TRIUMPH PUBLICATIONS

Fortify Sample Exam 1A

FURTHER MATHEMATICS

Written examination 1

Reading time: 15 minutes
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			20
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. 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 38 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 the formula sheet.

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 variables

postcode (number representing postal area)

land size (area of land in square metres)

A. are categorical and numerical respectively

B. are numerical and categorical respectively

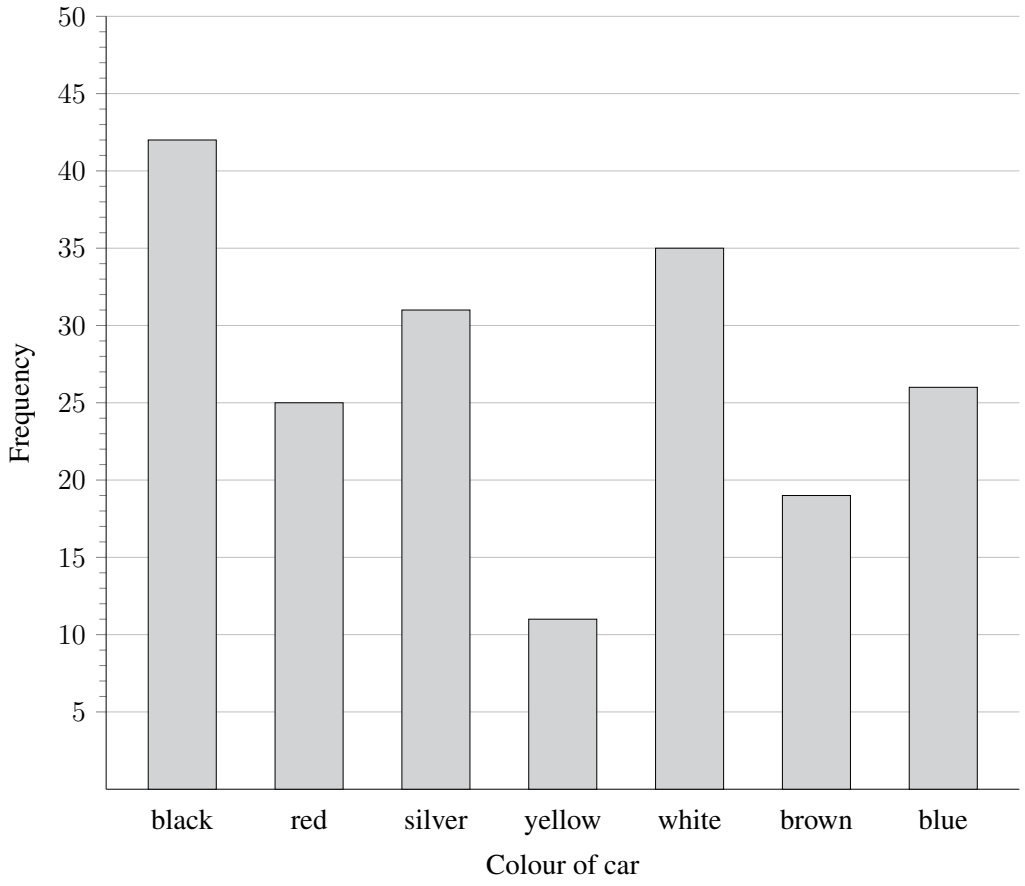
C. are neither categorical nor numerical

D. are both categorical

E. are both numerical

Use the following information to answer Question 2 and 3.

The following bar chart shows the distribution of colours of 189 cars recorded along a road on a particular day.



Question 2

According to the bar chart, the third most frequently observed car colour was

A. silver

B. red

C. black

D. white

E. yellow

Question 3

According to the bar chart, the percentage of the 189 cars that were observed to be red or white is closest to

A. 13%

B. 19%

C. 30%

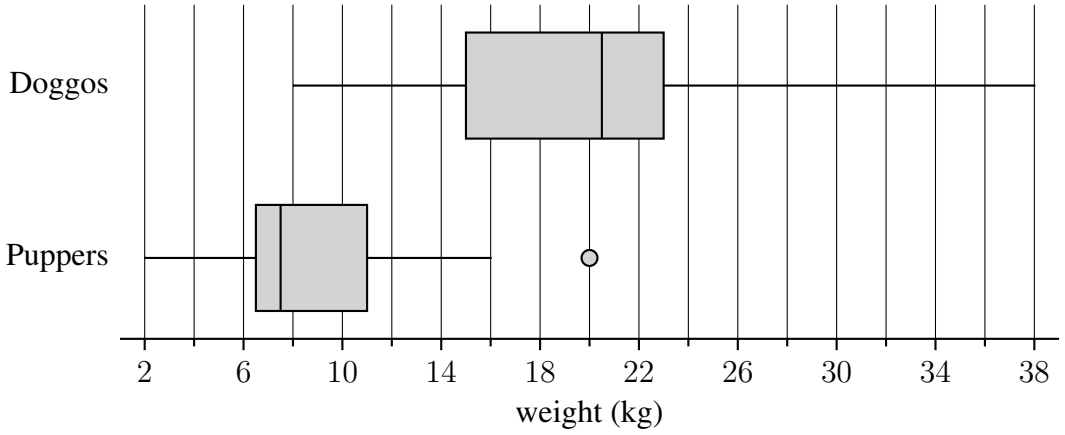
D. 32%

E. 68%

Use the following information to answer Question 4 and 5.

In Australia, dogs are categorised as either ”puppers” or ”doggos”.

The boxplots below can be used to compare the distribution of the weights of the puppers and the doggos.



Question 4

The five number summary for the weights of the puppers is closest to

A. 8, 15, 20.5, 23, 38

B. 8, 7.5, 11, 15, 20

C. 2, 6.5, 7.5, 23, 38

D. 2, 6.5, 7.5, 11, 20

E. 2, 6.5, 7.5, 11, 16

Question 5

Which one of the following statements is **not** true?

A. The weight of one of the puppers is an outlier.

B. The median weight of the doggos is greater than the weight of 100% of the puppers.

C. The doggos are more variable in weight than the puppers.

D. More than half of the doggos are less than 20kg in weight.

E. Less than half of the puppers are more than 8kg in weight.

Question 6

The following ordered stem plot shows the distance, in kilometres, of 25 houses to the nearest grocer.

key: 4|2 = 4.2 km

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

The median distance from these houses to the nearest grocer, in kilometres, is

A. 3.1 **B.** 3.3

C. 3.6 **D.** 33

E. 31

Question 7

For a set of bivariate data that involves the variables x and y with y as the response variable.

$$r = 0.983, \quad \bar{x} = 14.50, \quad \bar{y} = 22.00, \quad S_x = 3.03, \quad S_y = 8.59$$

The equation of the least squares regression line is closest to

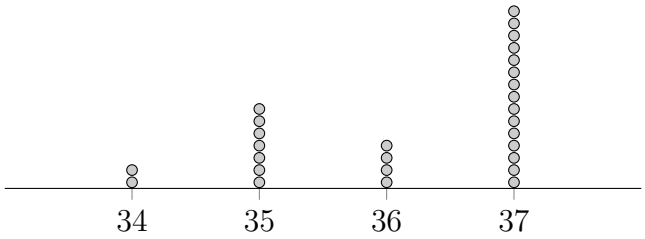
A. $y = -279 + 2.8x$ **B.** $y = 279 + 2.8x$

C. $y = 18 + 2.8x$ **D.** $y = -18 + 2.8x$

E. $y = -18 - 2.8x$

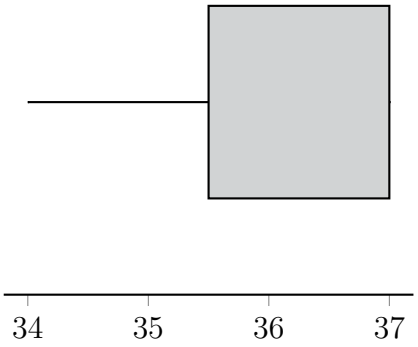
Question 8

A dot plot for a set of data is shown below.

