

The Mathematical Association of Victoria

Trial Examination 2017

FURTHER MATHEMATICS

Written Examination 1

STUDENT NAME: _____

Reading time: 15 minutes
Writing time: 1 hour 30 minutes

MULTIPLE-CHOICE QUESTION BOOK

Structure of Book

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of Modules</i>	<i>Number of modules to be answered</i>	<i>Number of marks</i>
A – Core	24	24			24
B - Modules	32	16	4	2	16
					Total 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.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

Materials supplied

- Question and answer book of 34 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 on this page.
- Write your **name** 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

- Place the answer sheet for multiple-choice questions inside the front cover of this book.

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

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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**Question 1**

The road accident fatality rates for Victoria (in fatalities per 100 000 population) each year for 25 years are given in the stemplot below.

Key : 4|2 = 4.2 fatalities per 100 000 population

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

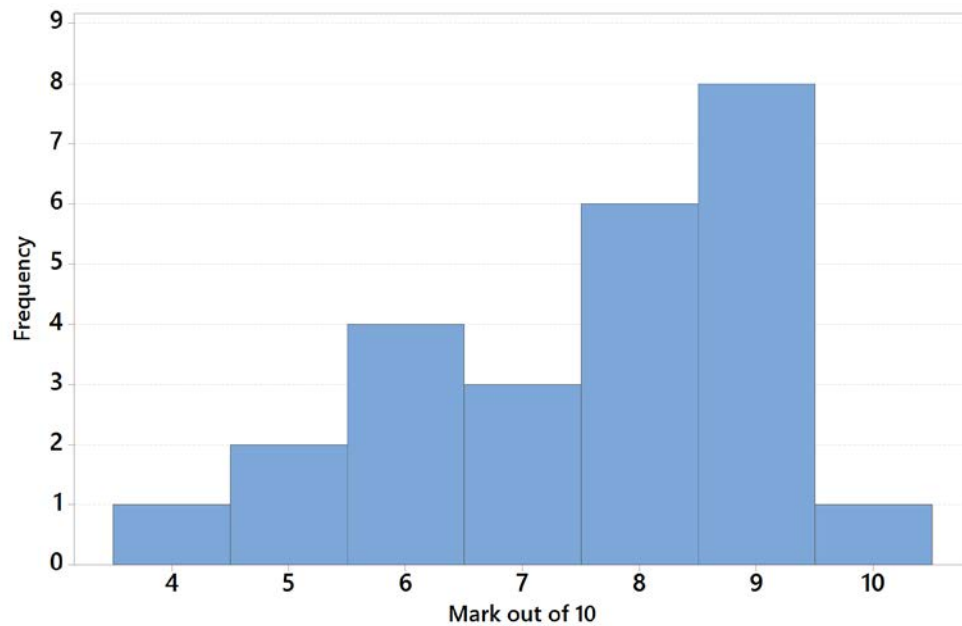
What percentage of years had a fatality rate of 8.3 or greater fatalities per 100 000 population?

- A. 44%
- B. 40%
- C. 38%
- D. 36%
- E. 32%

SECTION A - continued
TURN OVER

Question 2

Mrs Jones' maths class completed a multiple choice test with ten questions. The students' marks are displayed in the histogram below:



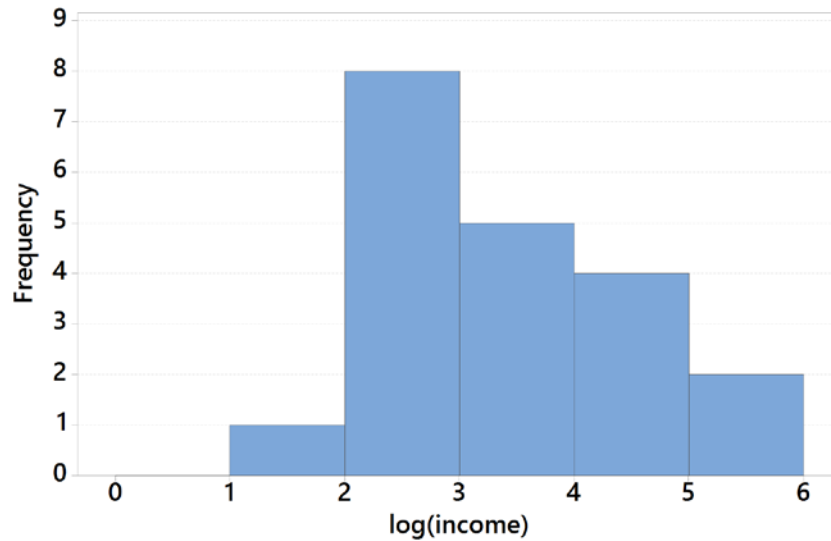
The mean, median and modal marks respectively are:

- A. 7.56, 8 and 9
- B. 7, 8 and 9
- C. 7.56, 7 and 9
- D. 8, 7 and 9
- E. 8.32, 7 and 8

SECTION A - continued

Question 3

A histogram showing the logarithm of the annual sales incomes of a number of eBay traders is shown below:



The percentage of these eBay traders making more than \$10 000 in sales is:

- A. 95%
- B. 70%
- C. 55%
- D. 30%
- E. 10%

Question 4

An appropriate statistical display to show the relationship between the size of a person's house (1= small, 2 = medium, 3 = large) and their income in dollars is:

- A. A two way percentaged frequency table
- B. A scatterplot
- C. A back to back stem and leaf plot
- D. A set of parallel box plots
- E. A histogram

Question 5

A group of people have a mean weight of 75 kg and a standard deviation of 7 kg. As they are about to go on a boat ride through rough water, they are all required to put on a life vest that weighs 2 kg. The effective weight of each person is now their weight plus the weight of the life vest.

The effective weights of this group of people have

- A. a mean of 75 kg with a standard deviation of 7 kg
- B. a mean of 75 kg with a standard deviation of 9 kg
- C. a mean of 77 kg with a standard deviation of 7 kg
- D. a mean of 77 kg with a standard deviation of 9 kg
- E. a mean of 77 kg with a standard deviation of 14 kg

SECTION A - continued
TURN OVER

Question 6

Kate has scored the following marks in her last five tests: 79 84 75 81 76

What is the lowest mark Kate needs to score in her sixth test to have a **mean** value of 80 for the six tests?

- A. 79
- B. 81
- C. 83
- D. 85
- E. 87

The following information applies to questions 7 and 8:

At an athletics club the distribution of times taken to run the 100 metres is normally distributed. The average time for these athletes is 12.0 seconds with a standard deviation of 0.6 seconds.

Question 7

The percentage of athletes who run the 100 metres in times between 10.8 seconds and 11.4 seconds is:

- A. 0.15%
- B. 2.5%
- C. 16%
- D. 13.5%
- E. 2.35%

Question 8

Liam's z-score for the 100 metre event is 1.2, while Con's z-score for the same event is -0.3 .

Which of the following statements is true?

- A. Con will beat Liam by 1.5 seconds
- B. Liam will beat Con by 1.5 seconds
- C. Con will beat Liam by 0.9 seconds
- D. Con will beat Liam by 1.2 seconds
- E. Liam will beat Con by 1.2 seconds

Question 9

Which of the following statements regarding the relationship between summary statistics for a sample drawn from a population and the population parameters is true?

- A. A biased sample will never have the same summary statistics as the population parameters
- B. An unbiased sample is most likely to have similar summary statistics to the population parameters
- C. An unbiased sample will always have similar summary statistics to the population parameters
- D. An unbiased sample will never have similar summary statistics to the population parameters
- E. Any sample will always have similar summary statistics to the population parameters

SECTION A - continued

Question 10

The percentage two-way frequency table shows the percentages of people who voted Republican, Democrat or Independent in the recent US elections who trust either Donald Trump or the News Media to tell the truth. In each group there is also a percentage who don't know.

