Neap

Trial Examination 2020

VCE Further 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

Section	*Number of questions*	*Number of questions to be answered*	*Number of modules*	*Number of modules to be answered*	*Number of marks*
A – Core	30	30			30
B – Modules	40	10	4	1	10
					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. 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 35 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** on your 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 2020 VCE Further Mathematics Units 3&4 Written Examination 1.

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 booklet are **not** drawn to scale.

Data analysis

Question 1

Consider the following set of data.

2|1 = 21

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

The mode of this data set is

A. 5
B. 7
C. 15
D. 16
E. 31

Question 2

A data set has the five-number summary –2, 3, 25, 36, 63.

Which one of the following is **not** necessarily true of this data set?

A. The IQR is 33.
B. The range is 65.
C. The mode is 25.
D. Q_2 is 25.
E. Q_3 is 36.

Question 3

Consider the following set of data.

Age	*Frequency*
0–<10	3
10–<20	12
20–<30	10
30–<40	4

Which one of the following could be used to calculate the mean *age* of the data set?

A. $\frac{10 + 20 + 30 + 40}{4}$

B. $\frac{5 + 15 + 25 + 35}{4}$

C. $\frac{3 \times 5 + 12 \times 15 + 10 \times 25 + 4 \times 35}{4}$

D. $\frac{3 \times 5 + 12 \times 15 + 10 \times 25 + 4 \times 35}{29}$

E. $\frac{3 + 12 + 10 + 4}{4}$

Question 4

Consider the following set of data.

x	f
8	3
9	7
10	4
11	2

The five-number summary for this data set is

A. 2, 2.5, 3.5, 4.5, 7.

B. 8, 8.5, 9, 10, 11.

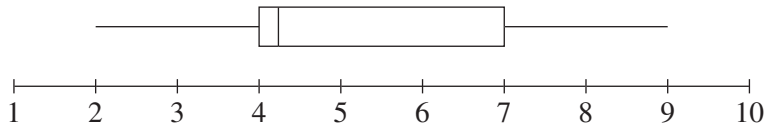
C. 8, 9, 9, 9, 11.

D. 8, 9, 9, 10, 11.

E. unable to be calculated.

Question 5

A box plot of a data set is shown below.



Which one of the following statements is **true**?

A. The IQR is 7.

B. The mean is 5.5.

C. The data has an outlier.

D. Twenty-five percent of the data is between 7 and 9.

E. The mode is 4.3.

Use the following information to answer Questions 6 and 7.

A survey asking how many times a month people visited a particular shopping centre was conducted. The information gathered was further divided according to the ages of the participants surveyed, and their answers were recorded in the back-to-back stem plot below.

2|1 = 21

Under 30										Stem	Over 30						
				5	4	2	2	1	1	0	2	2	3	3	3	5	7
9	9	8	8	6	3	3	2	0	0	1	0	2	2	4	7	8	
						5	2	2	0	2	0	3	5				

Question 6

Which one of the following is **not** correct?

A. There is no mode for the *under 30s*.

B. Thirty-six people were interviewed.

C. The IQR of both data sets is the same.

D. The difference between the medians is 2.

E. Both sets of data are symmetrical.

Question 7

The mean, median and mode of the *over 30s* data are closest to

A. 11, 10 and 3, respectively.

B. 11, 11 and 3, respectively.

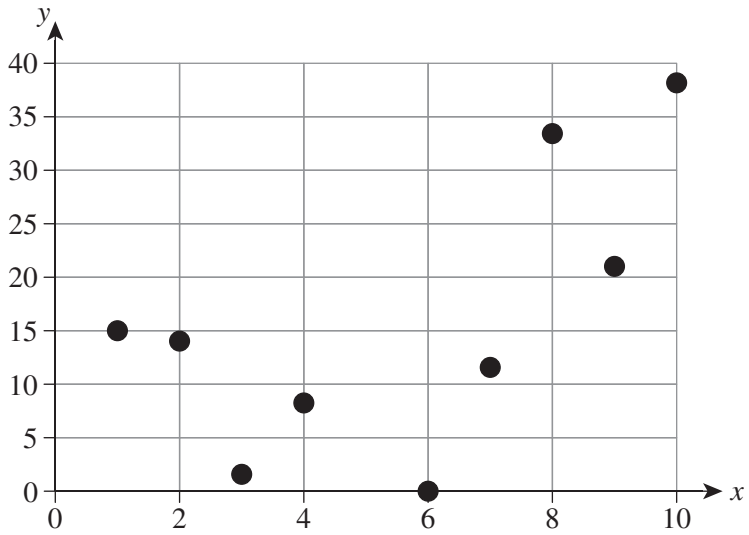
C. 10.4, 10 and 12, respectively.

D. 58.7, 11 and 3, respectively.

E. 3, 11 and 11, respectively.

Question 8

Consider the following scatterplot.



The value of r for this scatterplot is most likely to be

A. –1
B. –0.6
C. 0
D. 0.6
E. 1

Question 9

At a particular ice-cream store, the seasonal index for the sale of ice cream in the summer quarter is 1.81.

Which one of the following is completely **true**?

A. The summer quarter is the highest selling quarter for ice cream.
B. The mean of the seasonal indices for the other months is 0.7.
C. Eighty-one percent of all ice-cream sales occur during the summer.
D. Sixty-six percent of the cause of the extra sales is due to it being summer.
E. Each of the seasonal indices for the other three quarters is less than 2.2.

Question 10

The results of a school assessment task had a mean of 70% and a standard deviation of 22%. Jenni was told her z-score was –0.4.

