2020
VCE
Further Mathematics

Trial Examination 1

Kilbaha Education

Quality educational content

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VICTORIAN CERTIFICATE OF EDUCATION
2020

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	8	4	1	8
					Total 32

- 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 39 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

The Warburn and Yarragrove cinemas each show 19 films. The back to back stem plot below shows the distribution of *attendance* for the films at each cinema.

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

key: 5 \| 4 = 54 $n = 19$

Question 1

The distribution of *attendance* for Warburn is best described as

A. negatively skewed

B. positively skewed with outliers

C. positively skewed

D. approximately symmetrical

E. approximately symmetrical with outliers

Question 2

To check for outliers in the Yarragrove distribution, the upper fence is calculated. The correct calculation of the upper fence for Yarragrove is given by

A. $61 - 1.5 \times 20$

B. $41 + 1.5 \times 52$

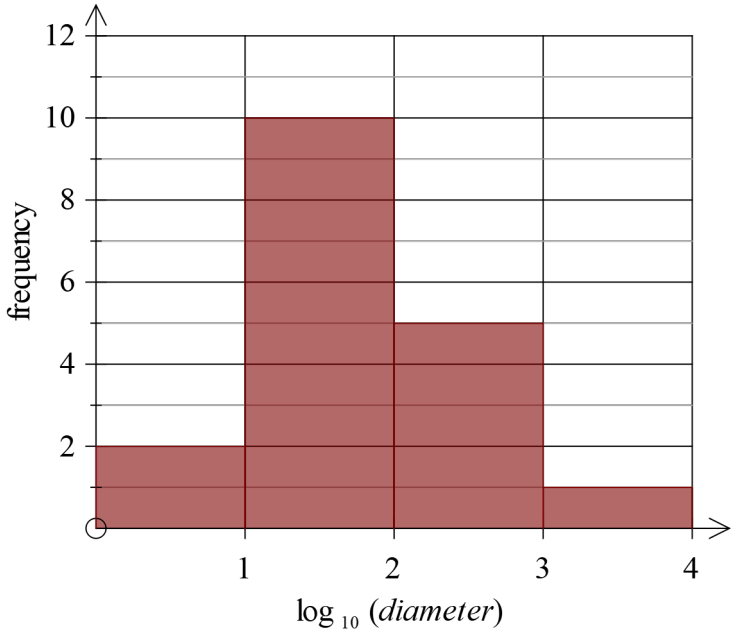
C. $61 + 1.5 \times 20$

D. $61 - 1.5 \times 41$

E. $41 - 1.5 \times 20$

Question 3

The histogram below shows the distribution of the $\log_{10}$ (*diameter*), with *diameter* in millimetres, of the trunks of a group of coastal Redwoods.



The percentage of coastal Redwoods with a trunk diameter greater than 10 centimetres is closest to

A. 50

B. 33

C. 27

D. 67

E. 89

Use the following information to answer questions 4 and 5

A film was shown to audiences at two separate cinemas, Warburn and Yarragrove. The audience at each cinema was asked to rank the film (good, fair, poor). The results are indicated in the table below. One value is missing.

Ranking	Cinema	
	Warburn	**Yarragrove**
good	96	125
fair	39	65
poor	15	
Total	150	250

Question 4

At Yarragrove, the **percentage** of the audience who ranked the film as poor is

A. 60%

B. 10%

C. 40%

D. 24%

E. 39%

Question 5

Which of the following statements, by itself, supports the contention that the ranking given is associated with the cinema at which the film is shown?

A. 65 people at Yarragrove ranked the film as fair, compared to 39 at Warburn.

B. 64% of the Warburn audience ranked the film as good while 50% of the Yarragrove audience ranked the film as good.

C. The majority of the Yarragrove audience ranked the film as good.

D. 26% of both the Warburn and Yarragrove audiences ranked the film as fair.

E. The audience at Yarragrove was larger than that at Warburn.

Use the following information to answer questions 6 and 7

In a quality control test, the amounts of sunscreen contained in a batch of 3600 bottles were approximately normally distributed with a mean of 249 mL and standard deviation of 2.3 mL.

Question 6

A bottle is rejected if it contains less than 244.4 mL. The expected number of these bottles to be rejected is closest to

A. 48

B. 85

C. 90

D. 576

E. 1224

Question 7

The amount of sunscreen in one of these bottles has a standardized value of $z = 1.2$
The actual amount, in mL, of sunscreen in this bottle is closest to

A. 246.2

B. 251.3

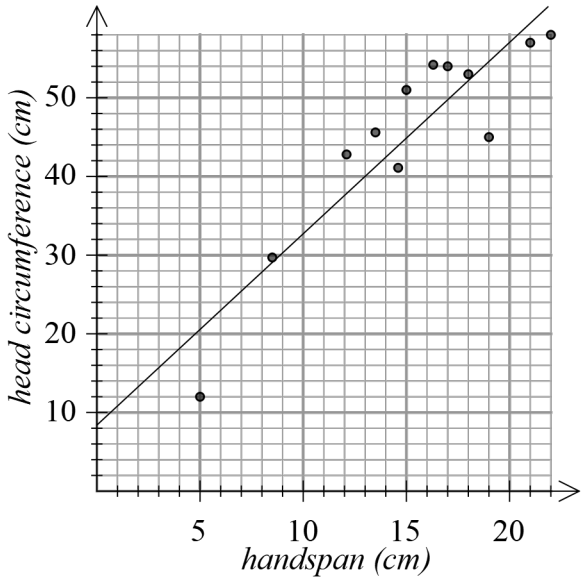
C. 246.7

D. 251.8

E. 253.8

Question 8

The scatterplot above shows the *head circumference*, in centimetres, and *handspan*, in centimetres of 12 primates. A least squares regression line has been fitted to the scatterplot.



