TSSM
Creating VCE Success

2019 Trial Examination

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STUDENT NUMBER | | | | | | | | | Letter |

FURTHER MATHEMATICS

Units 3 & 4 – Written examination 1

Reading time: 15 minutes
Writing time: 1 hour and 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	24	24			24
B	32	16	4	2	16
					Total 40

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers, one bound reference, one approved graphics calculator or approved CAS calculator or CAS software and, if desired, one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

Materials supplied

- Question book of 27 pages.
- Multiple Choice answer sheet

Instructions

- Print your name in the space provided on the top of this page.
- All written responses must be in English.

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

SECTION A – Core

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions. Choose the response that is **correct** for the question. A correct answer scores 1; an incorrect answer scores 0. Marks will **not** be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question. Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Core: Data analysis

Use the following information to answer Questions 1 to 3

The following are the marks scored by 30 candidates in an examination.

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

Key $1|2 = 12$

Question 1.

The percentage of candidates who scored above 85 is closest to

A. 4
B. 13
C. 17
D. 26
E. 87

Question 2.

The five-figure summary for the data of these 30 candidates is closest to

A. 26, 46, 62, 74, 92.
B. 26, 50, 60, 72, 92.
C. 26, 50, 61, 72, 92.
D. 26, 46, 61, 74, 92.
E. 26, 50, 62, 72, 92.

SECTION A - continued

Question 3.

The mean and standard deviation of marks scored by the 30 candidates respectively are closest to

A. 60 and 17.6
B. 17.6 and 60.8
C. 61 and 17.7
D. 60.8 and 17.7
E. 61 and 18

Use the following information to answer Questions 4 to 6

The weights of new born goslings are approximately normally distributed with a mean of 154 grams and a standard deviation of 27 grams.

Question 4.

A newborn gosling is found to have a standardised weight of $z = 1.6$ This gosling's actual weight is closest to

A. 91 grams.
B. 92 grams.
C. 181 grams.
D. 197 grams.
E. 246 grams.

Question 5.

Newborn goslings with a weight less than 100 grams will be rejected as they are considered underweight. The percentage of newborn goslings expected to be rejected is closest to

A. 0.15
B. 2.35
C. 2.5
D. 13.5
E. 16

Question 6.

The Lucky Goose farm had 4,809 goslings hatch in 2018. The number of these goslings expected to have a birth weight between 127 grams and 208 grams is closest to

A. 82
B. 1635
C. 3270
D. 3920
E. 4565

Question 7.

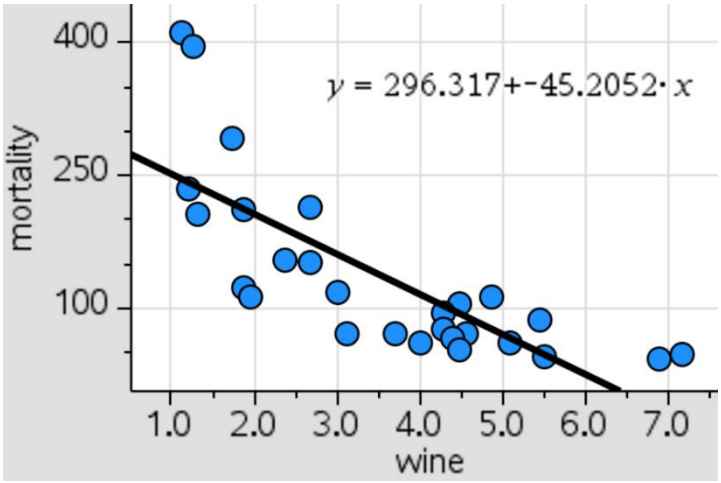
Data was collected in relation to the age (< 1 year, 1-2 years, 3-5 years, 6-10 years, >10 years) and the size of vehicle (small, medium, large) of sedans being sold second hand at a particular dealership.

Which one of the following is appropriate to use to determine if there is a relationship between these variables?

A. parallel dot plots
B. parallel box plots
C. back to back stem and leaf plots
D. segmented bar chart
E. scatter plot

Use the following information to answer questions 8 to 10

The scatter plot below displays the annual volume of wine consumed per capita and the number of mortalities due to cardiovascular disease per 100,000 population in 27 countries. A least squares line has been fitted to the data.



Question 8.

Given that the wine consumption in Australia is 4.48 litres per person per year and Australia has 54.11 mortalities due to cardiovascular disease per 100,000 population, the residual for Australia is closest to

A. 39.69
B. 39.68
C. -40.29
D. -39.68
E. -39.69

Question 9.

