The Mathematical Association of Victoria

2000

MATHEMATICS: FURTHER

Trial Examination 1

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

Student's Name: _____

Directions to students

This examination has two sections: **Section A (Core)** and **Section B (modules).** Both sections have multiple-choice questions only.

Answer **all** of the **Section A (Core)** questions.

Select three modules in **Section B (modules)** and answer **all** questions in each of your selected modules.

Answer all questions in on the multiple-choice answer sheet provided.

There are **40 marks** available for this task.

A formula sheet is attached.

These questions have been written and published to assist students in their preparations for the 2000 Further Mathematics Examination 1. The questions and associated answers and solutions do not necessarily reflect the views of the Board of Studies Assessing Panels. The Association gratefully acknowledges the permission of the Board to reproduce the formula sheet.

Multiple-Choice Answer Sheet

Student's Name: _____

Cross through the letter that corresponds to each answer.

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

Module: _____

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: _____

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: _____

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

Part I (Multiple Choice Questions)

SECTION A: Core Data Analysis

Specific instructions for Section A

Section A consists of **13** questions. Answer **all** questions in this section on the multiple-choice answer sheet provided. Only mark **one** letter for each question.

Question 1

VCE study scores, when graphed, form a bell-shaped curve with mean of 30 and standard deviation of 7. The percentage of candidates who obtain a study score greater than 44 is approximately

A. 2.5
B. 5
C. 12
D. 16
E. 95

Question 2

The given frequency table represents the number of goals scored by a school hockey team over the past 2 seasons

Goals scored	0	1	2	3	4	5	6
Frequency	3	2	5	3	0	5	2

The median number of goals scored during these 2 seasons is

A. 2
B. 2.5
C. 2.9
D. 3
E. 5

Question 3

The following table shows seasonal indices for sales at Moca's hardware store during 1999.

Quarter 1	Quarter 2	Quarter 3	Quarter 4
0.94	1.03	1.04	

Which one of the following statements is <u>not</u> true ?

A. The highest sales figure was recorded during Quarter 3.
B. The lowest sales figure was recorded during Quarter 1.
C. Sales for Quarter 2 were closest to the yearly average.
D. Sales for Quarter 4 were greater than those for Quarter 1.
E. The 2 closest seasonal indices were those for Quarter 2 and Quarter 3.

Question 4

Consider the following boxplot
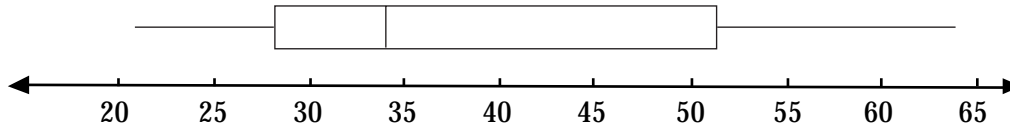
Which of the following statements is true?
A. The median is 45.
B. Less than a quarter of the results are less than 30.
C. More than a quarter of the results are greater than 50.
D. More than half the results are less than 30.
E. The range is 20.

Question 5

A relationship between exam performance and anxiety was investigated and Pearson's correlation coefficient found to be −0.6
The coefficient of determination for these 2 variables would be

A. 0.6
B. − 0.36
C. 0.36
D. − 0.77
E. 0.77

Question 6

A histogram was drawn from the heights of 100 five year old children who were randomly selected from Victorian schools. This distribution is most likely to be

A. symmetrical
B. bimodal
C. segmented
D. positively skewed
E. negatively skewed

Question 7

From a graphing calculator the following one variable statistics can be shown for a sample set of data . Which one of the following is true for this data set?

A. There is an outlier at 19.
B. The standard deviation is approximately 22.4.
C. The number of values in the data set is 19.
D. The interquartile range is 76.
E. The mean is greater than the median.

Question 8

The following two-way frequency table gives figures for gender and voting intention for 100 randomly selected voters at a polling booth
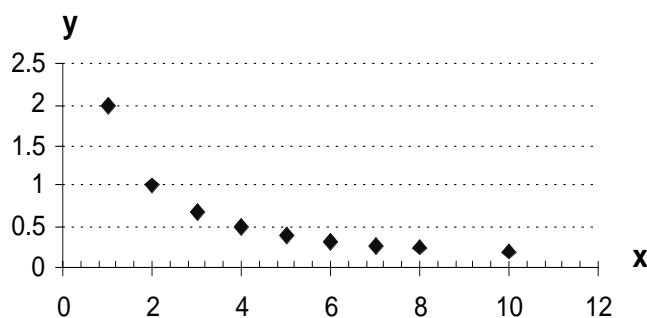
	Gender		
Voting intention	Male	Female	Total
Government	24	30	54
Opposition	13	33	46
Total	37	63	100

The percentage of females who intended to vote for the opposition is closest to

A.   30%
B.   33%
C.   35%
D.   52%
E.   72%

Question 9

A scatterplot of y versus x has the following shape

In an attempt to linearise this graph, which one of the following could <u>not</u> be used ?