Jenni's raw score was closest to

A. –8.8%
B. 8.8%
C. 36.8%
D. 61.2%
E. 78.8%

Question 11

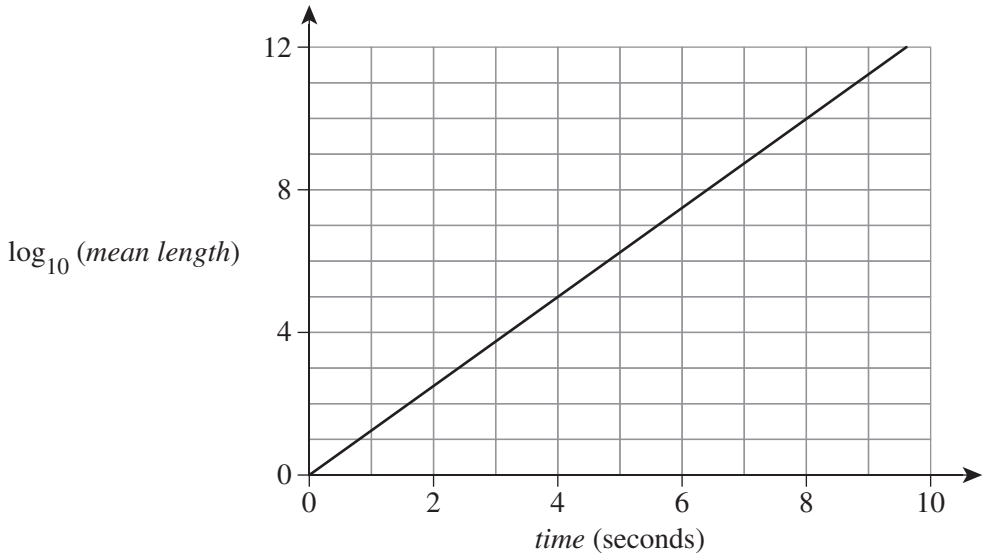
A store sells bolts that have a mean length of 8 cm. Ninety-five percent of the bolts sold are between 7.86 cm and 8.14 cm. The lengths of the bolts follows a normal distribution.

The standard deviation is

A. 0.07
B. 0.14
C. 0.28
D. 0.7
E. 1.4

Question 12

The length of a polymer is the number of carbon atoms in the chain. The *mean length* of a polymer chain increases dramatically over the first ten seconds of a certain chemical reaction, as shown in the graph below.

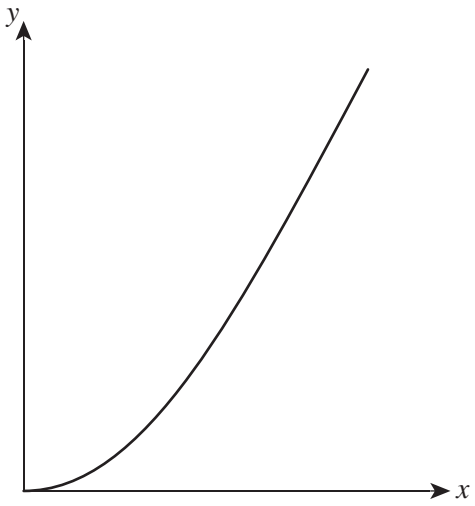


The *mean length* after four seconds is closest to

A. 5
B. 500
C. 5 000
D. 100 000
E. 1 000 000

Question 13

Consider the following graph.



The method to transform this graph into a linear graph is most likely to

A. performing a four-point moving average.

B. performing a three-point moving average.

C. applying an x^2 transformation.

D. applying a $\frac{1}{x}$ transformation.

E. finding the line of best fit.

Use the following information to answer Questions 14 and 15.

A bivariate relationship exists between variables x and y. The data has the following descriptive statistics.

- $s_y = 4.8$
- $s_x = 1.6$
- $\bar{y} = 22$
- $\bar{x} = 6$
- $r = 0.8$

Question 14

The linear relation between the variables is given by

A. $y = 2.4 + 7.6x$

B. $y = 7.6 + 2.4x$

C. $y = 2.4 - 7.6x$

D. $y = 7.6 - 2.4x$

E. $y = 36.4 + 2.4x$

Question 15

It can be concluded that

A. 80% of the change in the response variable is due to the change in the explanatory variable.

B. 80% of the change in the explanatory variable is due to the change in the response variable.

C. 64% of the change in the response variable is due to the change in the explanatory variable.

D. 64% of the change in the explanatory variable is due to the change in the response variable.

E. x is the response variable.

Question 16

The correlation between the number of sports grounds and the number of hospital beds in a city is close to 0.7.

This is an example of

A. random correlation.

B. both variables responding to a third variable.

C. confounding correlation.

D. cause and effect.

E. evidence that a lot of injuries result from playing sport.

Question 17

An investigation is conducted to measure the reaction rate of an experiment at various temperatures. The following equation is found to apply over the range 0–30°C with $r = 0.96$.

$$\text{reaction rate} = 0.045 \times (\text{temperature} + 273) + 3.7$$

The residual for the real data point (20, 16.5) is closest to

A. –0.39
B. 0.39
C. 16.89
D. 19.2
E. 23.7

Question 18

After an x^2 transformation has been applied, the following values for a graph are found:

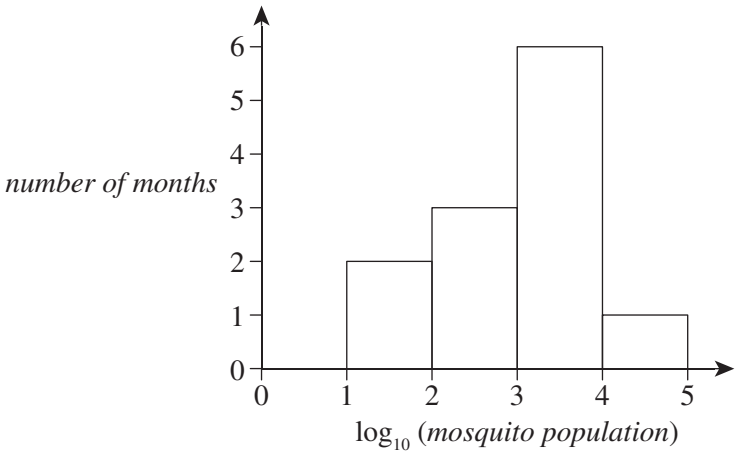
- $r = 0.9$
- gradient = 26
- y-intercept = –13

The least squares regression equation is

A. $y = -13 + 26x$
B. $y = 26x + 13$
C. $y = 26x^2 + 13$
D. $y = -26x^2 + 13$
E. $y = 26x^2 - 13$

Question 19

The *mosquito population* in a pond is recorded each month for six months. The results are shown in the graph below.



