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Year 12 *Trial Exam Paper*
2016
FURTHER MATHEMATICS
Written examination 1

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

STUDENT NAME:

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of modules*	*Number of modules to be answered*	*Number of marks*
A – Core	24	24			24
B – Modules	32	16	4	2	16
					Total 40

- Students are permitted to bring into the 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 43 pages.
- Formula sheet.
- Answer sheet for multiple-choice questions.
- Working space is provided throughout the book.

Instructions
- Write your **name** in the space provided above and on the multiple-choice answer sheet.
- Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

At the end of the examination
- You may keep this question book.

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

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 1–4.

The scores for a Year 12 Further Mathematics test were recorded by the Mathematics teacher of 12A as a raw score out of 40 marks. The scores are listed below:

34	38	40	38	15	25	22	26	21	33	34
38	39	39	38	26	37	31	30	40	3	17

Question 1

The variable *Further Mathematics test scores* can be classified as

A. categorical ordinal.

B. categorical nominal.

C. numerical discrete.

D. numerical continuous.

E. numerical nominal.

Question 2

The most appropriate graphical tool to investigate the relationship between *Further Mathematics test score* and *gender* would be

A. a histogram.

B. a segmented bar chart.

C. a scatterplot.

D. parallel boxplots.

E. a dot plot.

Question 3

The test scores for 12A are displayed in an ordered stem plot, as shown below.

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

Key: 1 | 3 = 13

The distribution for *Further Mathematics test scores* could best be described as

A. negatively skewed with an outlier.

B. negatively skewed.

C. approximately symmetric with an outlier.

D. approximately symmetric.

E. positively skewed with an outlier.

Question 4

Which of the following statements describing the distribution of *Further Mathematics test scores* for 12A is **incorrect**?

A. 75% of *Further Mathematics test scores* were below 38.

B. The mean value for *Further Mathematics test scores* is 30, correct to the nearest whole number.

C. For this distribution, the mean is less than the median.

D. It would be appropriate to use the mean as a measure of centre for the distribution of *Further mathematics test scores.*

E. It would also be appropriate to display the data for *Further Mathematics test scores* as a dot plot.

Question 5

The time spent studying, each week by the students in Year 12 is approximately normally distributed with a mean of 90 minutes and a standard deviation of 4 minutes.

If there are 284 students in the Year level, the number of students who are expected to spend between 82 and 94 minutes studying per week is closest to

A. 45

B. 53

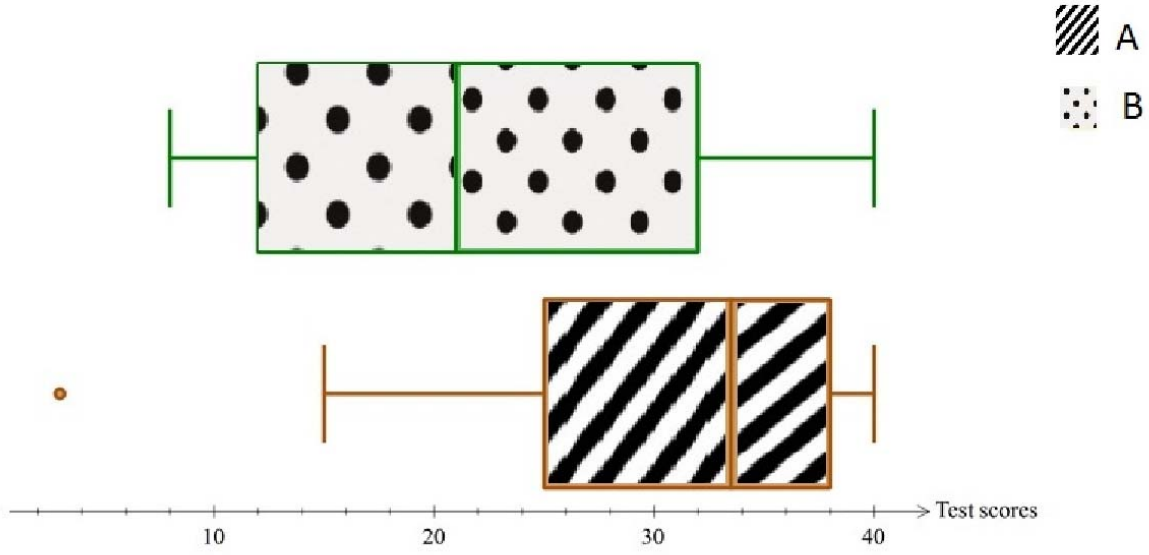
C. 82

D. 182

E. 231

Question 6

The teachers of 12A and 12B decided to compare their class's *Further Mathematics test scores*. The parallel boxplots for scores from 12A and 12B are shown below:



Which of the following statements is **correct**, when comparing the *Further Mathematics test scores* for both class 12A and 12B?

A. When considering the range, the scores for class 12A were more varied than the scores for class 12B.

B. The scores for 12A are positively skewed compared to those for 12B, which are approximately symmetric.

C. The median score for 12A was lower than the median score for 12B.

D. The top 25% of scores for 12A were lower than the top 25% of scores for 12B.

E. The minimum score for 12A is higher than the minimum score for 12B.

Question 7

The science teacher for 12A decides to investigate the relationship between *Further Mathematics test score* and *Science test score*.

Her statistical summary is shown below

	Mean	**Standard deviation**
Mathematics	30.18	9.84
Science	32.00	8.71

Pearson's correlation coefficient is equal to $r = 0.82$.

Using the information, the equation that allows the science teacher to predict *Science test score* from *Further Mathematics test score* is

A. $Science = 3.93 + 0.93 \times Further\ Mathematics$

B. $Science = 9.97 + 0.73 \times Further\ Mathematics$

C. $Science = 0.73 + 9.97 \times Further\ Mathematics$

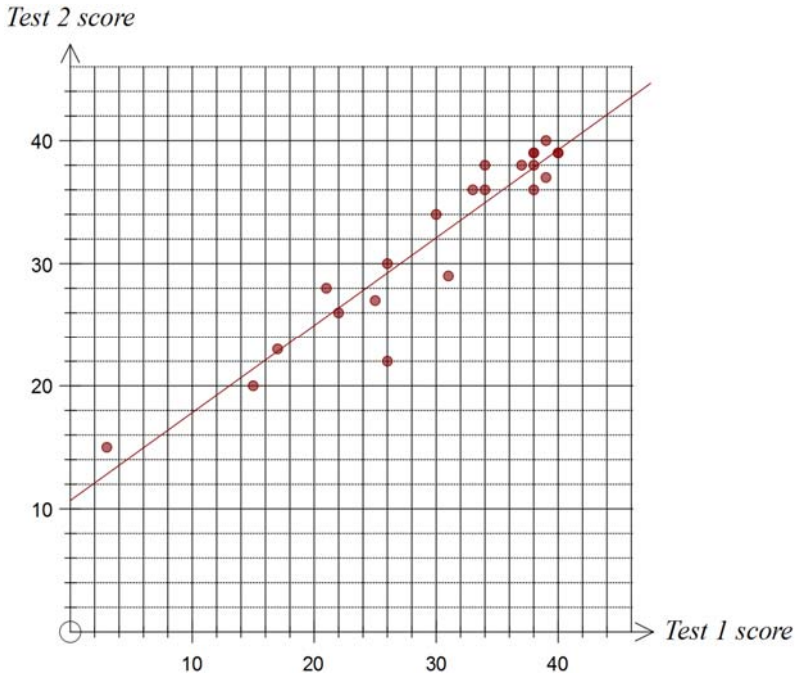
D. $Science = 0.42 + 0.93 \times Further\ Mathematics$

E. $Science = 6.82 + 0.73 \times Further\ Mathematics$

Use the following information to answer Questions 8–11.

The relationship between the scores achieved on two Further Mathematics tests, *Test 1* and *Test 2*, for class 12A is being investigated.

A scatterplot showing *Test 1* and *Test 2* scores is shown below.



The value of Pearson's correlation coefficient is 0.9505, written to 4 significant figures.

Question 8

By considering the scatterplot above, the relationship between *Test 1* and *Test 2* scores can best be described as

A. a moderate, positive, linear relationship.

B. a moderate, negative, linear relationship.

C. a strong, positive, non-linear relationship.

D. a strong, positive, linear relationship.

E. a strong, negative, linear relationship.

Question 9

The equation for the least squares regression line, allowing a student to predict their *Test 2* from their *Test 1* score is closest to

A. $\textit{Test 1} = 10.58 + 0.71 \times \textit{Test 2}$

B. $\textit{Test 2} = 10.58 + 0.71 \times \textit{Test 1}$

C. $\textit{Test 2} = 0.71 + 10.58 \times \textit{Test 1}$

D. $\textit{Test 1} = 10.58 + 1.27 \times \textit{Test 2}$

E. $\textit{Test 2} = 10.58 + 1.27 \times \textit{Test 1}$

Question 10

Which of the following statements is **correct**, regarding the relationship between *Test 1* and *Test 2* scores?

