THE HEFFERNAN GROUP

P.O. Box 1180
Surrey Hills North VIC 3127
Phone 03 9836 5021
Fax 03 9836 5025
info@theheffernangroup.com.au
www.theheffernangroup.com.au

Student Name……

FURTHER MATHEMATICS

TRIAL EXAMINATION 1

2010

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

Instructions to students

This exam consists of Section A and Section B.
Section A contains 13 multiple-choice questions from the core, 'Data Analysis'.
Section A is compulsory and is worth 13 marks.
Section B consists of 6 modules each containing 9 multiple-choice questions. You should choose 3 of these modules and answer every question in each of your chosen modules.
Each of the modules is worth 9 marks.
Section B begins on page 9 of this exam.
There is a total of 40 marks available for this exam.
Unless otherwise stated the diagrams in this exam are not drawn to scale.
Students may bring one bound reference into the exam.
An approved graphics or CAS calculator may be used in the exam.
An answer sheet appears on page 38 of this exam.
Formula sheets can be found on pages 36 and 37 of this exam.

This paper has been prepared independently of the Victorian Curriculum and Assessment Authority to provide additional exam preparation for students. Although references have been reproduced with permission of the Victorian Curriculum and Assessment Authority, the publication is in no way connected with or endorsed by the Victorian Curriculum and Assessment Authority.

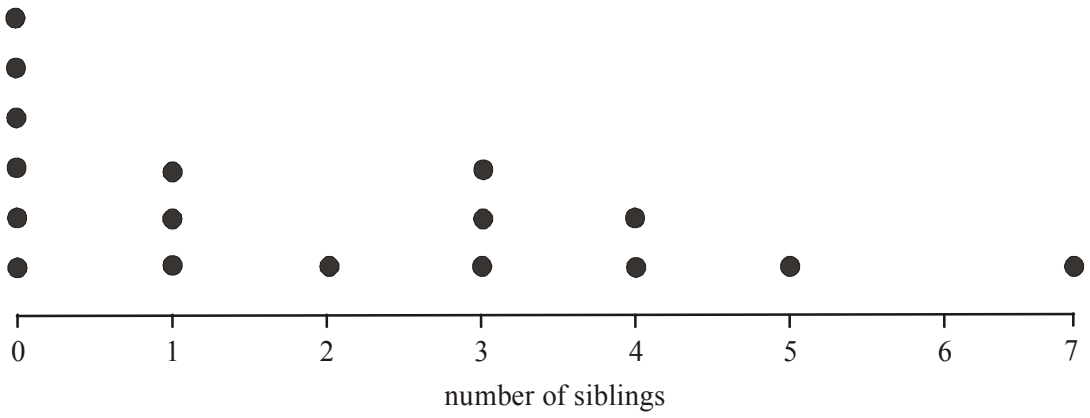
SECTION A

CORE : Data analysis

This section is compulsory.

The following information relates to Questions 1 and 2.

The dot plot below shows the distribution of the number of siblings of 17 Year 1 students.



Question 1

The mode of this distribution is

A. 0
B. 1
C. 2
D. 6
E. 7

Question 2

The mean of this distribution is

A. 0
B. 0.5
C. 1
D. 1.5
E. 2

Question 3

The ordered stemplot below shows the distribution of the unemployment rate, expressed as a percentage, in 14 countries.

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

The interquartile range (IQR) of the unemployment rates in these 14 countries is

A. 1
B. 7.5
C. 8
D. 12
E. 24

Question 4

The breathing rate of a large group of tertiary students is approximately normally distributed with a mean of 14 breaths/minute and a standard deviation of 0.8 breaths/minute.
The percentage of tertiary students with a breathing rate between 14 breaths/minute and 15.6 breaths/minute is

A. 45%
B. 47.5%
C. 49.85%
D. 95%
E. 99.7%

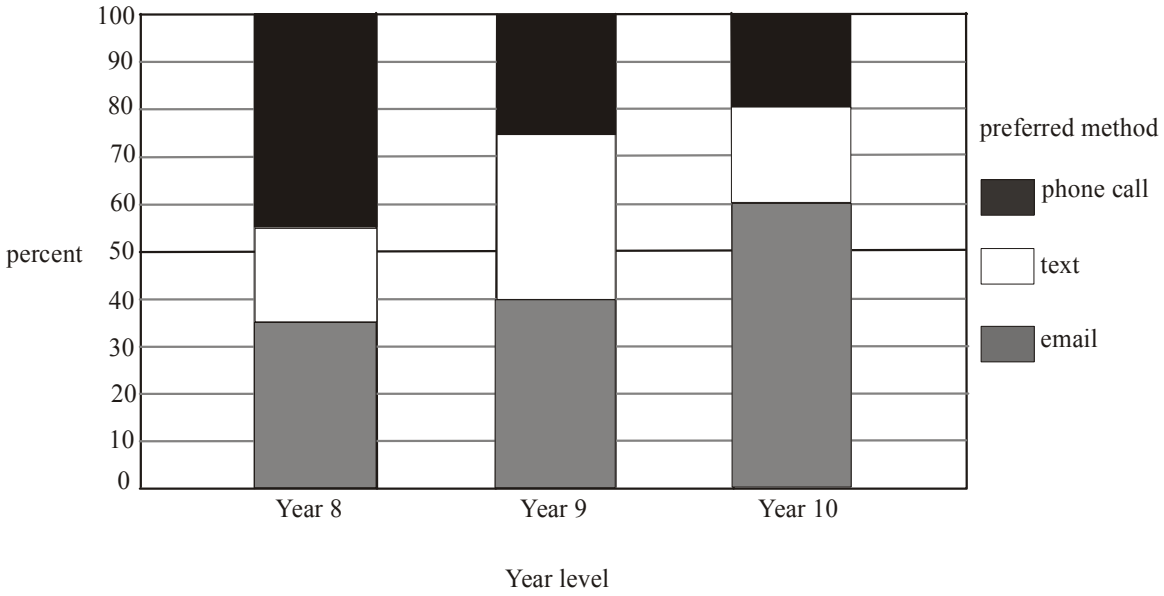
Question 5

The mean head circumference (in cm) of a randomly chosen group of 10-year-old girls is 52cm and the standard deviation is 1.2cm.
A 10 year old girl has a head circumference of 50.5cm.
Her standardized head circumference (z score) relative to this group of 10-year-old girls is

A. – 1.5
B. – 1.25
C. 0.3
D. 1.25
E. 1.5

Question 6

A study investigating the relationship between a student's *year level* and their *preferred method* of contacting friends was conducted.
The percentage segmented bar chart below summarises the results.



The percentage of Year 9 students whose preferred method is a text is

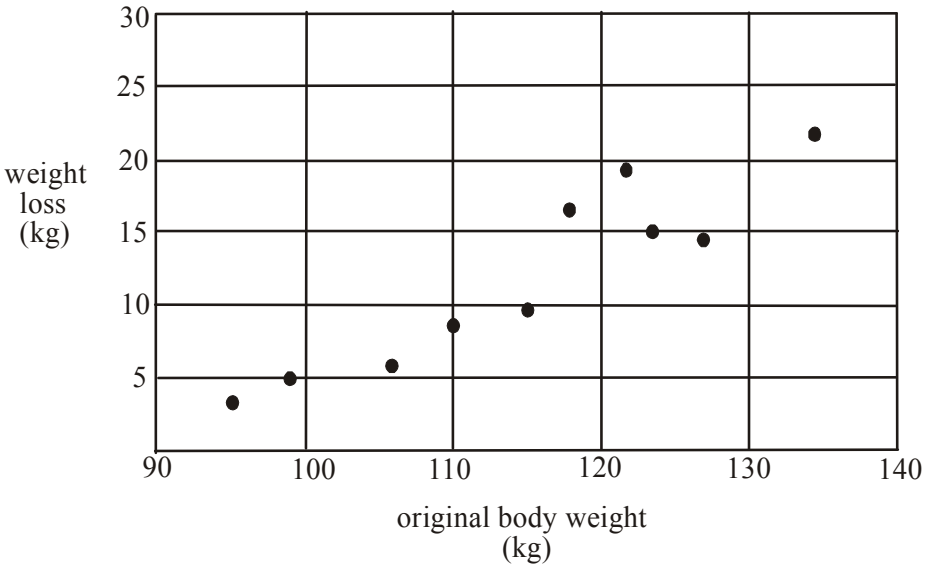
A. 20%
B. 25%
C. 30%
D. 35%
E. 45%

The following information relates to Questions 7 and 8.

