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YEAR 12 *Trial Exam Paper*

2022

FURTHER MATHEMATICS

Written examination 1

STUDENT NAME:

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			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 35 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 and the formula sheet.

Students are NOT permitted to bring mobile phones and/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.

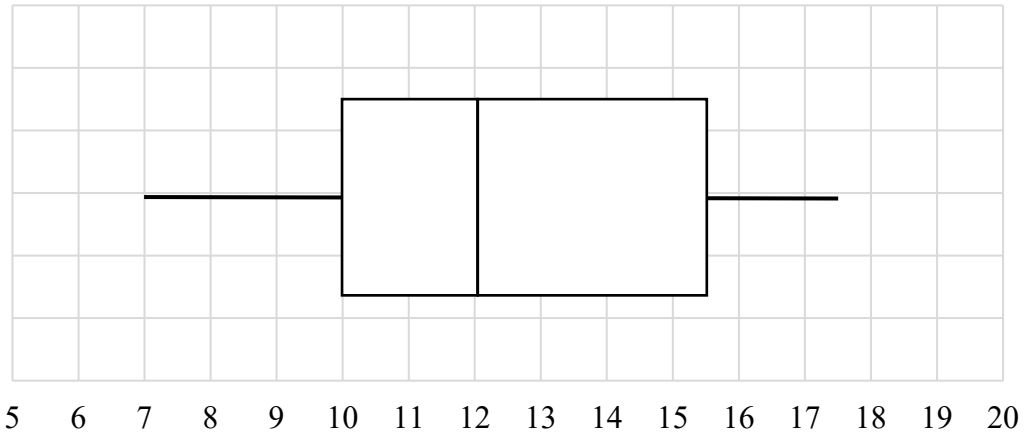
Marks will **not** be deducted for incorrect answers.

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

Question 1



The interquartile range for the data represented by the boxplot above is

A. 2

B. 3.5

C. 5.5

D. 8.5

E. 10.5

Question 2

The distance, in kilometres, that 18 students travel to school from home is recorded and the following summary statistics are calculated.

Minimum	First quartile (Q_1)	Median	Third quartile (Q_3)	Maximum	Mean	Standard deviation
0.9	3.2	4.7	7.9	12.7	5.4	3.5

One student moves house, which changes her distance travelled from 4.3 km to 4.6 km.

What impact will this have on the statistics shown above?

A. The range will increase.

B. The mean will increase.

C. The interquartile range (IQR) will increase.

D. The median will increase.

E. The standard deviation will increase.

Question 3

The stem plot below represents the number of students enrolled in Year 7 over 20 years at a local high school.

key: 9|6 = 96 n = 20

9	6
10	4
11	2 5 8
12	3 6 7 7 8
13	2 4 4 6 6 6 9
14	3 5 5

The distribution of this data is best described as

A. symmetric.

B. a positive association.

C. a negative association.

D. positively skewed.

E. negatively skewed.

Question 4

Shoppers were asked to rate the customer service at a store. They were asked to rate the *speed of service* (1 = fast, 2 = average, 3 = slow) and their *likelihood of returning* to the store (yes, no).

These variables are

A. a numerical and ordinal variable respectively.

B. an ordinal and nominal variable respectively.

C. a nominal and ordinal variable respectively.

D. both ordinal variables.

E. both nominal variables.

Question 5

Which of the following would **not** represent a positive association?

A. *temperature* and *number of heaters sold*

B. *population* and *number of hospitals*

C. *time spent exercising* and *calories burned*

D. *number of cars on the road* and *levels of sound pollution*

E. *hours of study* and *test results*

Use the following information to answer Questions 6 and 7.

An exam was undertaken at five schools, with the results normally distributed at each school.

	Number of students	**Mean** ($\bar{x}$)	**Standard deviation** (s_x)
School A	120	64	4
School B	165	70	3
School C	112	65	6
School D	90	72	5
School E	105	70	5

Question 6

Mostyn achieved a score of 73 and was informed he was in the top 2.5% of students who undertook the exam in his school.

The school Mostyn attends is

A. School A.

B. School B.

C. School C.

D. School D.

E. School E.

Question 7

76 students from one school achieved a standardised score within one standard deviation of the school mean.

The school they attend is

A. School A.

B. School B.

C. School C.

D. School D.

E. School E.

Question 8

The average windspeed, in kilometres per hour, is measured on 12 consecutive days and is recorded below.

