENCIL** for **ALL** entries.
  If you make a mistake, **ERASE** it - **DO NOT** cross it out.
- Marks will **NOT** be deducted for incorrect answers.
- **NO MARK** will be given if more than **ONE** answer is completed for any question.
- All answers must be completed like **THIS** example.

A	B	C	D	E

VCE FURTHER MATHEMATICS 2022
Trial Written Examination 1
ANSWER SHEET

NAME: _____

STUDENT NUMBER _____

SIGNATURE _____

Instructions

- Write your name in the space provided above.
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- **NO MARK** will be given if more than **ONE** answer is completed for any question.
- All answers must be completed like **THIS** example.

A	B	C	D	E

Section A

1	A	B	C	D	E
2	A	B	C	D	E
3	A	B	C	D	E
4	A	B	C	D	E
5	A	B	C	D	E
6	A	B	C	D	E
7	A	B	C	D	E
8	A	B	C	D	E
9	A	B	C	D	E
10	A	B	C	D	E
11	A	B	C	D	E
12	A	B	C	D	E

13	A	B	C	D	E
14	A	B	C	D	E
15	A	B	C	D	E
16	A	B	C	D	E
17	A	B	C	D	E
18	A	B	C	D	E
19	A	B	C	D	E
20	A	B	C	D	E
21	A	B	C	D	E
22	A	B	C	D	E
23	A	B	C	D	E
24	A	B	C	D	E

Please turn over . . .

VCE FURTHER MATHEMATICS 2022
Trial Written Examination 1
ANSWER SHEET

Section B

(Shade the box of the one module selected **and** write the name of the module you have selected. There are a total of four from which to choose)

	Matrices	**Module 1**	**1**	A	B	C	D	E
		_____	**2**	A	B	C	D	E
			3	A	B	C	D	E
		_____	**4**	A	B	C	D	E
			5	A	B	C	D	E
		_____	**6**	A	B	C	D	E
			7	A	B	C	D	E
			8	A	B	C	D	E
	Networks and decision mathematics	**Module 2**	**1**	A	B	C	D	E
		_____	**2**	A	B	C	D	E
			3	A	B	C	D	E
		_____	**4**	A	B	C	D	E
			5	A	B	C	D	E
		_____	**6**	A	B	C	D	E
			7	A	B	C	D	E
			8	A	B	C	D	E
	Geometry and measurement	**Module 3**	**1**	A	B	C	D	E
		_____	**2**	A	B	C	D	E
			3	A	B	C	D	E
		_____	**4**	A	B	C	D	E
			5	A	B	C	D	E
		_____	**6**	A	B	C	D	E
			7	A	B	C	D	E
			8	A	B	C	D	E
	Graphs and relations	**Module 4**	**1**	A	B	C	D	E
		_____	**2**	A	B	C	D	E
			3	A	B	C	D	E
		_____	**4**	A	B	C	D	E
			5	A	B	C	D	E
		_____	**6**	A	B	C	D	E
			7	A	B	C	D	E
			8	A	B	C	D	E

Please DO NOT fold, bend or staple this form