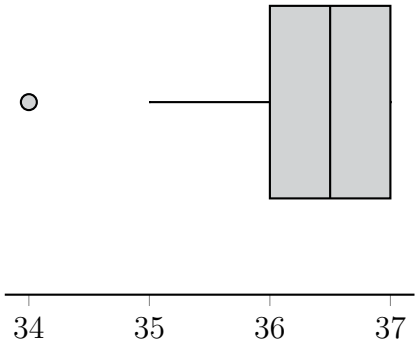


Which one of the following boxplots would best represent the dot plot above?

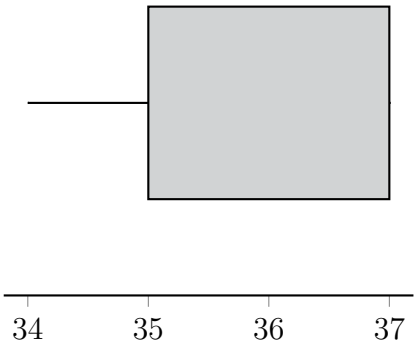
A.



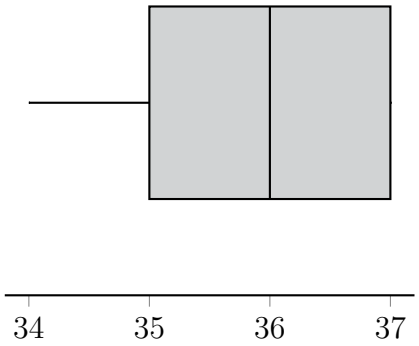
B.



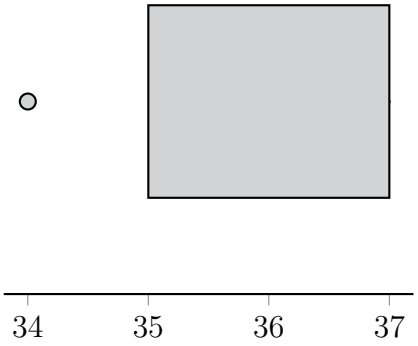
C.



D.



E.



Question 9

The seasonal index for ski sales in summer is 0.8. To correct for seasonality, the actual ski sales in summer would be

A. reduced by 25%

B. increased by 25%

C. reduced by 80%

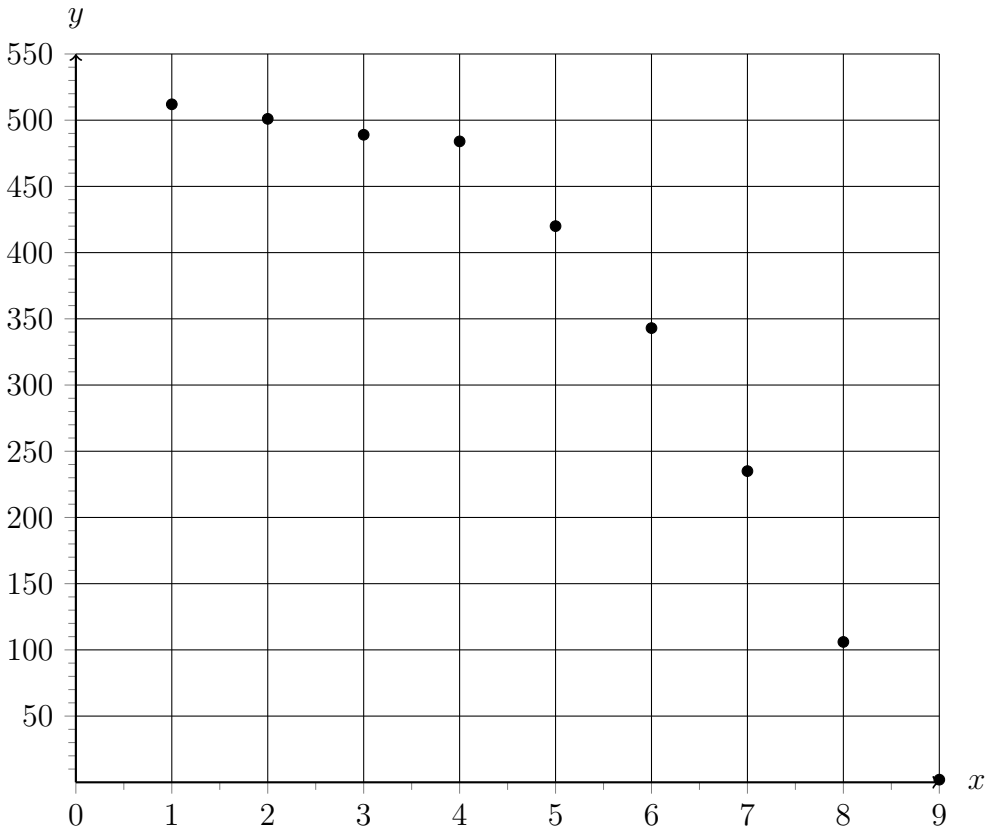
D. increased by 20%

E. reduced by 20%

Question 10

A student uses the following data to construct the scatterplot below.

x	1	2	3	4	5	6	7	8	9
y	512	501	489	484	420	343	235	106	2



A squared transformation is applied to variable x, linearise the scatterplot with y as the response variable. The slope of the least squares regression line that is fitted to the **linearised** plot is closest to

A. 6.65

B. 0.15

C. -0.15

D. -6.65

E. $-37\ 537$

Question 11

The equation of a least squares regression line is used to predict the age of a piglet, in weeks, from the piglet's weight, in grams.

This equation predicts that a piglet weighing 3,200 grams will be 7.2 weeks old, while a piglet weighing 2,700 grams will be 5.7 weeks old.

The slope of this least squares regression line is closest to

A. 0.003

B. -0.004

C. 250

D. 0.004

E. -200

Question 12

A squared transformation is applied to linearise the relationship between the amount of savings per week, in dollars, and number of children in a family. When a least squares regression line is fitted to the transformed data, its equation is

$$savings = 554 - 6.6x^2$$

The equation predicts that a family with 3 children has savings per week, in dollars, that is closest to

A. \$22

B. \$534

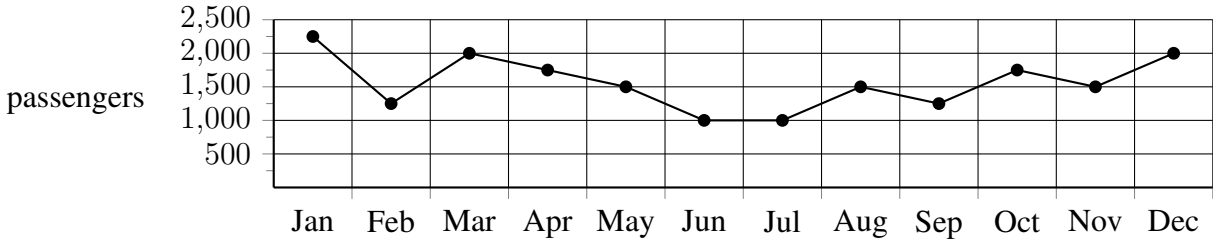
C. \$4,927

D. \$495

E. \$1,642

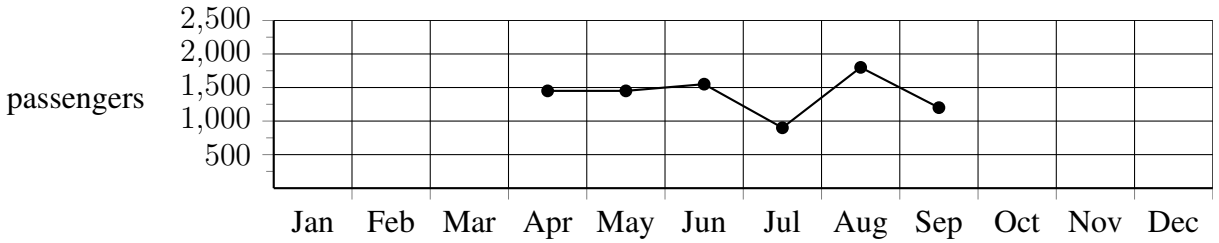
Question 13

The time series below shows the number of passengers on a ferry each month during 2016.