Day	1	2	3	4	5	6	7	8	9	10	11	12
Average windspeed	3.2	5.1	7.8	7.9	8.9	9.7	10.4	12.1	12.1	12.2	15.8	19.1

The windspeed of 19.1 is considered to be an outlier.

For this windspeed to **not** be considered an outlier, which of the following changes should occur?

A. a decrease in Q_1 and an increase in Q_3

B. an increase in Q_1 and a decrease in Q_3

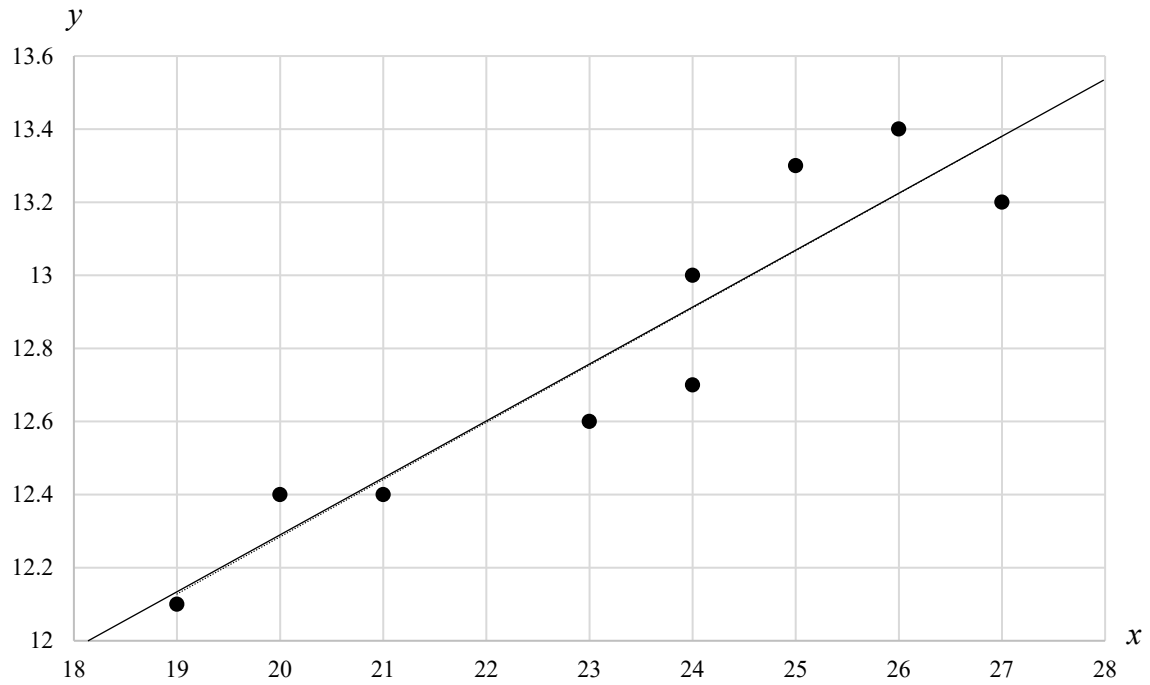
C. an increase in Q_1 only

D. a decrease in Q_3 only

E. a decrease in both Q_1 and Q_3

Question 9

The scatterplot below shows a least squares line fitted to a scatterplot.



The statistics for the set of data above are shown in the table below.