The equation of this line is closest to

A. $handspan = 8.2 + 2.4 \times head\ circumference$

B. $head\ circumference = 2.4 + 8.2 \times handspan$

C. $head\ circumference = 8.2 + 2.4 \times handspan$

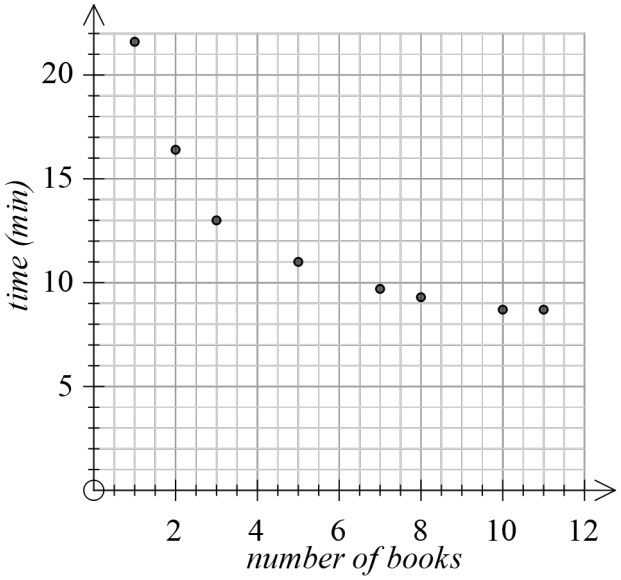
D. $handspan = 2.6 + 8.2 \times head\ circumference$

E. $head\ circumference = 8.2 + 2.6 \times handspan$

Use the following information to answer questions 9 -11

For a group of eight children, the *number of books* read in a month and the *time,* in minutes, taken to complete a spelling test are shown in the table and scatterplot below.

number of books	*time* (min)
1	21.6
2	16.4
3	13
5	11
7	9.7
8	9.3
10	8.7
11	8.7



Question 9

The mean, $\bar{y}$, and standard deviation, s_y, for *time*, in minutes, are closest to

A. $\bar{y} = 12.3 \quad s_y = 4.6$

B. $\bar{y} = 5.9 \quad s_y = 3.7$

C. $\bar{y} = 5.9 \quad s_y = 4.6$

D. $\bar{y} = 12.3 \quad s_y = 4.3$

E. $\bar{y} = 11.2 \quad s_y = 3.5$

Question 10

When a least squares regression line is fitted to the data, the equation of the line is found to be

$$time = 18.65 - 1.08 \times number\ of\ books$$

When this line is used to predict the *time* taken to complete a spelling test when 5 books are read, the residual is closest to

A. 0.99

B. -2.25

C. -6.19

D. 3.45

E. -2.65

Question 11

To linearise the data, a reciprocal transformation is applied to the variable *number of books*.
A least squares line is then fitted to the transformed data.
With *number of books* as the explanatory variable, the equation of this least squares line is closest to

A. $time = 20.80 - 2.6 \times number\ of\ books$

B. $\frac{1}{time} = 0.05 + 0.007 \times number\ of\ books$

C. $\frac{1}{time} = 14.46 - 0.007 \times number\ of\ books$

D. $time = 2.6 + 20.80 \times \frac{1}{number\ of\ books}$

E. $time = 7.76 + 14.56 \times \frac{1}{number\ of\ books}$

Question 12

The *average gold price*, in dollars per ounce, is plotted each year over the period 1980 to 2000. A least squares line is fitted to the data.

The equation of the least squares line is

$$average\ gold\ price = 285770 - 141.25 \times year$$

The coefficient of determination is $r^2 = 0.5364$

The Pearson correlation coefficient, r, is closest to

A. 0.2877

B. 0.7324

C. -0.8558

D. -0.7324

E. 0.8558

Use the following information to answer questions 13 -15

The table below shows the price, in dollars per kilogram, of Yarragrove artisan cheese each month in 2019.

Month	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Price ($/kg)	27.1	28.4	19.8	26.3	19.9	22	19	14.7	17.5	16	18.7	10.6

Question 13

The data is used to estimate the seasonal indices for the price of cheese each month.
The seasonal index for September is closest to

A. 0.88

B. 0.92

C. 1.14

D. 0.85

E. 0.18

Question 14

The seasonal index for cheese price in December is 0.53
To correct for seasonality, the actual cheese price figure for December should be

A. reduced by 53%

B. increased by 91.3%

C. increased by 88.7%

D. reduced by 11.3%

E. increased by 47%

Question 15

A four-point moving mean with centring is used to smooth the data.
The smoothed cheese price, in dollars per kilogram, for April is closest to

A. 21.8

B. 23.6

C. 25.4

D. 24.5

E. 22.8

Question 16

The number of ice-creams sold by The Warburn Pantry each quarter in 2019 is shown in the Table 1.

Table 1

Quarter number	1	2	3	4
Sales (ice-creams sold)	2462	1950	840	2120

The quarterly seasonal indices for ice-cream sales by The Warburn Pantry are displayed in Table 2.

Table 2

Quarter number	1	2	3	4
Seasonal index	1.4	1.1	0.4	1.1

The sales data in Table 1 is to be deseasonalised before a least squares regression line is fitted. The equation of this least squares regression line, correct to 2 significant figures, is closest to

A. $deseasonalised\ sales = -7.8 + 0.0054 \times quarter\ number$

B. $deseasonalised\ sales = 1700 - 21 \times quarter\ number$

C. $deseasonalised\ sales = 2400 - 210 \times quarter\ number$

D. $deseasonalised\ sales = 54 - 7.8 \times quarter\ number$

E. $deseasonalised\ sales = 1700 + 83 \times quarter\ number$

Recursion and financial modelling

Question 17

A sequence is generated by the recurrence relation

$$T_0 = 2, \quad T_{n+1} = 3T_n - 7$$

The first four terms of this sequence will be

A. 2, -1, 12, 29

B. 2, -1, -10, -37

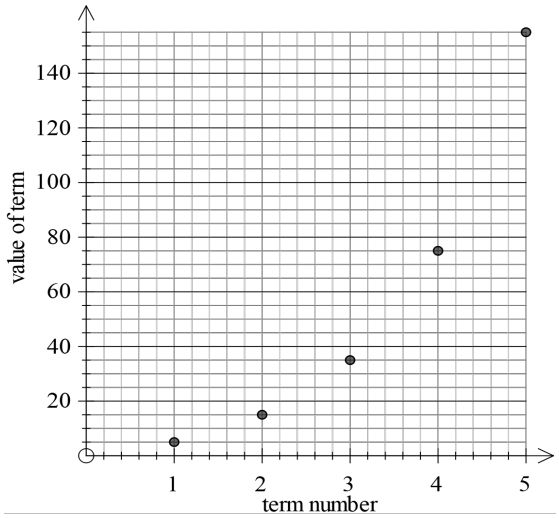
C. 2, 13, 32, 89

D. 2, -15, 24, -65

E. 2, -13, 46, -131

Question 18

The values of the first five terms of a sequence are plotted on the graph below.