The *number of months* with fewer than 1000 mosquitoes recorded was

A. 1
B. 2
C. 3
D. 5
E. 6

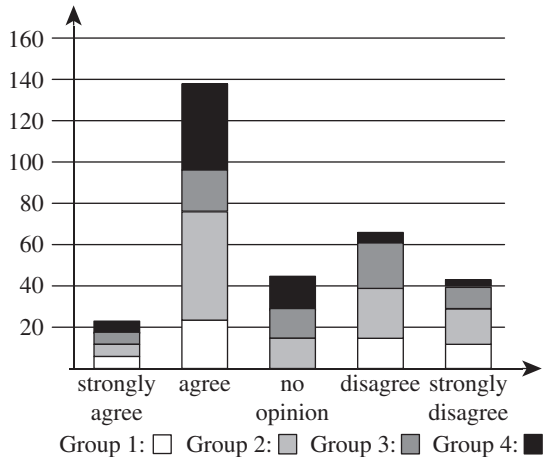
Question 20

The following table shows the results of a survey taken to determine to what extent people from various groups (1–4) agreed with the decisions of the umpire in a sporting event.

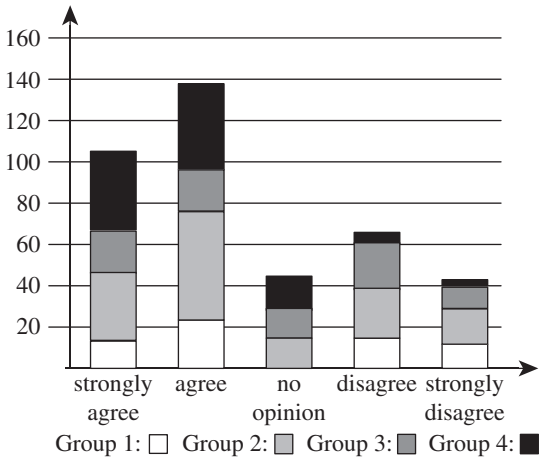
	Strongly agree	Agree	No opinion	Disagree	Strongly disagree
Group 1	12	25	0	14	10
Group 2	34	48	12	23	18
Group 3	21	23	15	24	12
Group 4	38	41	20	8	4

Which one of the following diagrams accurately displays the data given in the table above?

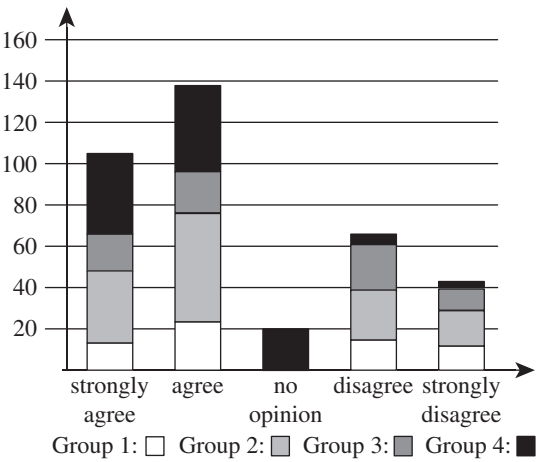
A.



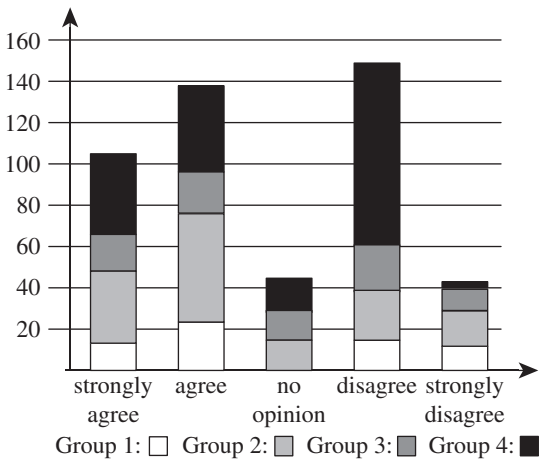
B.



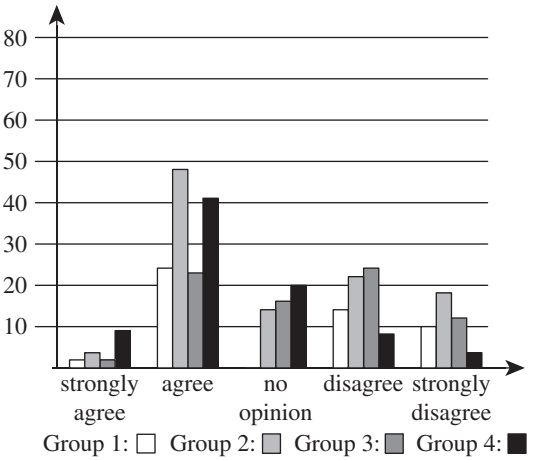
C.



D.



E.



Recursion and financial modelling

Question 21

The series 7, –14, 28, –56 … n is best described by:

A. $t_{n+1} = -2t_n$

B. $t_{n+1} = 2t_n$

C. $t_{n+1} = -2t_n;\ t_1 = 7$

D. $t_{n+1} = 2t_n;\ t_1 = 7$

E. $t_n = -2t_{n+1};\ t_1 = 7$

Question 22

The terms t_1 and t_3 generated by the recurrence relation $t_{n+1} = \frac{t_n}{10} + 200,\ t_0 = 1000$ are, respectively,

A. 1200 and 203.2.

B. 300 and 230.

C. 230 and 300.

D. 300 and 223.

E. 230 and 223.

Question 23

The number of new cases of a particular flu strand increases by 12% every day for the first eight days. The number of reported cases on day 0 was 60.

Which one of the following relationships accurately describes the number of new cases on day $n + 1$ given the number on day n?

A. $t_{n+1} = 12t_n + 60;\ t_0 = 60$

B. $t_n = 1.12n;\ t_0 = 60$

C. $t_{n+1} = 1.12n;\ t_0 = 60$

D. $t_{n+1} = 1.12t_n;\ t_0 = 60$

E. $t_{n+1} = 12t_n;\ t_0 = 60$

Question 24

An infectious disease is spreading through an isolated community. The symptoms of the disease last for two weeks before a patient can be said to be disease free. The *number of new patients infected on day n* and the *total number of infected patients, N*, per *day* are shown in the table below.