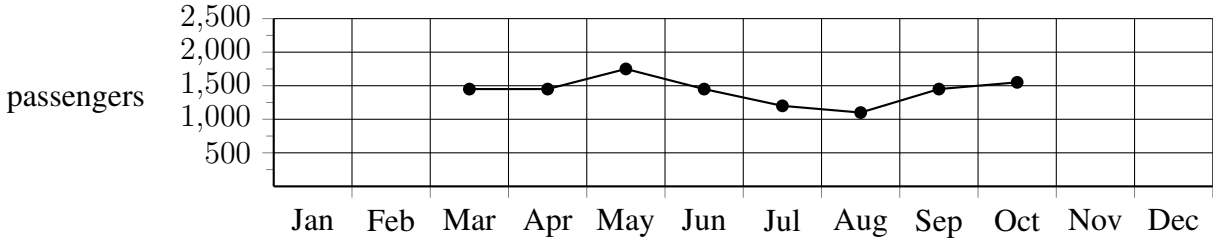


Using the five-mean smoothing method, the smoothed time series plot will look most like

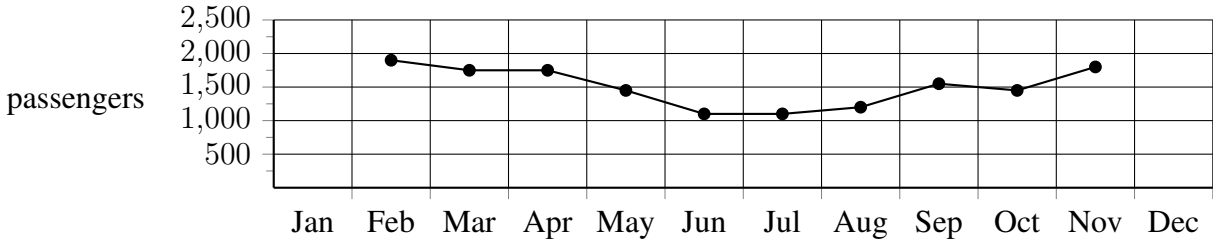
A.



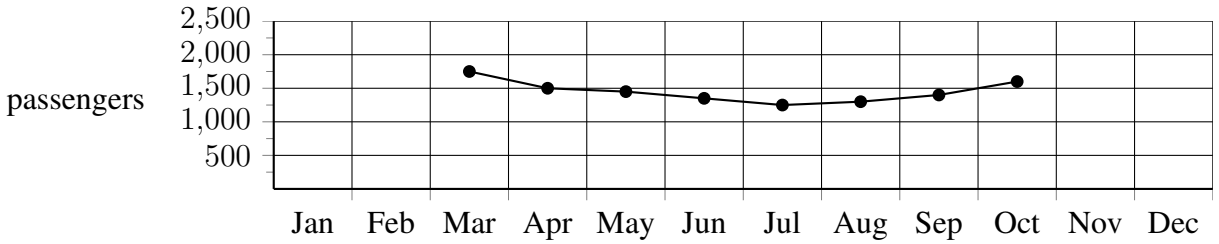
B.



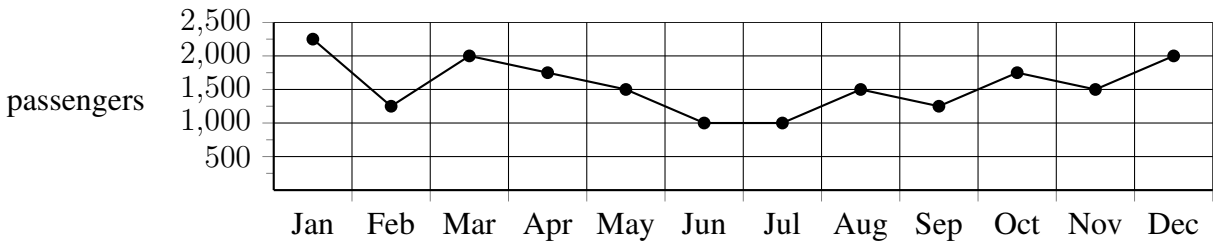
C.



D.

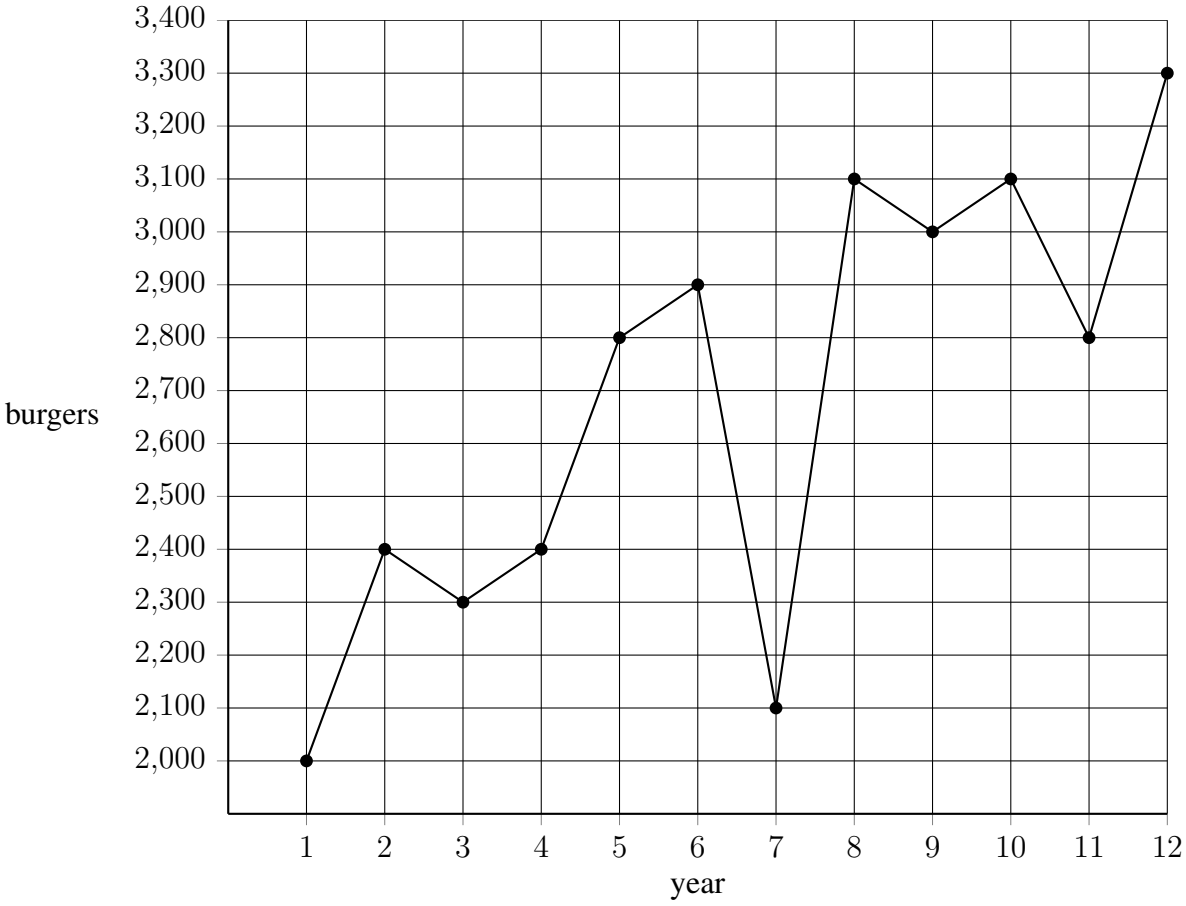


E.



Question 14

The time series plot below charts the number of burgers ordered per year from a takeaway store over a 12 year period.



Using five-mean smoothing, the smoothed number of burgers in year 7 was closest to

A. 2,100

B. 2,660

C. 2,780

D. 2,840

E. 2,900

Question 15

The time, in hours, that students spent on social networking platforms during a week was recorded for 2,080 students. The distribution of the times was found to be approximately normal with a mean of 15.6 hours and a standard deviation of 1.8 hours.