The recurrence relation that could generate this sequence is

A. $T_0 = 5, \quad T_{n+1} = 3T_n$

B. $T_0 = 5, \quad T_{n+1} = 5T_n - 10$

C. $T_0 = 5, \quad T_{n+1} = T_n + 20$

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

E. $T_0 = 5, \quad T_{n+1} = 3T_n - 15$

Use the following information to answer questions 19 and 20

Laura invests $25000 at an interest rate of 1.8% per annum compounding monthly. At the end of each month, after interest is calculated, she withdraws $400.

Question 19

Which one of the following recurrence relations could be used to determine the amount in her investment account after n months, A_n?

A. $A_0 = 25000, \quad A_{n+1} = 1.0015\, A_n - 400$

B. $A_0 = 25000, \quad A_{n+1} = 1.0018\, A_n - 400$

C. $A_0 = 25000, \quad A_{n+1} = 1.015 - 400\, A_n$

D. $A_0 = 25000, \quad A_{n+1} = 1.8\, A_n - 400$

E. $A_0 = 25000, \quad A_{n+1} = 1.08\, A_n - 720$

Question 20

The value of Laura's investment at the end of 12 months is closest to

A. $25713

B. $25663

C. $24638

D. $20245

E. $20614

Question 21

Sarah takes out a reducing balance home loan at an interest rate of 3.8 % per annum compounding monthly.
The loan is to be repaid with monthly repayments of $1809.
Three lines of an amortization table for payments 101 to 103 are shown below.

Payment number	Repayment	Interest	Principal reduction	Balance of loan
101	1809	847.78	961.22	266758.78
102				265344.52
103	1809	840.26	968.74	264375.78

Sarah is able to make a larger repayment in the 102nd month. The amount of her 102nd repayment is closest to

A. $3618

B. $2154

C. $2259

D. $1904

E. $2713

Question 22

A perpetuity is set up to provide a $50 prize each month. An amount is invested earning interest at a rate of 2.8% per annum compounding monthly.
The amount that needs to be invested is closest to

A. $21429

B. $21979

C. $18365

D. $22675

E. $17857

Question 23

Miriam invests $25000 in an account that earns interest at a rate of 3.2% per annum compounding monthly. Each month, after interest has been calculated, Miriam withdraws a fixed amount of money.
After $2\frac{1}{2}$ years, the balance of the account is $16475.
The amount Miriam withdraws each month is closest to

A. $284

B. $396

C. $340

D. $530

E. $1396

Question 24

Eddie borrows $150000 at 5.6% per annum compounding monthly, to be repaid over 25 years with monthly repayments. After 3 years, the interest rate rises to 6.1% per annum.
In order to pay off the loan in 25 years, Eddie's repayments must

A. increase by **$**26.55

B. double

C. decrease by $71.50

D. increase by 0.5%

E. increase by $41.39

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.
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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

Which one of the following is a symmetric matrix?

A.

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

B.

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 4 & 0 & 0 & 9 \\ 9 & 0 & 1 & 0 \\ 0 & 4 & 0 & 0 \end{bmatrix}$$

C.

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

D.

$$\begin{bmatrix} 16 \\ 9 \\ 4 \\ 25 \end{bmatrix}$$

E.

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

Question 2

The matrix product $\begin{bmatrix} 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} E \\ A \\ R \\ T \\ H \end{bmatrix}$ is equal to

A. $\begin{bmatrix} H \\ A \\ T \\ E \\ R \end{bmatrix}$ **B.** $\begin{bmatrix} R \\ A \\ T \\ H \\ E \end{bmatrix}$ **C.** $\begin{bmatrix} R \\ E \\ A \\ T \\ H \end{bmatrix}$ **D.** $\begin{bmatrix} A \\ E \\ T \\ R \\ H \end{bmatrix}$ **E.** $\begin{bmatrix} T \\ R \\ A \\ E \\ H \end{bmatrix}$

Module 1: Matrices

Question 3
A system of simultaneous equations is to be solved using the matrix equation shown below.

$$\begin{bmatrix} a & -1 \\ 15 & -5 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} b \\ 35 \end{bmatrix}$$

For the system of equations to be dependent, the values of a and b are

A. a = -3, b = 5

B. a = 3, b = 3

C. a = 2, b = 7

D. a = -3, b = 3

E. a = 3, b = 7

Question 4

Consider the matrix M, where M = $\begin{bmatrix} 4 & 6 \\ 5 & 7 \\ 6 & 8 \end{bmatrix}$

The element in row i and column j of matrix M is m_{ij}.
The elements in matrix M are determined by the rule

A. $m_{ij} = 2i + 1$

B. $m_{ij} = 5 - i$

C. $m_{ij} = i + 2j + 1$

D. $m_{ij} = 3i + 2$

E. $m_{ij} = 2i - j + 1$

Module 1: Matrices

Question 5

Four teams, A, B, C and D played against each other once in a table tennis competition.
There were no draws.
The results of the competition are shown in the matrix below

A '1' in the matrix indicates that the team named in that row defeated the team named in that column.

$$\begin{array}{cc} & \text{loser} \\ & \begin{array}{cccc} A & B & C & D \end{array} \\ \text{winner} \begin{array}{c} A \\ B \\ C \\ D \end{array} & \begin{bmatrix} 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix} \end{array}$$

At the end of the competition, the order of the teams from 1st to 4th was

A. B, D, C, A

B. B, D, A, C

C. B, C, D, A

D. D, B, C, A

E. D, A, B, C

Module 1: Matrices

Question 6

Three films, Sad, Funny and Scary are shown to an audience. Audience members must award each film points by holding up either a red, yellow or blue card.

The table below shows the number of each card held up, and the total number of points scored by each film.

	Red	**Yellow**	**Blue**	**Total points**
Sad	3	3	4	35
Funny	1	5	4	33
Scary	7	1	2	43

Let r = the point value of a red card
Let y = the point value of a yellow card
Let b = the point value of a blue card

The matrix product evaluated to find the matrix $\begin{bmatrix} r \\ y \\ b \end{bmatrix}$ is

A.

$$\begin{bmatrix} 3 & 1 & 7 \\ 3 & 5 & 1 \\ 4 & 4 & 2 \end{bmatrix}^{-1} \begin{bmatrix} r \\ y \\ b \end{bmatrix}$$

B.

$$\begin{bmatrix} 3 & 3 & 4 \\ 1 & 5 & 4 \\ 7 & 1 & 2 \end{bmatrix}^{-1} \begin{bmatrix} r \\ y \\ b \end{bmatrix}$$

C.

$$\begin{bmatrix} 3 & 3 & 4 \\ 1 & 5 & 4 \\ 7 & 1 & 2 \end{bmatrix} \begin{bmatrix} r \\ y \\ b \end{bmatrix}$$

D.

$$\begin{bmatrix} 3 & 3 & 4 \\ 1 & 5 & 4 \\ 7 & 1 & 2 \end{bmatrix}^{-1} \begin{bmatrix} 35 \\ 33 \\ 41 \end{bmatrix}$$

E.

$$\begin{bmatrix} 3 & 1 & 7 \\ 3 & 5 & 1 \\ 4 & 4 & 2 \end{bmatrix} \begin{bmatrix} 35 \\ 33 \\ 41 \end{bmatrix}$$

Module 1: Matrices

Use the following information to answer questions 7 and 8

The Phillipa marine sanctuary consists of four small islands, Albatross (A), Barren (B), Coral (C) and Duncan (D).