A group of ten men join a weight loss program. Their *original body weight* (in kg) together with their *weight loss* (in kg) is shown on the table below.

original body weight (kg)	**weight loss (kg)**
98	5
110	8
115	9
123	15
95	3
106	6
122	19
134	22
118	17
127	14

A scatterplot is constructed for this data and is shown below.



Question 7

The value of Pearson's product-moment correlation coefficient for original body weight and weight loss is closest to

A. – 0.9207
B. – 0.8479
C. 0.8479
D. 0.9207
E. 0.9596

Question 8

A least squares regression line is fitted to the data and is given by

$$weight\ loss = -42.68 + 0.47 \times original\ body\ weight$$

This equation is used to predict the weight loss of the man with an original body weight of 115kg. The residual value (in kg) for this prediction is closest to

A. – 29.45
B. – 2.37
C. 2.37
D. 9
E. 29.45

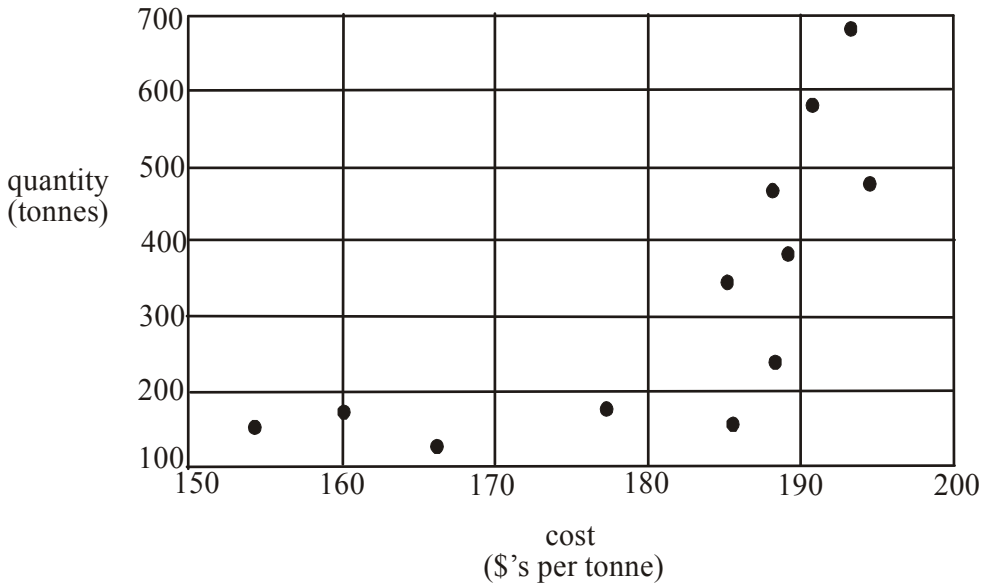
Question 9

The relationship between the variables *size* (small, medium, large, extra large, extra extra large) and *number ordered* is best displayed by

A. a parallel boxplot
B. a back-to-back stemplot
C. a histogram
D. a bar chart
E. a scatterplot

Question 10

The *quantity* (in tonnes) of a raw material that is being imported and the *cost* (in $'s per tonne) of its importation on 12 separate occasions is displayed on the scatterplot below.



In an effort to linearise the data the plot should show

A. *quantity* against $\frac{1}{cost}$

B. *quantity* against $\log(cost)$

C. $(quantity)^2$ against *cost*

D. $\log(quantity)$ against *cost*

E. $(quantity)^2$ against $\frac{1}{cost}$

The following information relates to Questions 11 – 13.

A time series plot is to be constructed using the data contained in the table below.

Month number	**Cost ($)**
1	58
2	92
3	123
4	136
5	151
6	162
7	159
8	139
9	172
10	180
11	185
12	179

Question 11

A least squares regression line is fitted to the time series plot so that the *cost* can be predicted by the *month number*.
The equation of this least squares regression line is

A. $cost = -5.58 + 0.08 \times month\ number$
B. $cost = 0.08 + 5.5 \times month\ number$
C. $cost = 0.08 + 83.12 \times month\ number$
D. $cost = 9.5 + 83.12 \times month\ number$
E. $cost = 83.12 + 9.5 \times month\ number$

Question 12

Using a two-point moving mean with centring to smooth the data, the smoothed value for month number 8 is

A. 152.25
B. 156.67
C. 158.32
D. 160.88
E. 165.5

Question 13

The data in the table is used to calculate the seasonal index for each month.
The seasonal index for month number 4 is closest to

A. 0.81
B. 0.85
C. 0.94
D. 1.04
E. 1.06

SECTION B

Module 1: Number patterns

If you choose this module all questions must be answered.

Question 1

In an arithmetic sequence the second term is 14 and the fourth term is 30.
The first term is

A. – 2
B. 6
C. 22
D. 36
E. 38

Question 2

The first three terms of a geometric sequence are 20, 12, 7.2,…
The fourth term is

A. 1.2
B. 3.6
C. 3.82
D. 4.32
E. 4.8

Question 3

The difference equation $t_{n+1} = 3t_n + b,\ t_1 = 4$ generates the sequence 4, 6, 12, 30,…
The value of b is

A. – 8
B. – 6
C. – 4
D. 2
E. 6

Question 4

Keisha starts her cross-country running training by running 2km in the first week, 4.5km in the second week and 7km in the third week.
If she were to continue in this pattern, the total number of kilometers she would have run over 10 weeks would be

A. 24.5
B. 45
C. 132.5
D. 177.5
E. 12 714

Question 5

Vince's tomato crop is coming to an end. The number of tomatoes being produced is reducing by 20% each week.
He picked 26 tomatoes this week.
Including this week's, the total number of tomatoes remaining in the crop is

A. 31
B. 33
C. 55
D. 112
E. 130

Question 6

At the start of each day a recycling plant receives 10 tonnes of material to be recycled. Each day the plant is able to recycle 94% of the material present at the plant and the rest is left to be recycled the next day. The amount of material, in tonnes, needing to be recycled at the plant at the start of the n^{th} day just after the delivery is given by R_n.
A difference equation which describes this situation is

A. $R_{n+1} = 0.06R_n + 10, \quad R_1 = 10$
B. $R_{n+1} = 0.94R_n + 10, \quad R_1 = 10$
C. $R_{n+1} = 1.06R_n + 10, \quad R_1 = 10$
D. $R_{n+1} = 1.94R_n + 6, \quad R_1 = 10$
E. $R_{n+1} = 10R_n + 94, \quad R_1 = 10$

Question 7

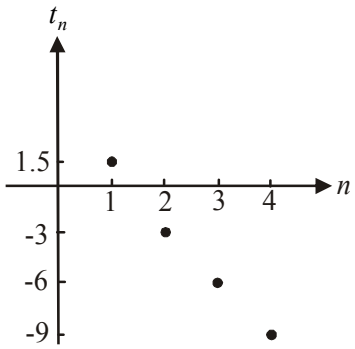
The first five terms of a Fibonacci related sequence are 0,1,1,3,5,…
The difference equation that generates this sequence is