Who tells the truth?	Republican	Democrat	Independent
Trusts Trump	78%	7%	37%
Trusts News Media	13%	86%	53%
Don't know who to trust	9%	7%	10%

Source: Statista

Which statement supports the contention that who a person trusts is associated with their voting preferences?

- A. Similar percentages of people who voted Republican, Democrat and Independent don't know who to trust
- B. More than half of the people who voted Independent trust the News Media
- C. 78% of people who voted Republican trust Trump and 86% of people who voted Democrat trust the News Media
- D. Only 7% of people who voted Democrat trust Trump
- E. A greater percentage of people who voted Democrat trust the News Media at 86% than those who voted either Republican or Independent at 13% and 53% respectively.

Question 11

A study compared the child mortality rates against life expectancy in years for a large number of countries in 2015. A least squares line was fitted to the data.

The equation of this least squares line is $Child\ mortality = 335 - 4.27 \times life\ expectancy$.

The coefficient of determination is $r^2 = 91.9\%$

The value of Pearson's product moment correlation coefficient, r , for this data, correct to three decimal places is

- A. -0.959
- B. -0.919
- C. 0.845
- D. 0.919
- E. 0.959

SECTION A - continued
TURN OVER

Question 12

The rainfall in mm in a particular Australian city during the first week of April was recorded. The results are seen in the table below:

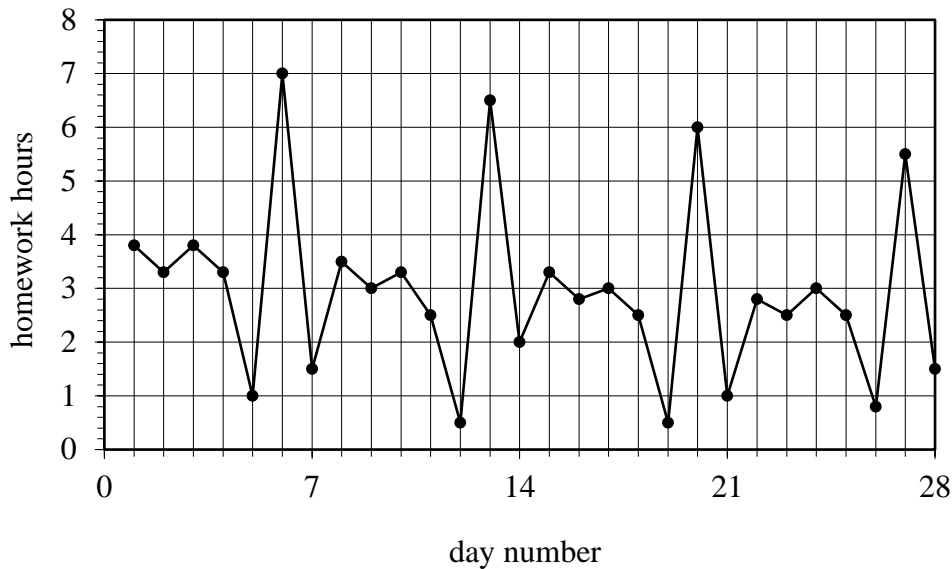
Day	1	2	3	4	5	6	7
Rainfall	15	12	3	8	23	4	16

The data is smoothed using a four point moving mean with centring. The smoothed value at day 4 would be:

- A. 5.25
- B. 9.5
- C. 10.5
- D. 11.5
- E. 21

Question 13

Consider the time series plot below, showing the number of hours of homework by a Year 12 student over four weeks.



The pattern in the times series plot above is best described as having

- A. irregular fluctuations only
- B. a decreasing trend with irregular fluctuations
- C. seasonality with irregular fluctuations
- D. seasonality with an increasing trend
- E. seasonality with a decreasing trend

SECTION A - continued

Use the following information to answer Questions 14 to 16.

The table below shows a number of the quarterly seasonal indices for electricity costs for a Melbourne home.

Seasonal Index	Quarter			
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
	0.857	0.987	1.152	

Question 14

The seasonal index for Quarter 4 is closest to

- A. 0.868
- B. 0.998
- C. 1.000
- D. 1.004
- E. 1.015

Question 15

The seasonal index for Quarter 3 is 1.152.

This tells us that, on average, the quarterly electricity cost for Quarter 3 is

- A. 84.8% less than the quarterly average
- B. 15.2% less than the quarterly average
- C. the same as the quarterly average
- D. 15.2% more than the quarterly average
- E. 84.8% more than the quarterly average

Question 16

The deseasonalised electricity cost for each time period for this Melbourne home is given by:

$$\text{deseasonalised cost} = 180.50 + 15.10 \times t$$

where Quarter 1, 2015 is $t = 1$, Quarter 2, 2015 is $t = 2$, etc.

The actual cost of electricity for Quarter 1, 2017 is closest to

- A. \$271.15
- B. \$301.30
- C. \$316.40
- D. \$331.50
- E. \$369.19

SECTION A - continued
TURN OVER

Recursion and Financial Modelling**Question 17**

A \$32 000 car depreciates at 18% per annum on a reducing balance method. A recurrence relation that could represent the value of the car after n years is:

- A. $V_n = 32\,000$ $V_{n+1} = 0.82 \times V_n$
B. $V_0 = 32\,000$ $V_{n+1} = 0.82 \times V_n$
C. $V_0 = 32\,000$ $V_{n+1} = 1.18 \times V_n$
D. $V_0 = 32\,000$ $V_{n+1} = V_n - 5760$
E. $V_n = 32\,000$ $V_n = 0.82 \times V_{n+1}$

Question 18

A \$3500 photocopier depreciates by \$7.75 for every 500 copies that it completes. The number of copies that would be completed when the book value is reduced to \$1795 would be:

- A. 341 613
B. 220 000
C. 225 806
D. 115 806
E. 110 000

SECTION A - continued

Use the following information to answer Questions 19 and 20:

The amortisation table for a reducing balance loan that is based on monthly compounds and payments is shown below. The loan will be paid off over a five month period, with four equal monthly payments and a smaller fifth payment which will reduce the balance to zero.

Month	Payment	Interest Paid	Principal Reduction	Loan Balance
0	-	-	-	\$8000.00
1	\$1850.00	\$52.00	\$1798.00	\$6202.00
2	\$1850.00	\$40.31	\$1809.69	\$4392.31
3	\$1850.00	\$28.55	\$1821.45	\$2570.86
4	\$1850.00	\$16.71	\$1833.29	\$ 737.57
5				\$ 0.00

Question 19

The interest rate per annum for this loan is:

- A. 0.65%
- B. 6.5%
- C. 7.8%
- D. 11.2%
- E. 13.0%

Question 20

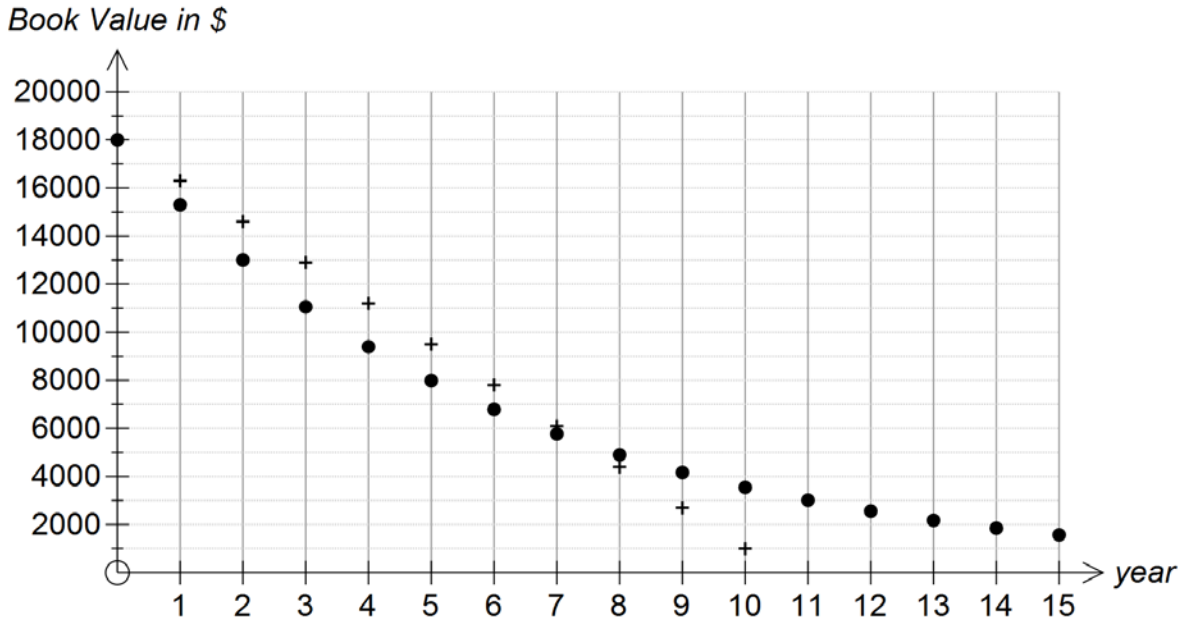
The three missing entries for the fifth month would be:

- A. \$742.36, \$4.79 and \$737.57 respectively
- B. \$737.57, \$4.79 and \$737.57 respectively
- C. \$742.36, \$4.79 and \$742.36 respectively
- D. \$737.57, \$0.00 and \$737.57 respectively
- E. \$732.78, \$4.79 and \$737.57 respectively

SECTION A – continued
TURN OVER

Question 21

The book value of an \$18 000 trailer using two different depreciation schedules, one using reducing balance depreciation and one using flat rate depreciation, is shown below:



Which of the following statements is NOT true about the depreciation of this trailer?

- A. The book value using flat rate depreciation is first lower than the book value using reducing balance depreciation at the end of eight years
- B. The book value using flat rate depreciation is \$9500 after 5 years
- C. The rate of reducing balance depreciation is lower than the rate of flat rate depreciation
- D. The trailer has depreciated by about \$10 000 after 5 years using the reducing balance method
- E. The book value of the trailer using reducing balance depreciation will take longer to fall below \$3000 than if flat rate depreciation was used.

Question 22

Ed recently inherited \$125 000 from his favourite Aunt. He invests the money in a perpetuity. Which of the following recurrence relations could represent the balance of his perpetuity, B_n , after n years?

- A. $B_0 = 125\ 000$ $B_{n+1} = B_n - 8125$
- B. $B_0 = 125\ 000$ $B_{n+1} = 1.0625 \times B_n - 8125$
- C. $B_0 = 125\ 000$ $B_{n+1} = 1.054 \times B_n - 7150$
- D. $B_0 = 125\ 000$ $B_{n+1} = 1.057 \times B_n - 7125$
- E. $B_0 = 125\ 000$ $B_{n+1} = 1.07 \times B_n - 8500$

SECTION A – continued

Question 23

Anwar has taken out a \$17 000 reducing balance loan at 4.7% per annum compounding monthly that is to be paid off over 24 months with equal monthly payments. After 18 months the interest rate increases to 5.4% and he must make slightly higher monthly payments to ensure that the loan is completed over the original 24 months. The **total extra amount** that Anwar needs to pay over the course of the last six months of this loan is closest to:

- A. \$1.50
- B. \$4.50
- C. \$8.60
- D. \$9.10
- E. \$10.40

Question 24

Jo is saving for her retirement. Her financial advisor suggests an annuity investment at 4.5% per annum, compounding monthly, that will pay her \$4200 every month for 20 years. She is worried that her investment would only last 20 years and decides that she would like a perpetuity, at the same per annum rate, that pays the same amount per month. The additional amount of money she would need to save, correct to three significant figures, would be:

- A. \$456 000
- B. \$664 000
- C. \$1 120 000
- D. \$460 000
- E. \$663 000

END OF SECTION A

TURN OVER

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SECTION B – Modules**Instructions for Section B**

Select **two** modules and answer **all** questions within the selected modules 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.

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Contents	Page
Module 1 – Matrices	15
Module 2 – Networks and decision mathematics.....	20
Module 3 – Geometry and measurement.....	25
Module 4 – Graphs and relations.....	29

SECTION B – continued

TURN OVER

Module 1 - Matrices**Question 1**

The transpose of $\begin{bmatrix} 1 & 0 & 0 \\ 2 & 6 & 0 \\ 5 & 3 & 4 \end{bmatrix}$ is

A. $\begin{bmatrix} 1 & 0 & 0 \\ 5 & 3 & 4 \\ 2 & 6 & 0 \end{bmatrix}$

B. $\begin{bmatrix} 1 & 2 & 5 \\ 3 & 6 & 0 \\ 4 & 0 & 0 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 2 & 5 \\ 0 & 6 & 3 \\ 4 & 0 & 0 \end{bmatrix}$

D. $\begin{bmatrix} 1 & 2 & 5 \\ 0 & 6 & 3 \\ 0 & 0 & 4 \end{bmatrix}$

E. $\begin{bmatrix} 1 & 2 & 5 \\ 3 & 6 & 0 \\ 0 & 0 & 4 \end{bmatrix}$

Question 2

The matrix equation below represents a pair of simultaneous linear equations.

$$\begin{bmatrix} a & b \\ 3 & d \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 11 \\ 8 \end{bmatrix}$$

These simultaneous linear equations have a unique solution when

A. $a = 6$ $b = 8$ $d = 4$

B. $a = 2$ $b = 4$ $d = 6$

C. $a = 9$ $b = 12$ $d = 4$

D. $a = 2$ $b = 6$ $d = 9$

E. $a = 4$ $b = 3$ $d = 2$

SECTION B -Module 1 continued

Question 3

M is a 4×2 matrix.

The element in row i and column j of M is given by $m_{ij} = i - j + 2$.

M is equal to

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

B. $\begin{bmatrix} 2 & 1 \\ 3 & 2 \\ 4 & 3 \\ 5 & 4 \end{bmatrix}$

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

D. $\begin{bmatrix} 2 & 3 \\ 3 & 4 \\ 4 & 5 \\ 5 & 6 \end{bmatrix}$

E. $\begin{bmatrix} 1 & 2 \\ 2 & 3 \\ 3 & 4 \\ 4 & 5 \end{bmatrix}$

Question 4

If matrix $K = \begin{bmatrix} O \\ P \\ T \\ S \end{bmatrix}$ and matrix $P = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$,

then the word formed by the matrix product $P^2 \times K$ is

A. $\begin{bmatrix} O \\ P \\ T \\ S \end{bmatrix}$

B. $\begin{bmatrix} S \\ P \\ O \\ T \end{bmatrix}$

C. $\begin{bmatrix} P \\ O \\ T \\ S \end{bmatrix}$

D. $\begin{bmatrix} S \\ T \\ O \\ P \end{bmatrix}$

E. $\begin{bmatrix} T \\ O \\ P \\ S \end{bmatrix}$

SECTION B - Module 1 continued
TURN OVER

Question 5

Kerry sells T-shirts customised with the names of musical groups.