A.   A log x transformation.

B.   A $\frac{1}{x}$ transformation.

C.   A log y transformation.

D.   A $\frac{1}{y}$ transformation.

E.   A y^2 transformation.

Question 10

Using a graphing calculator, a residual plot of residual values versus x had the following arrangement of points
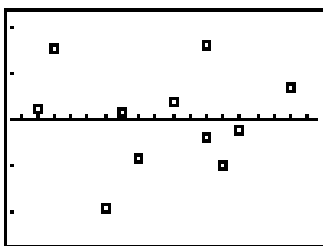
This suggests that the original linear model of y versus x

A. is suitable as the residuals show random variation only
B. is a perfect fit of the original data
C. should be discarded in favour of a regression line 'by eye'
D. is unsuitable as the residuals show a systematic pattern
E. should be discarded and replaced by an x^2 transformation

Question 11

The following data gives the number of days free of rainfall for the first 6 months of 1999 in the town of Forestville

Month	Jan	Feb	Mar	Apr	May	Jun
Number of days	23	19	22	15	13	20

If 3 point median smoothing is applied to the data then the smoothed value corresponding to the month of May will be

A. 13
B. 15
C. 16
D. 18
E. 20

Question 12

Which of the following would be most appropriate to display the relationship between a numerical variable (for example, test scores) and a 3 level categorical variable (for example, 3 classes of students) ?
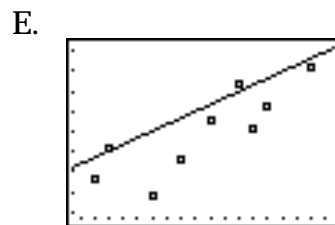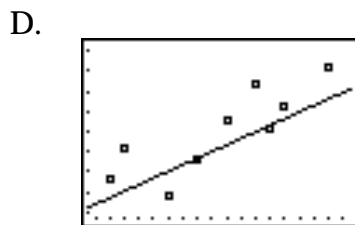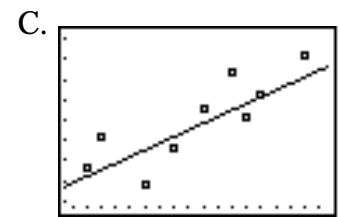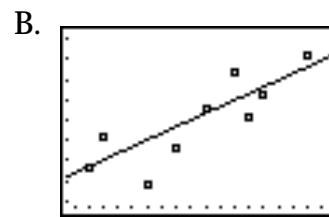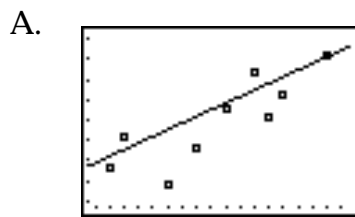
A. A back to back stemplot.
B. Parallel boxlots.
C. A segmented barchart.
D. A two way frequency table.
E. A histogram.

Question 13

A 3-median regression line is to be drawn on to the following scatterplot.
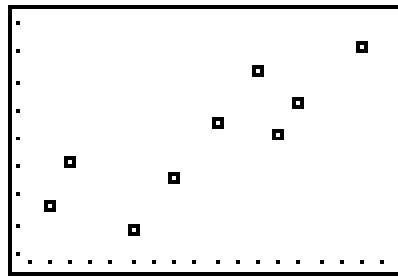
Which of the following best represents the scatterplot with the trend line drawn ?

A.

B.

C.

D.

E.

SECTION B

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Specific instructions for Section B

Section B consists of 5 modules. Each module contains 9 questions.

Select **3** modules and answer **all** questions in each of your selected modules on the multiple-choice answer sheet provided. Only mark **one** letter for each question.

There are 27 marks available in this section. Marks are not deducted for incorrect answers.

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Module	Page

Module 1 : Number patterns and applications

Question 1

An estate has been divided between cousins Jake, Ben and Simon in the ratio 3 : 5 : 4.
If Jake has received $18,000 from the estate then Simon will receive

A. $13,500
B. $22,500
C. $24,000
D. $30,000
E. $72,000

Question 2

A lever produces a mechanical advantage of 6 when used to lift a heavy load.

Load   Fulcrum

If the fulcrum is positioned 25 centimetres from the load then the length of the lever is

A.   1.25 metres
B.   1.5 metres
C.   1.75 metres
D.   3 metres
E.   4 metres

Question 3

Sterling silver contains pure silver and copper in the ratio 37 : 3. If 10 grams of pure silver is to
be used to make a quantity of sterling silver then the amount of copper required, to the nearest
milligram, is

A.   75
B.   123
C .   270
D.   750
E.   811

Question 4

Which of the following sequences is neither arithmetic nor geometric?