A. $t_n = t_{n-1} + 1, \quad t_1 = 0$
B. $t_n = 2t_{n-1} + 1, \quad t_1 = 0$
C. $t_n = t_{n-1} - t_{n-2}, \quad t_1 = 0, \ t_2 = 1$
D. $t_n = t_{n-1} + t_{n-2}, \quad t_1 = 0, \ t_2 = 1$
E. $t_n = t_{n-1} + 2t_{n-2}, \quad t_1 = 0, \ t_2 = 1$

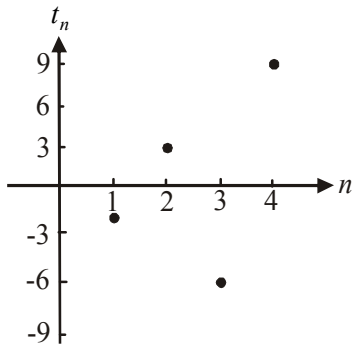
Question 8

The difference equation $t_{n+1} = 1.5t_n, \quad t_1 = -2$ generates a sequence of numbers. The first five terms of that sequence could be represented graphically by

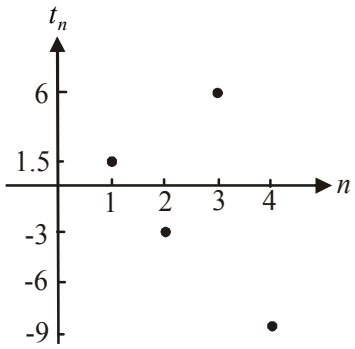
A.



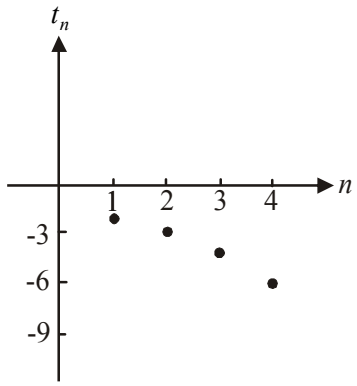
B.



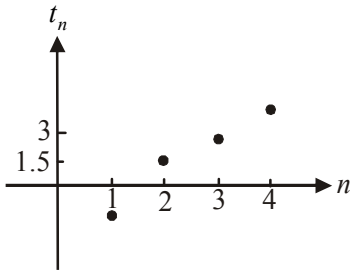
C.



D.



E.



Question 9

After a flood, the height of a swollen river decreased by 2.4m on the first day, by 1.92m on the second day and by 1.536m on the third day. If the height of the river continued to decrease in this way, then during the second week after the flood, the height of the river would decreases in total by approximately

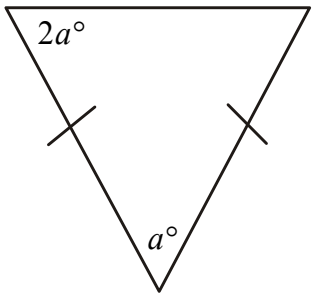
A. 0.13 metres
B. 0.5 metres
C. 1.99 metres
D. 9.48 metres
E. 11.47 metres

Module 2: Geometry and trigonometry

If you choose this module all questions must be answered.

Question 1

The triangle below is an isosceles triangle.

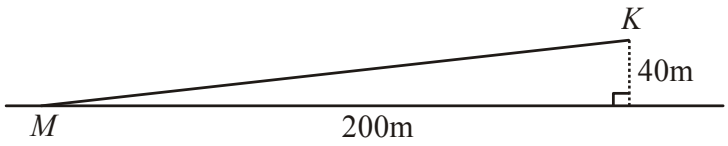


The value of a is

A. 30
B. 36
C. 45
D. 48
E. 60

Question 2

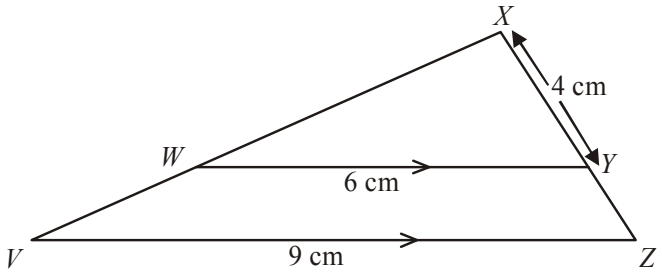
A man lying on level ground at M observes a kite, K, flying at a horizontal distance of 200m and at a vertical distance of 40m from him.



The angle of elevation of the kite from the man is closest to

A. 0.2°
B. 2°
C. 11°
D. 12°
E. 79°

Question 3

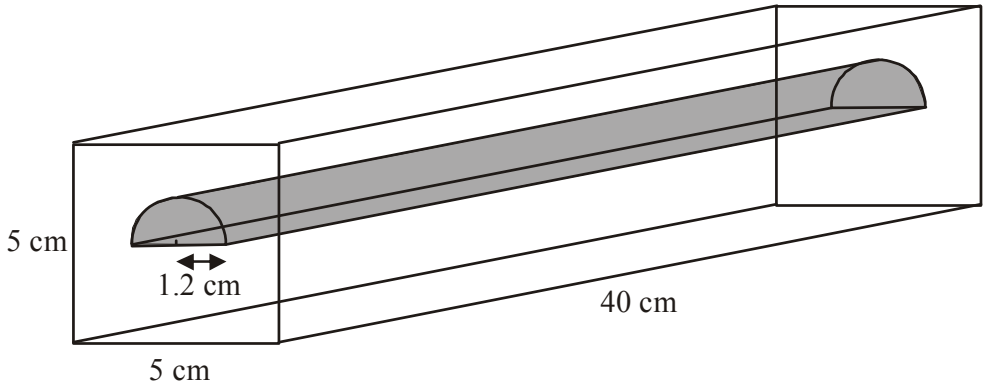


In the diagram above, VZ is parallel to WY, $VZ = 9\text{cm}$, $WY = 6\text{cm}$ and $XY = 4\text{cm}$.
The length, in cm, of YZ is

A. 1.5
B. 2
C. 3
D. 5
E. 6

Question 4

The diagram below shows a block of timber in the shape of a square prism with sidelengths 5cm and length 40cm.
A cavity in the shape of a prism with a semicircular cross-section of radius 1.2cm and length 40cm is made in the block.

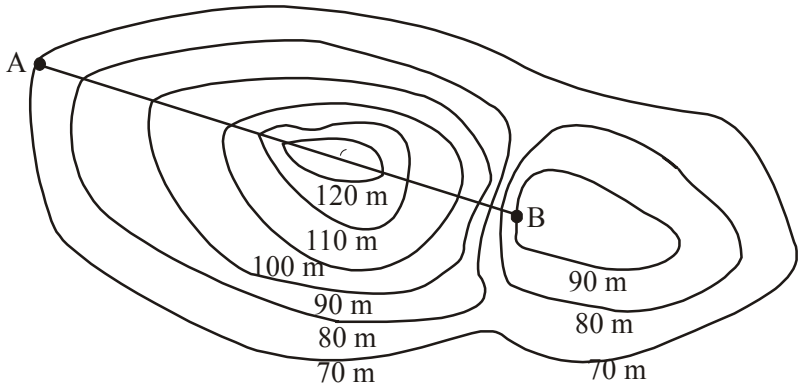


The volume of timber remaining, in cm^3, is closest to

A. 819
B. 849
C. 910
D. 925
E. 956

Question 5

The contour map below has a line *AB* drawn on it.

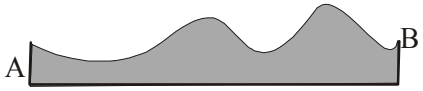


A cross-sectional profile that could represent the height of the land above sea level along the line *AB* is

A.

B.