The coefficient of determination is 0.5921

The correlation coefficient *r* is closest to

A. 0.3506
B. 0.7694
C. 0.7695
D. -0.7695
E. -0.7694

Question 10.

Which one of the following is a conclusion that can be made from this least squares line?

A. An increase in 1 mortality due to cardiovascular disease is associated with a reduction of 45.21 litres of wine consumed annually per person.
B. Increased wine consumption causes a drop in cardiovascular mortalities.
C. When no wine is consumed in a country the mortality rate due to cardiovascular disease will be 296 per 100,00 population.
D. The linear regression equation will not be reliable unless appropriate data transformations are completed and a new regression equation calculated.
E. 59.21% of the predictions made using this regression equation will be accurate.

Question 11.

Which one of the following is useful for determining if a data set needs to be transformed?

A. Correlation coefficient
B. Coefficient of determination
C. Residual plot
D. Box plot
E. Standard deviation

Use the following information to answer Questions 12 and 13

An analysis of Australian obesity rates (measured as a percentage of the population) over the years 1995 to 2004 was found to have a correlation coefficient of 0.9955 after applying a reciprocal transformation. The regression equation obtained is shown below.

$$\frac{1}{obesity\ rate} = 4.8224 - 0.002371 \times Year$$

Question 12.

Which one of the following statements is true?

A. Using the regression equation, the obesity rate in 2004 was approximately 14.1%.
B. Each year the obesity rate tends to fall by 0.0024 percent.
C. In 1995 the obesity rate in Australia was 4.8224 percent.
D. 99.5% of variation in obesity rate can be explained by variation in year.
E. 99.1% of variation in obesity rate can be explained by variation in year.

Question 13.

The regression equation predicts the obesity rate in 2016 to be closest to

A. 23.5%
B. 4.25%
C. 20.3%
D. 8.6%
E. 9.4%

Question 14.

Analysis of data from several countries was undertaken which looked at the obesity rates and the daily average number of steps taken by the population in each country. The daily average steps taken is to be used to predict the obesity rate of a population.

	average steps	**obesity rate**
Mean	5127	13.1
Standard deviation	803	5.6

Given that the slope of the regression equation is -0.0044 and the intercept is 35.6, then the correlation coefficient for this data is closest to

A. –1.722
B. –0.631
C. –1.124
D. 0.248
E. 0.634

Use the following information to answer Questions 15 and 16

The following table shows the long term average maximum temperature for each month as recorded at the Cape Otway Light Station over the years 1998 to 2016.

Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Ave Max Temp	21.1	21.3	19.9	17.7	15.5	13.5	13.0	13.6	15.0	16.7	18.0	19.3

Question 15.

The seasonal index for February is closest to

A. 0.80
B. 0.81
C. 1.17
D. 1.24
E. 1.25

Question 16.

To correct the average monthly maximum temperature of July to allow for seasonality, the actual figure should be

A. reduced by 31%
B. reduce by 24%
C. increase by 24%
D. increase by 27%
E. increase by 31%

Core: Recursion and financial modelling

Use the following information to answer Questions 17 and 18

The following recurrence relation can be used to determine the value of an annuity, V_n, in dollars, after *n* months.

$$V_0 = 15000, \qquad V_{n+1} = 1.005V_n - 200$$

Question 17.
What is the value of the annuity after 7 months?

A. \$14875
B. \$14368.72
C. \$14240.56
D. \$14111.77
E. \$13982.32

Question 18.
The interest rate being earned by the annuity is closest to

A. 5% per month
B. 5% per annum
C. 0.5% per annum
D. 6% per annum
E. 6.5% per annum

Question 19.
The first five terms of a sequence are 4, 12, 44, 172, 684…
The recurrence relation that generates this sequence could be

A. $S_0 = 4, \quad S_{n+1} = S_n + 8$
B. $S_0 = 4, \quad S_{n+1} = 2S_n + 4$
C. $S_0 = 4, \quad S_{n+1} = 3S_n$
D. $S_0 = 4, \quad S_{n+1} = 4S_n - 4$
E. $S_0 = 4, \quad S_{n+1} = 5S_n - 8$

Use the following information to answer Questions 20 and 21.

The value of an investment, in dollars, after *n* months, I_n , is modelled by the recurrence relation shown below.

$$I_0 = \$39\,000 \qquad I_{n+1} = 1.0052I_n + 250$$

Question 20.