A.   10, 0.1, 0.001, ……
B.   −128, −98, −68, …..
C.   16, 12, 9, ……
D.   8, 10, 14, ……
E.   1000, -800, 640, ……

Question 5

The 17th term and the sum of the first 17 terms of the sequence 185, 179, 173, …..
are, respectively

A.   83, 2412
B.   89, 2329
C.   89, 2412
D.   95, 2240
E.   95, 2329

Question 6

A geometric sequence has a common ratio of 2 and the 5th term has the value 4.
The 12th term of this sequence is

A.   32
B.   256
C.   512
D.   1024
E.   8192

Question 7

The sum to infinity of the geometric sequence 100, -40, 16, ….. is

A. $71\frac{3}{7}$

B. $72\frac{2}{5}$

C.   125

D. $166\frac{2}{3}$

E.   172

The following information relates to Questions 8 and 9

A sequence is generated by the difference equation

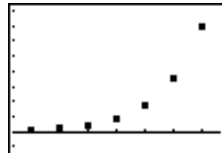$$t_{n+1} = 2t_n + 5 ; \quad t_1 = 6; \quad n = 1, 2, 3, \ldots.$$

Question 8

Which of the following graphs shows the terms of the sequence graphed for $1 \le n \le 7$?
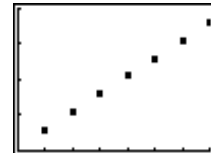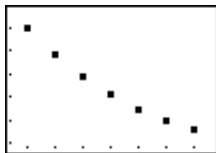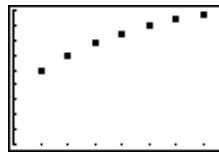
A.
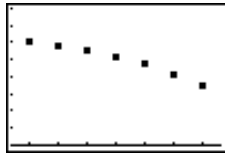
B.

C.

D.

E.

Question 9

The solution of this first-order difference equation which gives an expression for t_n in terms of n is

A. $t_n = 6 + (n - 1) \times 2$

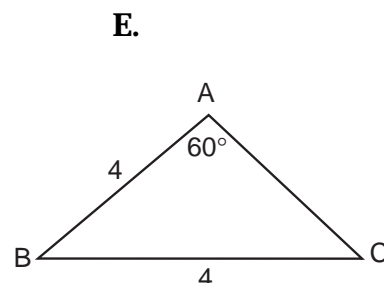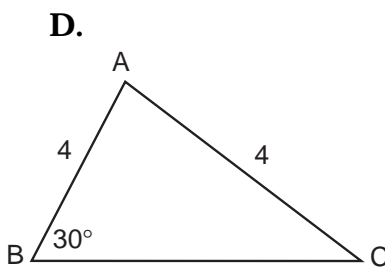B. $t_n = 11 \times 2^{n-1} - 5$
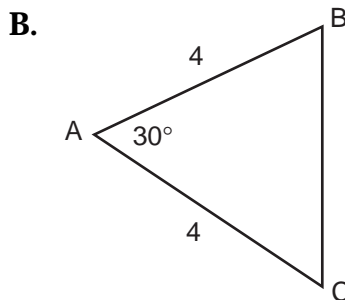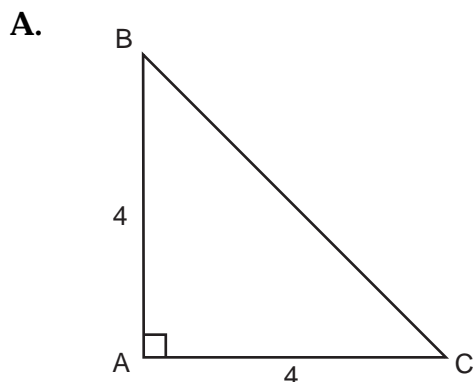
C. $t_n = 11 \times 2^n - 5$

D. $t_n = 2^{n-1} + 5$

E. $t_n = 2^n \times 6 - 6$

Module 2: Geometry and Trigonometry

Question 1

A triangle is described using the following geometric notation. $\overline{AB} = \overline{AC} = 4$ and $\angle A = 30^o$. Which triangle below best satisfies these parameters?

A.

B.

C.

D.

E.

Question 2

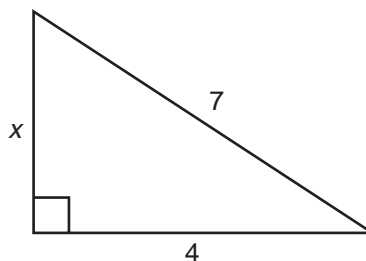Which expression would be used to find the value of x?

A. $x^2 = 4^2 + 7^2$

B. $x = \sqrt{4^2 + 7^2}$

C. $x = \sqrt{7^2 + 4^2}$

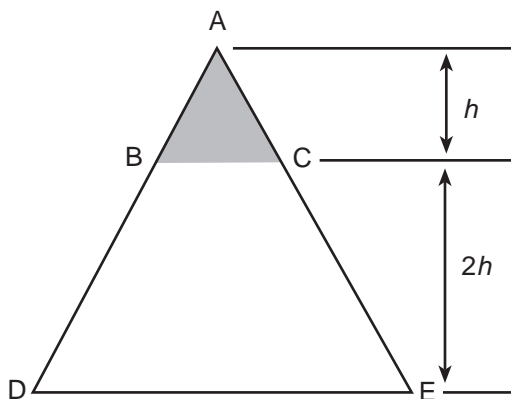**D.** $x = \sqrt{7^2 - 4^2}$

E. $x = \sqrt{4^2 - 7^2}$

Question 3

In the diagram below $\overline{BC}$ is parallel to $\overline{DE}$.