The time that 68% of these students spent on social networks during a week could be

A. less than 17.4 hours

B. more than 13.8 hours

C. between 13.8 and 17.4 hours

D. between 12 and 19.2 hours

E. less than 12 hours or more than 19.2 hours

Question 16

The table below shows the percentage of students in two age groups (12-15 years and 16-19 years) who regularly communicate with their friends using one or more of three platforms.

- Text message
- Facebook messenger
- Snapchat

	Age Group	
Messaging Platform	**12-15 years**	**16-19 years**
Text message	32%	88%
Facebook messenger	91%	91%
Snapchat	93%	45%

Of the students surveyed, which one of the following statements, by itself, supports the contention that the platform used for communication is associated with the age group?

A. 45% of students aged 16-19 used Snapchat to communicate with their friends.

B. 32% of students aged 12-15 used text message to communicate with their friends, while 93% of 12-15 year old students use Snapchat.

C. 91% of students aged 12-15 used Facebook messenger to communicate with their friends, and 88% of 16-19 year old students use text message to communicate with their friends.

D. the percentage of students who used text message to communicate with their friends increased from 32% for those aged 12-15 to 88% for those aged 16-19.

E. the percentage of students who used Facebook messenger to communicate with their friends was 91% for those aged 12-15 and 91% for those aged 16-19.

Recursion and financial modelling

Question 17

$5,000 is invested at a simple interest rate of 5.1% per annum.

The total interest earned in three years is

A. $255

B. $510

C. $765

D. $805

E. $5,765

Question 18

A jar of air from Kanye's most recent concert was bought for $20,000. Over a 5-year period, its value increased to $25,560.

The increase in value as a percentage of the purchase price is closest to

A. 2.8%

B. 5.6%

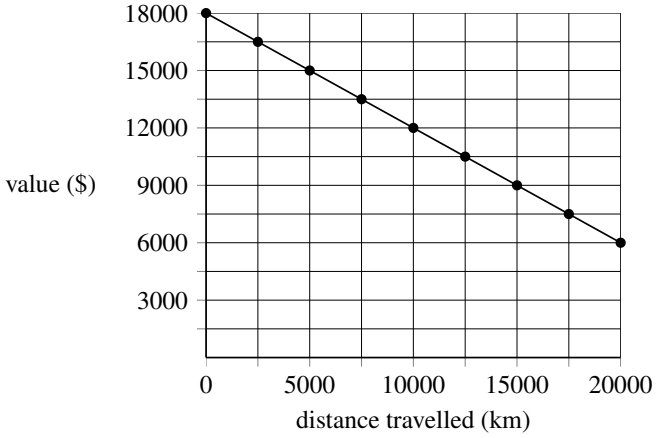
C. 21.6%

D. 27.8%

E. 78.2%

Question 19

The following graph shows the depreciating value of a jetski.



The graph could represent the jetski being depreciated using

A. flat rate depreciation with an initial value of $18,000 and a depreciation rate of $60 per year

B. flat rate depreciation with an initial value of $18,000 and a depreciation rate of $0.60 per year

C. unit cost depreciation with an initial value of $18,000 and a depreciation rate of $60 per kilometre travelled

D. unit cost depreciation with an initial value of $18,000 and a depreciation rate of $0.60 per kilometre travelled

E. reducing balance depreciation with an initial value of $18,000 and a depreciation rate of 6% per annum

Question 20

The purchase price of a ring is $12,000. A deposit of $4,000 is paid. The balance will be repaid with 36 monthly repayments of $350. The total amount of interest to be charged is

A. $60

B. $600

C. $4,600

D. $12,600

E. $16,600

Question 21

A mixed martial artist needs to lose weight before her fight in a couple of months. She has figured out that she needs to lose half a kilo per week in order to reach her target weight.

Her weight, M_n, in kilograms, after n weeks, would be modelled by the rule

A. $M_{n+1} = 0.5M_n$

B. $M_{n+1} = 0.95M_n$

C. $M_{n+1} = 1.05M_n$

D. $M_{n+1} = M_n - 5$

E. $M_{n+1} = M_n - 0.5$

Question 22

Consider the recurrence relation below:

$$A_0 = 3 \qquad A_{n+1} = 2A_n - 1$$

The first four terms of this recurrence relation are:

A. $-1,\ 1,\ 3,\ 5,\ ...$

B. $1,\ 3,\ 5,\ 7,\ ...$

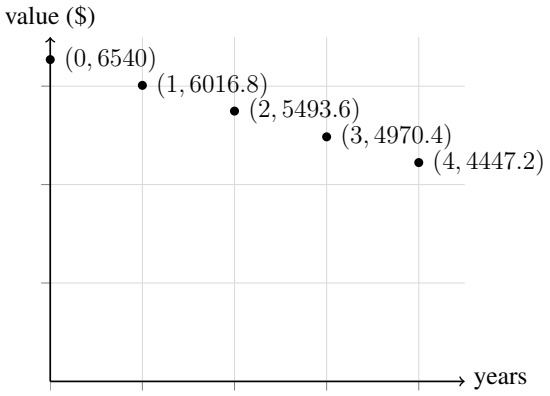
C. $3,\ 5,\ 9,\ 17,\ ...$

D. $3,\ 7,\ 13,\ 25,\ ...$

E. $3,\ 7,\ 15,\ 31,\ ...$

Question 23

Consider the graph below.



This graph could show the value of

A. A perpetuity earning interest at the rate of 8% per annum.

B. A compound interest investment earning interest at the rate of 8% per annum.

C. A piece of art depreciating with a reducing balance rate of 8% per annum.

D. An annuity investment with additional payments of 8% of the initial investment amount per annum.

E. A boat depreciating at a flat rate of 8% per annum.

Question 24

The following information relates to the repayment of a loan of $200,000.

- The loan is to be repaid fully with monthly payments of $1,700.
- Interest compounds monthly.
- $800 of the first payment goes towards reducing the principal.

Which one of the following statements is **not** true?

A. After the first monthly payment has been made, the amount owing on the loan is $199,200.

B. Payments of $2,000 rather than $1,700 per month will reduce the time to repay the loan fully by more than three years.

C. $900 of interest is paid in the first month.

D. Six years into the term of the loan, the amount still owing is over $105,000.

E. The loan will be fully repaid in 14 years.

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

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

$$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 3 & 3 & 1 & 5 \end{bmatrix} \begin{bmatrix} 0 & 5 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 3 & 0 & 0 \\ 0 & 3 & 0 & 0 \end{bmatrix} \text{ is equal to}$$

A. $\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 44 & 0 & 0 \end{bmatrix}$

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

C. $\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 36 & 0 & 0 \end{bmatrix}$

D. $\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 9 & 0 & 0 \end{bmatrix}$

E. $\begin{bmatrix} 0 & 5 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 3 & 0 & 0 \\ 3 & 9 & 1 & 5 \end{bmatrix}$

Question 2

Matrix A has two rows and five columns. Matrix B has five rows and three columns.
Matrix $C = A \times B$ has

A. Three rows and two columns

B. Five rows and five columns

C. Two rows and five columns

D. Five rows and three columns

E. Two rows and three columns

Question 3

A football team consists of players with one of three hairstyles: mullet (M), buzzcut (B) or long (L).

Following each year for the first three years, the players' choice of haircut is expected to change according to the transition matrix T_1, where

$$T_1 = \begin{array}{c} \\ M \\ B \\ L \end{array} \begin{array}{c} \begin{array}{ccc} \textit{this year} & & \\ M & B & L \end{array} \\ \begin{bmatrix} 0.65 & 0.30 & 0.15 \\ 0.10 & 0.55 & 0.05 \\ 0.25 & 0.15 & 0.80 \end{bmatrix} \end{array} \begin{array}{l} M \\ B \\ L \end{array} \quad \textit{next year}$$

After the first three years, due to changes in fashion, the players' choice of haircut is expected to change yearly according to the transition matrix T_2, where

$$T_2 = \begin{array}{c} \\ M \\ B \\ L \end{array} \begin{array}{c} \begin{array}{ccc} \textit{this year} & & \\ M & B & L \end{array} \\ \begin{bmatrix} 0.80 & 0.00 & 0.05 \\ 0.10 & 0.95 & 0.15 \\ 0.10 & 0.05 & 0.80 \end{bmatrix} \end{array} \begin{array}{l} M \\ B \\ L \end{array} \quad \textit{next year}$$

In Year 1, 9 players had mullets, 7 players had buzzcuts and 14 players had long hair. Let S_1 be the state matrix for Year 1.