Day	1	2	3	4	5
Number of new patients infected on day n	3	9	15	21	27
Total number of infected patients, N	3	12	27	48	75

A recursive relationship to describe the *total number of new patients* on any *day* is

A. $t_{n+1} = t_n + 6, t_1 = 3$

B. $t_{n+1} = 3t_n, t_1 = 3$

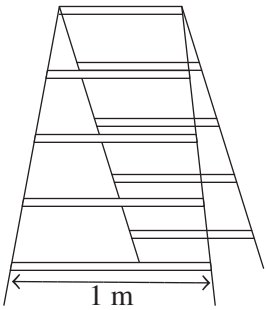
C. $t_{n+1} = 4(t_n, t_1) = 3$

D. $N + 1 = N + n$

E. $t_N = 3n^2, t_n = 1$

Question 25

The following diagram shows a stepladder. Each step of the ladder is 10% narrower than the step below. The bottom step is 1 m wide.



A recursive relationship to describe the length of each step above the bottom step

A. $t_n = 0.9^{n-1}, t_1 = 1$

B. $t_{n+1} = 0.9t_n, t_1 = 1$

C. $t_{n+1} = t_n - 0.1, t_1 = 1$

D. $t_{n+1} = t_n + 0.1, t_1 = 1$

E. $t_{n+1} = t_n + 0.9, t_1 = 1$

Question 26

Aisha is earning 1.3% per-annum interest compounding quarterly on her savings of $40 000.

Which one of the following expressions could be used to calculate Aisha's account balance after two years?

A. $T_2 = 40\,000 \times \left(\frac{\frac{1.3}{4}}{100}\right)^{2 \times 4}$

B. $T_2 = 40\,000 \times (1.00325)^8$

C. $T_2 = 40\,000 \times \left(1 + \frac{1.013}{100}\right)^2$

D. $T_8 = \frac{40\,000 \times \frac{1.3}{12} \times 8}{100}$

E. $T_8 = 40\,000 \times \left(1 + \frac{\frac{1.3}{4}}{100}\right)^{2 \times 4}$

Question 27

A new commercial printer is bought for $6700. Over its working life, it is expected to make 10 million copies before being sold for $1000.

An expression to calculate the printer's value after n copies is

A. $t_n = 5700 - 0.57n$

B. $t_n = 5700 - 0.00057n$

C. $t_n = 6700 - 0.57n$

D. $t_n = 6700 - 0.0057n$

E. $t_n = 6700 - 0.00057n$

Question 28

Chris has an annuity account that earns him $2000 interest each month, which he then withdraws.

If the fixed interest rate is 2.1% per annum, Chris's investment is closest to

A. $42

B. $11 430

C. $95 200

D. $114 300

E. $1 143 000

Question 29

The interest to Mika's account is added at a rate of 0.08% per month on the lowest balance for the month. The following transactions are made in January:

- January 1 opening balance of $4500
- January 4 deposit of $800
- January 8 withdrawal of $2000
- January 18 deposit of $800

How much interest does the account earn for January?

A. $1.32
B. $2.64
C. $3.28
D. $3300
E. $4100

Question 30

Sean borrows $280 000 from his bank to purchase an investment property. The terms of the loan are five years at an interest rate of 4.8% per annum compounding monthly.

Sean's monthly repayment is closest to

A. $5258
B. $6480
C. $4714
D. $13 440
E. $56 673

END OF SECTION A

SECTION B – MODULES

Instructions for Section B

Select **one** module and answer **all** questions within the selected module in pencil on the answer sheet provided for multiple-choice questions.

Show the module you are answering by shading the matching box on your multiple-choice answer sheet.

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.

Contents **Page**

Module 1 – Matrices

Before answering these questions, you must **mark** the 'Matrices' box on the answer sheet for multiple-choice questions.

Question 1

The matrix below shows the results of a table tennis tournament between Arthur (A), Ben (B), Carrie (C) and Douglas (D).

$$T = \begin{array}{c} \\ A \\ B \\ C \\ D \end{array} \begin{array}{c} \begin{array}{cccc} A & B & C & D \end{array} \\ \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix} \end{array} \begin{array}{l} \\ \\ \\ \\ \textit{Winners} \end{array}$$

Losers

Which one of the following statements is **true**?

A. Arthur won two matches.
B. Carrie won two matches.
C. Ben won one match.
D. Douglas won two matches.
E. A total of four matches were played.

Use the following information to answer Questions 2–5.

Consider the following three matrices.

$$A = \begin{bmatrix} 4 & 6 \\ 3 & 2 \end{bmatrix} \quad B = \begin{bmatrix} 4 & 1 \\ 2 & 3 \end{bmatrix} \quad C = \begin{bmatrix} 1 & 1 \end{bmatrix}$$

Question 2

Which one of the following matrix equations correctly shows the solution to $3A - B$?

A. $\begin{bmatrix} 16 & 19 \\ 19 & 9 \end{bmatrix}$

B. $\begin{bmatrix} 8 & 7 \\ 5 & 5 \end{bmatrix}$

C. $\begin{bmatrix} 24 & 21 \\ 15 & 15 \end{bmatrix}$

D. $\begin{bmatrix} 8 & 17 \\ 7 & 3 \end{bmatrix}$

E. $\begin{bmatrix} 11 & 10 \\ 8 & 8 \end{bmatrix}$

Question 3

Which one of the following matrix products is undefined?

A. AB
B. BA
C. CB
D. BC
E. CA

Question 4

B^T is

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

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

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

D. $\begin{bmatrix} 0.3 & -0.1 \\ -0.2 & 0.4 \end{bmatrix}$

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

Question 5

The determinant of matrix A is

A. –10
B. 0
C. 10
D. 15
E. 18

Question 6

G is a matrix such that $G_{ij} = 3i - j$.

Which one of the following matrices is G?