A. On average, *Test 2* scores will decrease by one mark, as *Test 1* score increases by one mark.

B. 90.3% of the variation in *Test 2* scores can be explained by the variation in *Test 1* scores.

C. On average, a student who achieves a score of 0 on *Test 1* will achieve a score of 0.71 on *Test 2.*

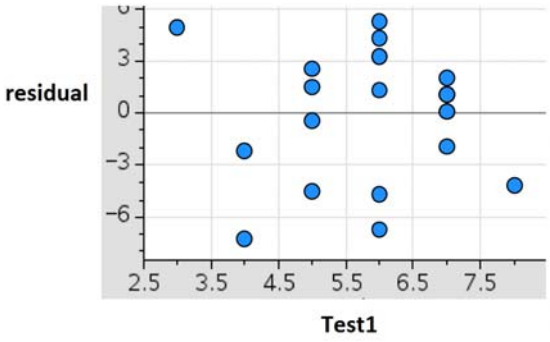
D. Pearson's correlation coefficient confirms that a high score on students' *Test 1* will cause a student to achieve a high score on *Test 2*.

E. A squared transformation must be performed on the graph of *Test 1* against *Test 2* scores.

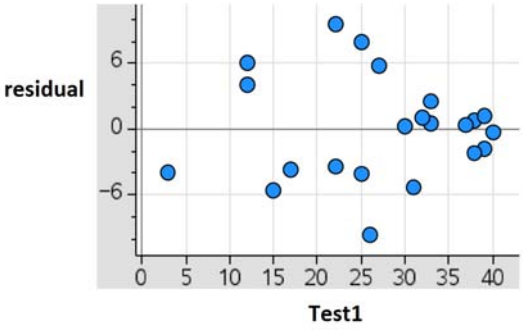
Question 11

Which of the following could be the residual plot for the relationship between *Test 1* and *Test 2* scores?

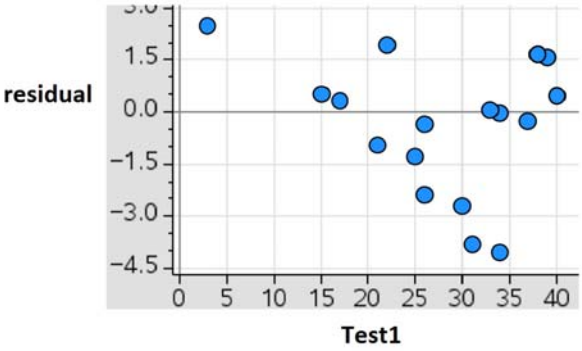
A.



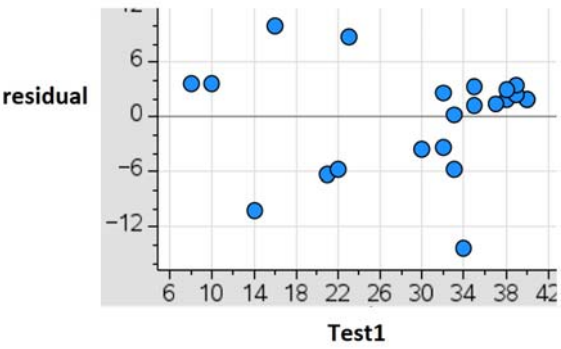
B.



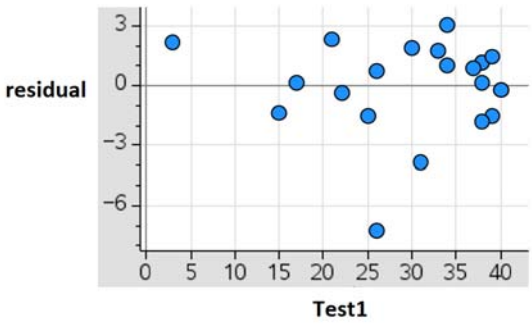
C.



D.

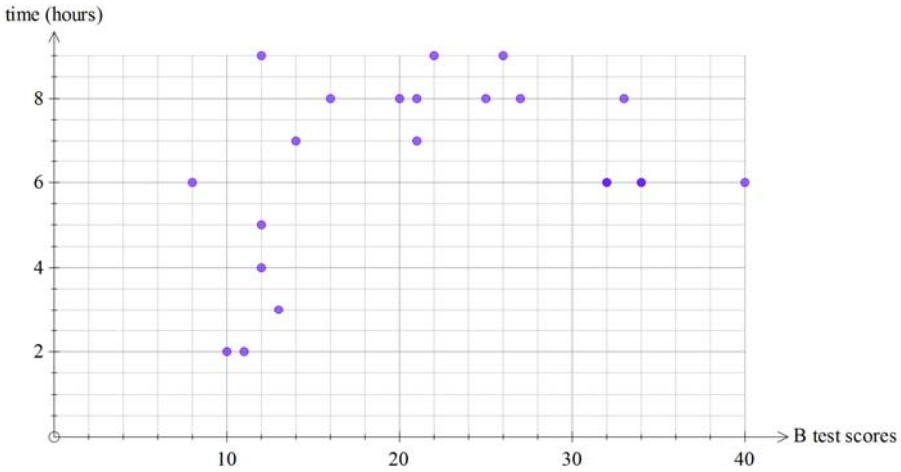


E.



Question 12

Students in 12B recorded the time spend studying (in hours) next to their test scores. The data is shown below, in both a table and on a scatterplot.



Student	B test score	Time (hours)
1	27	8
2	32	6
3	40	6
4	34	6
5	16	8
6	26	9
7	21	7
8	22	9
9	13	3
10	14	7
11	20	8
12	21	8
13	32	6
14	33	8
15	34	6
16	11	2
17	10	2
18	12	4
19	8	6
20	12	9
21	25	8
22	12	5

The association between 12B test scores and time studying is non-linear, as seen in the scatterplot.

In order to linearise the data, which of the following lists the correct options for data transformations?

A. $\log x, \log y, \frac{1}{x}$

B. y^2, x^2

C. $y^2, \log x, \frac{1}{x}$

D. $\log y, y^2, x^2$

E. $\log y, \frac{1}{y}, x^2$

Question 13

Average test scores for the Further Mathematics test have been recorded over a number of years. The scores are listed in the table below:

Year	2010	2011	2012	2013	2014	2015
Average test score	32	18	22	26	35	25

A two-point moving mean is used to smooth the time series.

The smoothed value for the average test score in 2013 is closest to

A. 24

B. 26

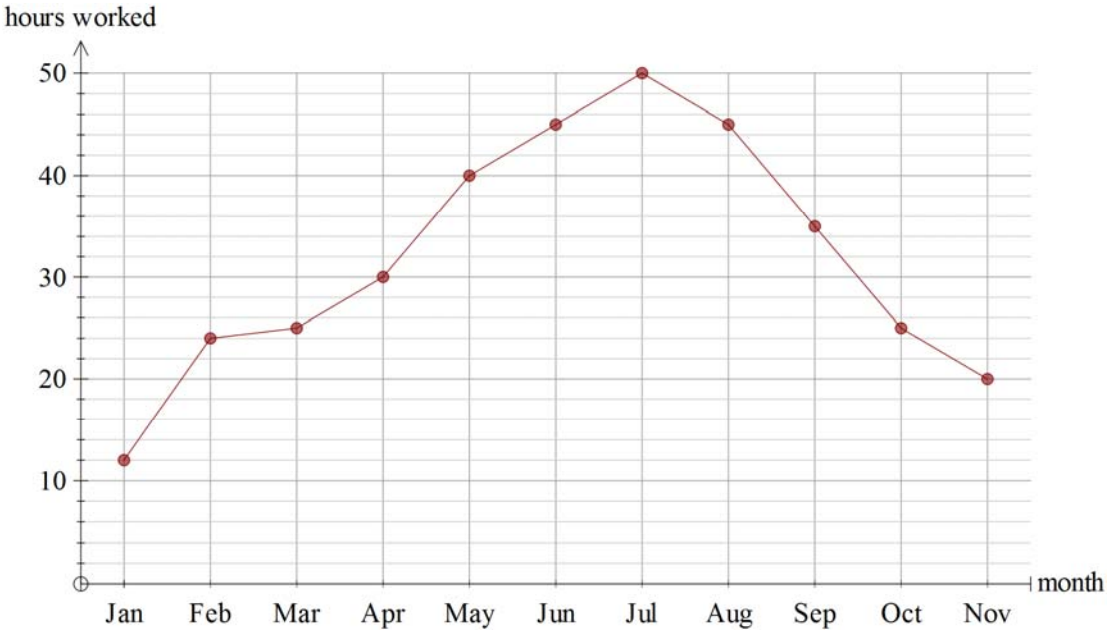
C. 27

D. 28

E. 30

Use the following information to answer Questions 14–16.