Question 7

A colony of mutton birds chooses nesting spots on these islands every year.
The change in the number of mutton birds nesting on each island from year to year is shown in matrix T below.

this year

$$T = \begin{matrix} \\ A \\ B \\ C \\ D \end{matrix} \begin{matrix} \begin{matrix} A & B & C & D \end{matrix} \\ \begin{bmatrix} 0.3 & 0.1 & 0.2 & 0.3 \\ 0.5 & 0.3 & 0.2 & 0.2 \\ 0.1 & 0.4 & 0.5 & 0.1 \\ 0.1 & 0.2 & 0.1 & 0.4 \end{bmatrix} \end{matrix} \begin{matrix} \\ A \\ B \\ C \\ D \end{matrix}$$

next year

In the long term, 1782 mutton birds are expected to nest on Barren Island each year.

In the long term, the number of mutton birds expected to nest on Coral Island is closest to

A. 1122

B. 1907

C. 1282

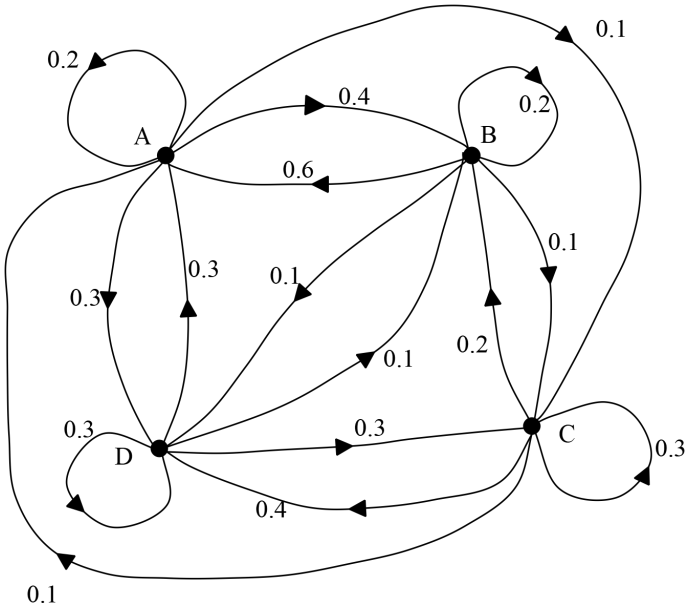
D. 1805

E. 1569

Module 1: Matrices

Question 8

A colony of fairy penguins also has nesting spots on the four islands.
The fairy penguins can change their nesting spots each year.
The change in the number of fairy penguins nesting on each island from year to year is shown in the transition diagram below.



The state matrix for the number of penguins nesting on each island in 2019 is $P_{2019} = \begin{bmatrix} 9625 \\ 7465 \\ 6178 \\ 8732 \end{bmatrix} \begin{matrix} A \\ B \\ C \\ D \end{matrix}$

The state matrix for the number of penguins nesting on each island in 2020 is $P_{2020} = \begin{bmatrix} 9641 \\ 7452 \\ 6182 \\ 8725 \end{bmatrix} \begin{matrix} A \\ B \\ C \\ D \end{matrix}$

Of the penguins expected to be nesting on Albatross Island in 2020, the percentage of these penguins nesting on Duncan Island in 2019 is closest to

A. 27%

B. 20%

C. 30%

D. 46%

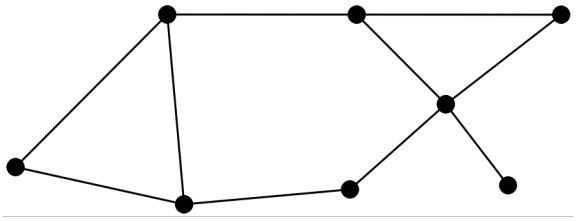
E. 33%

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



The number of vertices with an odd degree in the network above is

A. 1

B. 2

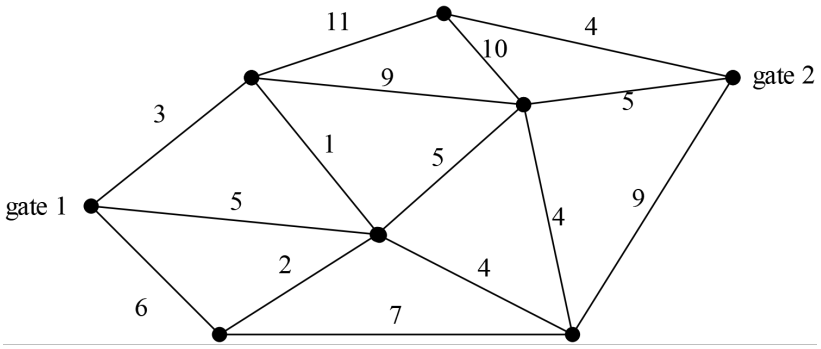
C. 3

D. 4

E. 5

Questions 2 and 3 refer to the following information

A national park has two gates, gate 1 and gate 2. There are six waterfalls in the park.
The network below shows the distance, in kilometres, along roads that connect the gates and waterfalls in the park.



Module 2: Networks and decision mathematics

Question 2

The shortest distance, in kilometres, from gate 1 to gate 2 is

A. 16

B. 15

C. 14

D. 13

E. 12

Question 3

What is the smallest possible length, in kilometres, of roadway needed so that the gates and waterfalls are all accessible from each other?

A. 29

B. 24

C. 33

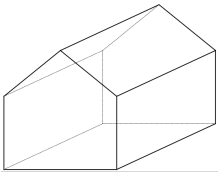
D. 30

E. 26

Module 2: Networks and decision mathematics

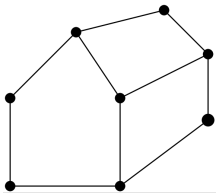
Question 4

A playing token for the board game of 'Greedy' is made of solid plastic in the shape of a house as shown below. It has 10 vertices, 15 edges and 7 faces.