$\overline{x}$	$\overline{y}$	s_x	s_y	r
23.2	12.8	2.7	0.46	0.9351

The equation of the least squares line is

A. $y = 5.5 - 114.5x$

B. $y = 0.16 + 9.10x$

C. $y = -114.5 + 5.5x$

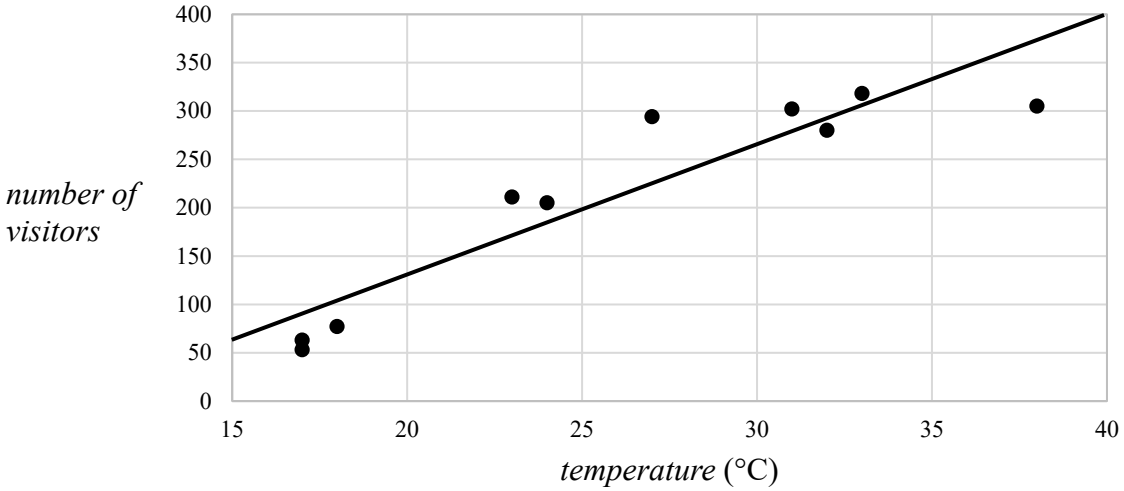
D. $y = 0.16 - 9.10x$

E. $y = 9.10 + 0.16x$

Use the following information to answer Questions 10–12.

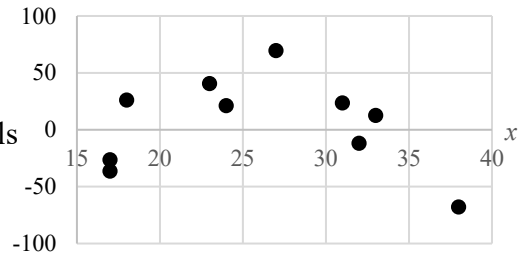
The data below shows the *temperature* and the *number of visitors* to a local pool each day over a 10-day period.

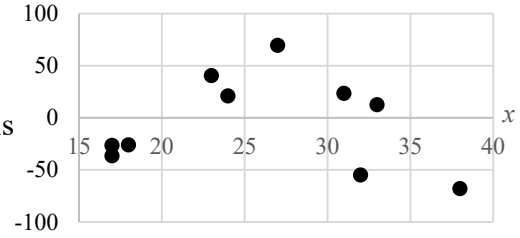
***Temperature* (°C)**	17	23	27	31	33	32	38	24	18	17
Number of visitors	63	211	294	302	318	280	305	205	77	53

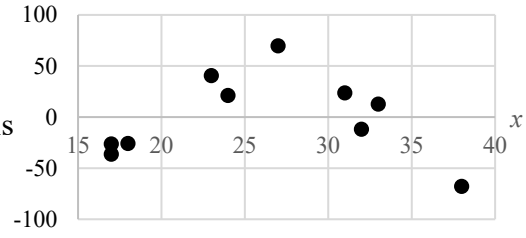


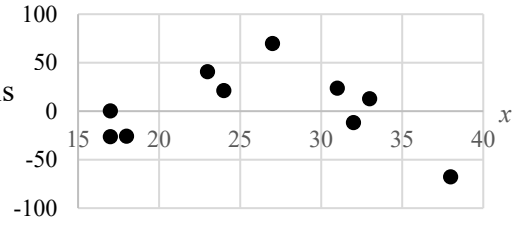
Question 10

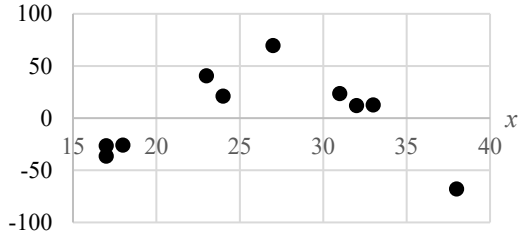
The residual plot that matches the data is

A.


B.


C.


D.


E.


Question 11

A reciprocal transformation is applied to the *temperature* in order to attempt to linearise the data.

The equation of the least squares line for the transformed data is

$$number\ of\ visitors = 494.7 - 7191 \times \frac{1}{temperature}$$

Which one of the following changes has occurred after the transformation?

A. The correlation coefficient has become weaker from 0.830 to –0.917

B. The correlation coefficient has become stronger from 0.830 to –0.917

C. The coefficient of determination has increased from 0.670 to 0.955

D. The coefficient of determination has decreased from 0.841 to 0.690

E. The coefficient of determination has decreased from 0.841 to 0.670

Question 12

The equation of the least squares line for the transformed data is used to predict the *number of visitors*.

The *number of visitors* predicted when the *temperature* is 30 °C is closest to

A. 15

B. 182

C. 255

D. 402

E. 759

Question 13

The table below shows the average temperature, in degrees Celsius, for each month in a year.