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

A. The interest rate is 6.24% p.a.

B. The interest is calculated monthly.

C. Regular additions of $250 are deposited every month.

D. The value of the investment after 3 months will be $40365.48.

E. The interest earned in the first 3 months will be $1365.48.

Question 21.

Between the end of the first and the end of the second years, the increase in value of the investment is closest to

A. $5950.80

B. $3000

C. $5433.60

D. $2433.60

E. $5591.73

Question 22.

A borrower plans on taking out a loan for $2000 and paying it off in a lump sum at the end of 1 year. Below are given five different loan options.

- Option A: 8.25% p.a. compounding fortnightly
- Option B: 8.24% p.a. compounding weekly
- Option C: 8.26% p.a. compounding monthly
- Option D: 8.32% p.a. compounding quarterly
- Option E: 8.25% p.a. compounding monthly

The option which offers the best returns for the financial institution is

A. Option A

B. Option B

C. Option C

D. Option D

E. Option E

Use the following information to answer Questions 23 and 24

The amortisation table below outlines several payments into an investment. Payments are made monthly and the interest rate (a percentage to one decimal place) remained unchanged for the first 12 payments.

Payment number	Payment	Interest	Principal addition	Balance of investment
10	$ 2,000.00	$ 177.30	$ 2,177.30	$ 36,273.08
11	$ 2,000.00	$ 178.34	$ 2,178.34	$ 38,451.42
12	$ 2,000.00	$ 189.05	$ 2,189.05	$ 40,640.47
13	$ 2,500.00			

Question 23.

The initial balance of the investment was closest to

A. $15000
B. $15005
C. $15045
D. $15070
E. $15075

Question 24.

Given that the interest rate increases by 0.2% p.a. after payment 12, and the payment is increased as shown in the table, the principal addition for the thirteenth month is

A. $206.59
B. $2206.60
C. $2212.12
D. $2712.12
E. $2706.59

END OF SECTION A

SECTION B - Modules

Instructions for Section B

Select **two** modules and answer **all** questions within the selected modules.
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.

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SECTION B - continued
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Module 1 – Matrices

Use the following matrices to answer questions 1 to 3

$$A=\begin{bmatrix}-6 & -12\\ 1 & 2\end{bmatrix} \quad B=\begin{bmatrix}16\\ 24\\ 0\end{bmatrix} \quad C=\begin{bmatrix}1 & -1 & 3\\ 5 & 2 & -7\end{bmatrix} \quad D=\begin{bmatrix}1 & 2\\ -3 & 6\end{bmatrix} \quad E=\begin{bmatrix}0 & 2 & 1\\ -1 & 0 & 3\\ 1 & -2 & 0\end{bmatrix}$$

Question 1.

A matrix multiplication $X\times\begin{bmatrix}1\\ 2\\ 3\end{bmatrix}$ is defined. The number of matrices *A*-*E* that could be used to replace *X* is

A. 1
B. 2
C. 3
D. 4
E. 5

Question 2.

The number of matrices *A*-*E* that have a defined inverse is

A. 1
B. 2
C. 3
D. 4
E. 5

Question 3.

The matrix product $A\times D$ is equal to

A. $\begin{bmatrix}-6 & -24\\ -3 & 12\end{bmatrix}$

B. $3\begin{bmatrix}-2 & -12\\ -1 & 4\end{bmatrix}$

C. $\begin{bmatrix}-4 & -8\\ 24 & 48\end{bmatrix}$

D. $\begin{bmatrix}-5 & -10\\ -2 & 8\end{bmatrix}$

E. $\begin{bmatrix}30 & -84\\ -5 & 14\end{bmatrix}$

Use the following information to answer Questions 4 and 5

A group of five students sit in a circle and are only allowed to communicate directly with the students seated either side of them. Messages can be sent in either direction around the circle. The communications matrix shows who each of the students Anna (A), Brendan (B), Clara (C), Dennis (D) and Eliza (E) can communicate directly with.

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

Question 4.

The Communications matrix contains one error. The error relates to communication between

A. Brendan and Clara
B. Dennis and Brendan
C. Eliza and Dennis
D. Dennis and Clara
E. Anna and Dennis

Question 5.

Eliza wishes to send a message to Dennis. The shortest path for this message to travel is

A. Eliza – Brendan – Anna – Dennis
B. Eliza – Dennis
C. Eliza – Anna – Dennis
D. Eliza – Clara – Dennis
E. Eliza – Brendan - Dennis

Question 6.