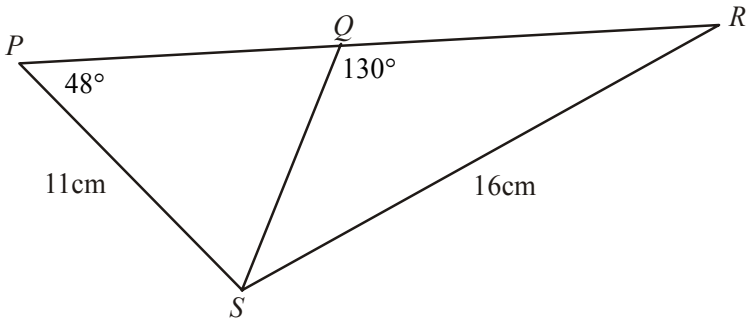
C.



D.

E.

Question 6



In the diagram above the point Q lies on the line PR. The length QS is equal to

A. $\dfrac{11 \times \sin 48^\circ}{\sin 50^\circ}$

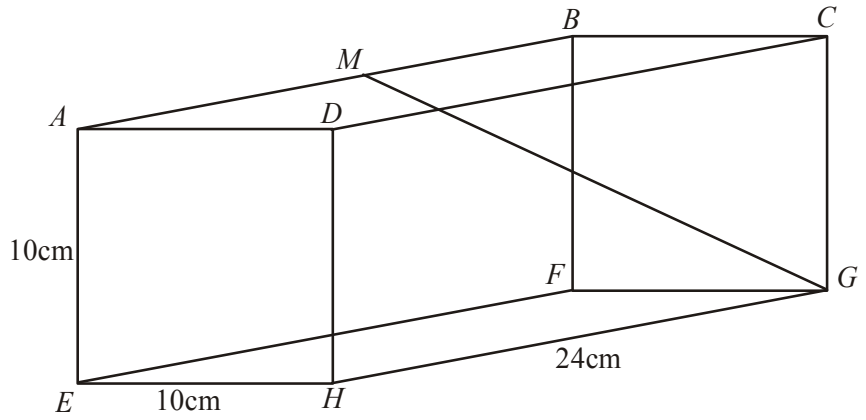
B. $\dfrac{11 \times \sin 130^\circ}{\sin 48^\circ}$

C. $\sqrt{11^2 + 16^2 - 352 \cos 48^\circ}$

D. $\sqrt{11^2 + 16^2 - 352 \cos 130^\circ}$

E. $\sqrt{11^2 + 16^2 - 352 \cos 50^\circ}$

Question 7

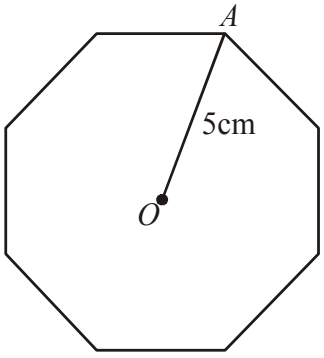


In the rectangular prism above, $AE = 10\text{cm}$, $EH = 10\text{cm}$, $HG = 24\text{cm}$ and M is the midpoint of AB.
The length of GM in cm, is closest to

A. 12
B. 13.2
C. 14
D. 15.6
E. 18.5

Question 8

For the regular octagon shown below, O is the centre and $AO = 5\text{cm}$.

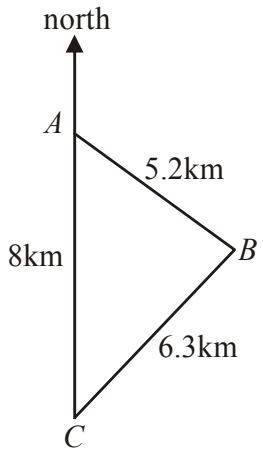


The area, in cm^2 of the octagon is closest to

A. 9
B. 63
C. 71
D. 100
E. 142

Question 9

Three camp sites, *A*, *B* and *C* are established in bushland. The campsite at *C* is 8km due south of *A*. The camp site at *B* is 5.2km from *A* and 6.3km from *C* as indicated in the diagram below.



The bearing of *B* from *A* is closest to

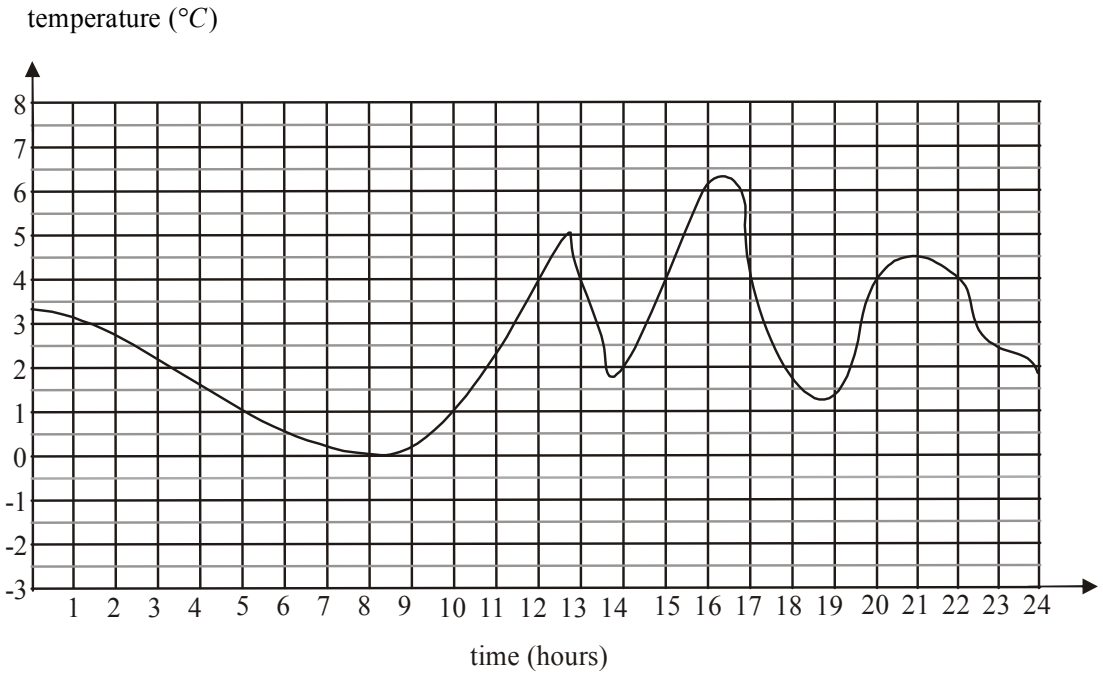
A. 052°
B. 095°
C. 110°
D. 128°
E. 142°

Module 3: Graphs and relations

If you choose this module all questions must be answered.

Question 1

The graph below shows the temperature inside an old refrigerator over a 24-hour period.

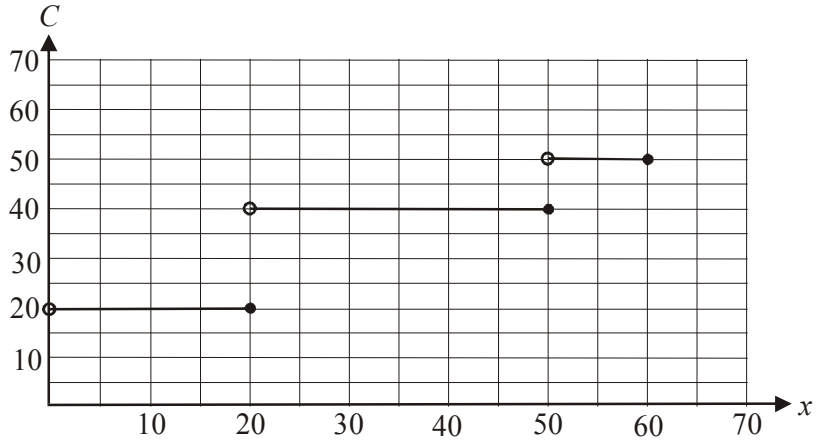


For safe food storage, the temperature range should be 1°C – 4°C.
The number of hours that food could be safely stored in this refrigerator over this 24-hour period was

A. 5
B. 8
C. 10
D. 14
E. 15

The following information refers to Questions 2 and 3.