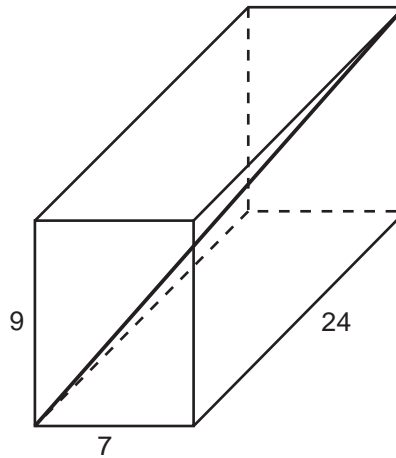The ratio of unshaded area to shaded area is

A. 2:1
B. 3:1
C. 8:1
D. 9:1
E. 1:9

Question 4

A rectangular box has a rod positioned as shown in the diagram. The expression for the angle the rod makes with the base of the box is
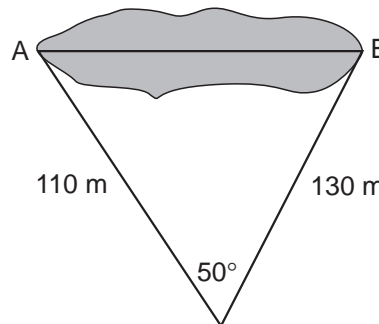
A. $\tan \theta = \dfrac{9}{25}$

B. $\sin \theta = \dfrac{9}{25}$

C. $\tan \theta = \dfrac{7}{24}$

D. $\tan \theta = \dfrac{7}{25}$

E . $\cos \theta = \dfrac{7}{24}$

Question 5

To find the distance across a large excavation, the following measurements were found as shown in the diagram. The distance across the excavation AB is closest to
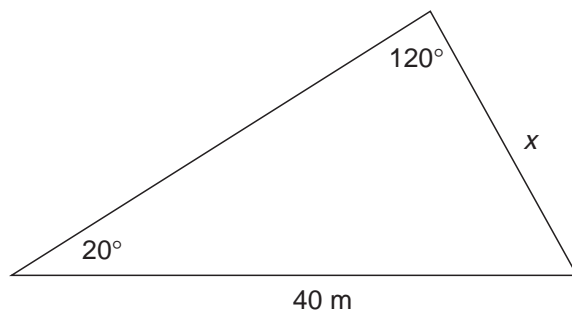
A.   80 metres
B.   100 metres
C.   110 metres
D.   170 metres
E .   240 metres

Question 6

The side marked *x* in the given triangle has length, in metres given by

A. $40 \tan 20°$

B . $\dfrac{40 \sin 20°}{\sin 120°}$

C. $\dfrac{\sin 20°}{40 \sin 120°}$

D. $\dfrac{40 \cos 20°}{\cos 120°}$

E. $20^2 + 120^2 - 2 \times 20 \times 120 \times \cos 40$

Question 7

For the triangle shown below $\overline{AC}$ is on a bearing of $76°T$

$\overline{BC}$ is on a bearing of $294°T$

and $\overline{AB}$ is 4.5 kilomtres long on an East-West line

The value of side marked x to 2 decimal places in kilometres is

A.   1.09
B.   1.83
C.   2.97
D.   4.11
E.   4.43
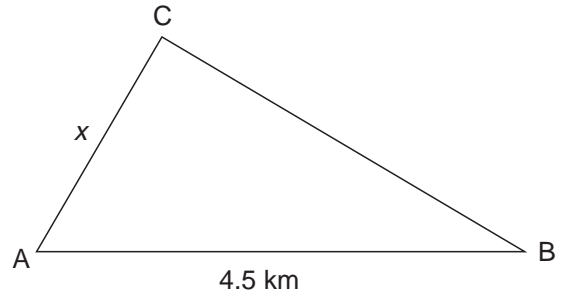
Question 8

Below is surveyor's notes on a property using traverse offset for a plot of land. Which of the following plans of land matches the surveyor's notes.
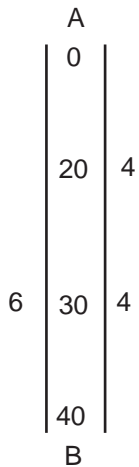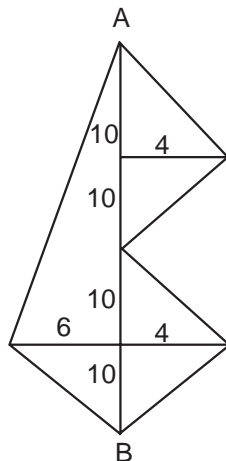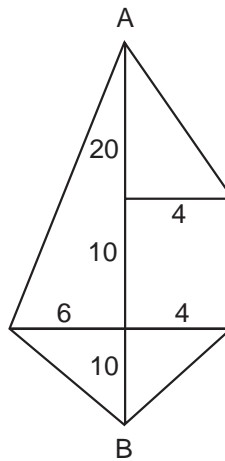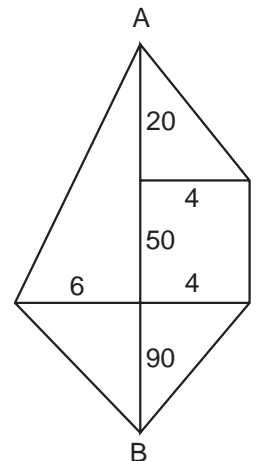
Question 9