A permutations matrix P has order 4×4. The matrix multiplication $Y \times P$ results in the third and fourth columns of matrix Y being swapped and the first and second columns of matrix Y also being swapped.

The permutations matrix P is

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

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

Question 7.

Matrix C is a 3×2 matrix which follows the rule $c_{ij} = 2i - j$ and matrix D is a 2×3 matrix defined by the rule $d_{ij} = j - 2i$.

The matrix product $D \times C$ is

A. $\begin{bmatrix} 4 & 4 \\ -14 & -8 \end{bmatrix}$ **B.** $\begin{bmatrix} -35 & -26 \\ -26 & -20 \end{bmatrix}$ **C.** $\begin{bmatrix} -1 & 0 \\ -9 & -4 \end{bmatrix}$

D. $\begin{bmatrix} -1 & 0 & 1 \\ -9 & -4 & 1 \\ -17 & -8 & 1 \end{bmatrix}$ **E.** $\begin{bmatrix} -1 & -3 & -5 \\ -3 & -13 & -23 \\ -5 & -23 & -41 \end{bmatrix}$

Question 8.

Consider the matrix recurrence relation below.

$$S_0 = \begin{bmatrix} 260 \\ 320 \\ 450 \end{bmatrix}, \quad S_{n+1} = T \times S_n + U \text{ where } T = \begin{bmatrix} 0.7 & 0.2 & 0.1 \\ 0.1 & 0.6 & W \\ X & Y & Z \end{bmatrix} \text{ and } U = \begin{bmatrix} 5 \\ 7 \\ 11 \end{bmatrix}$$

T is a regular transition matrix.

Given that $S_1 = \begin{bmatrix} 296 \\ 405 \\ 352 \end{bmatrix}$, which one of the following is **not** true?

A. $X = Y$

B. $X + Y + Z < 1$

C. $W > Z$

D. $Y + W + Z > 1$

E. $W = X + Y$

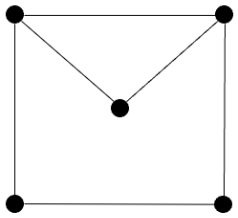
END OF MODULE 1 - SECTION B - continued
TURN OVER

Module 2 – Networks and decision mathematics

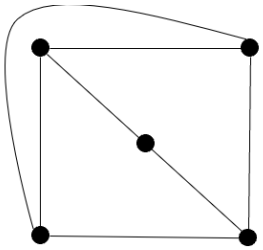
Question 1.

Which one of the following networks contains an Eulerian circuit?

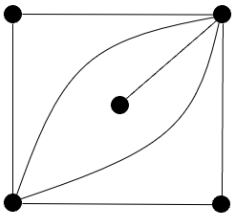
A.



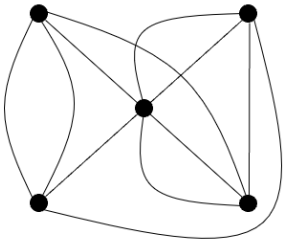
B.



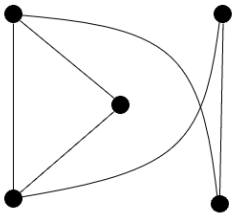
C.



D.

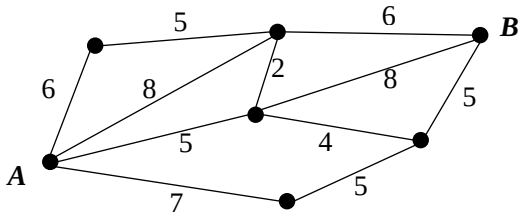


E.



Question 2.

The weighted network below shows the average travel times in minutes between major intersections on a road network.



The shortest time in minutes to travel from ***A*** to ***B*** is

A. 18

B. 17

C. 14

D. 13

E. 2

Question 3.

A planar graph has 13 edges. Which of the following would **not** be possible for this graph?

A. Twelve vertices and three faces

B. Seven vertices and eight faces

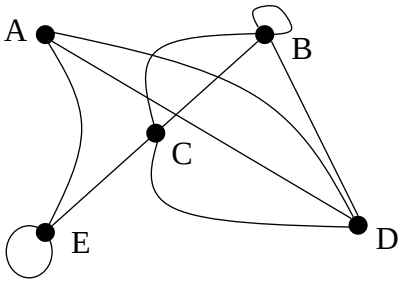
C. Four vertices and eleven faces

D. Six vertices and seven faces

E. Eleven vertices and four faces

Question 4.