The cost C, in dollars, of a monthly membership at a gym is based on the number of classes x attended during the month. The graph below shows the cost of a monthly membership at this gym.



Question 2

Joan pays the monthly membership for both of her daughters. One daughter attends 18 classes per month and the other attends 50. The amount Joan pays each month is

A. \$20
B. \$40
C. \$50
D. \$60
E. \$70

Question 3

A rule that could be used to describe this graph is

A. $C = \begin{cases} 20 & \text{for} \quad 0 \le x < 20 \\ 40 & \text{for} \quad 20 \le x < 50 \\ 50 & \text{for} \quad 50 \le x < 60 \end{cases}$

B. $C = \begin{cases} 20 & \text{for} \quad 0 < x \le 20 \\ 40 & \text{for} \quad 20 < x \le 50 \\ 50 & \text{for} \quad 50 < x \le 60 \end{cases}$

C. $C = \begin{cases} 20 & \text{for} \quad 0 < x < 20 \\ 40 & \text{for} \quad 20 < x < 40 \\ 60 & \text{for} \quad 40 < x < 60 \end{cases}$

D. $C = \begin{cases} 20 & \text{for} \quad 0 < x \le 20 \\ 50 & \text{for} \quad 20 < x \le 40 \\ 60 & \text{for} \quad 40 < x \le 50 \end{cases}$

E. $C = \begin{cases} 20 & \text{for} \quad 0 \le x < 20 \\ 50 & \text{for} \quad 20 \le x < 40 \\ 60 & \text{for} \quad 40 \le x < 50 \end{cases}$

Question 4

Glenda bought 1kg of bananas and 3 punnets of strawberries for a total cost of $9.
At the same green grocer, Mark bought 2kg of bananas and 2 punnets of strawberries for a total cost of $10.
At this green grocer a punnet of strawberries costs

A. $1
B. $2
C. $2.50
D. $3
E. $3.50

Question 5

An importer receives a consignment of CD players. He has a fixed cost of $1800 for the consignment plus a cost of $80 for each CD player.
If he sells each CD player for $100 he will break even.
The number of CD players in the consignment is

A. 18
B. 20
C. 90
D. 120
E. 180

Question 6

Two lines intersect at the point $(3,-1)$.
The equation of one of these lines could be

A. $-x-y=2$
B. $-x+y=4$
C. $x+2y=-1$
D. $2x-y=5$
E. $2x-2y=8$

Question 7

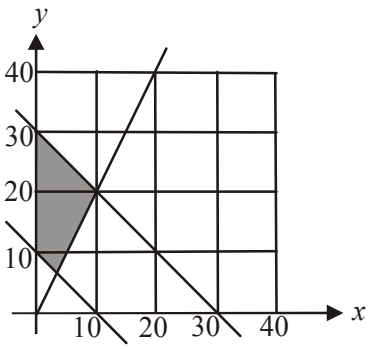
An interstate school trip is being organised for Year 10 and 11 students. In order for the trip to go ahead there must be

- a maximum of 30 students
- a minimum of 10 students
- at least twice as many Year 11 students as Year 10 students

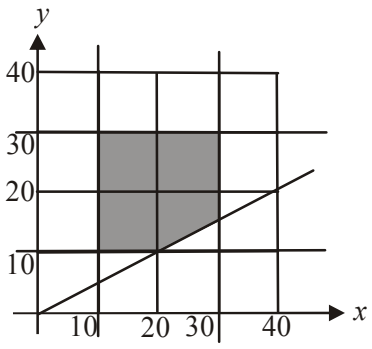
Let x represent the number of Year 10 students going on the trip.
Let y represent the number of Year 11 students going on the trip.

The shaded region that represents the feasible region for this problem is

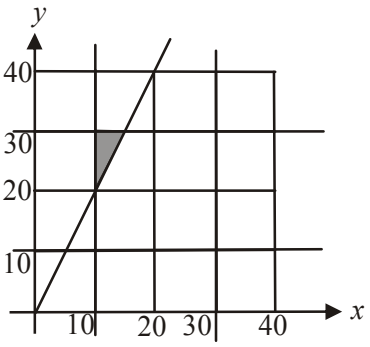
A.



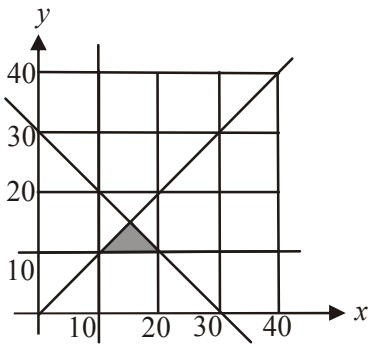
B.



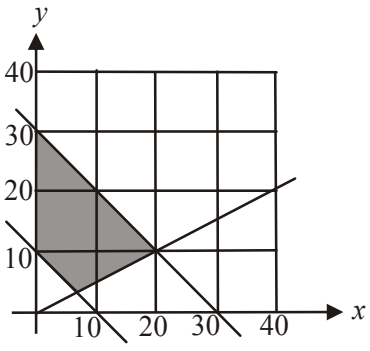
C.



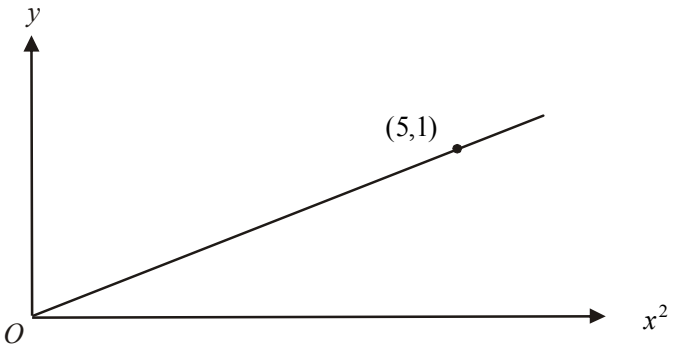
D.



E.

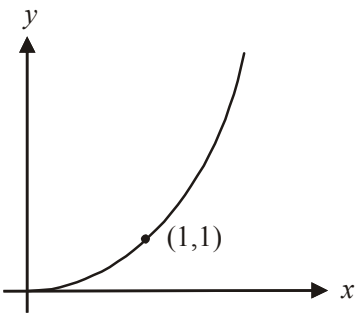


Question 8

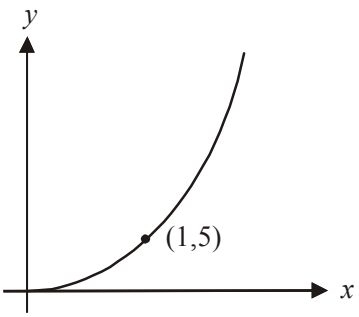


The graph above shows the relationship between y and x^2. The graph showing the same relationship between y and x is

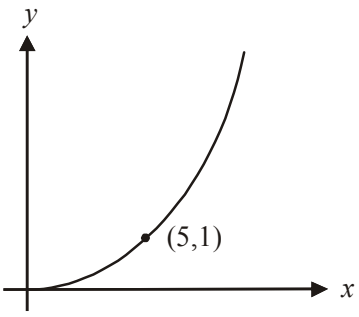
A.



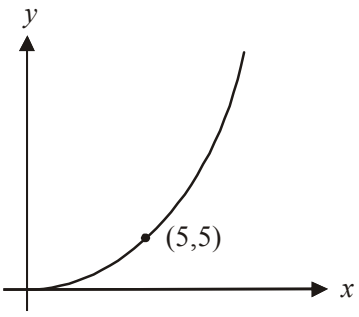
B.