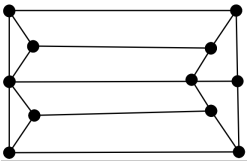


Which one of the following graphs could be used to represent the same token?

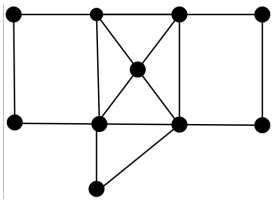
A.



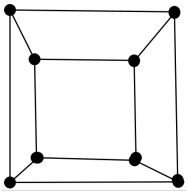
B.



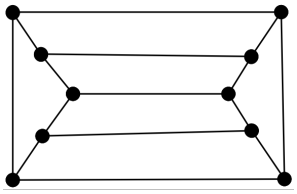
C.



D.



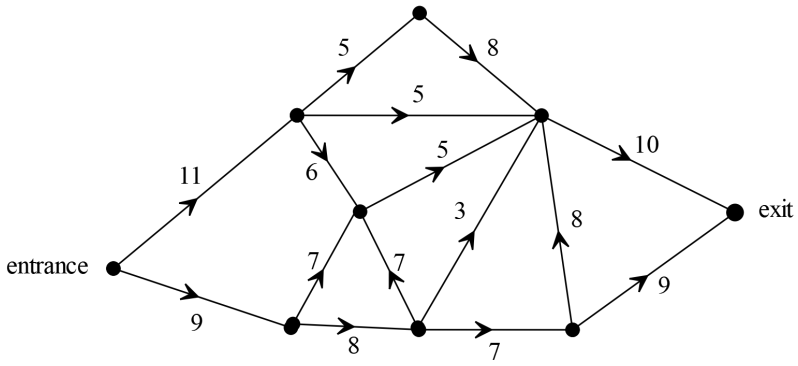
E.



Module 2: Networks and decision mathematics

Question 5

A limestone cave has several one-way tunnels through which people can move to get from the entrance to the exit, as represented on the directed graph below. The value on each edge gives the tunnel's flow capacity, in people per minute.



The maximum flow, in people per minute, from entrance to exit is

A. 20

B. 17

C. 19

D. 16

E. 18

Module 2: Networks and decision mathematics

Question 6

Laura, Robert, Jasper and Ally are entering a race as a team. The race consists of four events to be completed consecutively. Each team member can only perform one event.
The table below shows the minimum time, in minutes, in which each person can complete each event.

	Ski	**Cycle**	**Paddle**	**Run**
Laura	48	52	32	14
Robert	54	49	38	10
Jasper	63	55	29	11
Ally	50	50	35	12

If each event is to be assigned to only one person, what is the optimal assignment which minimises the total time for the team to complete the race?

A. Laura to ski, Robert to cycle, Jasper to paddle, Ally to run

B. Laura to paddle, Robert to run, Jasper to cycle, Ally to ski

C. Laura to run, Robert to paddle, Jasper to ski, Ally to cycle

D. Laura to ski, Robert to run, Jasper to paddle, Ally to cycle

E. Laura to paddle, Robert to ski, Jasper to cycle, Ally to run

Question 7

A graph with seven vertices has no loops or multiple edges.
Which one of the following statements is **not** true?

A. The graph can have up to a maximum of 28 edges.

B. If the graph has 6 edges it may have two isolated vertices

C. If the graph is complete it will have 21 edges

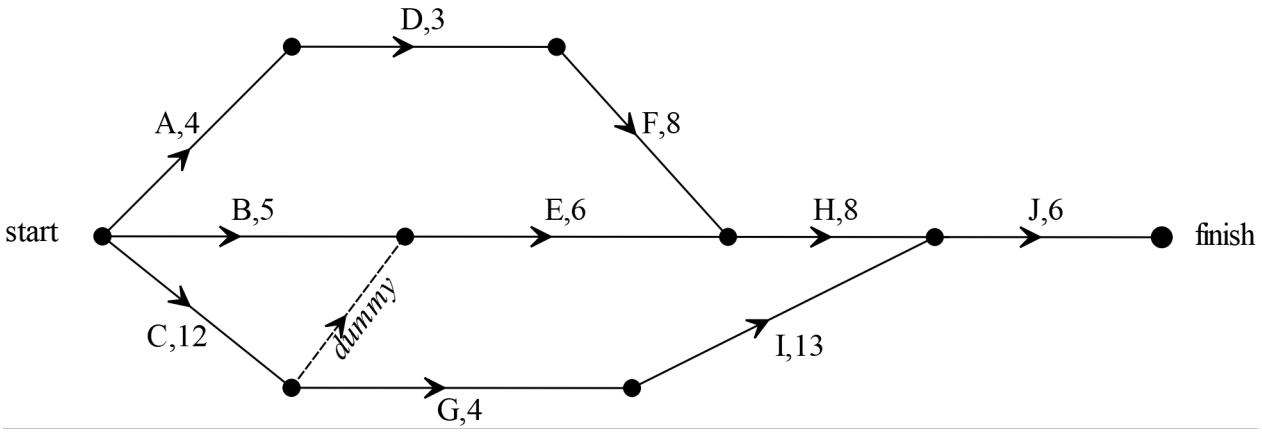
D. If the graph has a cycle it will have a minimum of three edges

E. If the graph is a tree, it has six edges

Module 2: Networks and decision mathematics

Question 8

The directed graph below shows the ten activities necessary to complete the building of a tunnel. The time, in months, that each activity is expected to take is shown on the corresponding edge.



Due to an upgrade in equipment, it is found that activities E and I can be reduced by up to 2 months each and activity G can be reduced by 1 month.

The earliest completion time, in months, of the project is now

A. 29

B. 30

C. 25

D. 32

E. 31

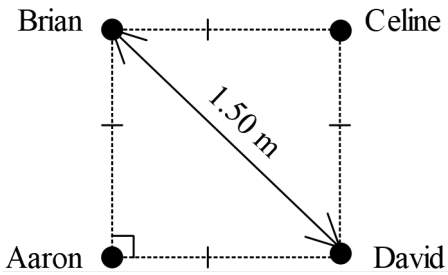
End of Module 2

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

Aaron, Brian, Celine and David stand at the four corners of a square as shown below. The shortest distance between Brian and David is 1.50 metres.