Consider the following network.



The adjacency matrix for this graph will have order 5 x 5. Which of the following is true for the adjacency matrix?

A. It will contain twelve 0's.

B. The leading diagonal will contain only 0's.

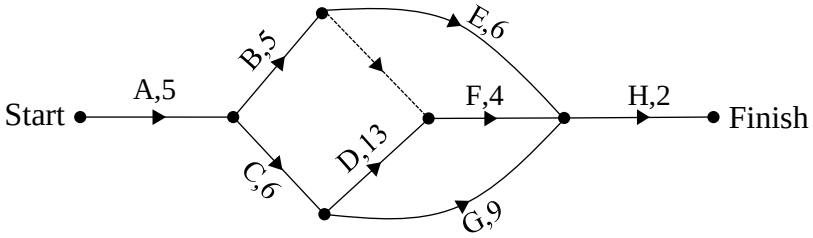
C. It will contain four 2's.

D. It will not be symmetric.

E. It will be a triangular matrix.

Use the following information to answer Questions 4 and 5

The directed graph below shows a sequence of activities required to complete a project. The time to complete each activity, in days, is also shown.



Question 5.

The earliest starting time, in days, of activity H is

A. 14

B. 16

C. 19

D. 20

E. 28

Question 6.

The completion time for this project can be reduced by 3 days if an additional worker is added to one of the activities along the critical path. If the activity is not reduced by more than one half of its initial duration, the number of activities where the additional worker could be added is

A. 1

B. 2

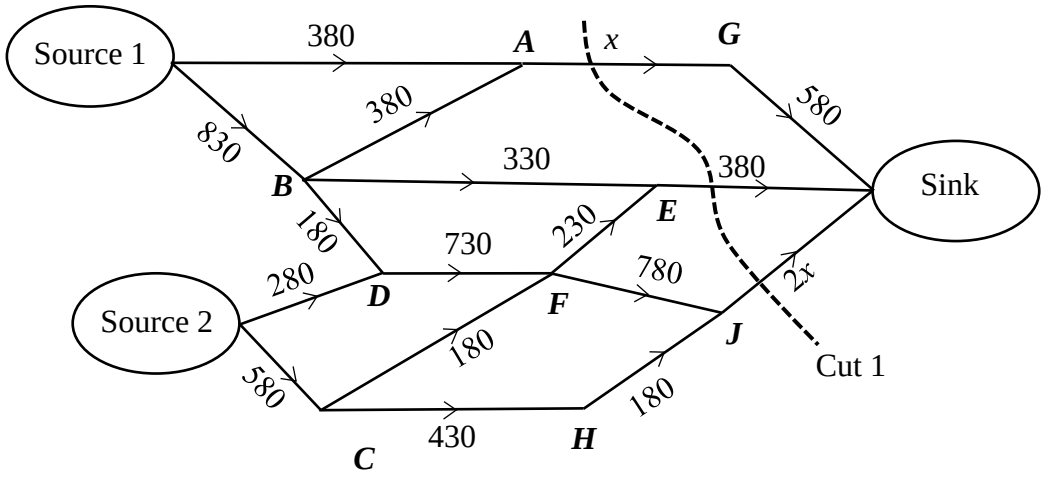
C. 3

D. 4

E. 5

Question 7.

The following flow diagram shows the movement of water through water pipes within a system.



Cut 1 will determine the maximum flow for this network if

A. $x < 580$

B. $x < 490$

C. $x < 445$

D. $x < 385$

E. $x < 190$

Question 8.

The time it takes four employees (A, B, C and D) to complete four jobs (1, 2, 3, 4) are shown in the table below.

	A	**B**	**C**	**D**
Job 1	5	8	5	7
Job 2	5	7	6	4
Job 3	7	7	9	x
Job 4	4	4	4	3

There is only one optimum allocation with A to do job 2, B to do job 4, C job 1 and D job 3. Given this information, the maximum value that x could be is

A. 2

B. 3

C. 4

D. 5

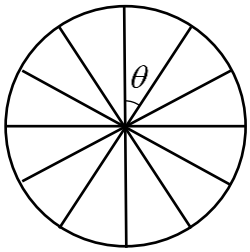
E. 6

END OF MODULE 2 - SECTION B - continued
TURN OVER

Module 3 – Geometry and measurement

Question 1.

A water wheel is to be built with twelve equally spaced spokes as shown in the diagram below.