A. $\begin{bmatrix} 1 & 2 \\ 4 & 5 \\ 7 & 8 \end{bmatrix}$

B. $\begin{bmatrix} 3 & -1 \\ 3 & -1 \\ 3 & -1 \end{bmatrix}$

C. $\begin{bmatrix} 2 & 5 & 8 \\ 1 & 4 & 7 \end{bmatrix}$

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

E. $\begin{bmatrix} 2 & 1 \\ 5 & 4 \\ 8 & 7 \end{bmatrix}$

Question 7

Consider the following equations.

$$7x - 4y = 36$$

$$5x - 3y = 26$$

A matrix equation that solves the simultaneous equations above is

A. $\begin{bmatrix} 7 & -4 \\ 5 & -3 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 36 \\ 26 \end{bmatrix}$

B. $\begin{bmatrix} 7 & -4 \\ 5 & -3 \end{bmatrix} \begin{bmatrix} 36 \\ 26 \end{bmatrix} = \begin{bmatrix} x \\ y \end{bmatrix}$

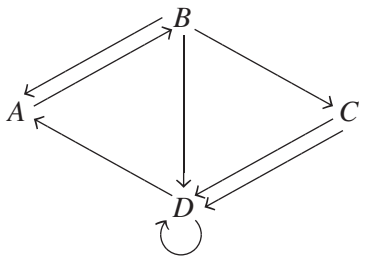
C. $\begin{bmatrix} 3 & -4 \\ 5 & -7 \end{bmatrix} \begin{bmatrix} 36 \\ 26 \end{bmatrix} = \begin{bmatrix} x \\ y \end{bmatrix}$

D. $\begin{bmatrix} 3 & -4 \\ 5 & -7 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 36 \\ 26 \end{bmatrix}$

E. $\begin{bmatrix} 7 & -4 \\ 5 & -3 \end{bmatrix} \begin{bmatrix} 36 \\ 26 \end{bmatrix}^{-1} = \begin{bmatrix} x \\ y \end{bmatrix}$

Question 8

Consider the diagram below.



Which one of the following matrices could represent the diagram above?

A.

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

B.

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

C.

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

D.

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

E.

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

Question 9

The entry code AJFBLR for a lock is scrambled for security and ABFJLR is written down.

The permutation matrix that would unscramble the code is

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

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

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

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

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

Question 10

Blybs Ribs is a food truck that sells ribs (*R*), macaroni and cheese (*M*), pavlova (*P*) and salad (*S*).
The price of each item in dollars is displayed in the matrix below.

$$\begin{matrix} R & M & P & S \end{matrix}$$
$$\begin{bmatrix} 10 & 6 & 5 & 6 \end{bmatrix}$$

A matrix calculation that would total the cost of one of each item is

A. $\begin{bmatrix} 10 & 6 & 5 & 6 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$

B. $\begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} \begin{bmatrix} 10 & 6 & 5 & 6 \end{bmatrix}$

C. $\begin{bmatrix} 10 & 6 & 5 & 6 \end{bmatrix} \begin{bmatrix} 1 & 1 & 1 & 1 \end{bmatrix}$

D. $\begin{bmatrix} 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 10 & 6 & 5 & 6 \end{bmatrix}$

E. $\begin{bmatrix} 27 \end{bmatrix}$

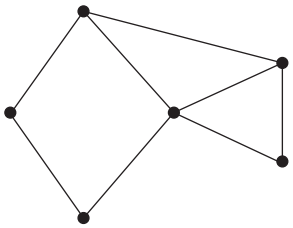
END OF MODULE 1

Module 2 – Networks and decision mathematics

Before answering these questions, you must **mark** the 'Networks and decision mathematics' box on the answer sheet for multiple-choice questions.

Use the following information to answer Questions 1 and 2.

Consider the graph below.



Question 1

Which one of the following calculations could be used to calculate the number of faces in the graph above?

A. $6 - f - 8 = 2$
B. $6 - 8 + f = 2$
C. $6 - f - 2 = 8$
D. $8 - 6 - f = 2$
E. $8 - 6 + f = 2$

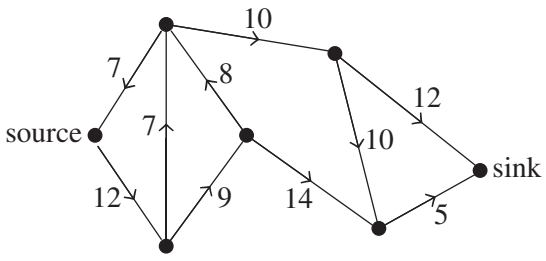
Question 2

The sum of the degrees of the vertices in the graph above is

A. 6
B. 8
C. 15
D. 16
E. 17

Question 3

Consider the graph below.

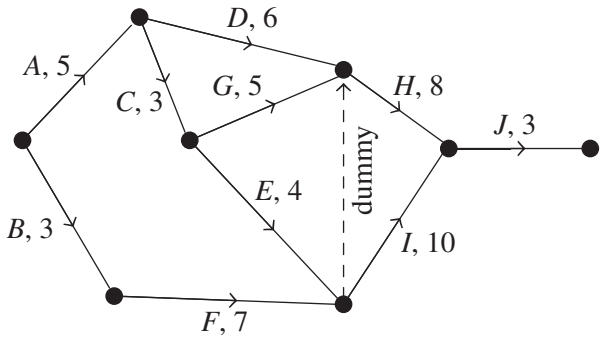


The maximum flow for the graph is

A. 15
B. 16
C. 17
D. 19
E. 24

Use the following information to answer Questions 4–6.

The graph below shows a multi-stage project with the length of time each stage (*A*–*J*) will take.



Question 4

The minimum completion time for the project is

A. 21
B. 22
C. 23
D. 24
E. 25

Question 5

The float time on *H* is

A. 1
B. 2
C. 3
D. 4
E. 8

Question 6

The earliest time that *F* can start is

A. 3
B. 4
C. 5
D. 10
E. 12

Question 7

The Hungarian algorithm has been started to allocate four projects to four people in the most efficient way possible. The table below has been created.

		Person			
		Anjum	**Belle**	**Costa**	**Dave**
Project	**1**	5	0	2	3
	2	0	0	1	0
	3	0	4	5	2
	4	3	1	0	3

Which one of the following statements is **not** correct.?