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
29	28	23	20	19	10	7	9	11	16	24	30

The two-mean smoothed average temperature with centring for August is

A. 8

B. 9

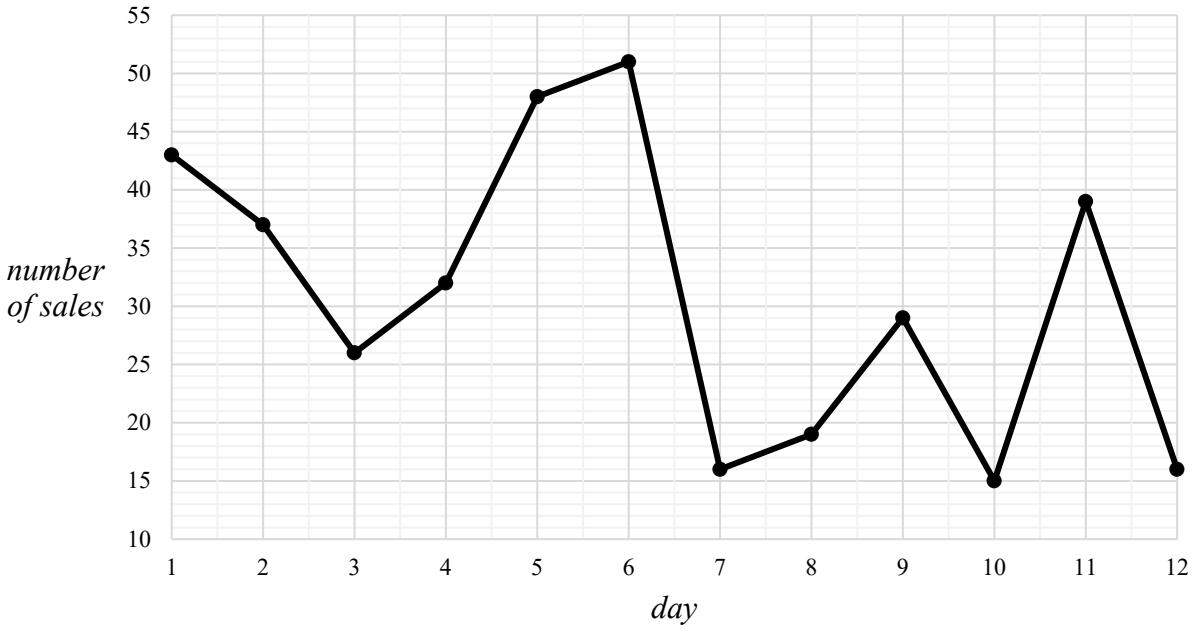
C. 10

D. 11

E. 20

Question 14

The online sales for a bookstore over 12 days are shown in the time series plot below.



The seven-median smoothed *number of sales* value for day 8 is closest to

A. 19

B. 29

C. 39

D. 48

E. 51

Question 15

The table below shows two of the seasonal indices for the quarterly sales figures of a business.

Quarter 1	Quarter 2	Quarter 3	Quarter 4
1.07	1.03		

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

A. The sales in Quarter 1 are 7% above the average sales.

B. The mean seasonal index for Quarter 3 and Quarter 4 is 0.95

C. The seasonal index for Quarter 3 could be 0.98

D. The seasonal index for Quarter 4 could be 1.06

E. The sales for the year are 400% above the average sales.

Question 16

A business has a seasonal index of 1.20 for Quarter 1.

To correct for seasonality, its sales for Quarter 1 would need to be

A. decreased by 20%

B. decreased by 17%

C. decreased by 13%

D. increased by 17%

E. increased by 13%

Recursion and financial modelling

Question 17

The following recurrence relation generates a sequence of numbers.

$$T_0 = 6, \qquad T_{n+1} = 3T_n$$

T_5 is equal to

A. 18

B. 216

C. 486

D. 729

E. 1458

Question 18

An appliance is purchased for \$486. It depreciates using the rule shown below, where n represents the number of time periods.

$$V_n = 486 - 14n$$

This model of depreciation shown is

A. reducing balance depreciation, at a rate of depreciation of 14% per time period.

B. flat rate depreciation, at a rate of depreciation of \$14 per time period.

C. reducing balance loan, at a rate of depreciation of 14% per time period.

D. reducing balance depreciation, at a rate of depreciation of \$14 per time period.

E. flat rate depreciation, at a rate of depreciation of 14% per time period.

Question 19

A \$24 000 perpetuity is invested for 10 years at a rate of 2.12% per annum, compounding monthly.