The angle between the spokes must be

A. 12^o

B. 15^o

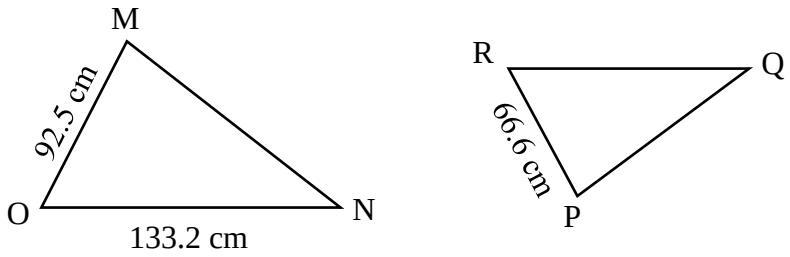
C. 24^o

D. 30^o

E. 36^o

Question 2.

Triangle MNO is similar to triangle PQR.



The length of QR in centimetres is closest to

A. 95.9 cm

B. 69.0 cm

C. 46.3 cm

D. 87.9 cm

E. 95.4 cm

Question 3.

Three locations on the earth's surface have coordinates as given below:

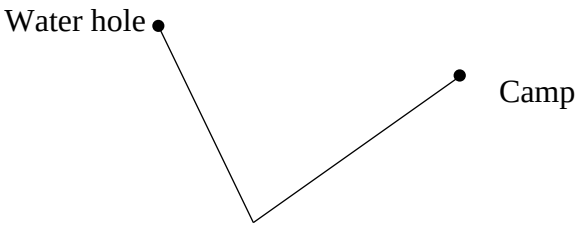
Position A	$45^oS\ 116^oE$
Position B	$27^oN\ 97^oE$
Position C	$45^oN\ 62^oW$

In which order, from first to last, will the sun rise on a given date?

A. Point A, Point C, Point B
B. Point C, Point B, Point A
C. Point C, Point A, Point B
D. Point A, Point B, Point C
E. Point B, Point C, Point A

Question 4.

A group of scouts participate in an orienteering activity. They are to hike a distance of 3200 m on a bearing of S 57^o W where they will find a marker. From this point they are to hike 2900 m on a bearing of N 26^o W where they will find a water hole.

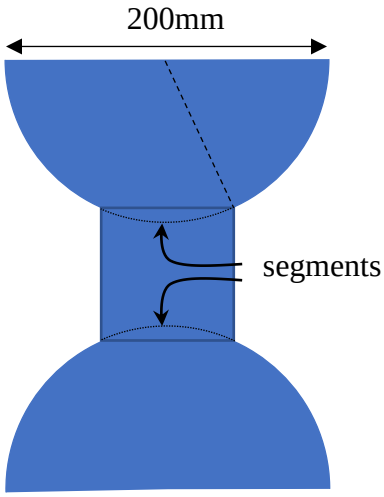


The direct distance of the Camp from the water hole is closest to

A. 4320 m
B. 4050 m
C. 3955 m
D. 4350 m
E. 4045 m

Question 5.

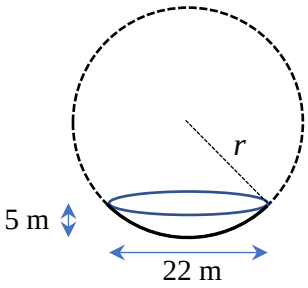
The diagram at right was created with two semicircles of diameter 200mm. A square is placed so that its corners align with the circumference of each circle. The square covers a segment on each semicircle. If the total area of the semicircles that is covered by the square is 1812 mm^2, then the side length of the square is closest to



A. 80 mm
B. 90 mm
C. 100 mm
D. 110 mm
E. 120 mm

Question 6.

A crater is approximately circular with a diameter of 22 metres. It is proposed that the shape of the crater forms part of a large sphere. Given the depth of the lowest point of the crater is 5 metres.



The radius of the sphere would be

A. 17.0 m
B. 50.9 m
C. 18.5 m
D. 14.6 m
E. 22.6 m

Question 7.

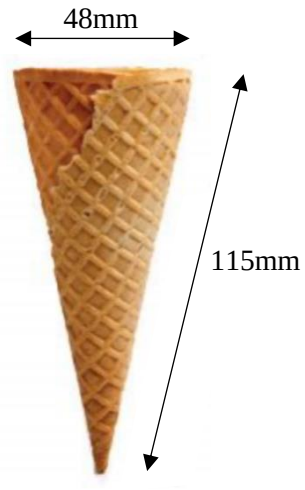
Triangle ABC has side length AB of 23cm, side length AC of 6cm and angle ABC of 14^o
Which of the following could also be true?