Last week, the T-shirt prices, in dollars, for the four groups Abyss (*A*), Bugs (*B*), Chorax (*C*) and Dedlok (*D*) can be represented in matrix *P* as shown below.

$$P = \begin{matrix} & A & B & C & D \\ \begin{bmatrix} 44 & 50 & 56 & 40 \end{bmatrix} & \end{matrix}$$

This week, Abyss and Chorax T-shirts are not selling, so Kerry will discount their T-shirts by 25% and 30% respectively. However, Bugs and Dedlok are in demand due to getting air-time on a local radio station, so Kerry will mark up their T-shirts by 25% and 30% respectively.

The matrix multiplication that correctly calculates the T-shirt prices this week is

A. $\begin{bmatrix} 44 & 50 & 56 & 40 \end{bmatrix} \times \begin{bmatrix} -0.25 & 0 & 0 & 0 \\ 0 & -0.30 & 0 & 0 \\ 0 & 0 & 0.25 & 0 \\ 0 & 0 & 0 & 0.30 \end{bmatrix}$

B. $\begin{bmatrix} 44 & 50 & 56 & 40 \end{bmatrix} \times \begin{bmatrix} 0.75 & 0 & 0 & 0 \\ 0 & 0.70 & 0 & 0 \\ 0 & 0 & 1.25 & 0 \\ 0 & 0 & 0 & 1.30 \end{bmatrix}$

C. $\begin{bmatrix} 44 & 50 & 56 & 40 \end{bmatrix} \times \begin{bmatrix} 0.75 & 0 & 0 & 0 \\ 0 & 1.25 & 0 & 0 \\ 0 & 0 & 0.70 & 0 \\ 0 & 0 & 0 & 1.30 \end{bmatrix}$

D. $\begin{bmatrix} 44 & 50 & 56 & 40 \end{bmatrix} \times \begin{bmatrix} 0.75 & 0 & 0 & 0 \\ 0 & 0.70 & 0 & 0 \\ 0 & 0 & 0.25 & 0 \\ 0 & 0 & 0 & 0.30 \end{bmatrix}$

E. $\begin{bmatrix} 44 & 50 & 56 & 40 \end{bmatrix} \times \begin{bmatrix} 0.25 & 0 & 0 & 0 \\ 0 & 0.30 & 0 & 0 \\ 0 & 0 & 0.25 & 0 \\ 0 & 0 & 0 & 0.30 \end{bmatrix}$

Question 6

The laundry-products manager in a local supermarket has noticed that the shoppers are not loyal towards buying dishwasher detergents.

The transition matrix that describes the sales for two different dishwasher detergents Rook (R) and DayFresh (D) is:

$$T = \begin{array}{cc} & \begin{array}{cc} D & R \end{array} \\ \begin{array}{c} D \\ R \end{array} & \begin{bmatrix} 0.75 & 0.30 \\ 0.25 & 0.70 \end{bmatrix} \end{array}$$

If the sales matrix for March was $S_3 = \begin{bmatrix} 258 \\ 242 \end{bmatrix} \begin{array}{c} D \\ R \end{array}$, the sales matrix for January, correct to the nearest whole number, was

A. $S_1 = \begin{bmatrix} 250 \\ 250 \end{bmatrix} \begin{array}{c} D \\ R \end{array}$

B. $S_1 = \begin{bmatrix} 266 \\ 234 \end{bmatrix} \begin{array}{c} D \\ R \end{array}$

C. $S_1 = \begin{bmatrix} 270 \\ 230 \end{bmatrix} \begin{array}{c} D \\ R \end{array}$

D. $S_1 = \begin{bmatrix} 240 \\ 260 \end{bmatrix} \begin{array}{c} D \\ R \end{array}$

E. $S_1 = \begin{bmatrix} 200 \\ 300 \end{bmatrix} \begin{array}{c} D \\ R \end{array}$

SECTION B - Module 1 continued
TURN OVER

Question 7

Boulevard Ice-Cream is facing fierce competition from other brands in the market-place.

The transition matrix that describes sales choices at the moment is:

$$T = \begin{array}{c} B \quad O \\ \left[\begin{array}{cc} 0.75 & 0.35 \\ 0.25 & 0.65 \end{array} \right] \begin{array}{l} B \\ O \end{array}, \text{ where } B \text{ represents Boulevard and } O \text{ represents the Other brands.} \end{array}$$

The sales matrix, representing the percentage share of the market, is $S_0 = \begin{bmatrix} 65 \\ 35 \end{bmatrix} \begin{array}{l} B \\ O \end{array}$.

Based on the information above, in the long term

- A. Boulevard's market share will increase by approximately 7%.
- B. Boulevard's market share will increase by approximately 3.5%.
- C. Boulevard's market share will be unchanged.
- D. Boulevard's market share will decrease by approximately 10%.
- E. Boulevard's market share will decrease by approximately 7%.

Question 8

The annual population movement into and around the four major regions (North (N), East (E),

South (S) and West (W)) of a large city can be described by the matrix recurrence relation $S_{n+1} = T \times S_n + B$ where

$$T = \begin{array}{c} \text{this year} \\ \begin{array}{cccc} N & E & S & W \end{array} \\ \left[\begin{array}{cccc} 0.92 & 0.01 & 0.01 & 0.01 \\ 0.02 & 0.95 & 0.01 & 0.02 \\ 0.04 & 0.02 & 0.97 & 0.03 \\ 0.02 & 0.02 & 0.01 & 0.94 \end{array} \right] \begin{array}{l} N \\ E \\ S \\ W \end{array} \text{ next year} \quad \text{and} \quad B = \begin{bmatrix} 750 \\ 875 \\ 1025 \\ 825 \end{bmatrix} \begin{array}{l} N \\ E \\ S \\ W \end{array}$$

In a particular year, the city's population by region can be represented by $S_0 = \begin{bmatrix} 35500 \\ 43500 \\ 51000 \\ 42000 \end{bmatrix} \begin{array}{l} N \\ E \\ S \\ W \end{array}$.

The population of the South region in two year's time will be closest to

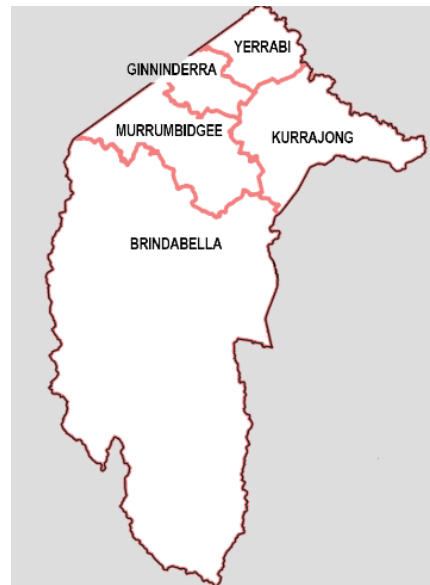
- A. 34 150
- B. 42 797
- C. 45 006
- D. 54 045
- E. 56 997

End of Module 1 - SECTION B - continued

Module 2: Networks and decision mathematics

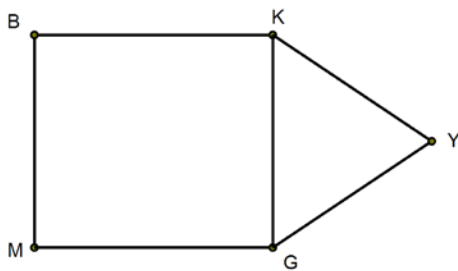
Question 1

A map of the five electoral regions of the Australian Capital Territory, (Brindabella (B), Murrumbidgee (M), Ginninderra (G), Yerrabi (Y) and Kurrajong (K)) is shown:

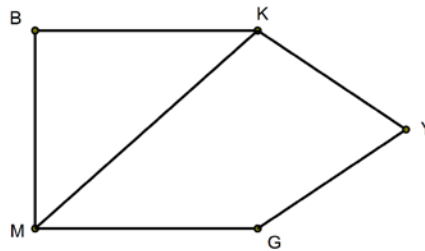


A network showing the relationship of “shares an electoral boundary with” could be:

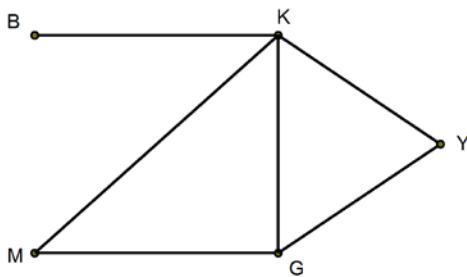
A.