The shortest distance, in metres, between Celine and David is closest to

A. 1.26

B. 1.50

C. 0.75

D. 1.73

E. 1.06

Question 2

From a point beside the road, Eddy can see Kate on a bearing of 102°. The bearing of Eddy from Kate is

A. 282°

B. 348°

C. 012°

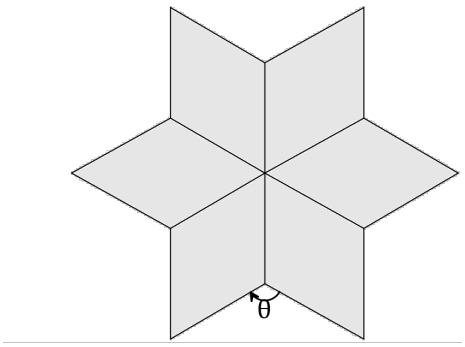
D. 258°

E. 358°

Module 3: Geometry and measurement

Question 3

'Six-pointed star' is a popular patchwork pattern made by sewing together 6 flat rhombuses as shown below. The rhombuses are all the same size and shape.



The size of the angle θ, shown in the diagram, is

A. 145°

B. 135°

C. 120°

D. 144°

E. 110°

Module 3: Geometry and measurement

Question 4

Graham sails 7 km from Ocean Pier on a bearing of 330° until he reaches Mud Island. From Mud Island, he sails 11 km on a bearing of 055° until he reaches Seal Rocks.
The shortest distance, in km, he must sail from Seal Rocks back to Ocean Pier is given by

A. $\sqrt{7^2 + 11^2 - 2\times7\times11\times cos(65°)}$

B. $\sqrt{7^2 + 11^2 - 2\times7\times11\times cos(55°)}$

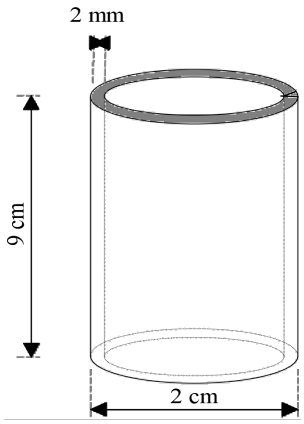
C. $\frac{11}{\sin 85°} \times \sin 95°$

D. $\frac{11}{\sin 85°} \times \sin 65°$

E. $\sqrt{7^2 + 11^2 - 2\times7\times11\times cos(95°)}$

Question 5

A narrow cylindrical tube is 9 cm long. The outside diameter of the tube is 2 cm and the thickness of its wall is 2 mm.



The volume of water this pipe can hold when full is closest to

A. 11 cm^3

B. 49 cm^3

C. 23 cm^3

D. 28 cm^3

E. 18 cm^3

Module 3: Geometry and measurement

Question 6

Jim flies from Melbourne (38° S, 145° E) to The Seychelles (4° S, 55° E).
He leaves Melbourne at 9:00 am.
If the flight takes 12 hours and 25 minutes, the time in The Seychelles when he arrives will be

A. 4:35:pm

B. 3:25 pm

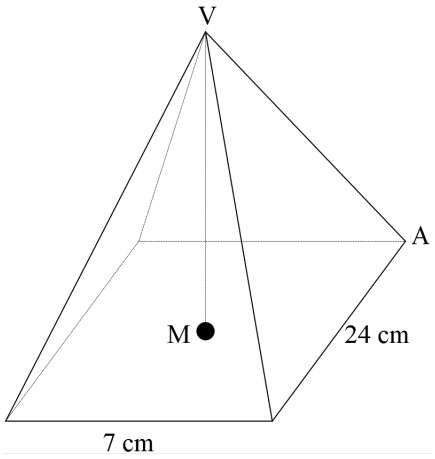
C. 2:35 am

D. 7:25 pm

E. 5:25 am

Question 7

A right pyramid, as shown below, has a rectangular base with length 24 cm and width 7 cm. The volume of the pyramid is 448 cm^3.



The angle VAM that the sloping edge VA makes with the base of the pyramid, to the nearest degree is

A. 33°

B. 40°

C. 57°

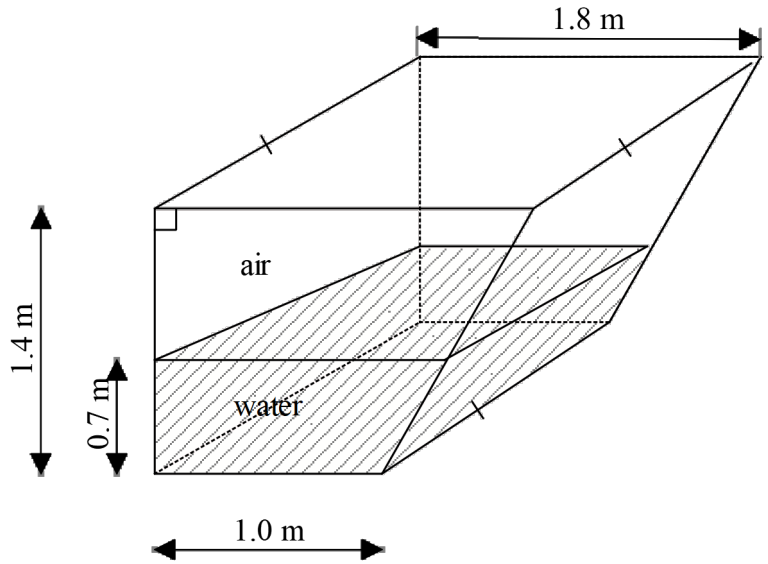
D. 18°

E. 12°

Module 3: Geometry and measurement

Question 8

A glass tank in an aquarium is a prism. The cross section is a trapezium with a height of 1.4 metres and parallel sides of 1.0 metre and 1.8 metres as shown below.
Water fills the trough to a depth of 0.7 metres.