A student from 12B recorded the number of hours spent working at the local knitwear store from January to November in 2015. The results are displayed in the time series plot below.



The seasonal indices for knitwear sales at the student's workplace are shown in the table below.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Seasonal index	0.65	0.75	0.76	0.83		1.45	1.5	1.45	0.84	0.72	0.73

Question 14

The seasonal index for May sales at the knitwear store is

A. 0.88

B. 1.32

C. 1.45

D. 1.00

E. 2.32

Question 15

The sales figures are deseasonalised, and a trend line fitted.

The equation for this trend line is:

Deseasonalised sales = 1250 + 1.37 × *sales*, where sales are recorded to the nearest hundred dollars.

The predicted sales for March 2016 are around $4200. The actual sales figure (in dollars) for March 2016 will be closest to:

A. 3200

B. 5300

C. 5600

D. 5700

E. 7000

Question 16

To correct for seasonality, the seasonal index for June should be

A. decreased by 67%

B. increased by 67%

C. decreased by 33%

D. increased by 33%

E. decreased by 50%

Recursion and financial modelling

Question 17

$$V_0 = 7, \quad V_{n+1} = 2V_n - 4$$

The first five terms of the sequence defined by the recurrence relation are

A. 7, –1, –9, –17, –25

B. 7, 3, –1, -5, –9

C. 7, 10, 16, 28, 52

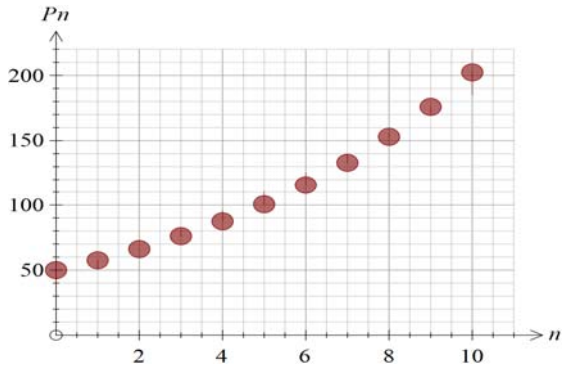
D. 7, 10, 28, 56, 112

E. 7, 18, 40, 84, 112

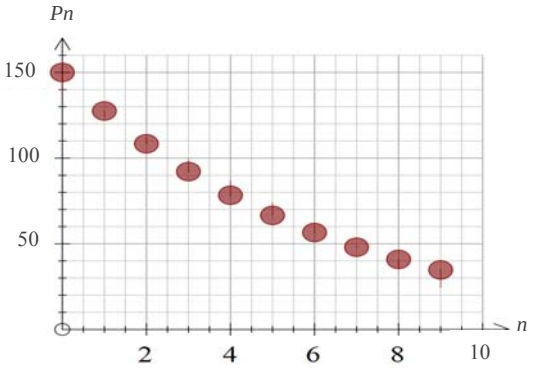
Question 18

Which of the following graphs could represent **depreciation**, as modelled by a linear decay model?

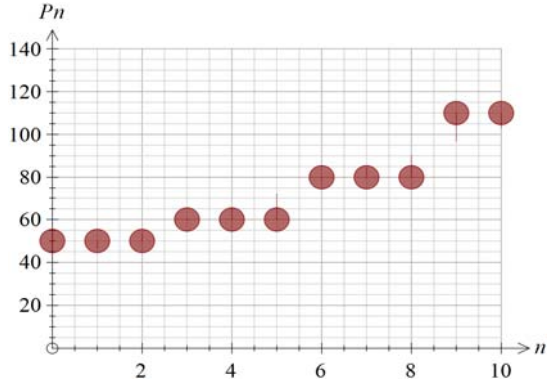
A.



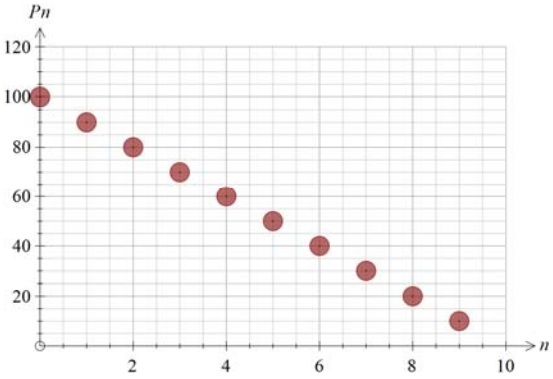
B.



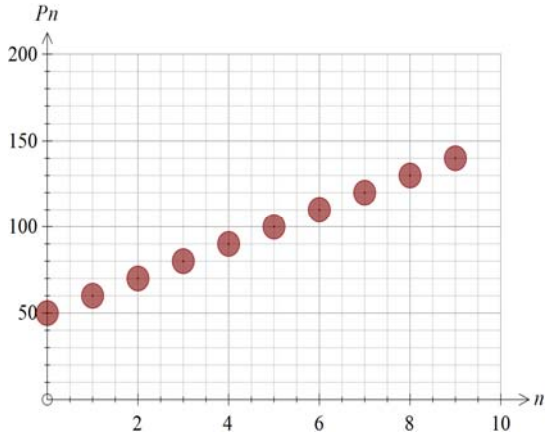
C.



D.



E.



Use the following information to answer Questions 19 and 20.

A new car was purchased for $32 000 in 2015. The car depreciates by 20% of its purchase price each year.

Question 19

An appropriate model for the depreciating value of this car using a recurrence relation could be

A. $V_0 = 32000$, $V_{n+1} = 32000 - 0.2V_n$

B. $V_0 = 32000$, $V_{n+1} = 32000 - 6400$

C. $V_0 = 32000$, $V_{n+1} = 32000n - 6400$

D. $V_0 = 32000$, $V_{n+1} = V_n - 6400$

E. $V_0 = 32000$, $V_n = V_{n+1} - 6400$

Question 20

The value of the car in 2018 is

A. $16 384

B. $25 600

C. $12 800

D. $256

E. $0

Question 21

An industrial printing company purchased a new printer at a cost of $78 000.

It has an estimated value of $18 000 after 10 years of operation.

If the value of the printer is depreciated using a reducing-balance method, the annual rate of depreciation is closest to

A. 7.7%

B. 13.6%

C. 15.8%

D. 23.1%

E. 186.4%

Use the following information to answer Questions 22 and 23.

Caterina borrows $1800 at an interest rate of 18% per annum, compounding monthly. She will repay the loan over 6 payments of $312.37, with one final payment of slightly more.

The amortisation table for Caterina's loan is shown below

Payment number	***Payment***	***Interest***	***Principal reduction***	***Balance of loan***
1	0	0.00	0.00	1800.00
2	312.37	27.00	285.37	1514.63
3	312.37	22.72	289.65	1224.98
4	312.37	*a*	294.00	930.98
5	312.37	13.96	298.41	632.57
6	312.37	9.49	302.88	329.69
7	*b*	4.95	329.69	0.00

Question 22

In the amortisation table above, the value of *a* is closest to

A. $1.84

B. $4.42

C. $4.68

D. $18.37

E. $183.75

Question 23

In the amortisation table above, the value of *b* is closest to

A. $312.37

B. $317.32

C. $324.74

D. $329.69

E. $334.64

Question 24

$25 000 is invested for 12 months.

For the first 6 months the interest rate is 6.1% per annum, compounding monthly.

After 6 months the interest rate decreases to 5.75% per annum, compounding monthly.

The total amount of interest earned by this investment over 12 months is closest to

A. $727.42

B. $1476.00

C. $1522.14

D. $1564.29

E. $1568.37

END OF SECTION A
TURN OVER

SECTION B – Modules

Instructions for Section B

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

Show the modules you are answering by shading the matching boxes on your multiple-choice answer sheet **and** writing the name of the module in the box provided.

Choose the response that is **correct** for the question.

A correct answer scores 1; an incorrect answer scores 0.