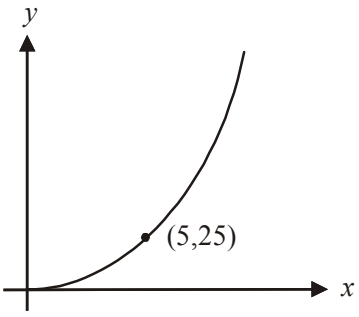
C.



D.



E.



Question 9

At a warehouse sale a wholesaler sells 400 lipsticks for $3 each and makes a profit of $1 on each. The wholesaler's costs include a fixed cost of $$x$ and a cost on each of the lipsticks of $1.50.
The value of x is

A. 1.5
B. 2
C. 200
D. 600
E. 800

Module 4: Business-related mathematics

If you choose this module all questions must be answered.

Question 1

Jarrod's bank statement for April is shown below.

Date	Transaction details	Withdrawals	Deposits	Balance
01 Apr	Opening balance			522.31
07 Apr	Deposit – cash		460.00	982.31
15 Apr	Withdrawal – ATM	160.00		822.31
23 Apr	Withdrawal – funds transfer	272.40		549.91
30 Apr	Closing balance			549.91

Jarrod receives interest on this account calculated at the rate of 0.2% per month on the minimum monthly balance. In April, the interest Jarrod received was

A. $1.04
B. $1.10
C. $1.37
D. $1.64
E. $2.61

Question 2

Will invested $8 000 in an account that earned simple interest of 4.5% per annum.
At the end of the investment he received $1 440 in interest.
Will had his money invested for

A. 2 years
B. 2.2 years
C. 4 years
D. 6 years
E. 8.1 years

Question 3

The price paid for a dress was $275. This price included 10% GST (Goods and Service Tax).
The amount of GST included in this price was

A. $2.75
B. $25.00
C. $27.50
D. $30.56
E. $75.00

Question 4

Greta invests $2 500 at a compound interest rate of 6% per annum calculated monthly.
After 10 years, the amount of interest she would have earned is

A. $2048.49
B. $2625.05
C. $2627.85
D. $3241.61
E. $4548.49

Question 5

A business purchased a document shredder for $1 250. The value of the shredder depreciates at a rate of 2 cents per page shredded.
When the document shredder reached a book value of zero dollars, the number of pages it would have shredded would have been

A. 625
B. 2 500
C. 6 250
D. 25 000
E. 62 500

Question 6

A private health fund increased its premiums by the rate of inflation only for the last two years. Inflation ran at 2% per annum in each of the last two years.
Angela's premium this year was $540. Two years ago Angela's premium was

A. $517.68
B. $518.40
C. $518.62
D. $519.03
E. $561.82

Question 7

Brad purchases a bed for $1100. He pays a deposit of $300 and quarterly repayments of $230 for one year.
The effective interest rate that Brad will be paying is approximately

A. 11%
B. 15%
C. 17%
D. 21%
E. 24%

Question 8

A sum of $45 000 is invested in an annuity that earns interest of 6.4% per annum compounding quarterly. This annuity is to last for 15 years. The annual sum that this annuity pays is

A. $1 172.28
B. $1 380.35
C. $3 398.21
D. $4 689.13
E. $5 249.16

Question 9

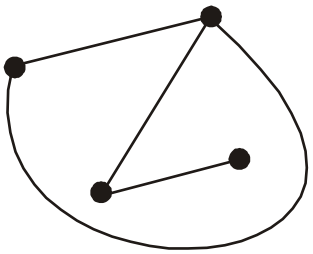
Ryan took out a home loan of $340 000. The loan; to be repaid over 25 years, has an interest rate of 7.6% per annum calculated quarterly on the reducing balance of the loan. Ryan will make equal quarterly repayments over the course of the loan.
The total amount of interest he will pay on the loan is closest to

A. $90 279
B. $422 025
C. $430 279
D. $631 420
E. $762 020

Module 5: Networks and decision mathematics

If you choose this module all questions must be answered.

Question 1

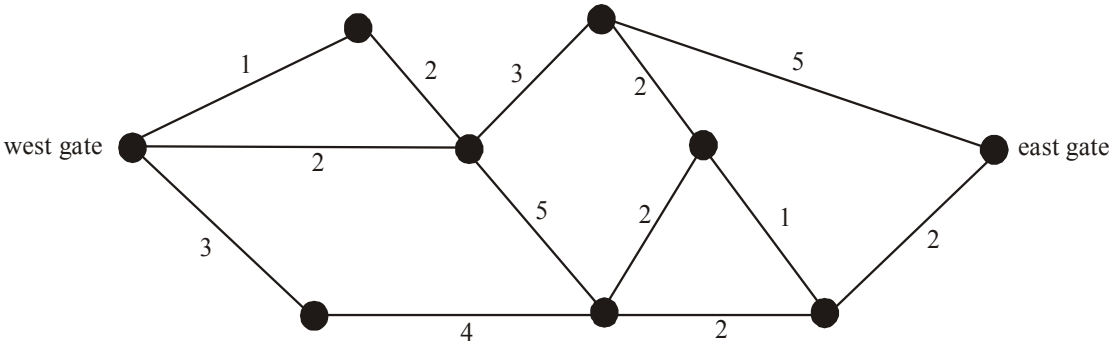


The graph shown above can be correctly described as

A. connected but not planar
B. connected but not simple
C. complete but not connected
D. complete but not planar
E. simple but not complete

Question 2

The network below shows the distances, in kilometres, of bike tracks that run between the west gate and the east gate of a large park.



The length in kilometres, of the shortest route between the west gate and the east gate is

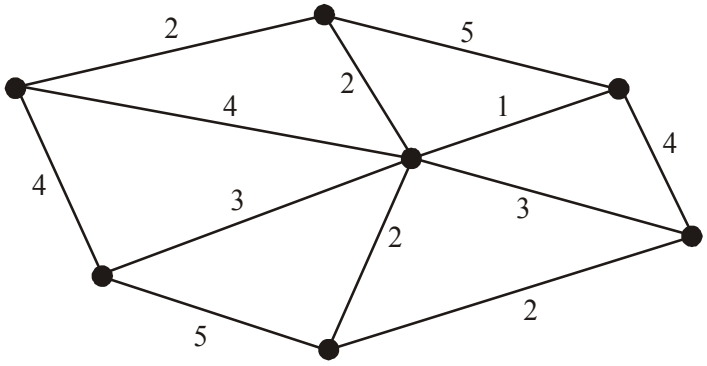
A. 7
B. 8
C. 9
D. 10
E. 11

Question 3

A connected, planar graph has 7 vertices and 12 edges.
The number of faces that this graph has is

A. 7
B. 9
C. 17
D. 19
E. 21

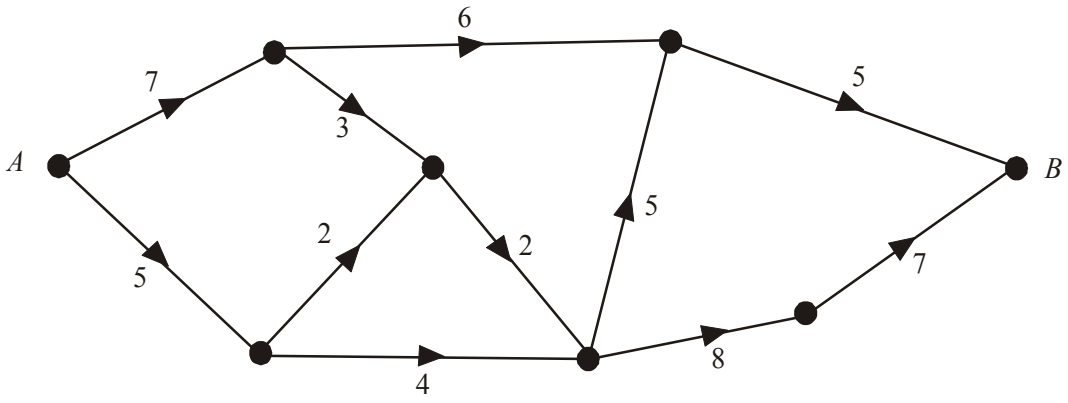
Question 4



For the network above, the total weight of the minimal spanning tree will be

A. 10
B. 12
C. 15
D. 20
E. 37

Question 5



For the graph above the maximum flow possible through the network from *A* to *B* is

A. 9
B. 10
C. 11
D. 12
E. 13

Question 6

Four manufacturers have been asked to provide the wholesale cost of producing 4 items for a large hardware distributor.
Each manufacturer will be allocated one item so that the total cost to the distributor is minimised.