The amount of interest earned over 10 years is

A. \$3060

B. \$5088

C. \$24 000

D. \$26 640

E. \$61 056

Question 20

Griffin invests $1500 into an investment account, earning interest at 3.7% per annum, compounding fortnightly.

Griffin wishes to add an additional payment each fortnight and has the option of paying $20 or $50.

If he makes additional fortnightly payments of $50, how much more will he have in his account after 2 years compared to if he contributed only $20 per fortnight?

A. $64

B. $546

C. $1618

D. $2720

E. $3074

Use the following information to answer Questions 21 and 22.

Nadia borrowed $700 000 at a rate of 3.3% per annum, compounding monthly. Her repayments are $3724 per month for 25 years.

The first four lines of the amortisation table are shown below.

Payment number	Repayment ($)	Interest ($)	Principal reduction ($)	Balance ($)
0	0.00	0.00	0.00	**700 000**
1	3724			
2	3724	1920.05	1803.95	696 397.05
3	3724	1915.09	1808.91	694 588.14

Question 21

The missing amounts in the amortisation table for payment number 1 are

A. $1925, $1799, $698 201

B. $1926, $1798, $700 000

C. $1926, $1799, $698 201

D. $1925, $1798, $700 000

E. $1925, $1799, $700 000

Question 22

The percentage of the third repayment that contributes to the principal reduction is closest to

A. 0.26%

B. 0.54%

C. 47.2%

D. 48.6%

E. 51.4%

Question 23

The recurrence relation for an annuity is shown below, where n is the number of quarters. The interest compounds quarterly.

$$V_0 = 13\,800, \qquad V_{n+1} = 1.0061V_n - 162.50$$

The length of the annuity, in quarters, is closest to

A. 85

B. 91

C. 96

D. 120

E. 193

Question 24

Nigella is saving for a house deposit.

She invests $4000 in an account earning 2.05% per annum, compounding fortnightly.

Nigella adds an additional $800 per fortnight to the account.

Every 12 months, when Nigella receives a salary increase, she increases the amount of the fortnightly deposit by $50, so that in the second year she is adding $850 per fortnight, and in the third year she is adding $900.

After three years, the balance of her investment is closest to

A. $6561

B. $8073

C. $68 586

D. $72 552

E. $176 711

END OF SECTION A

Module 1 – Matrices

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

Question 1

Consider the matrix M below.

$$M = \begin{bmatrix} 11 & 17 \\ 23 & 41 \\ 21 & 35 \end{bmatrix}$$

The element m_{21} is

A. 11

B. 17

C. 21

D. 23

E. 41

Question 2

Matrix E is a 2×3 matrix, and matrix F is a 2×4 matrix.

The order of $E^{\mathrm{T}} \times 2F$ is

A. 2×3

B. 3×4

C. 4×2

D. 2×4

E. 3×2

Question 3

A matrix equation is $KX = L$, where $K = \begin{bmatrix} 3 & 2 \\ -6 & -4 \end{bmatrix}$, $X = \begin{bmatrix} a \\ b \end{bmatrix}$ and $L = \begin{bmatrix} 3 \\ 5 \end{bmatrix}$.

Which one of the following statements is true?

A. $X = K^{-1} \times L$ has a unique solution.

B. K has a determinant of 0.

C. The determinant of K is -24.

D. The inverse of K is $\begin{bmatrix} \frac{1}{6} & \frac{1}{12} \\ \frac{1}{4} & -\frac{1}{8} \end{bmatrix}$.

E. $K \times K^{-1} \times L = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \times L$.

Question 4

$3M + 2N = \begin{bmatrix} 1 & -2 & 22 \\ 25 & 39 & 12 \end{bmatrix}$

If $N = \begin{bmatrix} -1 & 2 & 5 \\ 2 & 3 & 6 \end{bmatrix}$, matrix M is

A. $\begin{bmatrix} 1 & -2 & 4 \\ 7 & 11 & 0 \end{bmatrix}$

B. $\begin{bmatrix} -1 & -6 & 12 \\ 21 & 33 & 0 \end{bmatrix}$

C. $\begin{bmatrix} 3 & -6 & 12 \\ 21 & 33 & 0 \end{bmatrix}$

D. $\begin{bmatrix} -2 & 4 & 10 \\ 4 & 6 & 12 \end{bmatrix}$

E. $\begin{bmatrix} -1/3 & -2 & 4 \\ 7 & 11 & 0 \end{bmatrix}$

Question 5

Teachers A, B, C and D are on a roster to supervise after-school activities from Monday to Friday.