A. Angle BAC is 68^o to the nearest degree
B. Side length BC is 25.9 cm rounded to one decimal place
C. Angle BCA is 113^o to the nearest degree
D. Side length BC is 24.6 cm rounded to one decimal place
E. Angle BAC of 94^o to the nearest degree

Question 8.

A waffle cone has dimensions as shown

If a perfect hemisphere of icecream is placed on top then the total volume of the icecream and cone will be closest to



A. 96.8 cm^3

B. 125.7 cm^3

C. 98.3 cm^3

D. 127.3 cm^3

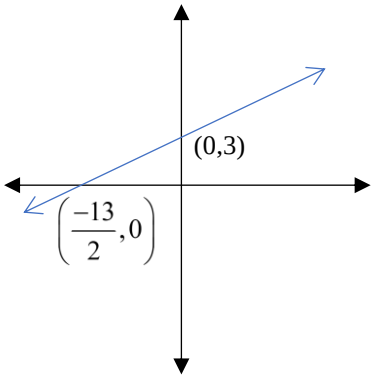
E. 95.4 cm^3

END OF MODULE 3 - SECTION B - continued
TURN OVER

Module 4 – Graphs and relations

Question 1.

The equation of the line shown on the graph below is



A. $6x-13y+39=0$

B. $y=\frac{13}{6}x+3$

C. $y=-\frac{6}{13}x+3$

D. $13y+6x=39$

E. $y+\frac{6}{13}x=3$

Question 2.

A market stall holder is charged a flat rate of $110 for a site at event A. At event B he is charged $20 for a site plus 10% of his sales. If he sells his product for $20 per unit, what is the minimum number of units he would need to sell to make event A more profitable than event B?

A. 42

B. 44

C. 46

D. 45

E. 49

Question 3.

The point $(25,80)$ lies on the graph of $y=\frac{k}{x}$. The value of k is

A. 2000

B. 1600

C. 4000

D. 2125

E. 8000

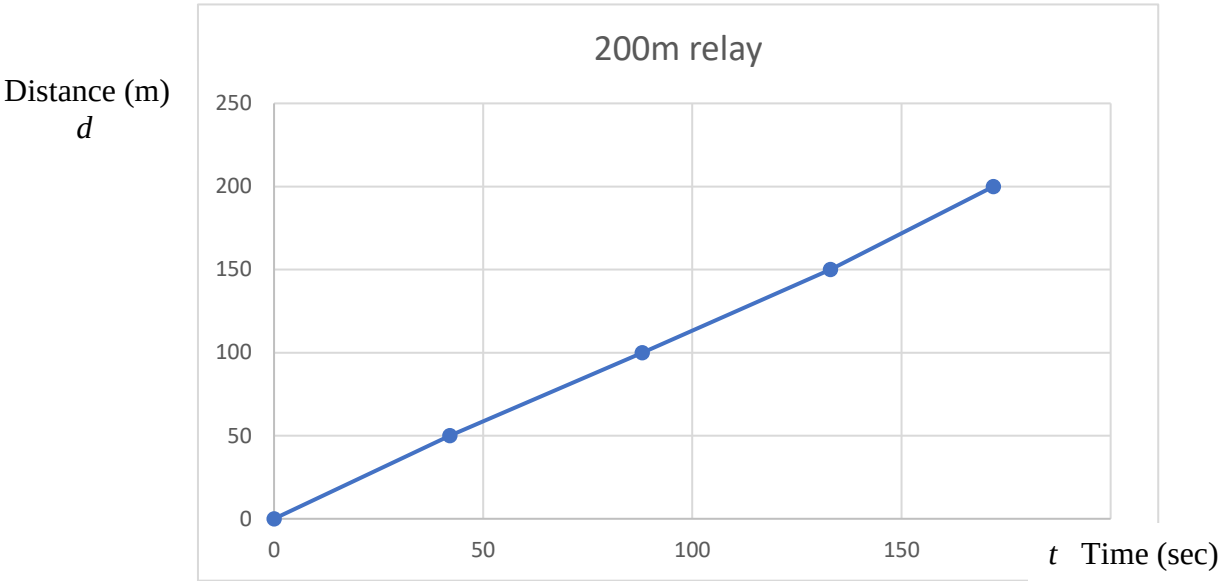
SECTION B – Module 4 – continued

Question 4.