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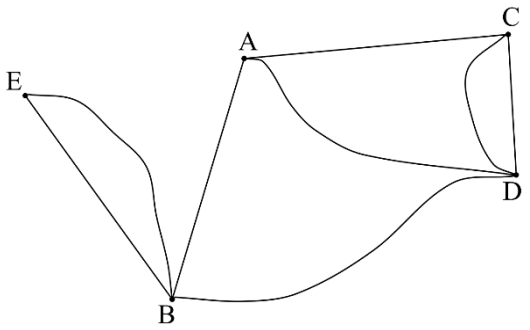
Contents **Page**

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 of the following matrices best represents the network diagram shown below?



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

B. $\begin{bmatrix} 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 & 2 \\ 1 & 0 & 0 & 2 & 0 \\ 1 & 1 & 2 & 0 & 0 \\ 0 & 2 & 0 & 0 & 0 \end{bmatrix}$

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

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

E. $\begin{bmatrix} 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 0 & 2 \\ 1 & 0 & 0 & 2 & 0 \\ 1 & 0 & 2 & 0 & 0 \\ 0 & 2 & 0 & 0 & 1 \end{bmatrix}$

Question 2

Which of the following best describes the type of matrix shown below?

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

The matrix is

A. a triangular matrix.

B. an identity matrix.

C. a diagonal matrix.

D. a transition matrix.

E. a symmetric matrix.

Question 3

The following table shows the type of tea sold by a local tea maker, and the amount sold (listed as number of 100 g packets) at its three stores for the month of February:

Type of tea	Earl Grey	Mint	Summer Berry	Vanilla	Green
Store A	25	18	32	8	24
Store B	32	24	27	12	35
Store C	42	19	32	17	39

The tea is sold for the following price, per 100 g packet:

Earl Grey	Mint	Summer Berry	Vanilla	Green
$ 13.00	$ 14.50	$ 16.00	$15.50	$18.00

Which of the following matrix calculations will give the total sales (in dollars) for each of the three stores?

A. $\begin{bmatrix} 25 & 18 & 32 & 8 & 24 \\ 32 & 24 & 27 & 12 & 35 \\ 42 & 19 & 32 & 17 & 39 \end{bmatrix} \times \begin{bmatrix} 13 & 14.5 & 16 & 15.5 & 18 \end{bmatrix}$

B. $\begin{bmatrix} 13 & 14.5 & 16 & 15.5 & 18 \end{bmatrix} \times \begin{bmatrix} 25 & 18 & 32 & 8 & 24 \\ 32 & 24 & 27 & 12 & 35 \\ 42 & 19 & 32 & 17 & 39 \end{bmatrix}$

C. $\begin{bmatrix} 13 \\ 14.5 \\ 16 \\ 15.5 \\ 18 \end{bmatrix} \times \begin{bmatrix} 25 & 32 & 42 \\ 18 & 24 & 19 \\ 32 & 27 & 32 \\ 8 & 12 & 17 \\ 24 & 35 & 39 \end{bmatrix}$

D. $\begin{bmatrix} 25 & 32 & 42 \\ 18 & 24 & 19 \\ 32 & 27 & 32 \\ 8 & 12 & 17 \\ 24 & 35 & 39 \end{bmatrix} \times \begin{bmatrix} 13 \\ 14.5 \\ 16 \\ 15.5 \\ 18 \end{bmatrix}$

E. $\begin{bmatrix} 25 & 18 & 32 & 8 & 24 \\ 32 & 24 & 27 & 12 & 35 \\ 42 & 19 & 32 & 17 & 39 \end{bmatrix} \times \begin{bmatrix} 13 \\ 14.5 \\ 16 \\ 15.5 \\ 18 \end{bmatrix}$

Question 4

The following matrix equation represents three simultaneous equations.

$$\begin{bmatrix} 2 & 1 & 1 \\ 0 & 2 & 1 \\ 2 & 0 & 1 \end{bmatrix} \begin{bmatrix} w \\ x \\ y \end{bmatrix} = \begin{bmatrix} -2 \\ 6 \\ -4 \end{bmatrix}$$

The solutions to these simultaneous equations are

A. $w = 1 \quad x = 2 \quad y = 2$

B. $w = -3 \quad x = 2 \quad y = 2$

C. $w = -3 \quad x = 2 \quad y = 1$

D. $w = -3 \quad x = 1 \quad y = 2$

E. $w = 0 \quad x = 1 \quad y = 2$

Use the following information to answer Questions 5–7.

In the first week of Term 1 in 2015, 215 children ordered sushi on Friday from the school canteen. There are three types of sushi available: vegetarian, chicken or tuna.

On the first Friday of Term 1, 100 children ordered chicken, 65 ordered vegetarian and 50 ordered tuna. This is information is represented in the initial state matrix:

$$S_1 = \begin{bmatrix} 100 \\ 65 \\ 50 \end{bmatrix} \begin{matrix} \text{C} \\ \text{V} \\ \text{T} \end{matrix}$$

Assuming the same number of students order sushi the following week, the transition matrix for students' choices for the following Sushi Friday are shown in the transition matrix below:

$$T = \begin{array}{c} \text{This week} \\ \begin{matrix} \text{C} & \text{V} & \text{T} \end{matrix} \\ \begin{bmatrix} 0.6 & 0 & 0.45 \\ 0.25 & 0.8 & 0.15 \\ 0.15 & 0.2 & 0.4 \end{bmatrix} \begin{matrix} \text{C} \\ \text{V} \\ \text{T} \end{matrix} \end{array} \text{ Next week}$$

Question 5

The number of students ordering each type of sushi in week 3, is best represented by

A. $S_3 = \begin{bmatrix} 83 \\ 85 \\ 47 \end{bmatrix}$

B. $S_3 = \begin{bmatrix} 70 \\ 95 \\ 48 \end{bmatrix}$

C. $S_3 = \begin{bmatrix} 65 \\ 101 \\ 49 \end{bmatrix}$

D. $S_3 = \begin{bmatrix} 71 \\ 95 \\ 49 \end{bmatrix}$

E. $S_3 = \begin{bmatrix} 100 \\ 65 \\ 50 \end{bmatrix}$

Question 6

In the long term, students will find their favourite type of sushi and will not change their selection. The equilibrium state matrix is found to be:

A. $S = \begin{bmatrix} 100 \\ 65 \\ 50 \end{bmatrix} \begin{matrix} \text{C} \\ \text{V} \\ \text{T} \end{matrix}$

B. $S = \begin{bmatrix} 59 \\ 106 \\ 50 \end{bmatrix} \begin{matrix} \text{C} \\ \text{V} \\ \text{T} \end{matrix}$

C. $S = \begin{bmatrix} 58 \\ 107 \\ 50 \end{bmatrix} \begin{matrix} \text{C} \\ \text{V} \\ \text{T} \end{matrix}$

D. $S = \begin{bmatrix} 57 \\ 108 \\ 50 \end{bmatrix} \begin{matrix} \text{C} \\ \text{V} \\ \text{T} \end{matrix}$

E. $S_3 = \begin{bmatrix} 61 \\ 104 \\ 50 \end{bmatrix} \begin{matrix} \text{C} \\ \text{V} \\ \text{T} \end{matrix}$

Question 7

The canteen manager has decided to advertise Sushi Fridays around the school, in order to increase the number of orders. She has found that often students do not continue to order sushi every week.

The number of sushi orders each week can be defined by the following relation:

$$S_{n+1} = T \times S_n + B$$

where, $S_1 = \begin{bmatrix} 100 \\ 65 \\ 50 \end{bmatrix} \begin{matrix} \text{C} \\ \text{V} \\ \text{T} \end{matrix}$, $T = \begin{matrix} \text{C} & \text{V} & \text{T} \\ \end{matrix} \begin{bmatrix} 0.5 & 0 & 0.2 \\ 0.1 & 0.6 & 0 \\ 0.1 & 0.2 & 0.2 \end{bmatrix} \begin{matrix} \text{C} \\ \text{V} \\ \text{T} \end{matrix}$ and $B = \begin{bmatrix} 18 \\ 26 \\ 15 \end{bmatrix}$

The number of sushi orders of each type on the 3rd Friday, after this new arrangement is put into place is:

A. $S_3 = \begin{bmatrix} 100 \\ 65 \\ 50 \end{bmatrix} \begin{matrix} \text{C} \\ \text{V} \\ \text{T} \end{matrix}$

B. $S_3 = \begin{bmatrix} 78 \\ 75 \\ 48 \end{bmatrix} \begin{matrix} \text{C} \\ \text{V} \\ \text{T} \end{matrix}$

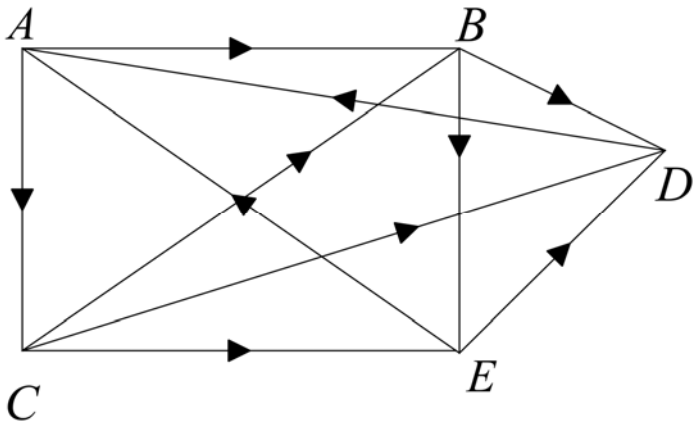
C. $S_3 = \begin{bmatrix} 67 \\ 79 \\ 47 \end{bmatrix} \begin{matrix} \text{C} \\ \text{V} \\ \text{T} \end{matrix}$

D. $S_3 = \begin{bmatrix} 138 \\ 124 \\ 81 \end{bmatrix} \begin{matrix} \text{C} \\ \text{V} \\ \text{T} \end{matrix}$

E. $S_3 = \begin{bmatrix} 61 \\ 104 \\ 50 \end{bmatrix} \begin{matrix} \text{C} \\ \text{V} \\ \text{T} \end{matrix}$

Question 8

The following diagram represents a round-robin competition for a one-on-one basketball game played by five Year 12 students during lunchtimes.



The **two-step dominance** matrix is represented by which of the following?

A.

	A	B	C	D	E
A	0	1	1	0	0
B	0	0	0	1	1
C	0	1	0	1	1
D	1	0	0	0	0
E	1	0	0	1	0

B.

	A	B	C	D	E
A	0	1	0	1	2
B	2	0	0	1	0
C	1	0	0	1	1
D	0	1	0	0	0
E	1	1	1	0	0

C.

	A	B	C	D	E
A	0	1	0	2	2
B	2	0	0	1	0
C	2	0	0	2	1
D	0	1	0	0	0
E	1	1	1	0	0

D.

	A	B	C	D	E
A	0	2	0	2	2
B	1	0	0	1	0
C	1	0	0	2	1
D	0	1	1	0	0
E	1	1	1	0	0

E.

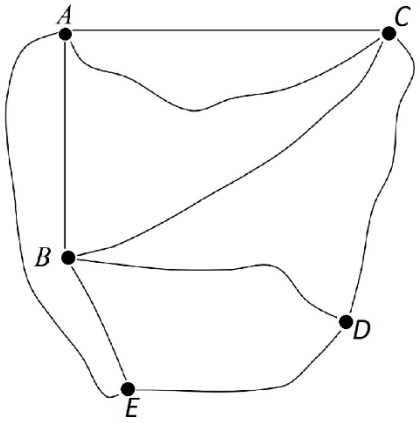
	A	B	C	D	E
A	0	1	0	2	2
B	2	1	0	1	0
C	2	0	0	2	1
D	0	1	0	1	0
E	1	1	1	0	0

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 following network shows roads connecting 5 towns.



The correct adjacency matrix for the network of towns is

A.

	A	B	C	D	E
A	0	1	2	0	0
B	1	0	1	1	1
C	2	1	0	1	0
D	0	0	1	1	0
E	1	1	0	1	0

B.

	A	B	C	D	E
A	0	1	0	1	2
B	2	0	0	1	0
C	1	0	0	1	1
D	0	1	0	0	0
E	1	1	1	0	0

C.

	A	B	C	D	E
A	0	1	1	0	0
B	1	0	1	1	1
C	1	1	0	1	0
D	0	1	1	0	1
E	1	1	0	1	0

D.

	A	B	C	D	E
A	0	1	0	1	0
B	1	0	1	1	0
C	2	0	0	0	1
D	0	1	1	0	1
E	1	1	0	1	0

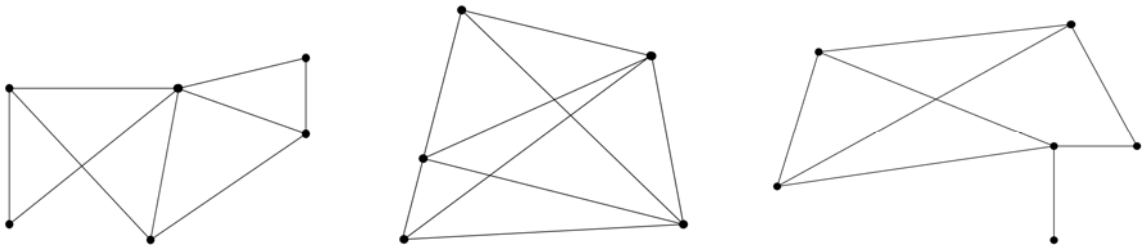
E.

	A	B	C	D	E
A	0	1	2	0	1
B	1	0	1	1	1
C	2	1	0	1	0
D	0	1	1	0	1
E	1	1	0	1	0

Question 2

Consider the following networks:

Network A **Network B** **Network C**



The network/s that contain/s an Eulerian trail is/are

A. A only.

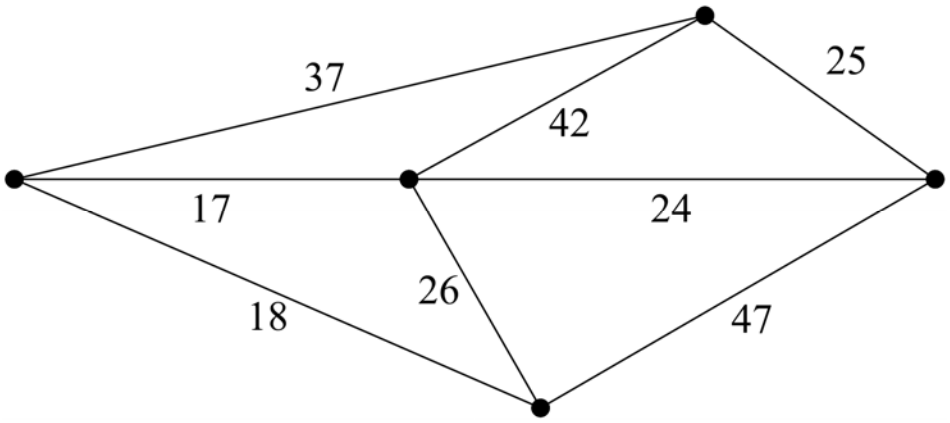
B. A and B only.

C. C only.

D. B only.

E. none of the networks.

Question 3



The length of the minimum spanning tree for this network is

A. 84

B. 93

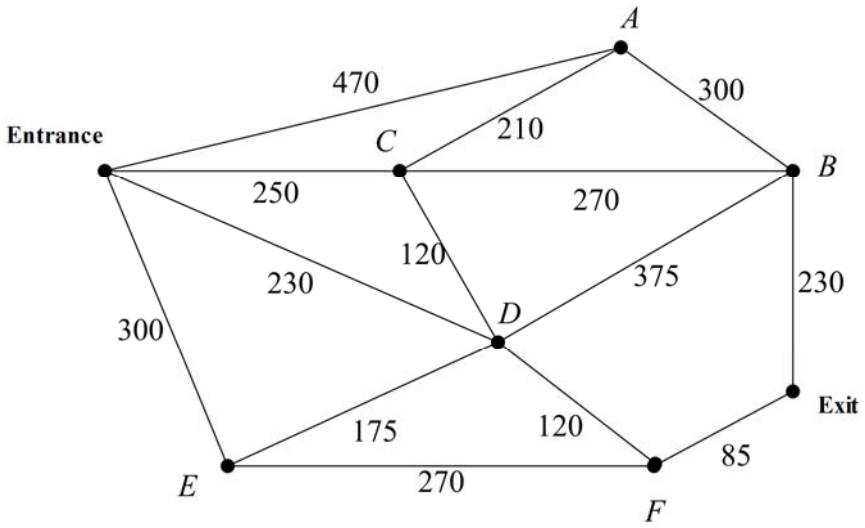
C. 104

D. 105

E. 107

Question 4

The network below shows the distance, in metres, along walkways that connect attractions *A, B, C, D, E* and *F* in a theme park:



The length of the shortest path, in metres, from the entrance to the exit is

A. 435 m

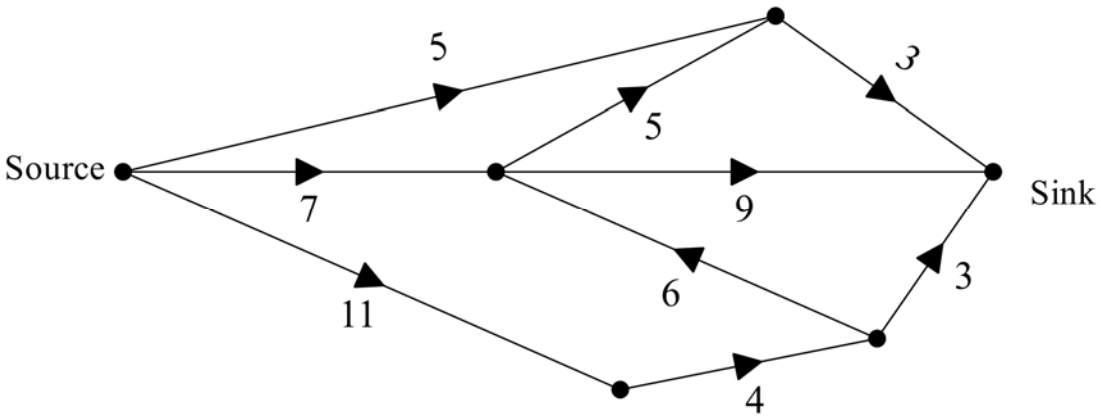
B. 475 m

C. 555 m

D. 575 m

E. 655 m

Question 5



The maximum flow for the diagram above is

A. 12

B. 13

C. 14

D. 15

E. 16

Question 6

A school enters four of their best mathematics students into a state Mathematics competition.

Each student within the team is to complete **one task**, with the objective being to complete all tasks in the shortest time possible.

The table below shows the best time (in minutes) achieved in practice sessions by each student, for each individual maths task.

	Mathematics task to complete			
Student	**Statistics**	**Financial maths**	**Networks**	**Geometry**
Andrea	12	14	21	18
Bryan	16	15	19	17
Carmen	17	13	20	19
David	14	16	21	16

The allocation of tasks that will achieve the minimum completion time for all tasks is

A. Andrea – Financial maths, Bryan – Statistics, Carmen – Networks, David – Geometry

B. Andrea – Statistics, Bryan – Networks, Carmen – Geometry, David – Financial maths

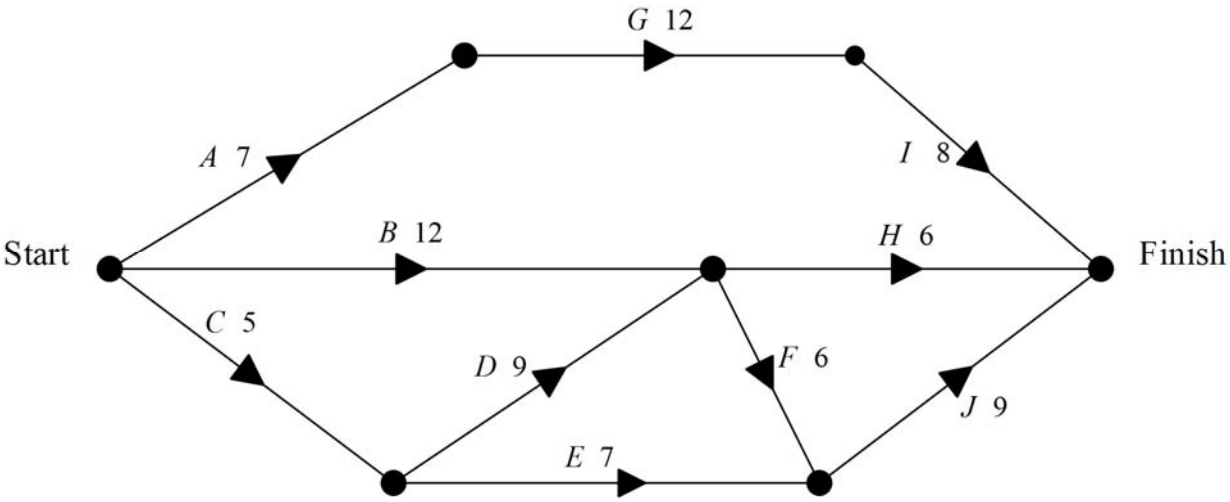
C. Andrea – Statistics, Bryan – Geometry, Carmen – Financial maths, David – Networks

D. Andrea – Networks, Bryan – Statistics, Carmen – Financial maths, David – Geometry

E. Andrea – Statistics, Bryan – Networks, Carmen – Financial maths, David – Geometry

Use the following information to answer Questions 7 and 8.

The directed graph below shows the activities needed to complete a project, and the time (in minutes) required to complete these activities



Question 7

The earliest start time for activity *J* is

A. 12

B. 16

C. 18

D. 20

E. 32

Question 8

The critical path for the project is

A. *C E J*

B. *C D F J*

C. *B H*

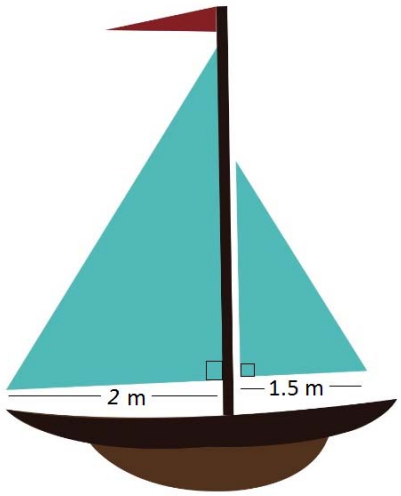
D. *A G I*

E. *B F J*

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



The sails on the boat shown above are made of similar triangles.

Maurice, the boat owner, is calculating the area of material required to replace both sails.

If the area of the smaller sail is 1.65 m^2, the area of material required to replace the larger sail, correct to 2 decimal places, is closest to

A. 2.00 m^2

B. 2.20 m^2

C. 2.93 m^2

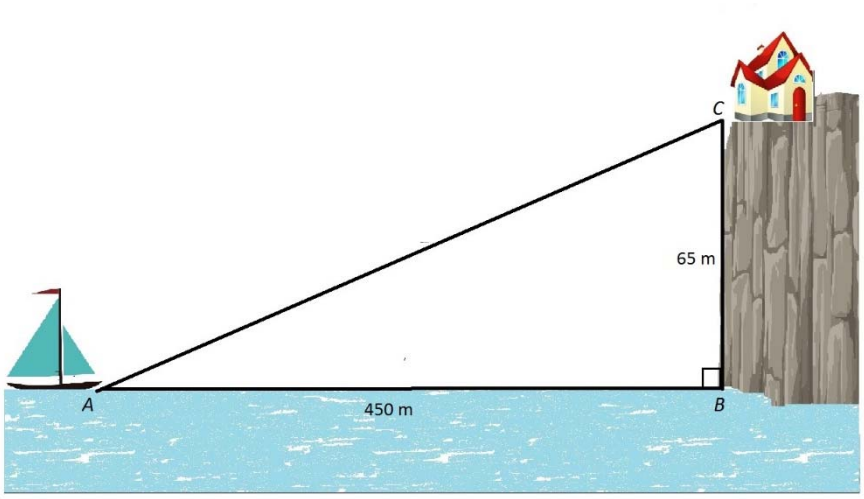
D. 3.50 m^2

E. 4.95 m^2

Question 2

Maurice takes his boat out in the bay.

From his deck, he can see his house on the top of a nearby 65 m high cliff.



If Maurice has anchored his boat 450 m from the base of the cliff, what is the angle of elevation from Maurice, at point A, to his house at point C?

A. 0.14°

B. 8.22°

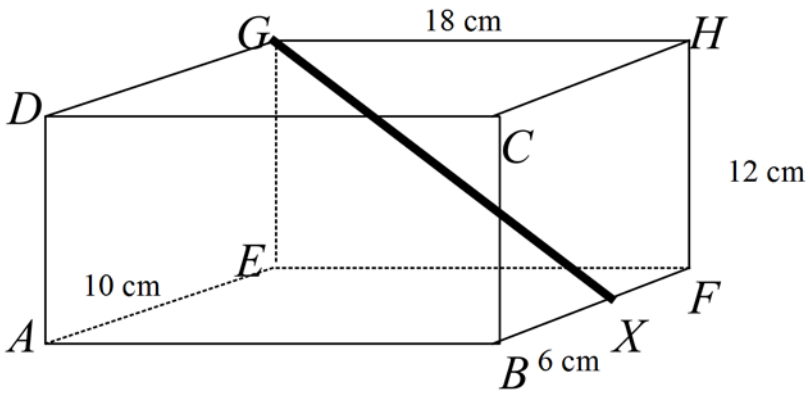
C. 8.31°

D. 81.69°

E. 81.78°

Question 3

A rectangular postage box, *ABCDEFGH*, is 18 cm long, 10 cm wide and 12 cm high, as shown.