The order of supervision follows the transition matrix, T, shown below.

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

Teacher A supervised first on Monday of the first week.

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

A. In the second week, Teacher C supervises twice.

B. The supervisor on Monday will always supervise on the Friday of the same week.

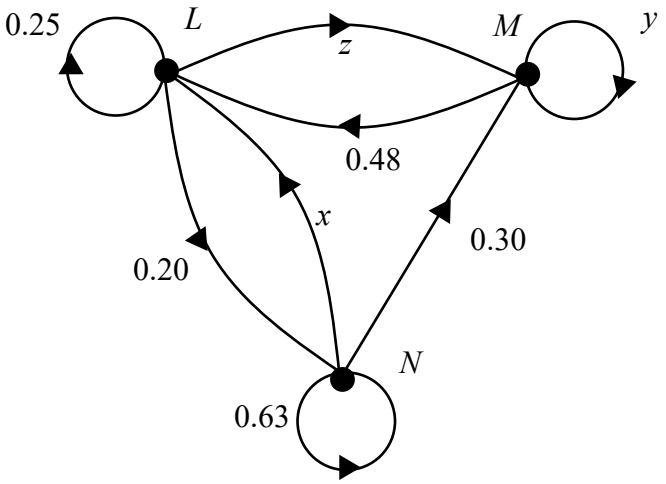
C. Teacher D will supervise on the third Tuesday.

D. In the first four weeks, all teachers supervise the same number of days.

E. The fifth supervision day for Teacher B will be on Friday of the third week.

Question 6

The transition diagram below shows the probability of customer movement between three venues. Some of the values are missing from the transitions.



The transition matrix that matches the transition diagram, with missing values included, is

A.

	from *L*	*M*	*N*	
	0.25	0.48	0.07	*L*
	0.55	0.52	0.30	*M*
	0.20	0	0.63	*N*

to

B.

	from *L*	*M*	*N*	
	0.25	0.48	0.07	*L*
	0.55	0.70	0.30	*M*
	0.20	0	0.63	*N*

to

C.

	from *L*	*M*	*N*	
	0.25	0	0.07	*L*
	0.55	0.52	0.30	*M*
	0.20	0.48	0.63	*N*

to

D.

	from *L*	*M*	*N*	
	0.25	0.30	0.07	*L*
	0.55	0.70	0.30	*M*
	0.20	0	0.63	*N*

to

E.

	from *L*	*M*	*N*	
	0.25	0.55	0.07	*L*
	0.48	0.52	0.30	*M*
	0.20	0	0.63	*N*

to

Question 7

A sample of 500 households are monitored for their television-watching habits.

The number of households watching three leading television shows on a Sunday night is recorded on the matrix below. The shows are *I'm a Student, Get Me Out of Here* (*S*), *Masterchess* (*M*) and *The Brick* (*B*).

$$T = \begin{array}{c} \quad \text{this Sunday} \\ \quad S \quad M \quad B \\ \begin{bmatrix} 0.81 & 0.08 & 0.06 \\ 0.10 & 0.77 & 0.02 \\ 0.09 & 0.15 & 0.92 \end{bmatrix} \begin{array}{l} S \\ M \\ B \end{array} \end{array} \begin{array}{l} \\ \\ \text{next Sunday} \end{array}$$

It is found that on the third Sunday, 125 households were watching *I'm a Student*, *Get Me Out of Here,* 212 were watching *Masterchess*, and the rest were watching *The Brick*.

The number of households watching *Masterchess* on the first Sunday is closest to

A. 111

B. 154

C. 163

D. 317

E. 374

Question 8

A store needs to send the quantities of packages shown in the table below.

	International shipping	**Domestic shipping**
Standard	15	8
Express	3	7

The international (I) and domestic (D) shipping rates, in dollars, for items via standard (S) and express (E) post are shown in the table below.