A swimming club has four swimmers who compete in a freestyle relay. The times for each swimmer, in seconds, are given in the table below:

Swimmer	Time	Cumulative time
Ellie	43	43
Abbey	47	90
Bailee	45	135
Jasmine	38	174

When graphed each leg of the race can be represented by a line segment.



The equation for the line segment representing Bailee's swim is

A. $d = \frac{10}{9}t$

B. $d = \frac{9}{10}t + 100$

C. $d = \frac{9}{10}t$

D. $y = \frac{50}{45}t + 100$

E. $y = 1.11t + 0.1$

Use the following information to answer questions 5 and 6

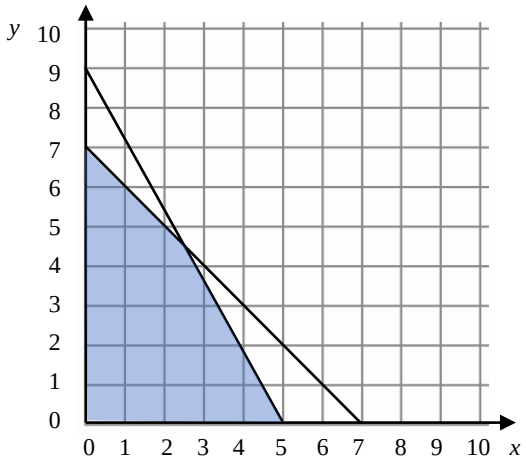
Consider the linear programing problem with the following constraints

$y \le -x + 7$

$x \ge 0$

$y \ge 0$

These inequations along with an unidentified inequation have been plotted on the graph below:



Question 5.

The equation of the constraint missing from the list above is

A. $7x + 5y \le 35$

B. $9x + 7y \le 63$

C. $y = -\frac{9}{5}x + 9$

D. $x + y \le 7$

E. $9x + 5y \le 45$

Question 6.

Given the objective function for the above linear programming problem is $C = 10x + 12y$, the coordinates of the point which maximises the objective function is

A. $(0, 0)$

B. $(2.5, 4.5)$

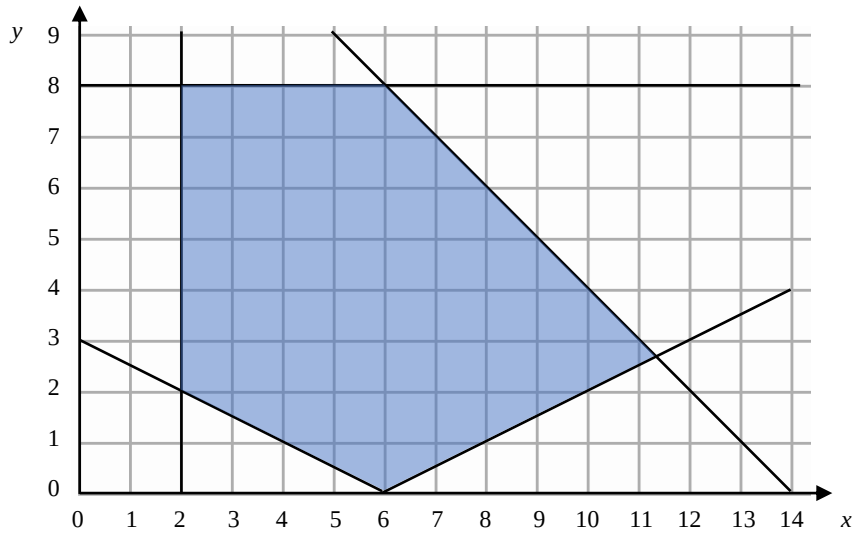
C. $(0, 7)$

D. $(5, 0)$

E. $(0, 9)$

The following information is required for Questions 7 and 8

The graph below shows the feasible region for a linear programming problem. The variables must have integer values.



Question 7.

The objective function which has a unique maximum value at the point $(11,3)$ is

A. $P = 18x + 24y$

B. $P = 12x + 16y$

C. $P = 50x + 45y$

D. $P = 20x - 10y$

E. $P = 3x + 3y$

Question 8.

Which of the following is true if the objective function $P = mx + 12y$ has a minimum value when $x = 6$ and $y = 0$?

A. $m < \frac{1}{2}$

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

C. $-\frac{1}{2} < m < \frac{1}{2}$

D. $m > 6$

E. $-6 < m < 6$

END OF MULTIPLE-CHOICE QUESTION BOOK