A. Belle should complete project 2.

B. Anjum should complete project 2 or 3.

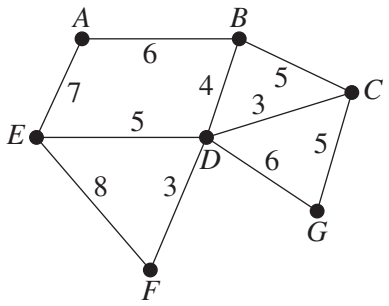
C. Costa should complete project 4.

D. Dave should complete project 2.

E. Project 3 can only be completed by Anjum.

Use the following information to answer Questions 8–10.

Consider the graph below.



Question 8

The minimum spanning tree for the graph above is

A. 23
B. 24
C. 25
D. 26
E. 27

Question 9

For an Eulerian trail to exist, an edge would need to be added between

A. *E* and *B*.
B. *A* and *D*.
C. *F* and *G*.
D. *A* and *G*.
E. *A* and *B*.

Question 10

The shortest route from *A* to *F* is

A. A–E–F.
B. A–E–D–F.
C. A–B–D–F.
D. A–B–C–D–F.
E. A–B–C–D–G–F.

END OF MODULE 2

Module 3 – Geometry and measurement

Before answering these questions, you must **mark** the 'Geometry and measurement' box on the answer sheet for multiple-choice questions.

Question 1

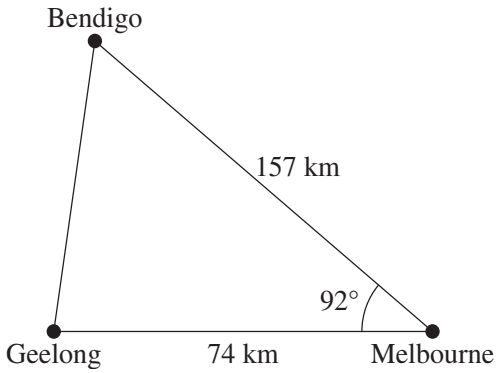
James travelled 1.3 kilometres at a bearing of 110° from point *A* to reach point *B*.

The distance that James travelled east of *A* to the nearest metre is

A. 1.2 m
B. 1.4 m
C. 1221 m
D. 1222 m
E. 1383 m

Question 2

The following diagram shows the three cities Bendigo, Geelong and Melbourne, along with some of the relative distances between the cities.

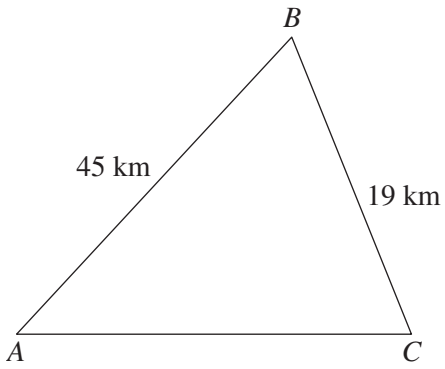


The distance between Bendigo and Geelong is closest to

A. 175 km
B. 176 km
C. 211 km
D. 30 936 km
E. 44 681 km

Question 3

Consider the following triangle. The area of the triangle is given as 384 000 000 m^2.



Angle *ABC* is

A. closest to 0.5°.

B. closest to 1.0°.

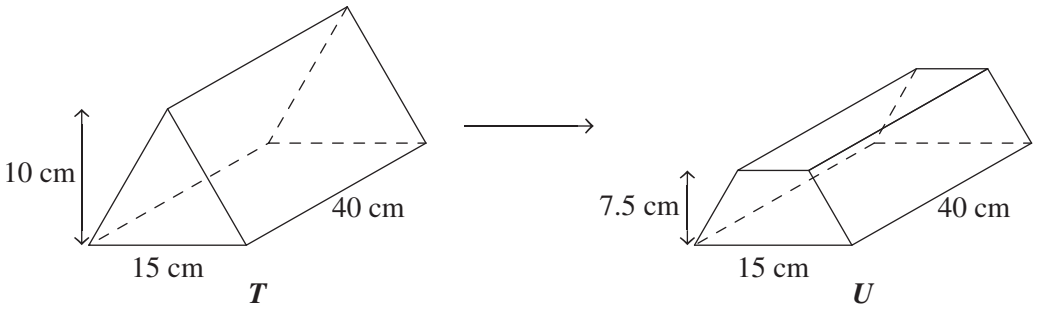
C. closest to 63°.

D. closest to 64°.

E. unable to be determined with the given information.

Use the following information to answer Questions 4 and 5.

The top of the triangular prism container *T* is cut off to form the container *U* as shown in the diagram below.



Question 4

The capacity of *U* is less than the capacity of *T* by

A. 0.1875 L
B. 0.75 L
C. 3 L
D. 18.75 L
E. 1875 L

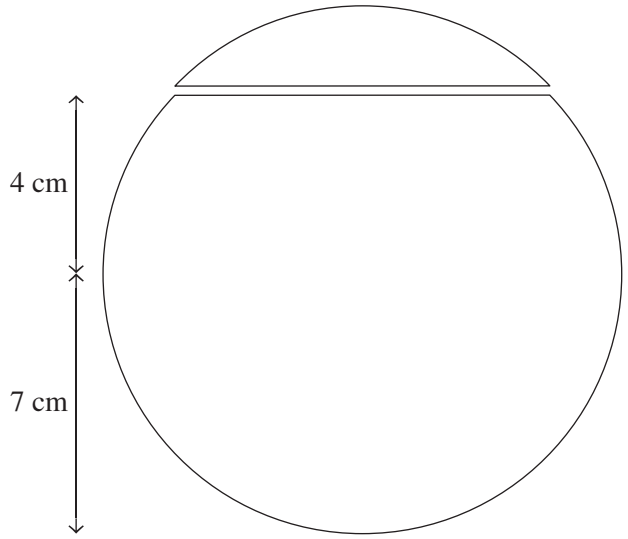
Question 5

The surface area of *T* is

A. 1150 cm^2
B. 1675 cm^2
C. 1750 cm^2
D. 1900 cm^2
E. 13 250 cm^2

Use the following information to answer Questions 6–8.