The number of players expected to have a mullet, a buzzcut or long hair in Year 6 can be found by evaluating

A. $S_1{T_1}^2{T_2}^3$

B. ${T_1}^5 S_1$

C. ${T_2}^2{T_1}^3 S_1$

D. ${T_2}^3{T_1}^2 S_1$

E. ${T_2}^3{T_1}^3 S_1$

Question 4

$$3.6x - 2.8y = 7$$
$$kx + 0.7y = 11$$

The set of simultaneous linear equations above has **no** solutions when k equals

A. -0.9

B. -0.4

C. 0.05

D. 0.4

E. 0.9

Question 5

Each week, the 180 employees of a factory choose ham (H), peanut butter (P) or jam (J) for afternoon lunch from the canteen.

The transition matrix below shows how the employees' choices change from day to day.

$$\begin{array}{c} \\ H \\ P \\ J \end{array} \begin{array}{c} \textit{today} \\ \begin{array}{ccc} H & P & J \end{array} \\ \begin{bmatrix} 0.4 & 0.3 & 0.4 \\ 0.3 & 0.5 & 0.1 \\ 0.3 & 0.2 & 0.5 \end{bmatrix} \end{array} \begin{array}{l} \\ H \\ P \\ J \end{array} \quad tomorrow$$

Based on the information above, it can be concluded that, in the long term

A. jam will be the most popular sandwich

B. no employee will choose peanut butter sandwiches

C. more employees will choose ham sandwiches than jam sandwiches

D. more employees will choose peanut butter sandwiches than jam sandwiches

E. ham will be the least popular sandwich

Question 6

A and B are square matrices such that $AB = BA = I$, where I is an identity matrix.

Which of the following statements is true?

A. $A^2B^2 = A^2$

B. $ABB = B$

C. A does not have an inverse

D. B does not have an inverse

E. A must equal B

Question 7

The numbers of senior, adult and child lift passes purchased at a popular ski resort over 4 years are shown in the table below.

Year	Senior	Adult	Child
1	62	210	98
2	75	215	118
3	80	149	89
4	79	196	87

Which one of the following matrix calculations can be used to determine the totals for the number of senior tickets, adult tickets and child tickets purchased?

A. $\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 62 & 210 & 98 \\ 75 & 215 & 118 \\ 80 & 149 & 89 \\ 79 & 196 & 87 \end{bmatrix}$

B. $\begin{bmatrix} 62 & 75 & 80 & 79 \\ 210 & 215 & 149 & 196 \\ 98 & 118 & 89 & 87 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 62 & 75 & 80 & 79 \\ 210 & 215 & 149 & 196 \\ 98 & 118 & 89 & 87 \end{bmatrix}$

D. $\begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} \begin{bmatrix} 62 & 210 & 98 \\ 75 & 215 & 118 \\ 80 & 149 & 89 \\ 79 & 196 & 87 \end{bmatrix}$

E. $\begin{bmatrix} 62 & 75 & 80 & 79 \\ 210 & 215 & 149 & 196 \\ 98 & 118 & 89 & 87 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$

Question 8

The transpose of $\begin{bmatrix} 10 & 9 \\ 4 & 6 \\ 9 & 11 \end{bmatrix}$ is

A. $\begin{bmatrix} 9 & 6 & 11 \\ 10 & 4 & 9 \end{bmatrix}$

B. $\begin{bmatrix} 10 & 4 & 9 \\ 9 & 6 & 11 \end{bmatrix}$

C. $\begin{bmatrix} 9 & 4 & 10 \\ 11 & 6 & 9 \end{bmatrix}$

D. $\begin{bmatrix} 9 & 10 \\ 6 & 4 \\ 10 & 9 \end{bmatrix}$

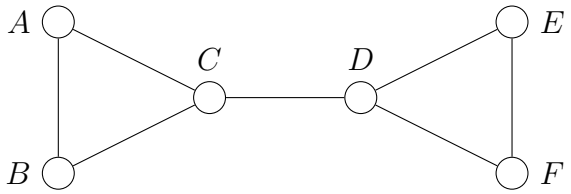
E. $\begin{bmatrix} 9 & 11 \\ 4 & 6 \\ 10 & 9 \end{bmatrix}$

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 graph below shows the streets connecting six roundabouts: A, B, C, D, E and F.



A postman starts at roundabout C then proceeds to travel to A, B, C, D, E, F, D.
The mathematical term for this route is

A. A Hamiltonian path

B. A Hamiltonian cycle

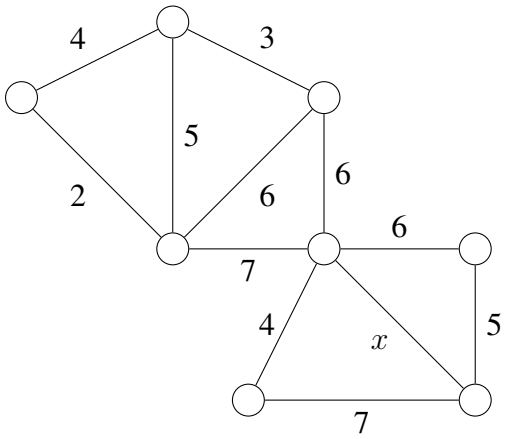
C. A minimum spanning tree

D. An Eulerian trail

E. An Eulerian circuit

Question 2

The minimum spanning tree for the network below includes the edge with a weight 'x'.



The total weight of all edges for the minimum spanning tree is 27. The value of 'x' is

A. 2

B. 3

C. 4

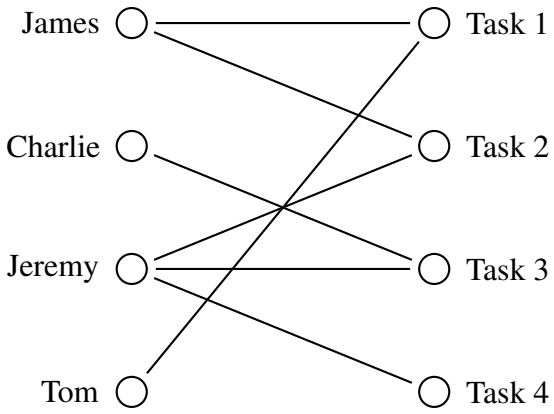
D. 5

E. 6

Question 3

James, Charlie, Jeremy and Tom are each going to be allocated one particular task in the renovation of a backyard.

The bipartite graph below shows which tasks each person is able to complete.



Each person completes a different task.

Task 2 must be completed by

A. James

B. Charlie

C. Jeremy

D. Tom

E. James or Jeremy

Question 4

A planar graph has eight vertices and eleven edges. The number of faces this graph has is

A. 3

B. 5

C. 7

D. 8

E. 11

Question 5

Which one of the following statements about critical paths is **true**?

A. If there is only one critical path in a project, then reducing the time of any activity on that path will reduce the minimum completion time for the project.

B. A critical path always contains the path with the most activities.

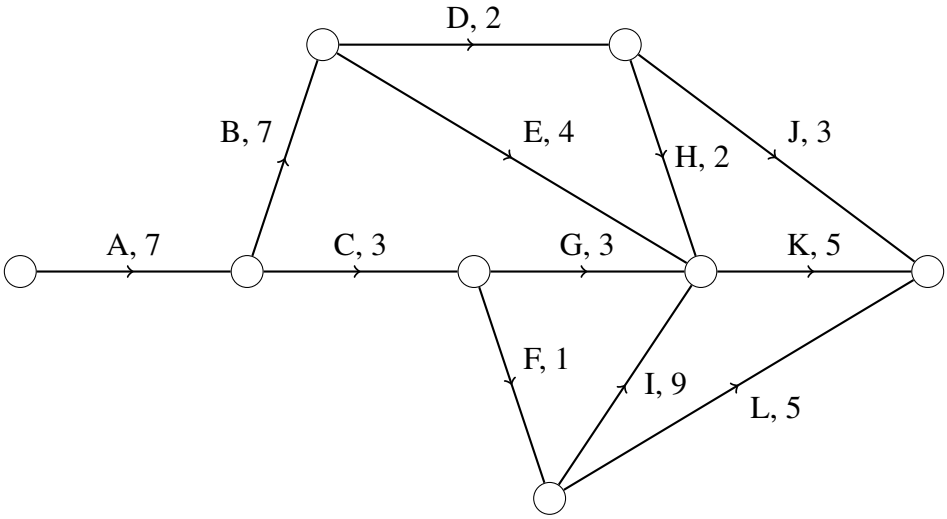
C. There cannot be two critical paths in a project.