A small metal rod is placed within the box, to maintain its shape and protect the parcel.

One end of the rod is at *G* and the other end sits at *X*.

The point *X* lies on the line *BF*, 6 cm from *B*.

The length of the rod, in cm, is closest to

A. 25 cm

B. 24 cm

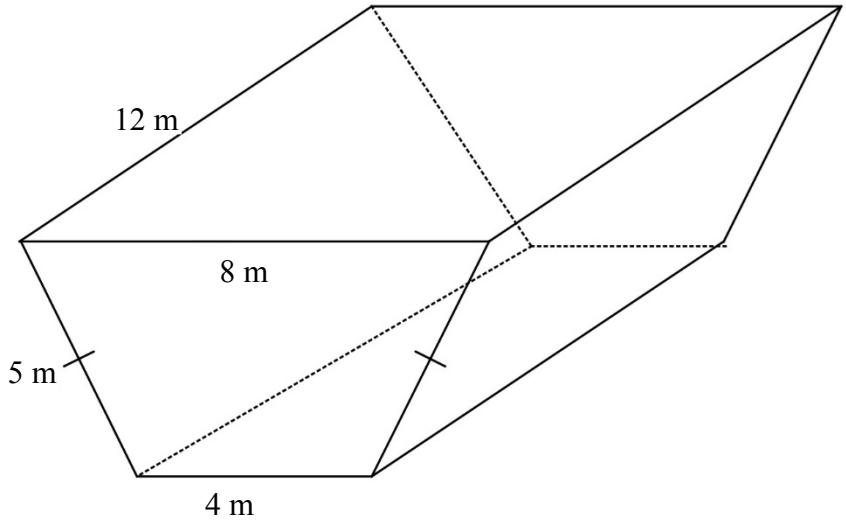
C. 22 cm

D. 20 cm

E. 13 cm

Question 4

A swimming pool is built in the shape of a trapezoidal prism, as shown in the diagram below.



The cross-section of the pool is an isosceles trapezium. The parallel sides of this trapezium are 8 m and 4 m respectively. The two equal sides are each 5 m.

The length of the pool is 12 m.

The inside of the pool will be painted with a sealer, to preserve the plastic.

The total area, in m^2, that will need to be painted is closest to

A. 186 m^2

B. 198 m^2

C. 206 m^2

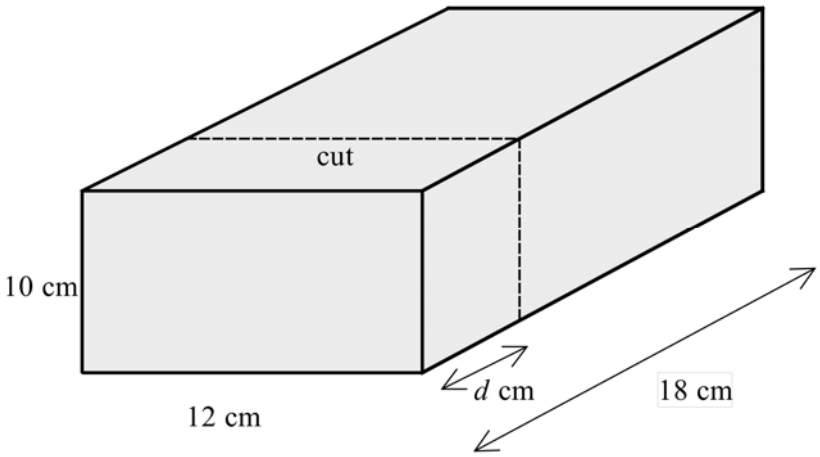
D. 223 m^2

E. 328 m^2

Question 5

A piece of chocolate cake is in the shape of a rectangular prism.

The piece of cake is 12 cm long, 18 cm wide and 10 cm high, as shown below.



A smaller piece of cake is cut from the larger chunk, as shown in the diagram.

The cut is made at a distance of d cm from the front edge of the cake. This splits the cake into two pieces.

The volume of the smaller piece is one quarter of the volume of the original cake.

The value of d, in centimetres, is closest to:

A. 4.0 cm

B. 4.5 cm

C. 6.0 cm

D. 8.0 cm

E. 13.5 cm

Question 6

Two cities with the same longitude have latitude 38°N and 23°S.

The distance between them in kilometres is closest to

A. 383 km

B. 710 km

C. 2569 km

D. 4245 km

E. 6814 km

Question 7

The city of Rome has a latitude of 42°N and a longitude of 13°E.

The distance of Rome from the South Pole is closest to

A. 829 km

B. 4 691 km

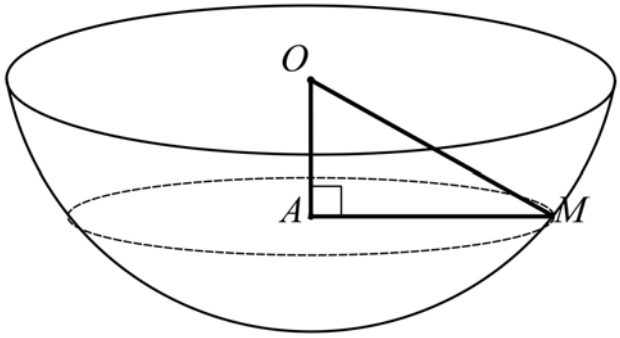
C. 5 362 km

D. 13 404 km

E. 14 745 km

Question 8

A pond in the shape of a hemisphere has radius of 6 m and contains water of depth 2.5 m.