	International shipping	**Domestic shipping**
Standard	\$14	\$6
Express	\$25	\$9

The matrix calculation that produces the total paid for international shipping and the total paid for domestic shipping is

A. $\begin{bmatrix} 14 & 6 \\ 25 & 9 \end{bmatrix} \times \begin{bmatrix} 15 & 8 \\ 3 & 7 \end{bmatrix} \times \begin{bmatrix} 1 \\ 1 \end{bmatrix}$

B. $\begin{bmatrix} 15 & 8 \\ 3 & 7 \end{bmatrix} \times \begin{bmatrix} 14 & 6 \\ 25 & 9 \end{bmatrix} \times \begin{bmatrix} 1 & 1 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 1 \end{bmatrix} \times \begin{bmatrix} 15 & 0 \\ 0 & 7 \end{bmatrix} \times \begin{bmatrix} 14 & 6 \\ 25 & 9 \end{bmatrix} \times \begin{bmatrix} 0 & 3 \\ 8 & 0 \end{bmatrix}$

D. $\begin{bmatrix} 1 & 1 \end{bmatrix} \times \left(\begin{bmatrix} 14 & 0 \\ 0 & 9 \end{bmatrix} \times \begin{bmatrix} 15 & 0 \\ 0 & 7 \end{bmatrix} + \begin{bmatrix} 3 & 0 \\ 0 & 8 \end{bmatrix} \times \begin{bmatrix} 25 & 0 \\ 0 & 6 \end{bmatrix} \right)$

E. $\begin{bmatrix} 1 \\ 1 \end{bmatrix} \times \left(\begin{bmatrix} 14 & 0 \\ 0 & 9 \end{bmatrix} \times \begin{bmatrix} 15 & 0 \\ 0 & 7 \end{bmatrix} \times \begin{bmatrix} 3 & 0 \\ 0 & 8 \end{bmatrix} \times \begin{bmatrix} 25 & 0 \\ 0 & 6 \end{bmatrix} \right)$

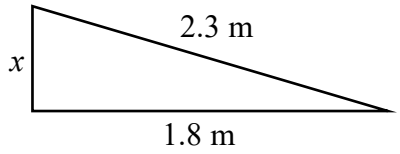
Module 3 – Geometry and measurement

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

Question 1

A ramp is built with a horizontal length of 1.8 m and a sloped-side length of 2.3 m.

What is the vertical height of the ramp, x?



A. 0.5 m

B. 0.71 m

C. 1.43 m

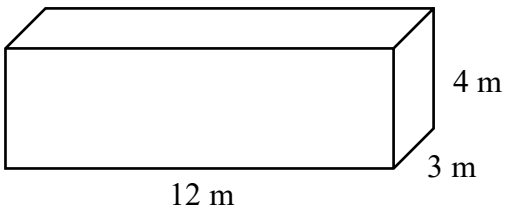
D. 2.05 m

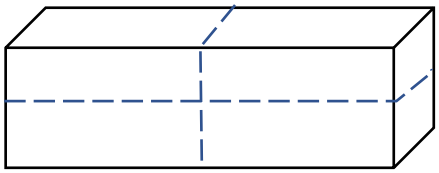
E. 2.92 m

Question 2

A slab of concrete has dimensions of 3 m × 4 m × 12 m. It is painted black on the outside.

The slab is cut into four equal-sized pieces, as shown in the diagram below.





To ensure all four pieces are painted black on the outside, what is the total surface area of the additional sides that needs to be painted?

A. 48 m^2

B. 60 m^2

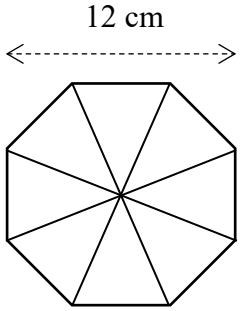
C. 96 m^2

D. 120 m^2

E. 144 m^2

Question 3

A regular octagon of width 12 cm is cut into eight equal triangular pieces, as shown in the diagram below.



The area of **one** of the eight pieces, correct to one decimal place, is

A. 6.0 cm^2

B. 12.7 cm^2

C. 13.0 cm^2

D. 14.9 cm^2

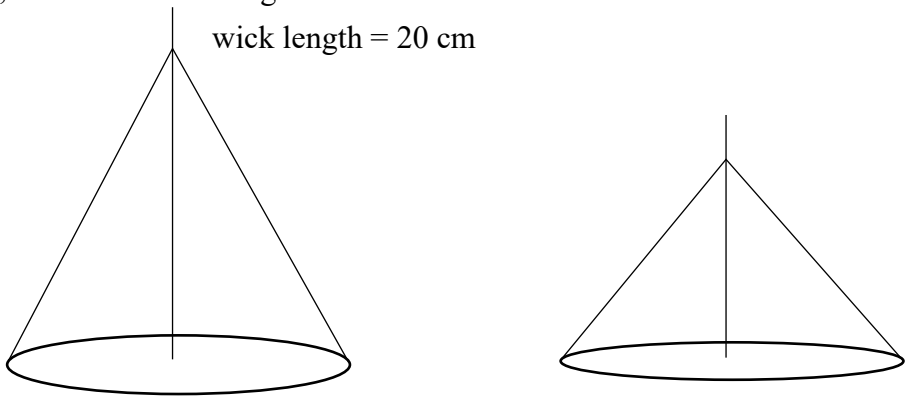
E. 21.4 cm^2

Question 4

A candle is shaped as a cone with a wick running perpendicular to the base. As the candle burns, the diameter of the base does not change.