A spherical container with radius 7 cm has a circular lid. The base of the lid is 4 cm above the centre of the container, as shown in the diagram below.



Question 6

The circumference of the lid is closest to

A. 5.74 cm
B. 18 cm
C. 35 cm
D. 36 cm
E. 104 cm

Question 7

The angle of elevation of the lid from the centre of the container is calculated by

A. $\cos^{-1}\left(\frac{4}{7}\right)$

B. $\sin^{-1}\left(\frac{4}{7}\right)$

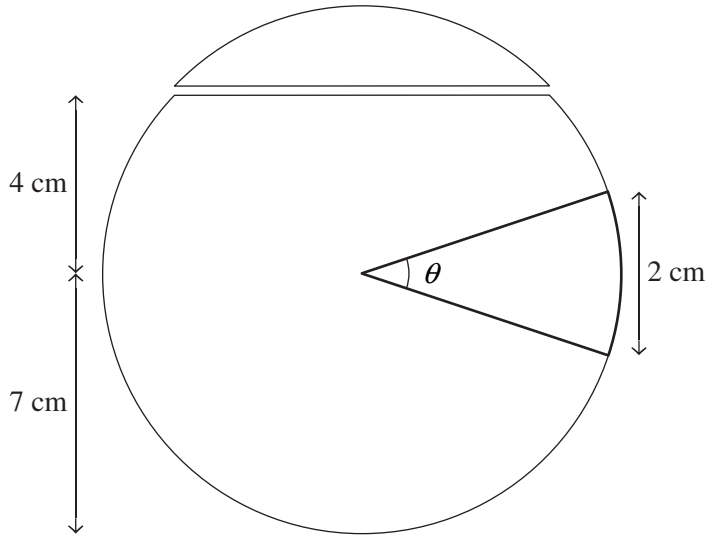
C. $\cos^{-1}\left(\frac{7}{4}\right)$

D. $\tan^{-1}\left(\frac{4}{7}\right)$

E. $\sin^{-1}\left(\frac{7}{4}\right)$

Question 8

A label that is 2 cm in height is placed on the side of the container in line with the horizontal as shown in the diagram below.



The angle θ closest to

A. 2°
B. 4°
C. 8°
D. 16°
E. 32°

Question 9

Which one of the following cities is furthest from the equator?

A. Rome (41°N, 12°E)
B. New York (42°N, 74°W)
C. Cape Town (34°S, 13°E)
D. Seattle (48°N, 122°W)
E. Beijing (40°N, 116°E)

Question 10

A cake is cut into slices. The volume of each slice of cake is 226 cm^3. The radius of the cake is 12 cm and the depth of the cake is 5 cm.

How many slices is the cake cut into?

A. 9
B. 10
C. 11
D. 12
E. 13

END OF MODULE 3

Module 4 – Graphs and relations

Before answering these questions, you must **mark** the 'Graphs and relations' box on the answer sheet for multiple-choice questions.

Question 1

The linear equation of the line that passes through the point (1, 3) with an x-intercept of 5 is

A. $y = -\frac{x}{4} - \frac{15}{4}$

B. $y = \frac{x}{4} + 15$

C. $y + 3x - 15 = 0$

D. $4y + x - 15 = 0$

E. $4y + 3x = 15$

Question 2

A manufacturer produces shoes and boots. They must produce at least ten times the number of shoes as boots. Let x be the number of shoes produced and let y be the number of boots produced.

Which one of the following systems of inequalities best represents this situation?

A. $x \geq 10y$

B. $y \geq 10x$

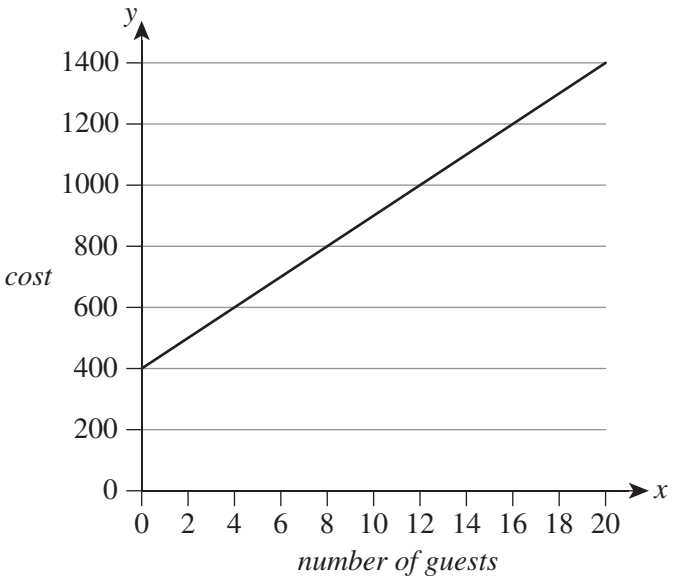
C. $x > 0$, $y > 0$ and $x \geq 10y$

D. $x \geq 0$, $y \geq 0$ and $x \geq 10y$

E. $x \geq 0$, $y \geq 0$ and $y \geq 10x$

Question 3

Alex is a chef who cooks for dinner parties in the homes of clients who hire him. He charges a booking fee of $400 plus a charge per guest. The graph below shows a representation of the price for various numbers of guests.

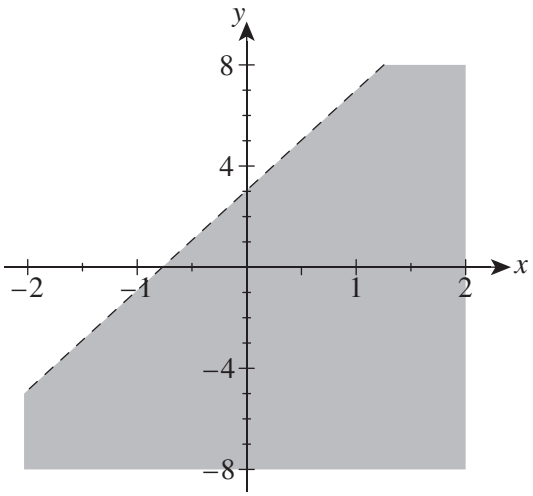


How much does Alex charge per guest?