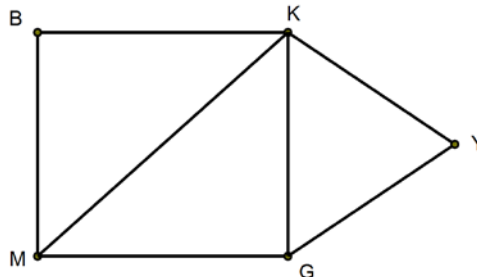
B.



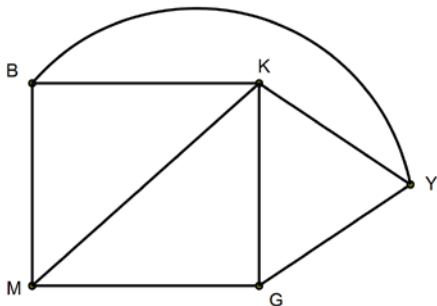
C.



D.



E.



**SECTION B -- Module 2 – continued
TURN OVER**

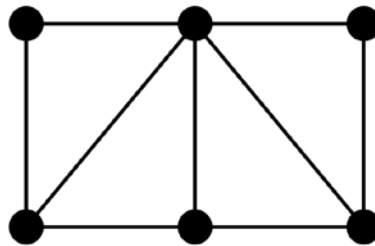
Question 2

For any planar graph with the same number of vertices and edges, the number of regions:

- A. Will be the same as the number of edges
- B. Will be two more than the number of vertices
- C. Will be different depending on the number of vertices and edges
- D. Will be two less than the number of vertices
- E. Will be exactly two

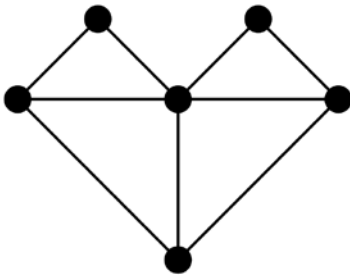
Question 3

An undirected network is shown below:

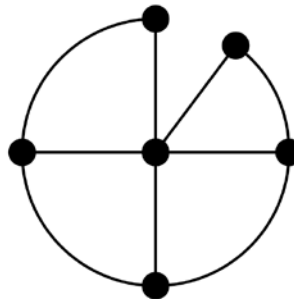


The network that could NOT represent the same network is:

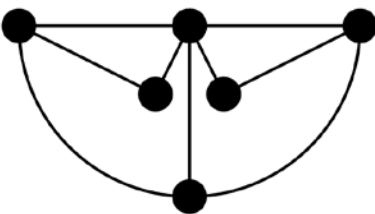
A.



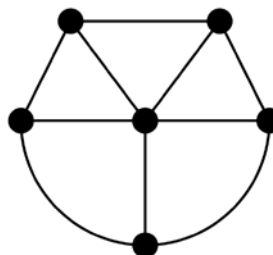
B.



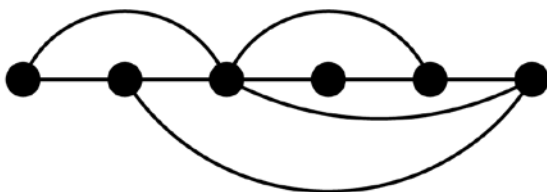
C.



D.

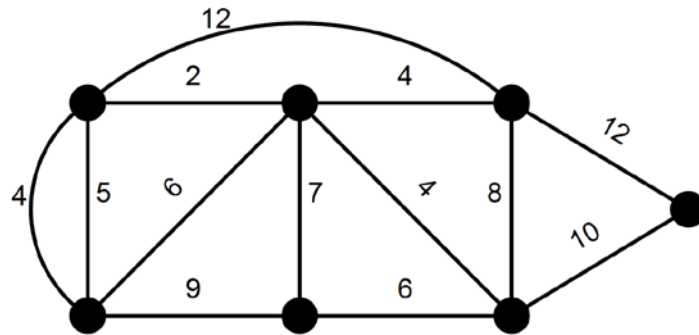


E.



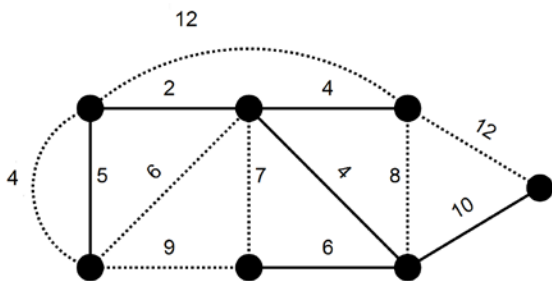
Question 4

A network is shown below:

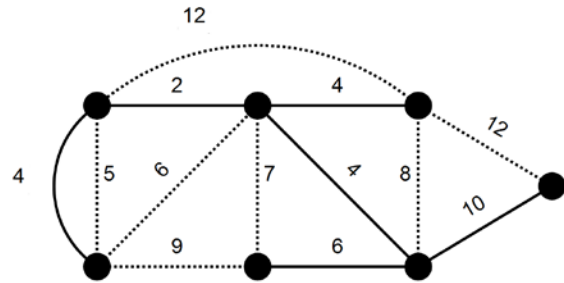


If the edges used in the minimum spanning tree are solid, the minimum spanning tree for this network is:

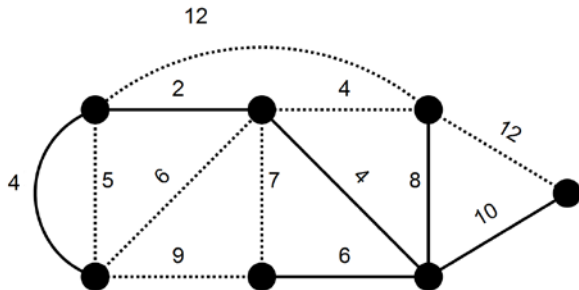
A.



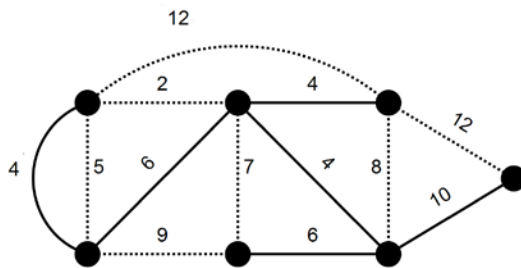
B.



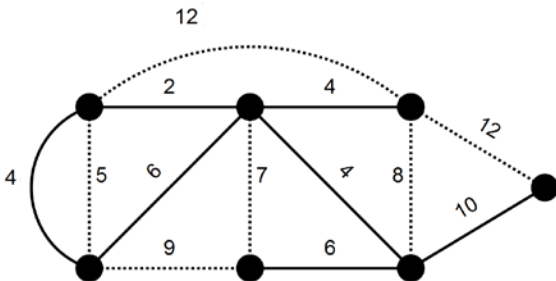
C.



D.