D. The critical path cannot contain the activity of the shortest time to complete.

E. No amount of increase or decrease in time can change the activity order of the critical path.

Use the following information to answer Question 6 and 7.

The directed graph below shows the sequence of activities required to complete a project.
All times are in days.



Question 6

The number of activities that have exactly 1 predecessor is

A. 2 **B.** 5

C. 6 **D.** 10

E. 12

Question 7

There is one critical path for this project.
Three critical paths would exist if the duration of activity

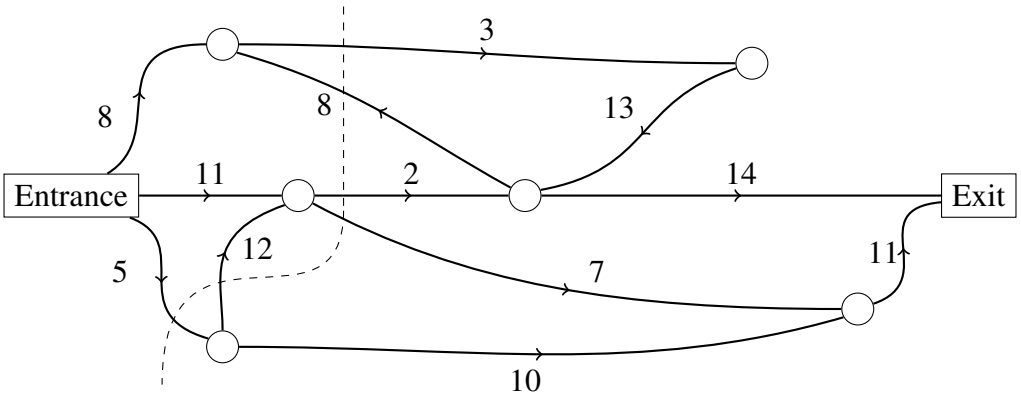
A. C were increased by a day **B.** H were increased by 2 days

C. I were reduced by 2 days **D.** K were reduced by 2 days

E. L were reduced by 3 days

Question 8

The arrows below show the direction of the flow of soldiers through a series of tunnels that lead behind enemy lines. The numbers along the edges show the number of soldiers per minute that can pass through each section of the tunnels.



The minimum cut is shown as a dotted line. The capacity of this cut, in soldiers per minute, is

A. 10

B. 17

C. 20

D. 25

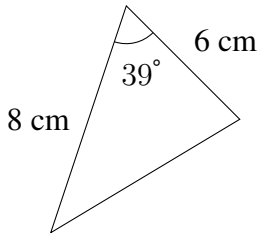
E. 37

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

Consider the following scalene triangle with side lengths 8 cm and 6 cm, and interior angle of 39°, as shown below.



The perimeter, P, in centimetres, can be found using the formula

A. $P = \sqrt{2 \times 6 \times 8 \times \cos(39^\circ) - 6^2 - 8^2}$

B. $P = \sqrt{6^2 + 8^2 - 2 \times 6 \times 8 \times \cos(39^\circ)} + 6 + 8$

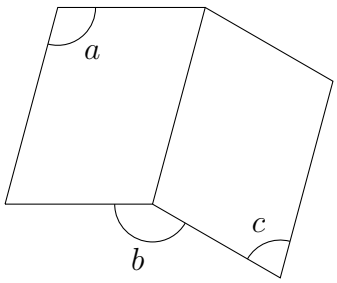
C. $P = \dfrac{\sin(39^\circ) \times 6}{\sin(51^\circ)} + 6 + 8$

D. $P = \sqrt{8^2 - 6^2} + 6 + 8$

E. $P = \dfrac{6}{8} \times \cos(39^\circ)$

Question 2

A composite shape is made up of two similar parallelograms, as shown below.



Which of the following is **not true**?

A. $2a + b = 360$

B. $2c = b$

C. $b = c + a$

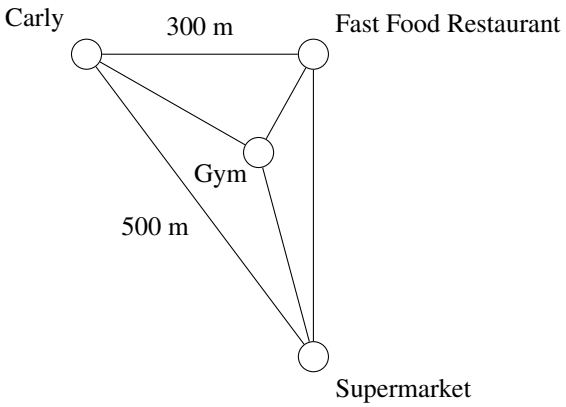
D. $a + c = 180$

E. $\frac{b}{2} + 2a = 360 - c$

Question 3

Carly lives 300 metres directly west of a local Fast Food Restaurant, 500 metres away from a local Supermarket, and nearby to a local Gym.

The Supermarket is directly south of the Fast Food Restaurant. The Gym is on a bearing of 340° from the Supermarket and 210° from the Fast Food Restaurant.



To stay healthy, Carly starts going to the gym after eating Fast Food. The straight-line distance, in metres, between the Gym and the Fast Food Restaurant is closest to

A. 179

B. 261

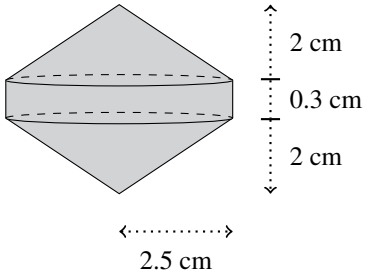
C. 260

D. 400

E. 274

Question 4

Leonardo requires a new conical spinning top made of marble to ensure his sanity. The dimensions of the top are presented in the figure below.



The volume of marble required to create this top, in cubic millimetres, is closest to

A. 18980

B. 26180

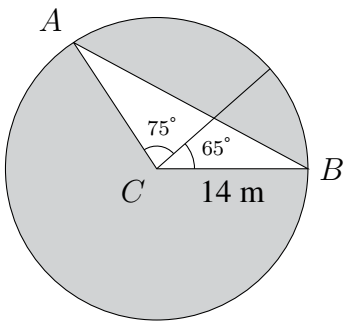
C. 28143

D. 32070

E. 84430

Question 5

Three segments are formed in a circle with angles 75° and 65°. The circle has a radius of 14 metres. These segments are presented in the figure below.



Removing triangle ABC formed by the segments, the area of the shaded region, in square metres, can be found using the formula

A. $\pi \times 14^2 - \frac{1}{2} \times 196 \times \sin\left(75^\circ\right) \times \sin\left(65^\circ\right)$

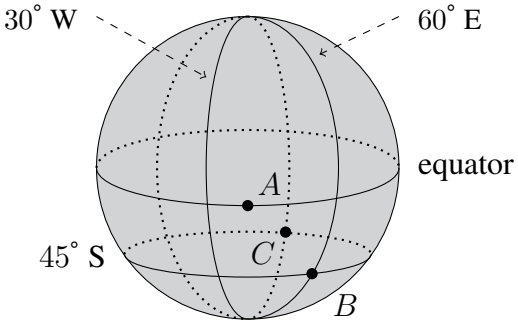
B. $\pi \times 14 - \frac{1}{2} \times 14^2 \times \sin\left(140^\circ\right)$

C. $\pi \times 14^2 - \frac{1}{2} \times 14 \times \sin\left(40^\circ\right)$

D. $\pi \times 196 + \frac{1}{2} \times 14^2 \times \sin\left(140^\circ\right)$

E. $\pi \times 14^2 - \frac{1}{2} \times 14^2 \times \sin\left(140^\circ\right)$

Question 6



Considering the above figure, which statement is **not true**?