The wick starts from the base of the candle and always extends 0.5 cm above the top of the wax, regardless of the amount of wax remaining.

When the candle is lit for the first time, the wick is 20 cm long and the volume of wax is 735 cm^3, as shown in the diagram on the left below.



wax = 735 cm^3 wax = 551.25 cm^3

After burning for 2 hours, 551.25 cm^3 of wax remains, as shown in the diagram on the right.

The full length of the wick now, in centimetres, is closest to

A. 14.5 cm

B. 14.6 cm

C. 15.0 cm

D. 15.1 cm

E. 15.5 cm

Question 5

Koen, Nullah and Allira all live in different time zones.

Koen is 5 hours ahead of Nullah. Allira is 14 hours behind Koen.

If it is 7.00 am Tuesday where Nullah is, what time is it for Allira?

A. 10.00 pm Monday

B. 4.00 pm Tuesday

C. 5.00 pm Monday

D. 2.00 am Tuesday

E. 12.00 pm Monday

Question 6

Aswin is in Papua New Guinea (8° S, 142° E). Ben is in Tanzania (8° S, 37° E).

The radius of the Earth is 6400 km.

The calculation for the distance between Aswin and Ben is

A. $\frac{105}{360} \times 2 \times \pi \times 6400$

B. $\frac{105}{360} \times 2 \times \pi \times 6338$

C. $\frac{105}{360} \times 2 \times \pi \times 1656$

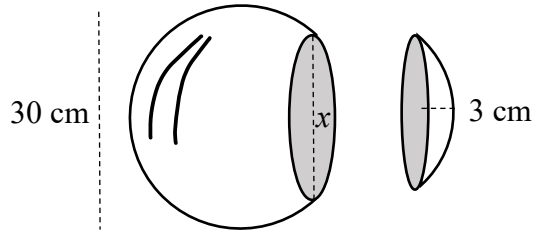
D. $\frac{179}{360} \times 2 \times \pi \times 6338$

E. $\frac{179}{360} \times 2 \times \pi \times 6400$

Question 7

A spherical model of the Earth has a diameter of 30 cm.

An accident results in a part of the sphere being sliced off. The width of the piece removed is 3 cm, as shown in the diagram below.



What is the diameter x, in centimetres, of the circular edge created?

A. 6

B. 9

C. 12

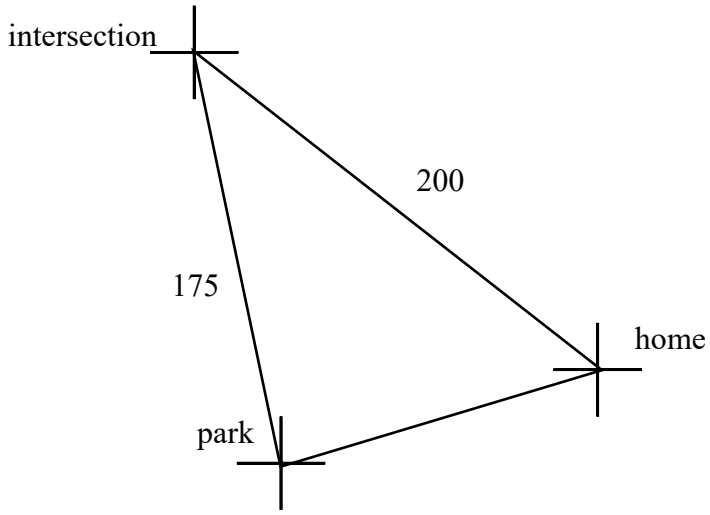
D. 16

E. 18

Question 8

Sandy's dog ran away from the park.

It ran 175 metres from the park to a major intersection, and then ran 200 metres back home.



The bearing of the park from home is 250°.

The bearing of the intersection from home is 310°.

What is the bearing of the park from the intersection, to the nearest degree?

A. 60°

B. 82°

C. 138°

D. 160°

E. 168°