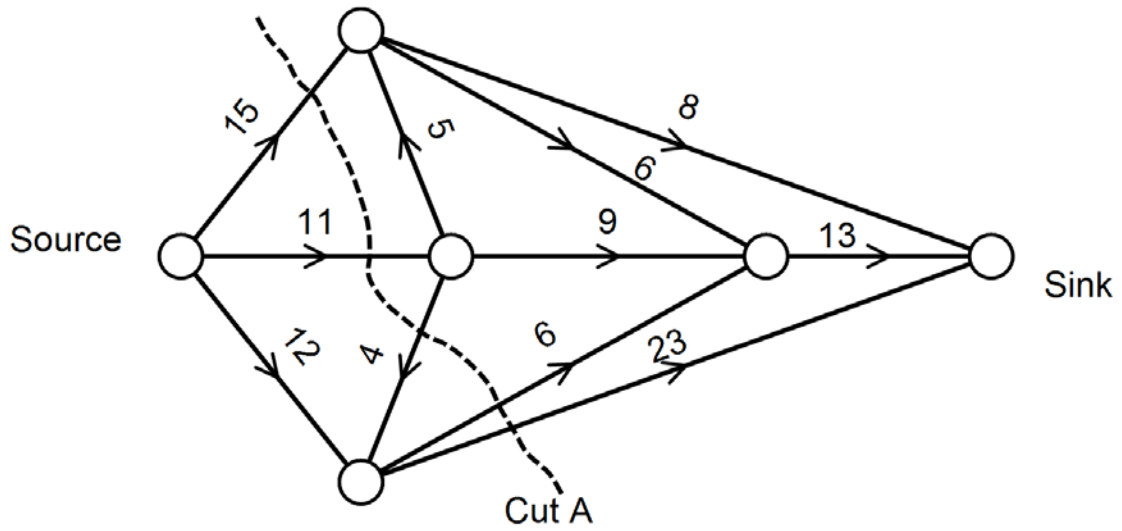


E.



**SECTION B - - Module 2 - continued
TURN OVER**

The flow network shown below is used in questions 5 and 6:



Question 5

The capacity of cut A shown on the network is:

- A. 64
- B. 59
- C. 55
- D. 53
- E. 38

Question 6

The maximum flow through this network from source to sink would be:

- A. 34
- B. 37
- C. 38
- D. 44
- E. 58

Question 7

A precedence table for an activity network is shown below. The duration of each activity in days is also shown:

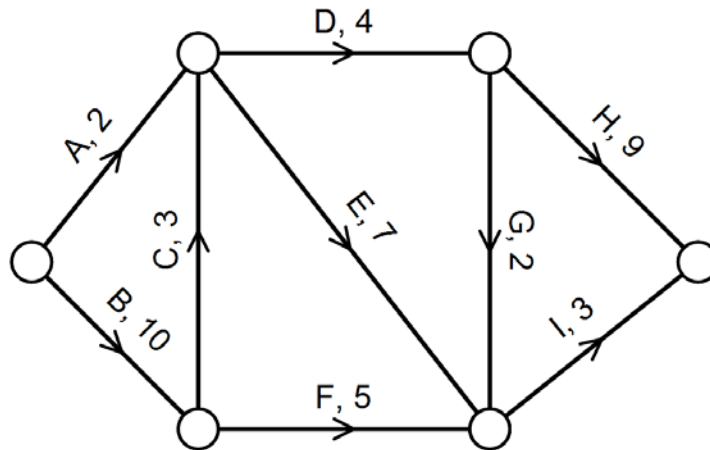
Activity	Duration of activity in days	Immediate predecessor(s)
A	1	-
B	3	A
C	2	B
D	3	A
E	4	D
F	5	D
G	2	F
H	4	C, E
I	3	G, H

The minimum number of days in which a project based on this activity network can be completed is:

- A. 15
- B. 14
- C. 13
- D. 12
- E. 16

Question 8

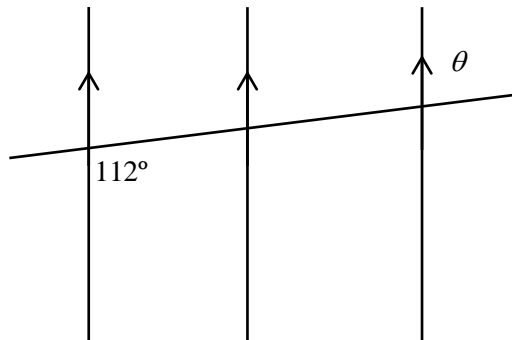
An activity network, with activity times in weeks, is shown below:



Each of the activities on the critical path of the network can be reduced by two weeks. The overall time saved would be:

- A. 3 weeks
- B. 4 weeks
- C. 6 weeks
- D. 7 weeks
- E. 8 weeks

**End of Module 2 - SECTION B - continued
TURN OVER**

Module 3: Geometry and Measurement**Question 1**

The value of θ is :

- A. 32°
- B. 56°
- C. 68°
- D. 88°
- E. 112°

Question 2

All parts of the nation of India are in the same time zone (by Government decree).

Ahmedabad (23° N, 72° E) and Kolkata (23° N, 88° E) are two significant cities in India.

On one day in January, the sun set at 6.20 pm in Ahmedabad.

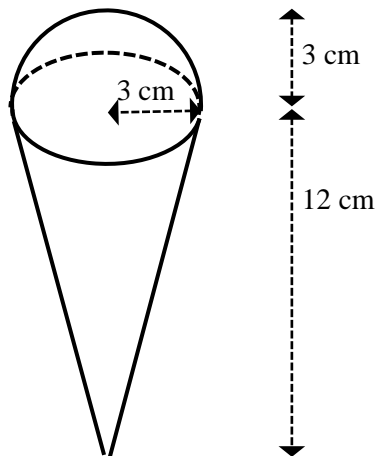
Assuming that 15° of longitude equates to one-hour time difference, the time that the sun was expected to set in Kolkata is

- A. 5.16 pm
- B. 6.04 pm
- C. 6.20 pm
- D. 6.36 pm
- E. 7.24 pm

SECTION B – Module 3 - continued

Question 3

The Great Berry Fruit Delight Cone contains a hemispherical serve of raspberry-flavoured ice-cream on top of a cone filled with strawberry-flavoured ice-cream, as shown in the diagram below.



The total volume of ice-cream that this confection can hold, in cubic centimetres, is closest to

- A. 35
- B. 170
- C. 226
- D. 396
- E. 452

Question 4

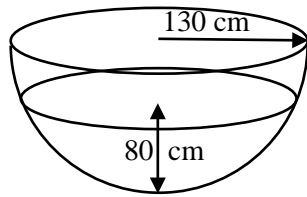
Amy stands 5.1 m on level ground from a streetlight pole one night and casts a shadow 2.4 m long. If Amy is 1.6 m tall, the height of the streetlight above the ground, in metres correct to one decimal place, will be

- A. 6.8
- B. 4.5
- C. 3.4
- D. 5.0
- E. 7.5

SECTION B - Module 3 - continued
TURN OVER

Question 5

Water is poured into a hemispherical bowl with a radius of 130 cm. The depth of water is 80 cm.

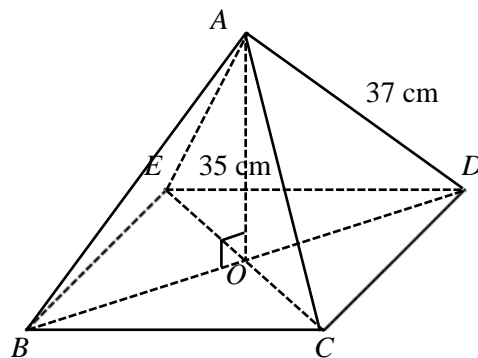


The diameter of the circular water surface would be:

- A. 120 cm
- B. 102.5 cm
- C. 160 cm
- D. 205 cm
- E. 240 cm

Question 6

The diagram below shows a square-based pyramid $ABCDE$. In this pyramid, $AB = AC = AD = AE = 37$ cm and $AO = 35$ cm



The length of one side of the square base, say BC , in centimetres correct to one decimal place is closest to

- A. 7.9
- B. 12.0
- C. 17.0
- D. 24.0
- E. 50.9

SECTION B - Module 3 continued

Question 7

A river runs in a straight line from South to North. From one side of the river at a point marked A, Kelly measures the bearing of a tree on the other side as being 125° .