The area of the **surface area of water** is closest to

A. 74.51 m^2

B. 93.31 m^2

C. 132.73 m^2

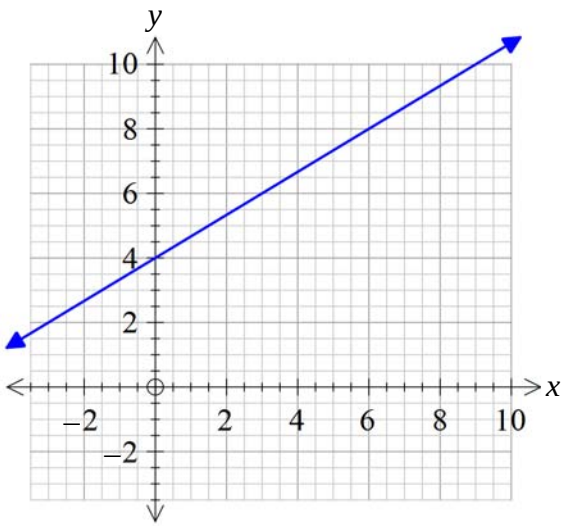
D. 151.75 m^2

E. 226.45 m^2

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



An equation for the straight line shown above is

A. $3y-2x=-12$

B. $2y-3x=12$

C. $3y-2x=12$

D. $2y+3x=12$

E. $3y+2x=12$

Question 2

A point that satisfies the inequality $4x-2y\leq 24$ is

A. $(1,-3)$

B. $(2,-9)$

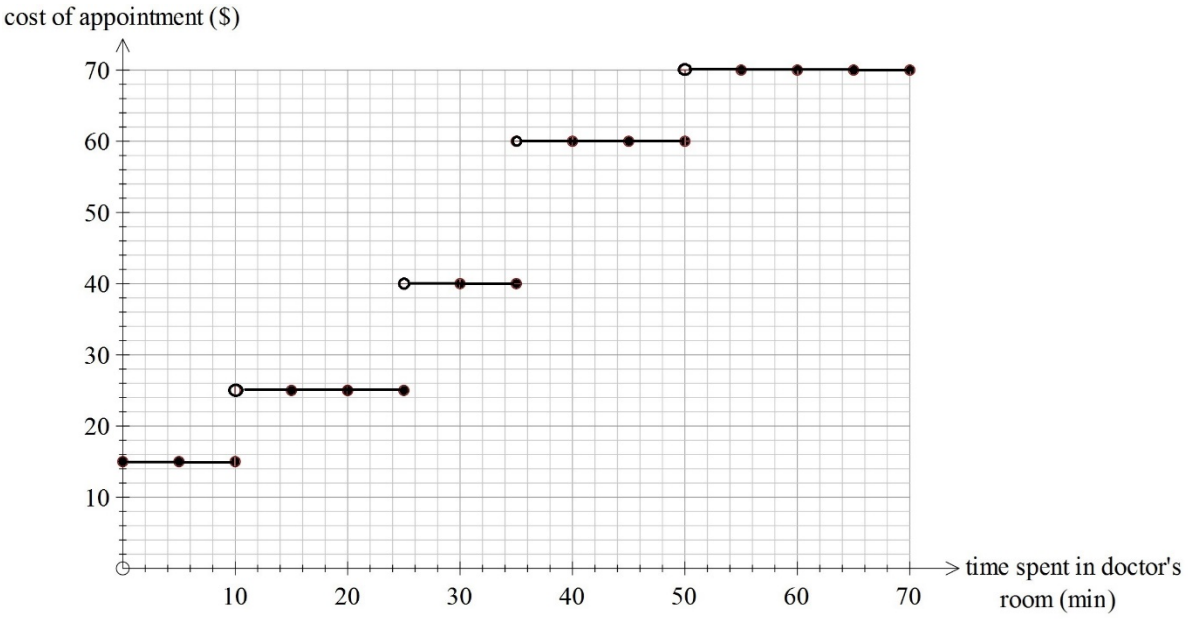
C. $(3,-7)$

D. $(4,-5)$

E. $(5,-6)$

Question 3

The step graph below shows the cost, in dollars, of visiting a doctor's surgery, based on the different lengths of appointments, measured in minutes.



Natalie booked an appointment for 35 minutes. The cost of her appointment was

A. $15

B. $20

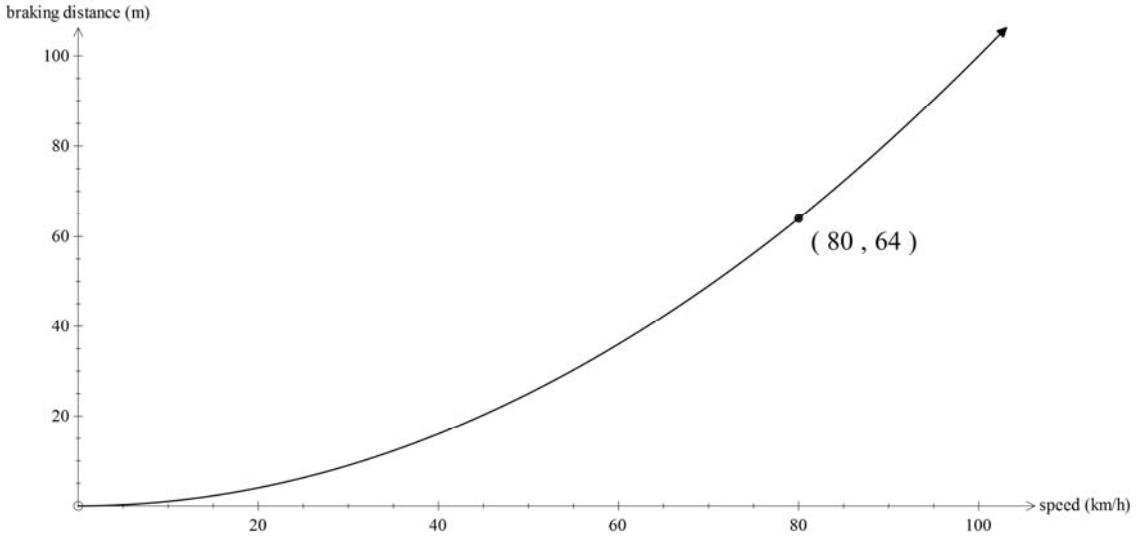
C. $25

D. $40

E. $80

Question 4

The graph below shows the braking distance, in metres, of cars at different speeds, in km/h.



The relationship between braking distance and speed can be modelled by an equation of the form

$$\text{braking distance} = k \times (\text{speed})^2$$

Using this model, the braking distance when the speed is 85 km/h is closest to

A. 58 m

B. 65 m

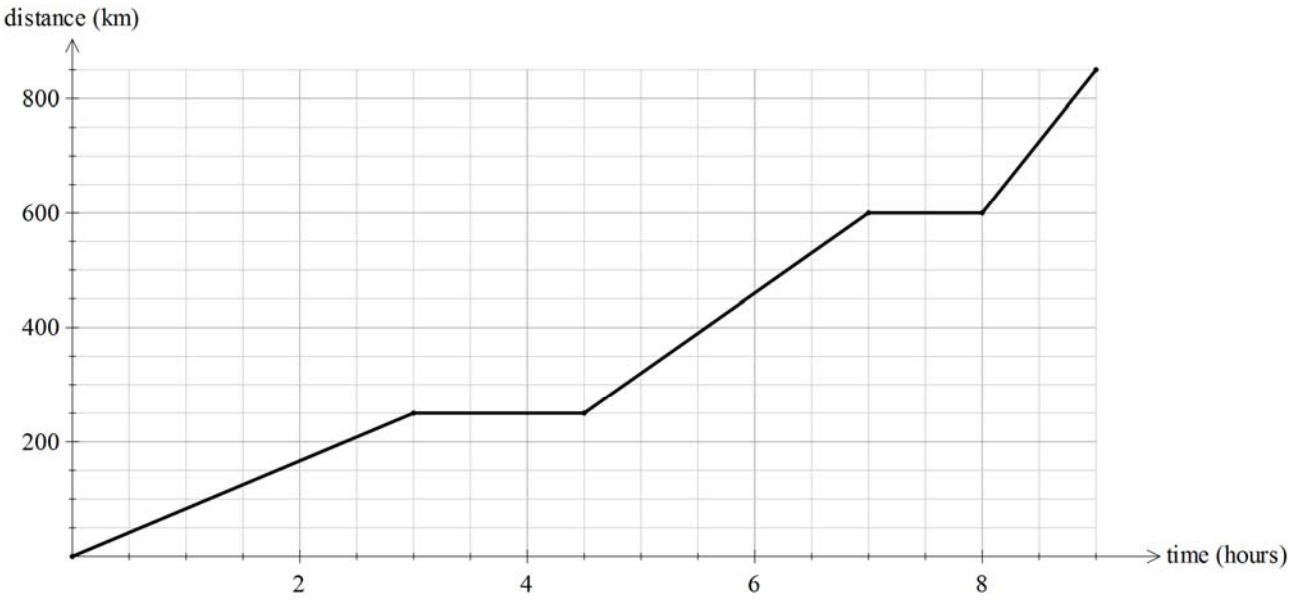
C. 72 m

D. 73 m

E. 85 m

Question 5

The following graph shows the distance Michelle travelled, in km, over a number of hours, on a car trip interstate to visit her family.



The average speed for Michelle's car trip is closest to

A. 89.9 km/h

B. 94.4 km/h

C. 100 km/h

D. 120 km/h

E. 163 km/h

Question 6

A school canteen sells chocolate muffins each day at a special price of $3.00 a muffin, for the first 150 muffins, and then $3.50 for any muffin sold after this target is reached.

The revenue, R, in dollars, made from selling n chocolate muffins each day is given by the rule

$$R = \begin{cases} 3n & 0 \le n \le 150 \\ 3.50n - 75 & n > 150 \end{cases}$$

The cost, C, of making n chocolate muffins each day is

$$C = 300 + 1.75n$$

To break even, the number of chocolate muffins that must be sold each day is

A. 79

B. 150

C. 214

D. 240

E. 300

Question 7

The constraints of a linear programming problem are given by the following set of inequalities:

$$2x + 3y \le 14$$
$$x + 2y \le 8$$
$$x \ge 0$$
$$y \ge 0$$

The coordinates of the points that define the boundaries of the feasible region for this linear programming problem are

A. (0, 0), (0, 4), (0, 7), (4, 2)

B. (0, 0), (0, 4), (7, 0), (4, 2)

C. (0, 0), (4, 0), (0, 7), (4, 2)

D. (0, 0), (0, 4), (0, 7), (2, 4)

E. (0, 0), (0, 4), (7, 0), (2, 4)

Question 8

A publisher produces a Further Mathematics revision guide each year.

To produce x copies, the cost is C dollars, where $C = 18\,000 + 12x$.

If all x copies produced are sold, then the revenue gained is R dollars, where $R = 75x$.

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

A. The cost and revenue equation are both linear.

B. The selling price for each copy of the textbook is \$75.

C. It will cost \$30 000 to produce 1000 copies of the textbook.

D. The profit from selling 1000 copies of the textbook is \$75 000.

E. The revenue is more than the cost if more than 190 copies are sold.

END OF MULTIPLE-CHOICE QUESTION BOOK