A. C and B are located on the same line of longitude.

B. B and C are located on the same line of latitude.

C. A is located on the equator.

D. B is located due west or due east of C.

E. B is located on a longitude of 60° E.

Question 7

A triangle ABC has:

- One side, AB, of length 6 cm
- One side, BC, of length 7 cm
- One angle, $\angle ACB$, of 44°

Which one of the following angles, correct to the nearest degree, could **not** be another angle in triangle ABC?

A. 10 **B.** 46

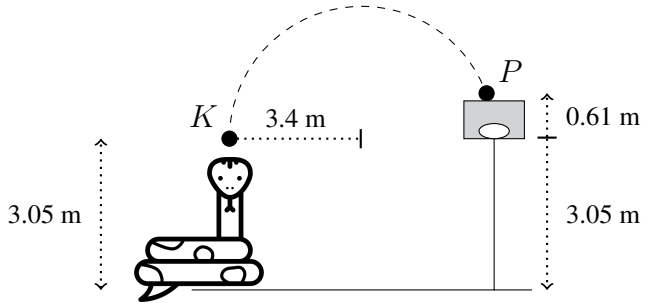
C. 54 **D.** 82

E. 126

Question 8

NBA player Kevin Snakerant shoots a basketball at the ring in a perfect circular arc from point K, which is at the same height as the basketball ring, 3.05 metres above the ground. Russell Herobrook is attempting to goaltend his shot, by intercepting it at point P, as shown in the following diagram.

The **vertical distance** from P to the basketball ring is 0.61 metres, and the radius of the arc made by Kevin's shot is 3.4 metres.



Assume that the referees ignore Russell Herobrook's illegal goaltend because they don't respect Kevin Snakerant. Like, at all.

The distance the ball travelled along the dotted arc, in metres, before interception at point P, is closest to

A. 10.1 **B.** 10.2

C. 10.7 **D.** 13.1

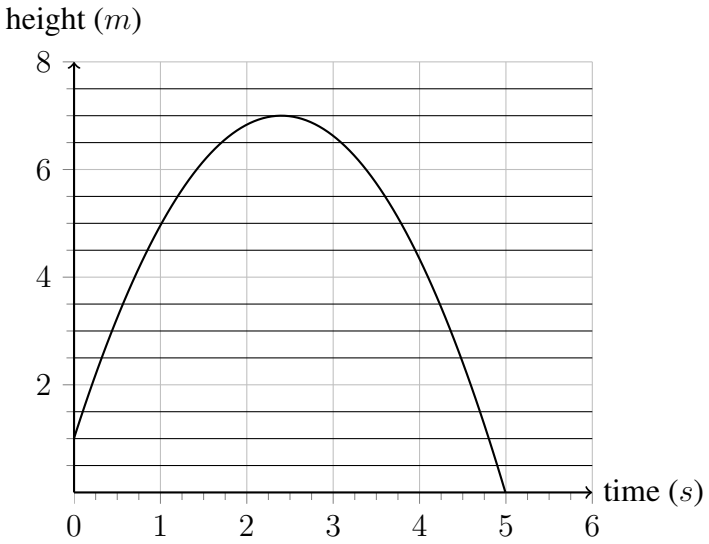
E. 21.4

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

Jacob kicks a football as far as he can. The graph below shows the height of the football above the ground, in metres, over time, in seconds.



From the moment it is kicked, the time it takes for the ball to hit the ground, in seconds, is closest to

A. 4.6 **B.** 4.8

C. 5.0 **D.** 5.2

E. 5.4

Question 3

An internet company charges a fixed connection fee of \$15 plus \$0.08 per megabyte of download. Let n be the number of megabytes downloaded in a month. Let C be the monthly internet bill, in dollars.

The equation for the relationship between the monthly internet bill, in dollars, and the number of megabytes downloaded is

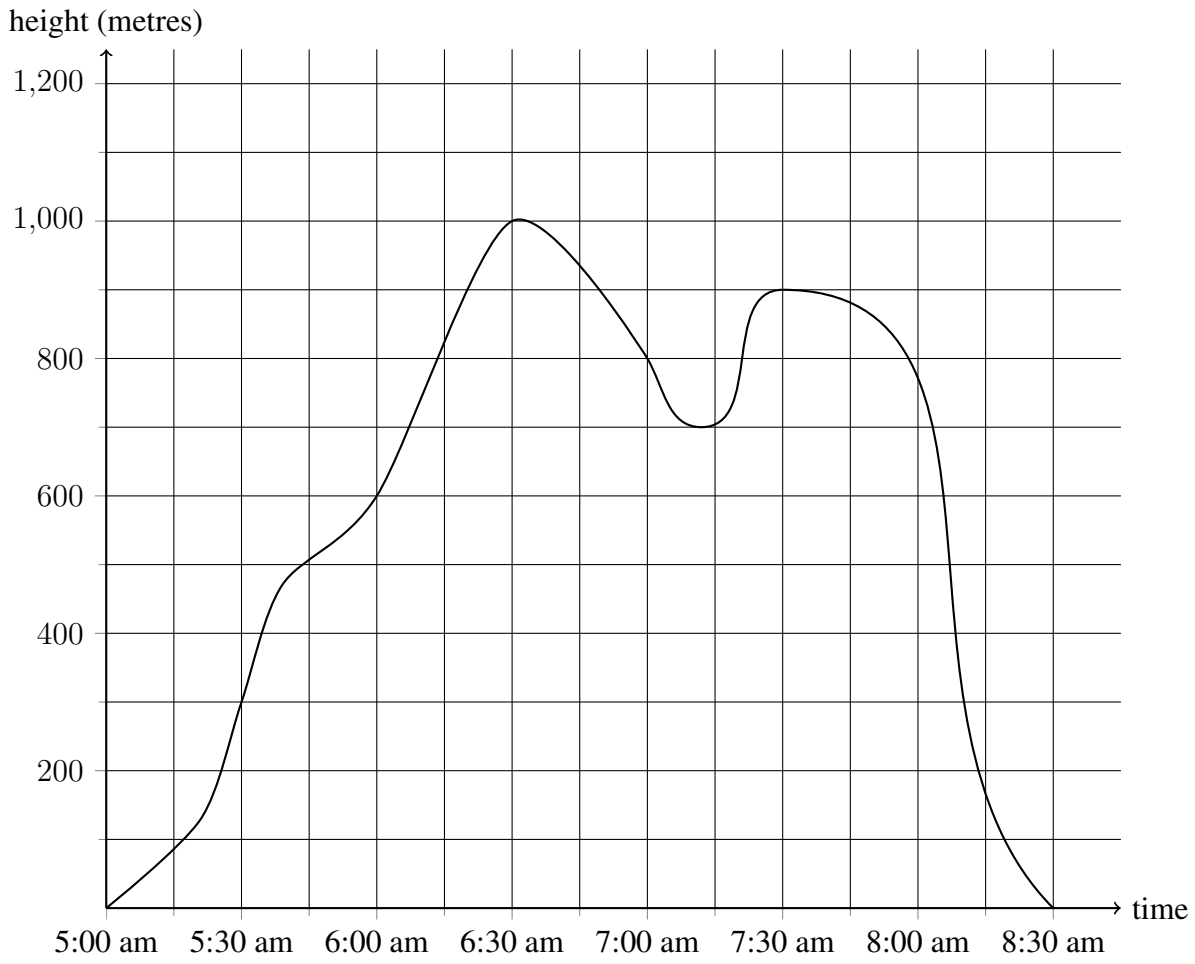
A. $C = 15 + 0.8n$ **B.** $C = 15 + 0.08n$

C. $C = 15n + 0.8$ **D.** $C = 15n + 0.08$

E. $C = 0.08(15 + n)$

Question 3

The graph below shows the altitude, in metres, of a hot air balloon ride from from 5:00am until 8:30pm.