From point B which is due south of point A, the bearing of the same tree is 045° .

If her calculations give the width of the river as being 25.0 m from the line AB to the tree, how far apart are points A and B, in metres, correct to one decimal place?

- A. 28.5
- B. 32.0
- C. 42.5
- D. 65.8
- E. 78.9

Question 8

The Japanese flag consists of a red circle in the centre of a white rectangle. The length of the flag is 1.5 times its height. The diameter of the red circle is three-fifths of the height of the flag.

Miss Hotham has prepared sheets of paper in two different sizes, in the correct proportions for the flag.

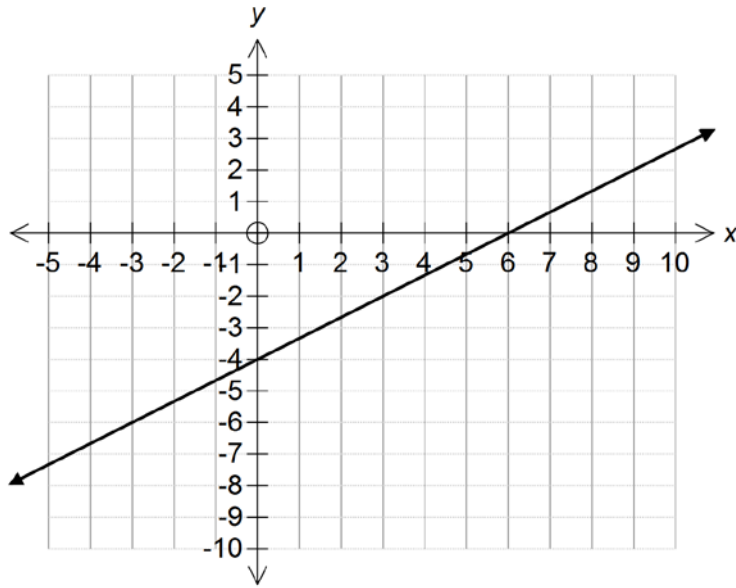
Amy has a piece which is 297 mm long by 198 mm high.

Jeremy has a piece which is 420 mm long by 280 mm high.

If both students correctly construct the circle for the centre of their flag, the ratio of the area of Jeremy's circle to the area of Amy's circle will be closest to

- A. 0.50
- B. 0.71
- C. 1.00
- D. 1.41
- E. 2.00

End of Module 3 - SECTION B - continued
TURN OVER

Module 4: Graphs and Relations**Question 1**

The equation of the line shown on the graph above is:

- A. $2x + 3y = 12$
- B. $2x - 3y = 12$
- C. $3x - 2y = 12$
- D. $3x + 2y = 12$
- E. $2x - 3y = -12$

Question 2

An oven's temperature when turned off is the same as the room temperature of 25° . When it is turned on it increases in temperature by 30° for every minute, before its temperature remains stable, due to the thermostat after 15 minutes.

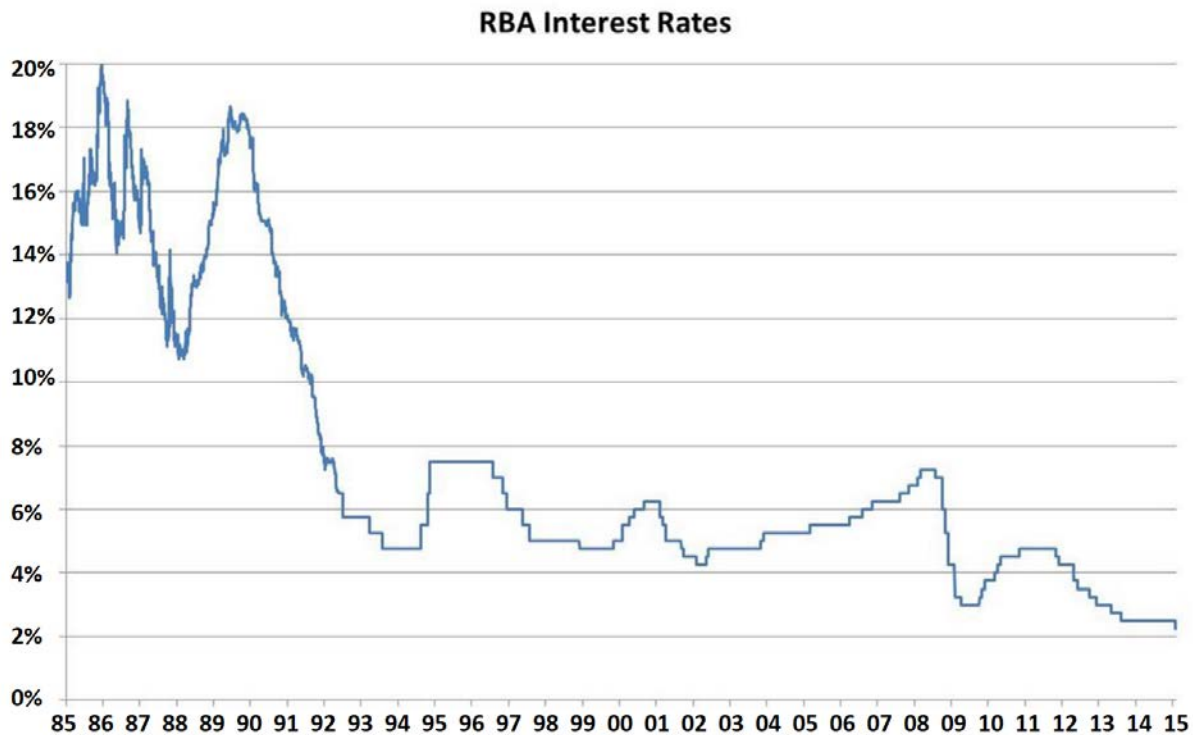
The relationship that would model the temperature T after t minutes would be:

- A. $T = 30t + 25, \quad t \leq 15$
- B. $T = 25t + 30, \quad 0 \leq t \leq 15$
- C. $T = 30t + 25, \quad 0 \leq t \leq 15$
- D. $T = 30t - 25, \quad 0 \leq t \leq 15$
- E. $T = 15t + 25, \quad 0 \leq t \leq 15$

SECTION B – Module 4 – continued

Use the following information to answer Questions 3 and 4:

The graph of the Reserve Bank of Australia's interest rates, recorded on the 1st of January each year from 1985 to 2015, is shown below:



Source: Reserve Bank of Australia

Question 3

Between 1985 and 2015 interest rates in Australia have been below 4% for:

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

Question 4

The average annual rate of change in interest rates over the period 1st January, 1985 to 1st January, 2015 is closest to:

- A. An annual increase of 0.35%
- B. An annual decrease of 0.35%
- C. An annual decrease of 1.15%
- D. An annual decrease of 11%
- E. An annual decrease of 0.7%

SECTION B – Module 4 – continued
TURN OVER

Question 5

Which of the following coordinate points satisfies the inequality $3x - 4y \leq -7$?