4 litres (L) of paint was used to paint the outside body surface of a real bus. A 1:20 scale model of the bus was also painted. The amount of paint needed for the model in millilitres (ml) is

A. 10 ml
B. 20 ml
C. 100 ml
D. 200 ml
E. 1000 ml

Module 3: Graphs and Relations

Question 1

A straight line is drawn parallel to the x axis and passing through the point $(2, 2)$.
The equation of this line is

A. $x = 2$
B. $y = 2$
C. $y = x$
D. $y = 2x - 2$
E. $y = \dfrac{1}{2}x + 1$
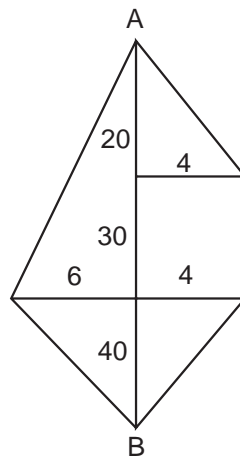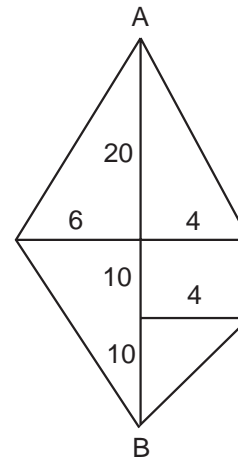
Question 2

A graph of y versus x^2 was drawn as follows
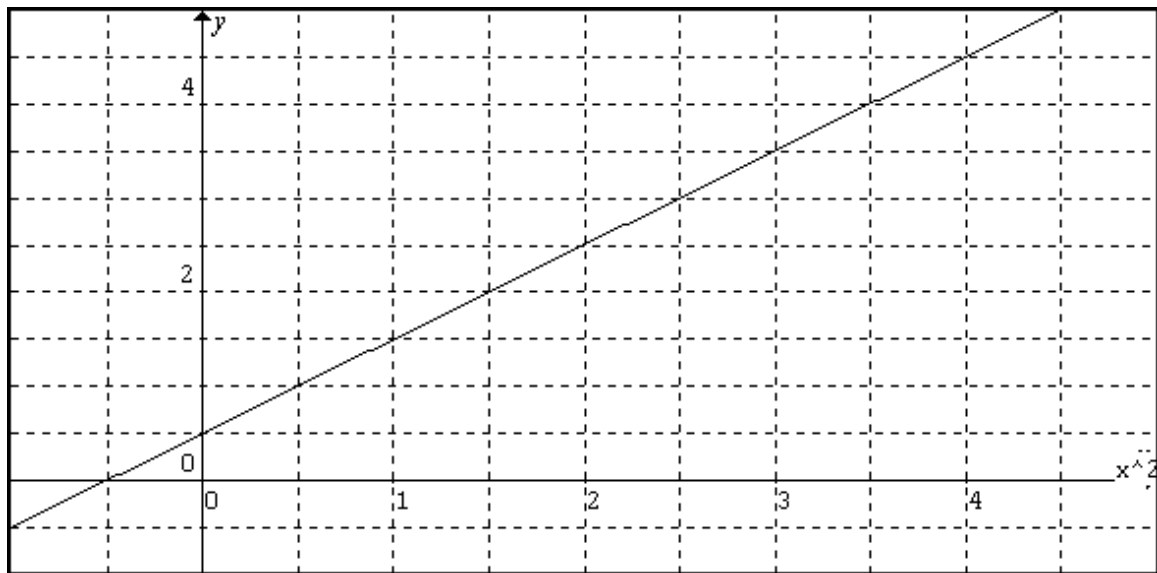
The equation of this linear relation is of the form

A. $y = mx + c$

B. $y = mx^2 + c$

C. $y = mx$

D. $y = mx^2$

E. $y = c$

Question 3

A straight line with equation $x - 2y = -2$ was sketched. Which one of the following points does this line not pass through ?