Manufacturer	Item			
	1	2	3	4
A	12	8	8	12
B	11	10	9	10
C	8	12	9	7
D	10	9	11	7

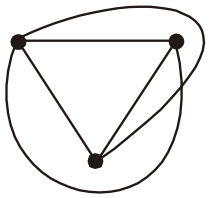
That total minimum cost will be

A. \$31
B. \$32
C. \$34
D. \$37
E. \$38

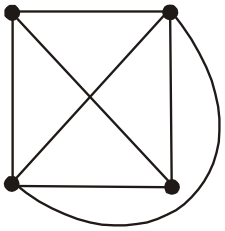
Question 7

Which one of the following graphs does Euler's formula involving faces, edges and vertices **not** apply to?

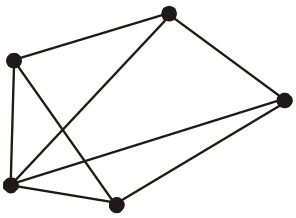
A.



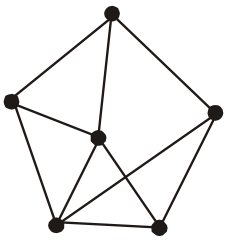
B.



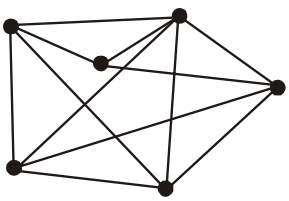
C.



D.

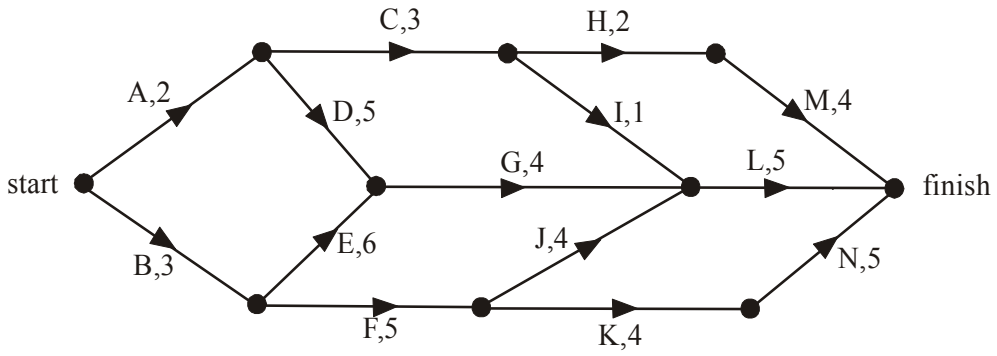


E.



The following information below relates to Questions 8 and 9.

The activities together with the time, in weeks, needed to complete them for a particular project are shown on the network below.



Question 8

The critical path for this project is

A. *A,C,H,M*
B. *A,D,G,L*
C. *B,E,G,L*
D. *B,F,J,L*
E. *B,F,K,N*

Question 9

The event that will cause an extra four activities to become critical to the completion of the project is

A. Activity *D* is decreased by 1 day
B. Activity *F* is increased by 1 day
C. Activity *J* is increased by 1 day
D. Activity *K* is increased by 1 day
E. Activity *N* is decreased by 1 day

Module 6: Matrices

If you choose this module all questions must be answered.

Question 1

For the matrix $A = \begin{bmatrix} 3 & 4 & 9 & 3 \\ 7 & 6 & 1 & 5 \\ 8 & 10 & 12 & 14 \end{bmatrix}$ the element $a_{2,3}$ is

A. 1
B. 4
C. 6
D. 10
E. 12

Question 2

Which one of the following does **not** equal $\begin{bmatrix} 2 & 8 \\ 6 & 10 \end{bmatrix}$?

A. $2 \times \begin{bmatrix} 1 & 4 \\ 3 & 5 \end{bmatrix}$

B. $\begin{bmatrix} 1 & 5 \\ 4 & 3 \end{bmatrix} + \begin{bmatrix} 1 & 3 \\ 2 & 7 \end{bmatrix}$

C. $\begin{bmatrix} 7 & 10 \\ 9 & 12 \end{bmatrix} - \begin{bmatrix} 5 & 2 \\ 3 & 2 \end{bmatrix}$

D. $\begin{bmatrix} 2 & 8 \\ 6 & 10 \end{bmatrix} - 0 \times \begin{bmatrix} 5 & 9 \\ 3 & 2 \end{bmatrix}$

E. $\begin{bmatrix} 4 & 14 \\ 10 & 12 \end{bmatrix} - 2 \times \begin{bmatrix} 1 & 3 \\ 2 & 2 \end{bmatrix}$

The following information relates to Questions 3 and 4.

The number of Prep – Year 2 students at reading levels 1A, 2A and 3A is shown in the table below.

Year level	Reading level		
	1A	2A	3A
Prep	14	4	1
1	26	9	4
2	12	20	7

Question 3

A 3×1 matrix showing the reading levels of Year 2 students is

A. $\begin{bmatrix} 12 & 20 & 7 \end{bmatrix}$

B. $\begin{bmatrix} 26 & 9 & 4 \end{bmatrix}$

C. $\begin{bmatrix} 14 \\ 4 \\ 1 \end{bmatrix}$

D. $\begin{bmatrix} 12 \\ 20 \\ 7 \end{bmatrix}$

E. $\begin{bmatrix} 14 & 4 & 1 \\ 26 & 9 & 4 \\ 12 & 20 & 7 \end{bmatrix}$

Question 4

The teacher time, in minutes, that should be allocated to students at each of the levels each week is shown in the matrix below.

$$\begin{bmatrix} 12 \\ 8 \\ 5 \end{bmatrix} \begin{matrix} 1A \\ 2A \\ 3A \end{matrix}$$

What is the total teacher time in minutes that should be allocated in a week to the Year 1 students?

A. 25
B. 205
C. 339
D. 404
E. 690

Question 5

For the matrix equation $AX = B$, matrix $B = \begin{bmatrix} 7 & 4 \\ 2 & 3 \\ 5 & 1 \end{bmatrix}$.

If matrix X is a square matrix then the order of matrix A is

A. (2×1)
B. (2×2)
C. (2×3)
D. (3×1)
E. (3×2)

Question 6

The solution to the matrix equation

$$\begin{bmatrix} 3 & 2 & -1 \\ 1 & 5 & 1 \\ 2 & 3 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 9 \end{bmatrix}$$

is given by

A. $\begin{bmatrix} 0 \\ 1 \\ 9 \end{bmatrix}$

B. $\begin{bmatrix} 2 \\ 1 \\ 4 \end{bmatrix}$

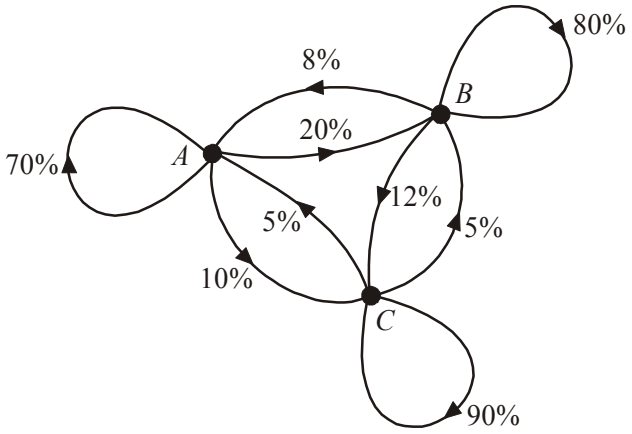
C. $\begin{bmatrix} 2 \\ -1 \\ 4 \end{bmatrix}$

D. $\begin{bmatrix} 1 \\ 3 \\ -2 \end{bmatrix}$

E. $\begin{bmatrix} 1 \\ -2 \\ 3 \end{bmatrix}$

Question 7

A research company records the viewing habits of a large group of people who watch one of three 6pm news bulletins available on channels *A*, *B* and *C*. The following transition diagram shows the percentages who stay with the same channel the next night or move to another channel.