The ratio, volume of water : volume of air is

A. 2:3

B. 1:1

C. 2:5

D. 3:4

E. 4:5

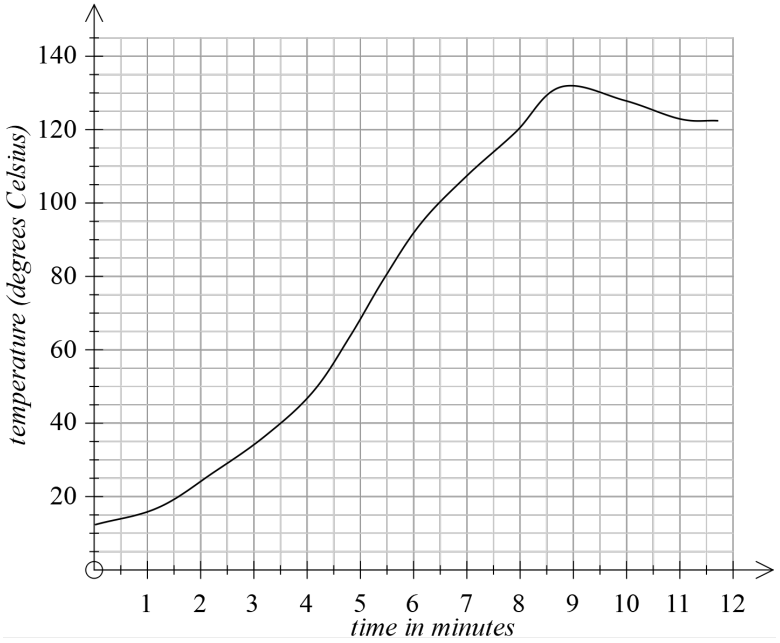
End of Module 3

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

Carolyn is heating an oven to 130° Celsius. The graph below shows the temperature, in degrees Celsius, in the oven while it is heating.



The period of greatest temperature increase is between

A. 0 and 2 minutes

B. 2 and 4 minutes

C. 4 and 6 minutes

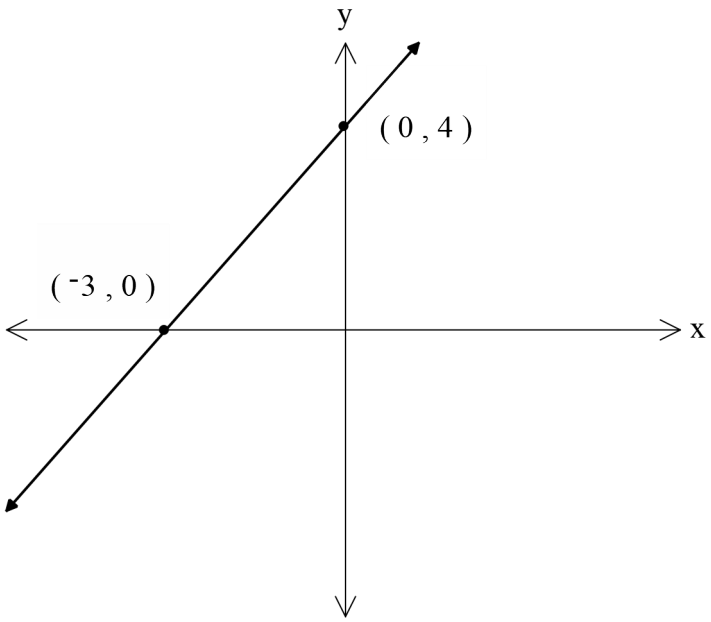
D. 6 and 8 minutes

E. 8 and 10 minutes

Module 4: Graphs and relations

Question 2

The graph below shows a straight line with x- intercept (-3, 0) and y- intercept (0, 4).



Which one of the following linear relations does **not** describe a line parallel to the one above?

A. $3y - 4x = 8$

B. $4x + 3y = 12$

C. $y = \frac{8}{6}x + 8$

D. $1.5y - 2x = 10$

E. $-12x + 9y + 5 = 0$

Module 4: Graphs and relations

Question 3

An equation for the linear graph that passes through the points (8,3) and (-8,-9) is

A. $3x - 4y = 8$

B. $4x - 2y = 6$

C. $3x - 4y = 12$

D. $3x + 4y = 9$

E. $4x - 3y = 14$

Question 4

Katy makes and sells jars of jam at a market.
The cost, in dollars, of making *n* jars is given by

$$cost = 5.50n + 40$$

At one market, she sells 72 jars of jam, making a profit of $464.
The amount, in dollars, that Katy charges for one jar of jam is

A. 6.05

B. 11.75

C. 5.85

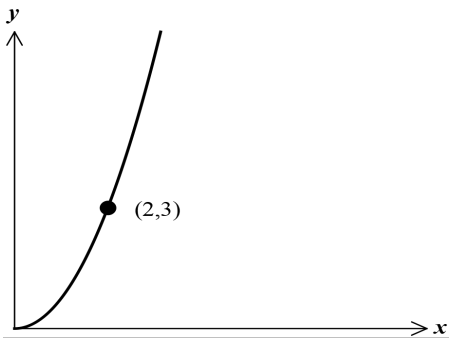
D. 12.50

E. 7.25

Module 4: Graphs and relations

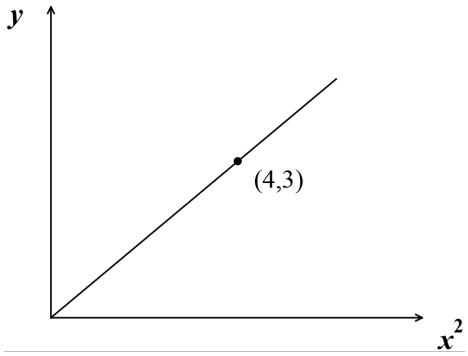
Question 5

The graph below shows a relationship between y and x.

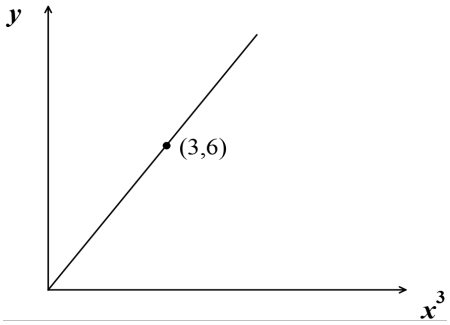


The graph that represents the same relationship between y and x could be

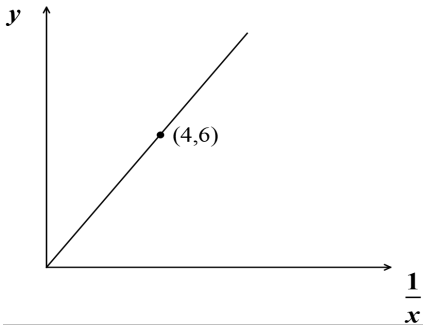
A.



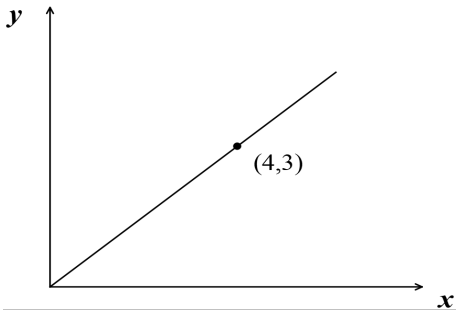
B.