A. $(2, 2)$
B. $(-2, 0)$
C. $(4, 3)$
D. $(1, 0)$
E. $(-4, -1)$

Question 4

Consider the straight line graph below.
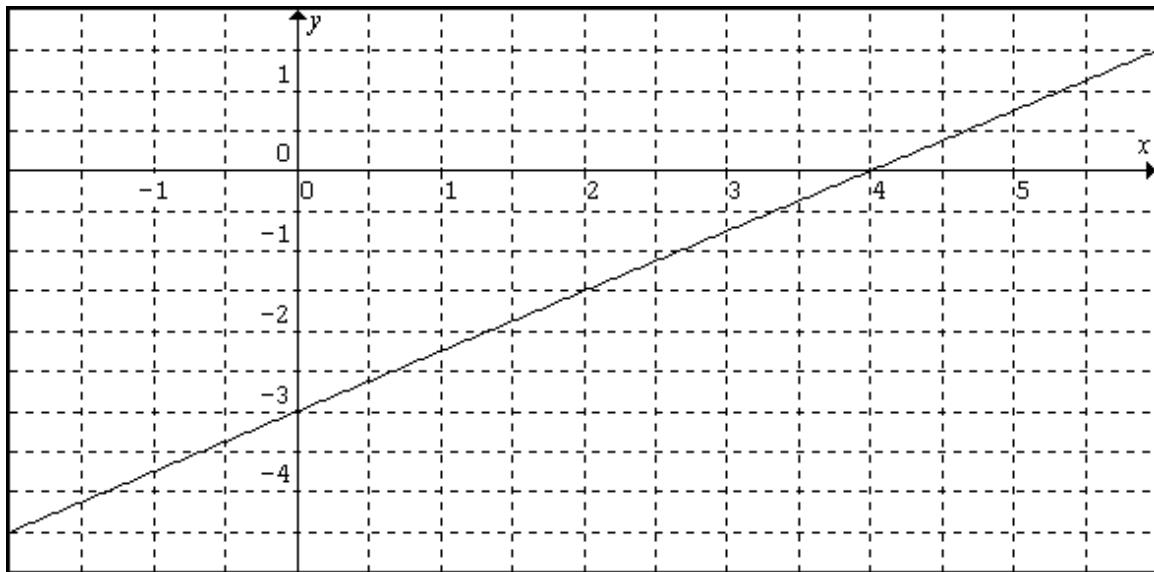
The equation of the graph above is

A. $3x + 4y = 12$

B. $4x - 3y = 12$

C. $3x - 4y = 12$

D. $4x + 3y = 12$

E. $3x - 4y = -12$

Question 5

The following diagram represents a section of a ride at a carnival
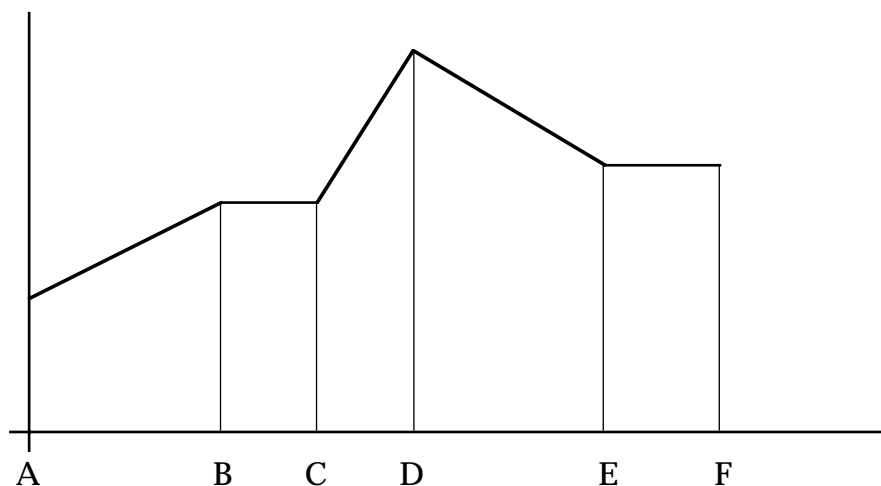
The speed of the passengers will change most quickly between

    A.   A and B

    B.   B and C

    C.   C and D

    D.   D and E

    E.   E and F

Question 6

The fines in dollars for late return of books at Ardo library can be displayed in the following graph.
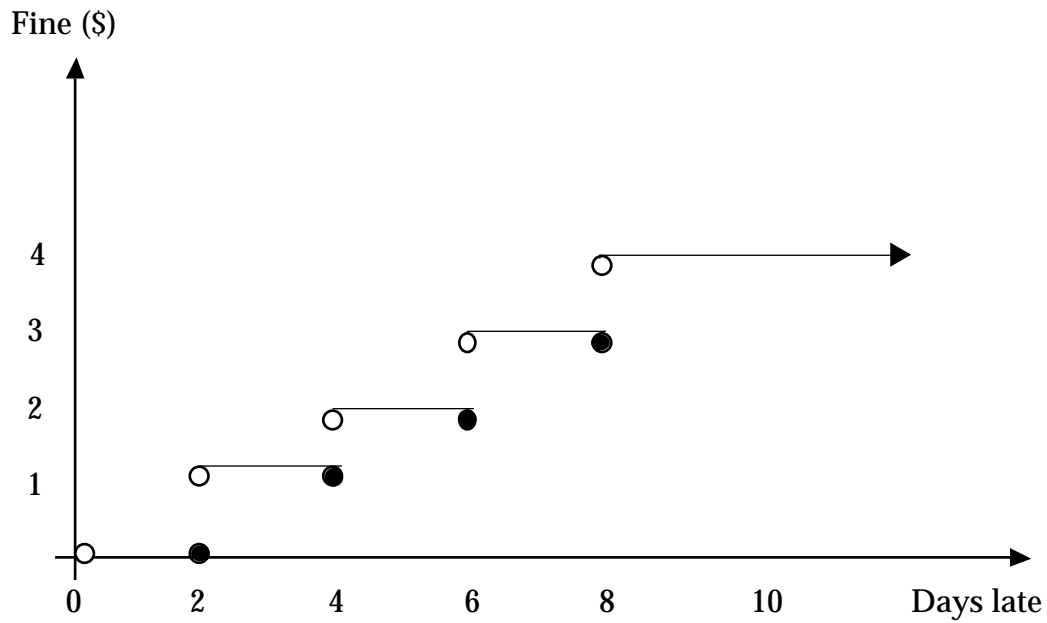
Fine ($)