A corresponding transition matrix could be

A.

one night

	A	*B*	*C*	
	0.7	0.2	0.1	*A*
	0.8	0.08	0.1	*B* next night
	0.9	0.05	0.05	*C*

B.

one night

	A	*B*	*C*	
	0.7	0.08	0.9	*A*
	0.2	0.8	0.05	*B* next night
	0.1	0.12	0.05	*C*

C.

one night

	A	*B*	*C*	
	0.7	0.8	0.9	*A*
	0.2	0.12	0.05	*B* next night
	0.1	0.08	0.05	*C*

D.

one night

	A	*B*	*C*	
	0.7	0.2	0.12	*A*
	0.08	0.8	0.05	*B* next night
	0.1	0.05	0.9	*C*

E.

one night

	A	*B*	*C*	
	0.7	0.08	0.05	*A*
	0.2	0.8	0.05	*B* next night
	0.1	0.12	0.9	*C*

Question 8

Secondary students who wished to attend an outdoor camp had to attend one session a week in either running, weights or swimming. Teachers noticed over time that 90% of students who attended a particular session one week attended the same session the next week.
They also noticed that

- 3% who attended weights one week attended running the next
- 4% who attended running one week attended swimming the next
- 5% who attended swimming one week attended weights the next

A transition matrix that could represent this information is

A.

this week

$$\begin{matrix} & R & W & S \\ \end{matrix}$$
$$\begin{bmatrix} 0.9 & 0.3 & 0.5 \\ 0.6 & 0.9 & 0.5 \\ 0.4 & 0.7 & 0.9 \end{bmatrix} \begin{matrix} R \\ W \\ S \end{matrix}$$ next week

B.

this week

$$\begin{matrix} R & W & S \end{matrix}$$
$$\begin{bmatrix} 0.9 & 0.03 & 0.05 \\ 0.06 & 0.9 & 0.05 \\ 0.04 & 0.07 & 0.9 \end{bmatrix} \begin{matrix} R \\ W \\ S \end{matrix}$$ next week

C.

this week

$$\begin{matrix} R & W & S \end{matrix}$$
$$\begin{bmatrix} 0.9 & 0.9 & 0.9 \\ 0.03 & 0.04 & 0.05 \\ 0.07 & 0.06 & 0.05 \end{bmatrix} \begin{matrix} R \\ W \\ S \end{matrix}$$ next week

D.

this week

$$\begin{matrix} R & W & S \end{matrix}$$
$$\begin{bmatrix} 0.9 & 0.05 & 0.04 \\ 0.03 & 0.9 & 0.06 \\ 0.07 & 0.05 & 0.9 \end{bmatrix} \begin{matrix} R \\ W \\ S \end{matrix}$$ next week

E.

this week

$$\begin{matrix} R & W & S \end{matrix}$$
$$\begin{bmatrix} 0.9 & 0.03 & 0.07 \\ 0.9 & 0.04 & 0.06 \\ 0.9 & 0.05 & 0.05 \end{bmatrix} \begin{matrix} R \\ W \\ S \end{matrix}$$ next week

Question 9

Campers who holiday each year near a remote beach can stay at two sites A and B.
The Parks Service who register each campers stay, develop a transition matrix T to try and predict where the campers will stay in future years.

one year

$$T = \begin{matrix} A & B \\ \end{matrix}$$
$$\begin{bmatrix} 0.8 & 0.1 \\ 0.2 & 0.9 \end{bmatrix} \begin{matrix} A \\ B \end{matrix}$$ next year

In 2009 there were a total of 200 campers at the sites and 120 of these were at site A.
The number of campers expected to be camping at site B in 2010 is

A. 76
B. 80
C. 96
D. 98
E. 104

Further Mathematics Formulas

Core: Data analysis

standardised score: $z = \dfrac{x - \bar{x}}{s_x}$

least squares line: $y = a + bx$ where $b = r\dfrac{s_y}{s_x}$ and $a = \bar{y} - b\bar{x}$

residual value: residual value = actual value – predicted value

seasonal index: $\text{seasonal index} = \dfrac{\text{actual figure}}{\text{deseasonalised figure}}$

Module 1: Number patterns

arithmetic series: $a + (a+d) + \ldots + (a+(n-1)d) = \dfrac{n}{2}[2a + (n-1)d] = \dfrac{n}{2}(a+l)$

geometric series: $a + ar + ar^2 + \ldots + ar^{n-1} = \dfrac{a(1-r^n)}{1-r}, \; r \neq 1$

infinite geometric series: $a + ar + ar^2 + ar^3 + \ldots = \dfrac{a}{1-r}, \; |r| < 1$

Module 2: Geometry and trigonometry

area of a triangle: $\dfrac{1}{2}bc\sin A$

Heron's formula: $A = \sqrt{s(s-a)(s-b)(s-c)}$ where $s = \dfrac{1}{2}(a+b+c)$

circumference of a circle: $2\pi r$

area of a circle: πr^2

volume of a sphere: $\dfrac{4}{3}\pi r^3$

surface area of a sphere: $4\pi r^2$

volume of a cone: $\dfrac{1}{3}\pi r^2 h$

volume of a cylinder: $\pi r^2 h$

volume of a prism: area of base × height

volume of a pyramid: $\dfrac{1}{3}$ area of base × height

Pythagoras' theorem $c^2 = a^2 + b^2$

sine rule: $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

cosine rule: $c^2 = a^2 + b^2 - 2ab\cos C$

Module 3: Graphs and relations

Straight line graphs

gradient (slope): $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

equation: $y = mx + c$

Module 4: Business-related mathematics

simple interest: $I = \dfrac{PrT}{100}$

compound interest: $A = PR^n$ where $R = 1 + \dfrac{r}{100}$

hire purchase: effective rate of interest $\approx \dfrac{2n}{n+1} \times$ flat rate

Module 5: Networks and decision mathematics

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

Module 6: 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 $\det A \neq 0$

END OF FORMULA SHEET

FURTHER MATHEMATICS

TRIAL EXAMINATION 1

MULTIPLE- CHOICE ANSWER SHEET

STUDENT NAME:...

INSTRUCTIONS

Fill in the letter that corresponds to your choice. Example: A ▬ C D E

The answer selected is B. Only one answer should be selected.

Section A - Core

1. A B C D E
2. A B C D E
3. A B C D E
4. A B C D E
5. A B C D E
6. A B C D E
7. A B C D E
8. A B C D E
9. A B C D E
10. A B C D E
11. A B C D E
12. A B C D E
13. A B C D E

Section B - Modules

Module Number ___

1. A B C D E
2. A B C D E
3. A B C D E
4. A B C D E
5. A B C D E
6. A B C D E
7. A B C D E
8. A B C D E
9. A B C D E

Module Number ___

1. A B C D E
2. A B C D E
3. A B C D E
4. A B C D E
5. A B C D E
6. A B C D E
7. A B C D E
8. A B C D E
9. A B C D E

Module Number ___

1. A B C D E
2. A B C D E
3. A B C D E
4. A B C D E
5. A B C D E
6. A B C D E
7. A B C D E
8. A B C D E
9. A B C D E