A. $40
B. $50
C. $60
D. $75
E. $80

Question 4

Consider the graph below.



The inequality that is represented by the shaded region is given by

A. $y \geq 2x + \frac{3}{2}$

B. $y < 4x + 3$

C. $y \leq 4x + 3$

D. $y < 2x + \frac{3}{2}$

E. $y < 4x + 2$

Question 5

The following inequalities were used to define the feasible region for a linear programming question:

- $y > 0$
- $x > 0$
- $y < 4$
- $x < 6$
- $3x + 4y < 24$

Which one of the following points lies within the feasible region?

A. (0, 0)

B. (0, 6)

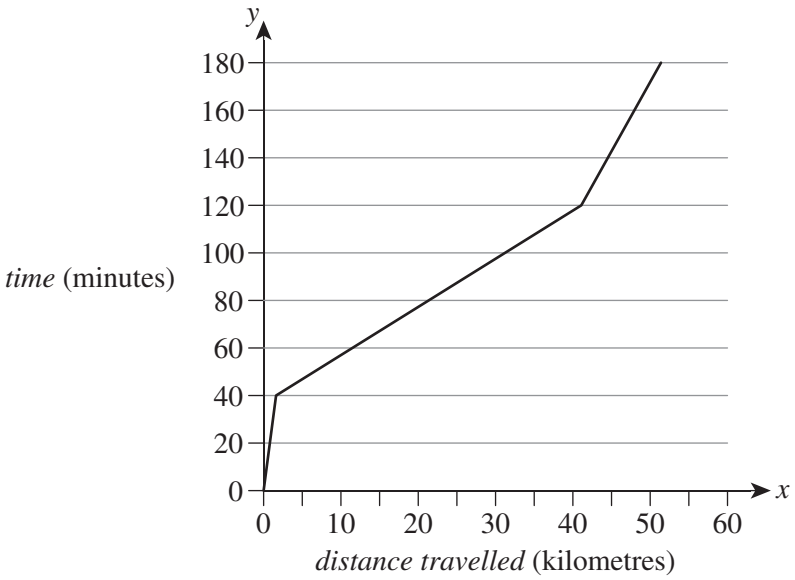
C. (2, 5)

D. (3, 4)

E. (4, 1)

Question 6

The triathlon is a race that involves swimming, cycling and running; triathletes complete the three sections of the race in that respective order. The Olympic distances for each section are: swimming, 1.5 km; cycling, 40 km; and running, 10 km. A particular triathlete's average time for each section is 40 minutes, 80 minutes and 60 minutes respectively. Their time–distance graph is shown below.



Given that d is the distance travelled and t is the time taken, the equation describing the travel in the cycling section of the race is

A. $t = 2d + 37;\ 1.5 \leq d \leq 41.5$

B. $t = \frac{d}{2} + 37;\ 1.5 \leq d \leq 41.5$

C. $t = 2d + 40;\ 1.5 \leq d \leq 41.5$

D. $t = 2d + 40;\ 0 \leq d \leq 41.5$

E. $t = 2d + 40;\ 0 \leq t \leq 180$

Question 7

The point (3, 3600) lies on a curve with the general formula $y = kx^2$.

The value of k is

A. 200

B. 300

C. 400

D. 600

E. 1200

Question 8

A family of two adults and three children pay $285 for admission to a theme park. A group of nine adults pays $675 for their admission. A school holiday program takes 12 children and four adults.

Assuming there is no group discount, how much will it cost the group from the holiday program to enter the theme park?

A. $45
B. $75
C. $120
D. $800
E. $840

Question 9

The cost, $\$C$, of using n kL of water is given by the equation $C = 28 + 0.57n$.

From the equation, it can be concluded that there is

A. a fixed charge of $0.28, and $0.57 is charged for every kL of water used.
B. a fixed charge of $28, and $0.57 is charged for every kL of water used.
C. a fixed charge of $28, and $57 is charged for every kL of water used.
D. no fixed charge and $0.57, is charged for every kL of water used.
E. no fixed charge and $28, is charged for every kL of water used.

Question 10

Sergio sells bunches of six flowers for $8 and bunches of 12 flowers for $14. Ralene bought nine bunches of flowers for $96.

How many bunches of 12 did she buy?

A. 2
B. 3
C. 4
D. 5
E. 6

END OF MULTIPLE-CHOICE QUESTION BOOKLET

Neap

Trial Examination 2020

VCE Further Mathematics Units 3&4

Written Examinations 1&2

Formula Sheet

Instructions

This formula sheet is provided for your reference.

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

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 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 = $\frac{\text{actual figure}}{\text{deseasonalised figure}}$

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, $S_{n+1} = TS_n + B$

Module 2 – Networks and decision mathematics

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

Module 3 – Geometry and measurement

area of a triangle	$A = \frac{1}{2}bc\sin(\theta°)$
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	$r \times \frac{\pi}{180} \times \theta°$
area of a circle	πr^2
area of a sector	$\pi r^2 \times \frac{\theta°}{360}$
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

Neap

Trial Examination 2020

VCE Further Mathematics Units 3&4

Written Examination 1

Multiple-choice Answer Sheet

Student's Name: _____

Teacher's Name: _____

Instructions

Use a **pencil** for **all** entries. If you make a mistake, **erase** the incorrect answer – **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

Use pencil only

Core: Data analysis
ONE ANSWER PER LINE

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

Core: Recursion and financial modelling
ONE ANSWER PER LINE

21	A	B	C	D	E
22	A	B	C	D	E
23	A	B	C	D	E
24	A	B	C	D	E
25	A	B	C	D	E
26	A	B	C	D	E
27	A	B	C	D	E
28	A	B	C	D	E
29	A	B	C	D	E
30	A	B	C	D	E

Continues over page

Show Module chosen by marking the appropriate box.

Use pencil only

Module:

- ☐ **Matrices**
- ☐ **Networks and decision mathematics**
- ☐ **Geometry and measurement**
- ☐ **Graphs and relations**

ONE ANSWER PER LINE

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