Jeff has two books overdue, one by 2 days and the other by 3 days. The fine imposed by the library on Jeff will be

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

Question 7

The graph of $5x - y = 5$ is represented by which of the following ?

A.

B.

C.

D.

E.
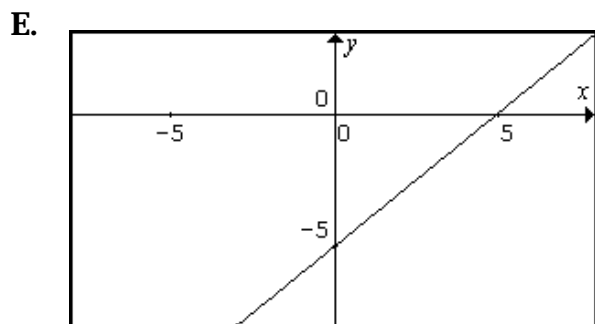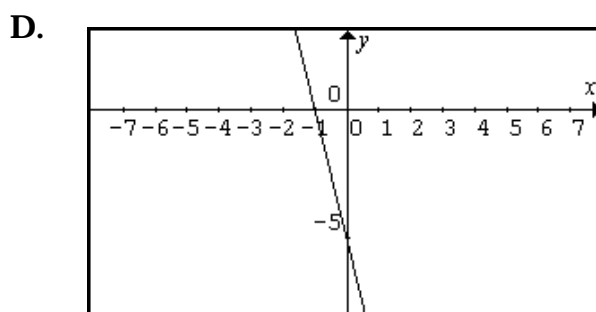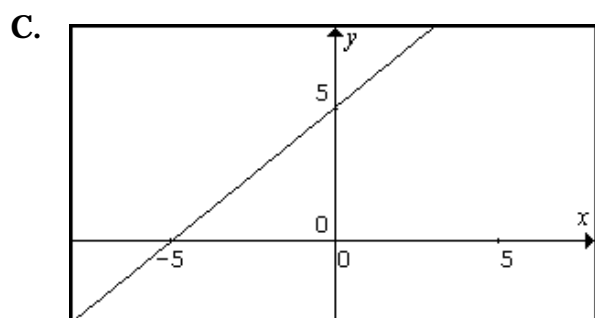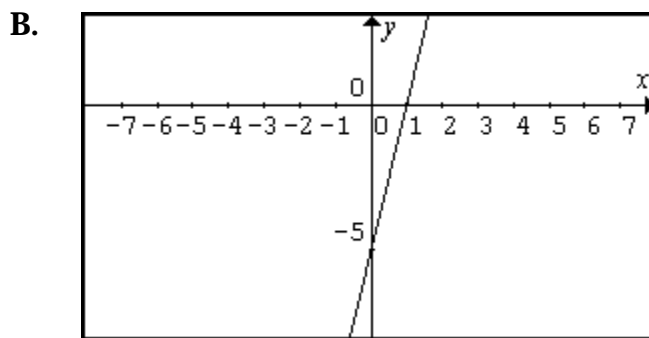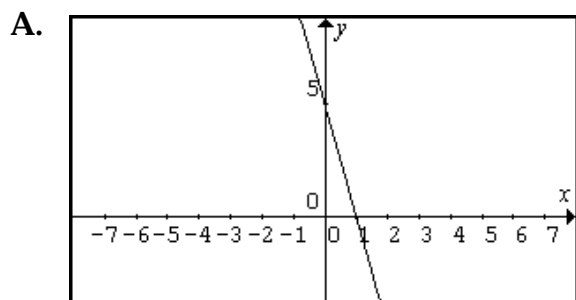
Question 8

The feasible region (shaded) could be described by which of the following sets of inequations
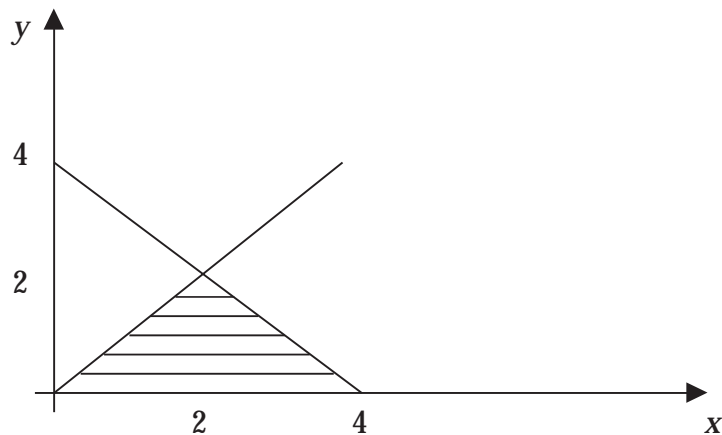
A. $x \geq 0$, $y \geq 0$, $y \leq x$, $x + y \leq 4$