- A. $(-1, -4)$
- B. $(7, -2)$
- C. $(3, 1)$
- D. $(2, 6)$
- E. $(-1, 1)$

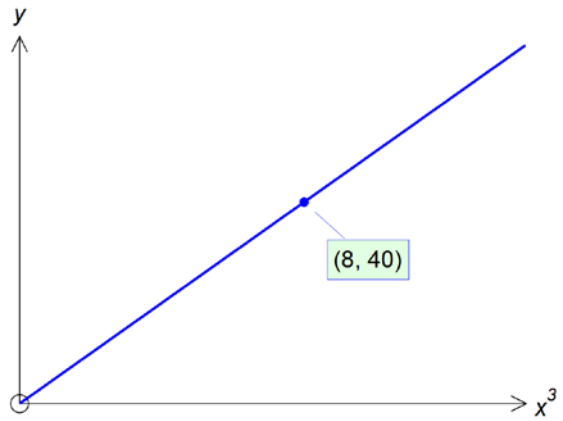
Question 6

A café employs two baristas, Xavier and Younnis. Between them Xavier and Younnis work no more than 50 hours per week, with Xavier working a minimum of 15 hours and Younnis working a minimum of 10 hours. Xavier must work at least twice as many hours as Younnis. If x is the number of hours worked by Xavier and y is the number of hours worked by Younnis, a set of constraint inequations for this situation would be:

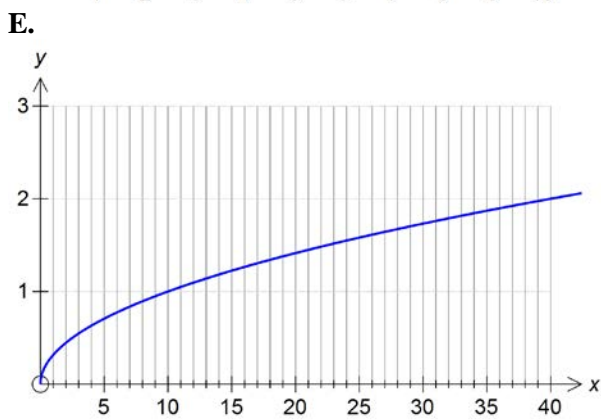
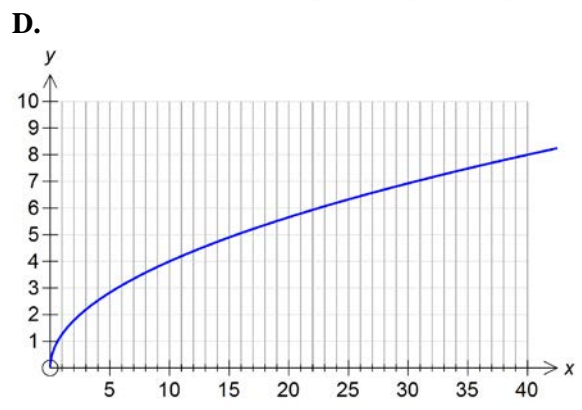
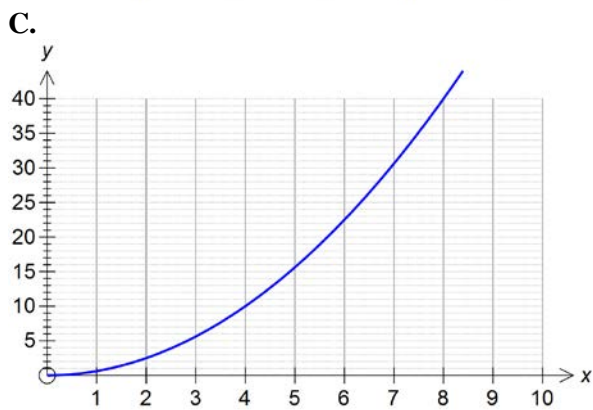
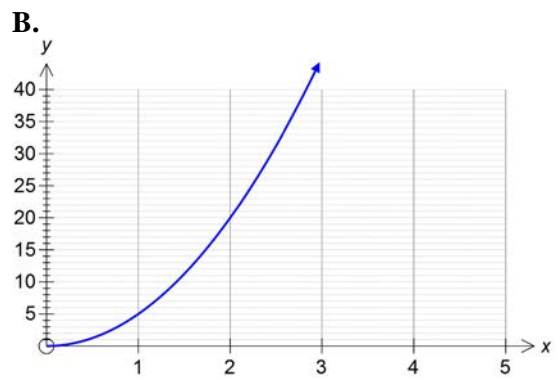
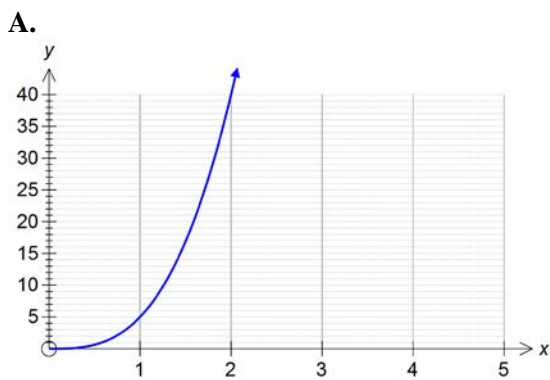
- A. $x \geq 15, y \geq 10, x + y \leq 50, y \leq 2x$
- B. $x \geq 15, y \geq 10, x + y \geq 50, y \leq \frac{x}{2}$
- C. $x \geq 15, y \geq 10, x + y \leq 50, y \leq \frac{x}{2}$
- D. $x \geq 15, y \geq 10, x + y \geq 50, y \geq 2x$
- E. $x \geq 15, y \geq 10, x + y \leq 50, y \geq 2x$

Question 7

The point $(8, 40)$ lies on the line shown:



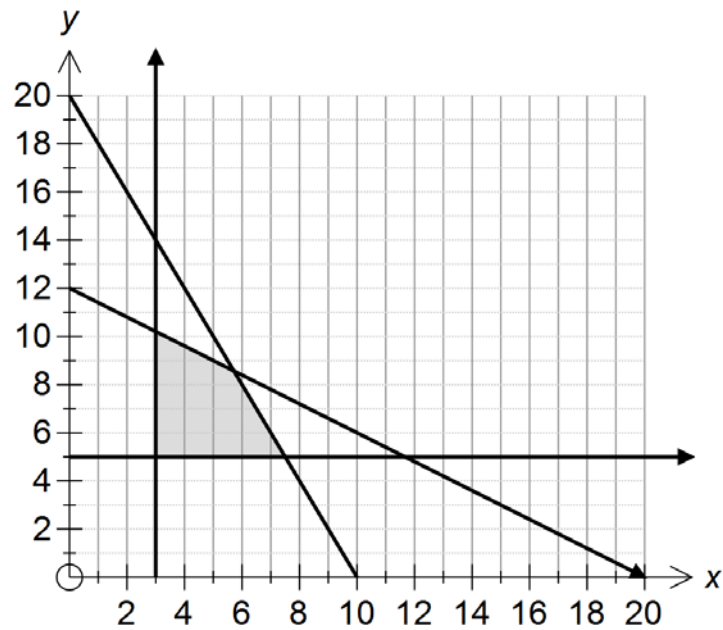
A graph that shows the same relationship is:



**SECTION B – Module 4 – continued
TURN OVER**

Question 8

A shaded feasible region is shown below:



The set of inequations that would produce this region could be:

- A. $x \leq 3, y \leq 5, 2x + y \geq 20, 3x + 5y \geq 60$
- B. $x \geq 3, y \geq 5, 2x + y \geq 20, 3x + 5y \leq 60$
- C. $x \geq 3, y \geq 5, 2x + y \geq 20, 3x + 5y \geq 60$
- D. $x \geq 5, y \geq 3, x + 2y \leq 20, 5x + 3y \leq 60$
- E. $x \geq 3, y \geq 5, 2x + y \leq 20, 3x + 5y \leq 60$

END OF MULTIPLE - CHOICE QUESTION BOOKLET