From 6:30am to 8:30am, the hot air balloon's altitude decreased by

A. 600 m

B. 800 m

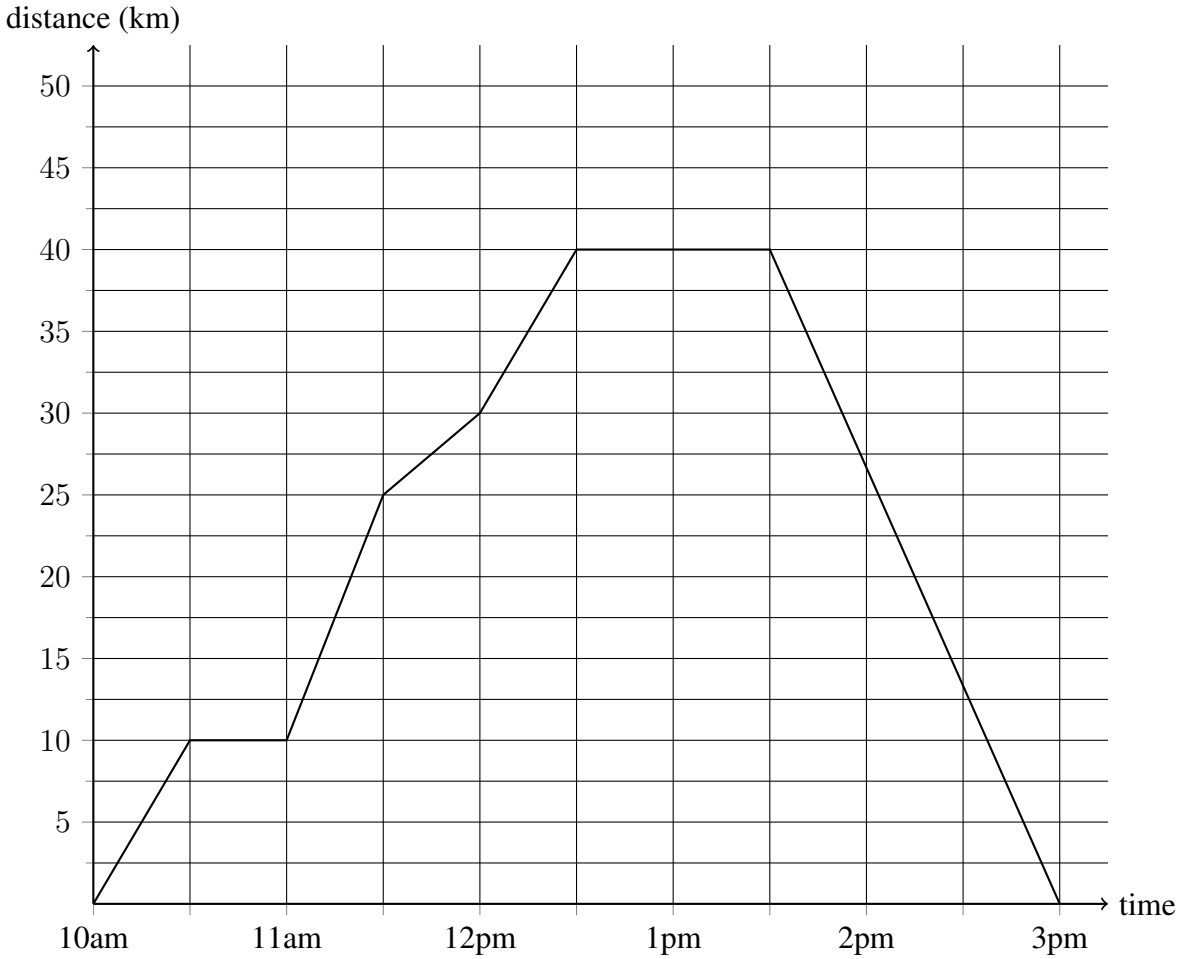
C. 900 m

D. 1000 m

E. 1100 m

Question 4

Christian rides his bike along a bush trail that leads directly north from his home. The graph below shows Christian's distance from home over a five-hour bike ride.



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

A. Christian is getting closer to his home between 10:30am and 11:00am.

B. Christian is travelling fastest between 12:00pm and 12:30pm.

C. Christian is 45 km away at his furthest distance from home.

D. Christian begins and ends his bike ride at two different locations.

E. Christian stops for an hour and a half in total.

Question 5

A point that lies on the graph of

$$4x - y = 7$$

is

A. $(7, 19)$

B. $(3, 4)$

C. $(6, 16)$

D. $(5, 13)$

E. $(8, 26)$

Question 6

The point $(-4, 1)$ satisfies the inequality

A. $y > 1$

B. $x < -4$

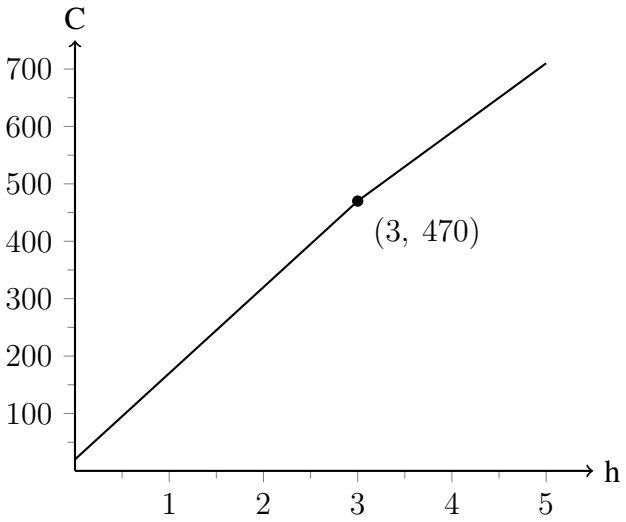
C. $-4 < x \leq 1$

D. $y \leq \frac{x}{4}$

E. $y > 4 + x$

Question 7

The graph below shows the cost, C, of hiring a musician for a wedding for h hours.



A function that can be used to model this is

$$C = \begin{cases} 150h + 20, & 0 \leq h < 3 \\ 120h + k, & 3 \leq h \leq 5 \end{cases}$$

The value of k is

A. 20

B. 110

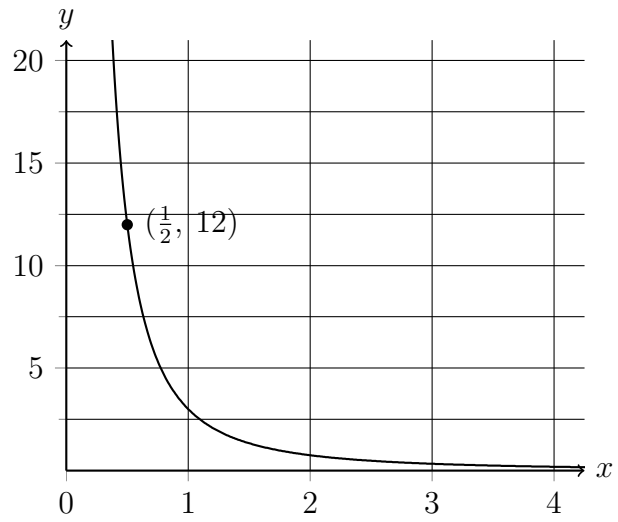
C. 200

D. 470

E. 590

Question 8

The point $\left(\frac{1}{2}, 12\right)$ lies on the graph $y = \frac{k}{x^2}$, as shown below.



The value of k is

A. $\frac{1}{3}$

B. $\frac{1}{2}$

C. 1

D. 3

E. 12

END OF QUESTION AND ANSWER BOOK

TRIUMPH PUBLICATIONS

FURTHER MATHEMATICS

Written examination 1

FORMULA SHEET

Instructions

This formula sheet is provided for your reference.
A multiple-choice question book is provided with this formula sheet.

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

Formula Sheet

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 of best fit	$y = a + bx$, 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	$r_{\text{effective}} = \left[\left(1 + \dfrac{r}{100n}\right)^n - 1\right] \times 100\%$

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

Module 2 - Networks and Decision Mathematics

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

Module 3 - Geometry and Measurement

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