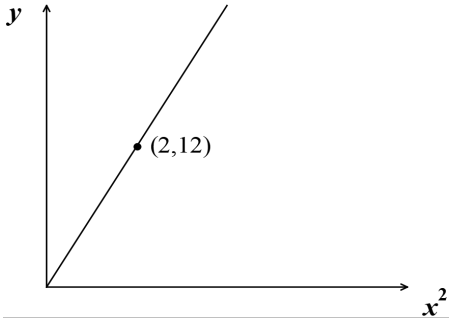
C.



D.



E.



Module 4: Graphs and relations

Question 6

Henry is making a mixture of oats and chocolate chips. The table below shows the amount of fat and fibre contained in each gram of oats and chocolate chips.

	1 gram of oats	**1 gram of chocolate chips**
Fat	0.02 gram	0.70 gram
Fibre	0.42 gram	0.02 gram

The mixture must contain at least 9 grams of fibre and no more than 2 grams of fat.
Let x be the mass, in grams, of oats that Henry puts into the mixture.
Let y be the mass, in grams, of chocolate chips that Henry puts into the mixture.

The inequalities that represent Henry's requirements for the mass of fat and fibre in the mixture are

A. $0.02x + 0.42y \geq 9 \; and \; 0.02x + 0.70y \leq 2$

B. $0.02x + 0.42y \geq 9 \; and \; 0.70x + 0.02y \leq 2$

C. $0.42x + 0.02y \geq 2 \; and \; 0.02x + 0.70y \leq 9$

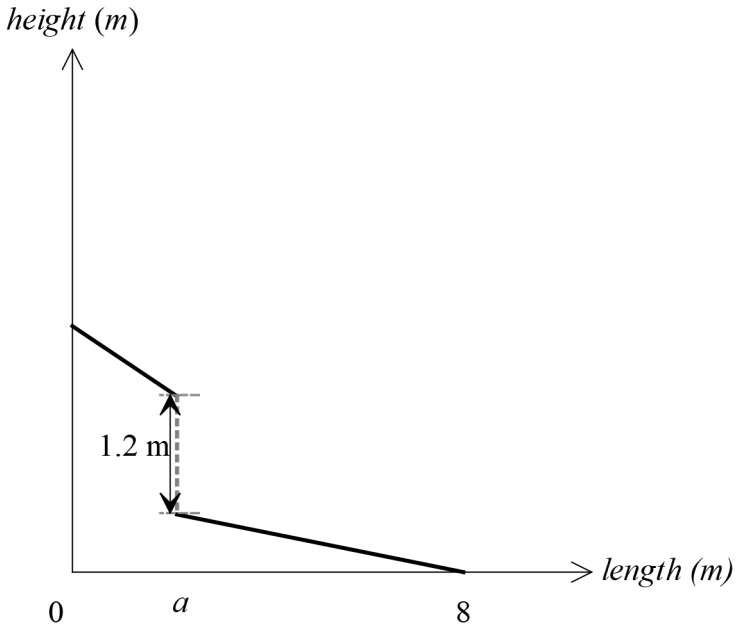
D. $0.42x + 0.02y \leq 9 \; and \; 0.02x + 0.70y \leq 2$

E. $0.42x + 0.02y \geq 9 \; and \; 0.02x + 0.70y \leq 2$

Module 4: Graphs and relations

Question 7

Paul has made a skateboard ramp consisting of two sections with a vertical drop between them. The sections are modelled by two linear graphs as follows.



$$height = \begin{cases} 2.5 - \frac{1}{3} \times length, & 0 \leq length \leq a \\ 0.8 - \frac{1}{10} \times length, & a < length \leq 8 \end{cases}$$

The vertical drop is 1.2 metres in height. The value of a is closest to

A. 3.4

B. 2.1

C. 3.2

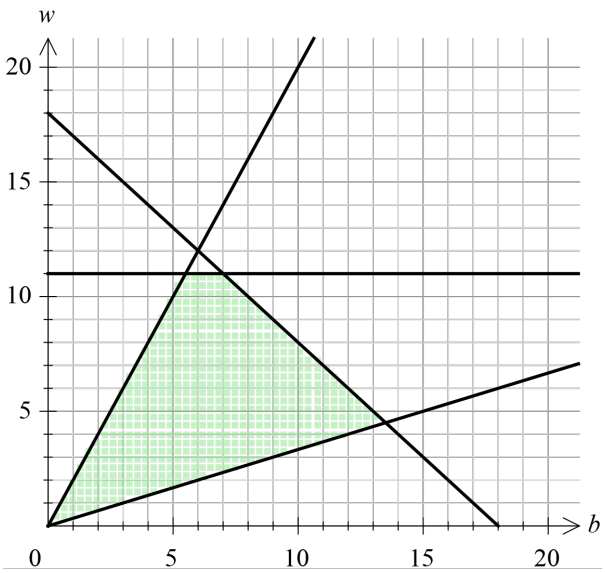
D. 2.6

E. 2.3

Module 4: Graphs and relations

Question 8

Emma runs a small business making bells and whistles.
Let b be the number of bells made each day
Let w be the number of whistles made each day
There are some constraints on the number of bells and whistles that can be made each day. These constraints define the feasible region shown shaded in the graph below.



One of the constraints that defines the feasible region is

A. The total number of bells and whistles made is at least 18

B. The number of bells made can be no more than 11

C. The number of bells made is at least twice the number of whistles

D. The number of bells made is no more than three times the number of whistles

E. The number of whistles made is at least three times the number of bells

End of Module 4

End of 2020 Further Mathematics Trial Examination 1

Kilbaha Education **PO Box 2227** **Kew Vic 3101** **Australia**	**Tel: (03) 9018 5376** **Fax: (03) 9817 4334** **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:	$z = \dfrac{x - \bar{x}}{s_x}$
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 $b = r\dfrac{s_y}{s_x}$ and $a = \bar{y} - b\bar{x}$
residual value:	residual value = actual value – predicted value
seasonal index:	seasonal index$= \dfrac{\text{actual figure}}{\text{deseasonalised figure}}$

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

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:	$A^{-1} = \dfrac{1}{\det A}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ 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 $\times$ height
volume of a pyramid:	$\frac{1}{3}$ $\times$ area of base $\times$ 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 2020
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 2020
Trial Written Examination 1
ANSWER SHEET

NAME: _____

STUDENT NUMBER _____

SIGNATURE _____

Instructions

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- 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 2020
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