B. $x \geq 0$, $y \geq 0$, $x \leq y$, $x + y \leq 4$

C. $x \geq 0$, $y \geq 0$, $y \leq x$, $x - y \leq 4$

D. $x \geq 0$, $y \geq 0$, $y \leq x$, $x - y \geq 4$

E. $x \geq 0$, $y \geq 0$, $y \leq -x$, $x + y \leq 4$

Question 9

A pair of equations has been solved simultaneously to give a solution at $(2, -3)$
The two equations could be

A. $x + y = -1$ and $2x - y = 1$

B. $3x - 2y = 12$ and $2x + 3y = -5$

C. $2x + y = 1$ and $4x - y = 5$

D. $3x + 2y = 12$ and $2x - 3y = -5$

E. $2x + y = -1$ and $4x + y = 5$

Module 4: Business Related Mathematics

Question 1
A Term Deposit Account offers the following rates given in the table below.

Deposits of less than $5 000		Deposits of $5 000 or more	
up to 3 months	1.2%	up to 3 months	5%
between 3 months and 1 year	1.5%	between 3 months and 1 year	1.8%
between 1 year to 5 years	1.6%	between 1 year to 5 years	2.0%
greater than 5 years	1.8%	greater than 5 years	2.4%

A retire has $ 3 000 to invest for 18 months. The interest rate that the investment will earn is

A.   1.2%
B.   1.5%
C.   1.6%
D.   1.8%
E.   2.0%

Question 2
A HIRE PURCHASE agreement requires a deposit of 10% on a TV set valued at $1 100. Then the balance is payed by weekly payments of $12 over 2 years. The total cost of the TV is

A. $ 600
B. $1 200
C. $1 310
D. $1 248
E. $1 358

Question 3
A car depreciates by $22\frac{1}{2}$ % in the first year. A car purchased for $24 000 would after the first year be valued at

A. $ 2 400
B. $ 5 400
C. $18 600
D. $20 000
E. $21 600

Question 4

The following table lists the time in years and Account Balance as seen on a graphics calculator. The best model to match this table of values is

A. reducing balance loan
B. simple interest savings account
C. compound interest savings account
D. straightline depreciation
E. reducing balance depreciation

Question 5

Two banks pay simple interest on short term deposits. Hales bank pays 8% pa over 5years and Countrybank pays 10% pa. for 4 years. What is the difference between the two banks final payout figure if $2000 was invested in each account?

A. $0
B. $800
C. $2 800
D. $150
E. $400

Question 6

Clayton invested $360 in a bank for 3 years earning 9% simple interest each year. How much will he receive in total at the end of the three years?

A. 360×1.09^3

B. $360 + 360 \times 1.09^3$

C. $\dfrac{360 \times 9 \times 3}{100}$

D. $360 + \dfrac{360 \times 9 \times 3}{100}$

E. 360×0.91^3

Question 7

A home loan of $150 000 is to be paid in full over 10years in monthly installments of $1 500. The interest is 7.5% per annum compounded monthly.

$$A = PR^n - \frac{Q(R^n - 1)}{R - 1}$$

In this example, using the Annuities formula, the the value of the pronumerals A, P and R is

A.	$A = \$0$	$P = \$150\ 000$	$R = 1.00625$
B.	$A = \$0$	$P = \$150\ 000$	$R = 1.075$
C.	$A = \$1\ 500$	$P = \$150\ 000$	$R = 7.5$
D.	$A = \$0$	$P = \$1\ 500$	$R = 1.00625$
E.	$A = \$150\ 000$	$P = \$0$	$R = 1.00625$

Question 8

The interest charged on a reducing balance loan of $9 500 is at the rate of 6.6% p.a. (debited monthly). Monthly repayments of $291.60 are made. The amount still owing after 6 months, to the nearest dollar, is

A. $7 750
B. $7 785
C. $8 145
D. $8 104
E. $8 044

Question 9

A machine bought for $8 500 is depreciated by the flat rate method. If its useful life is 6 years and its scrap value is $1 000 then the annual depreciation will be

A. $1 100
B. $1 250
C. $1 500
D. $7 494
E. $7 500

Module 5 : Networks and Decision Mathematics

Question 1

A connected planar graph divides the plane into 17 regions. If the graph has 10 vertices then the number of edges is

A. 9
B. 19
C. 23
D. 25
E. 29

Question 2
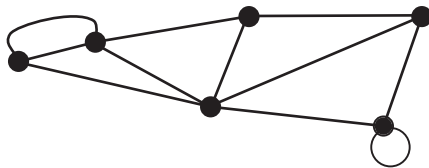
The sum of the degrees of the vertices on the graph shown is

A. 18
B. 20
C. 21
D. 22
E. 23

Question 3

Which of the following graphs has an Euler circuit?

A.

B.

C.

D.

E.
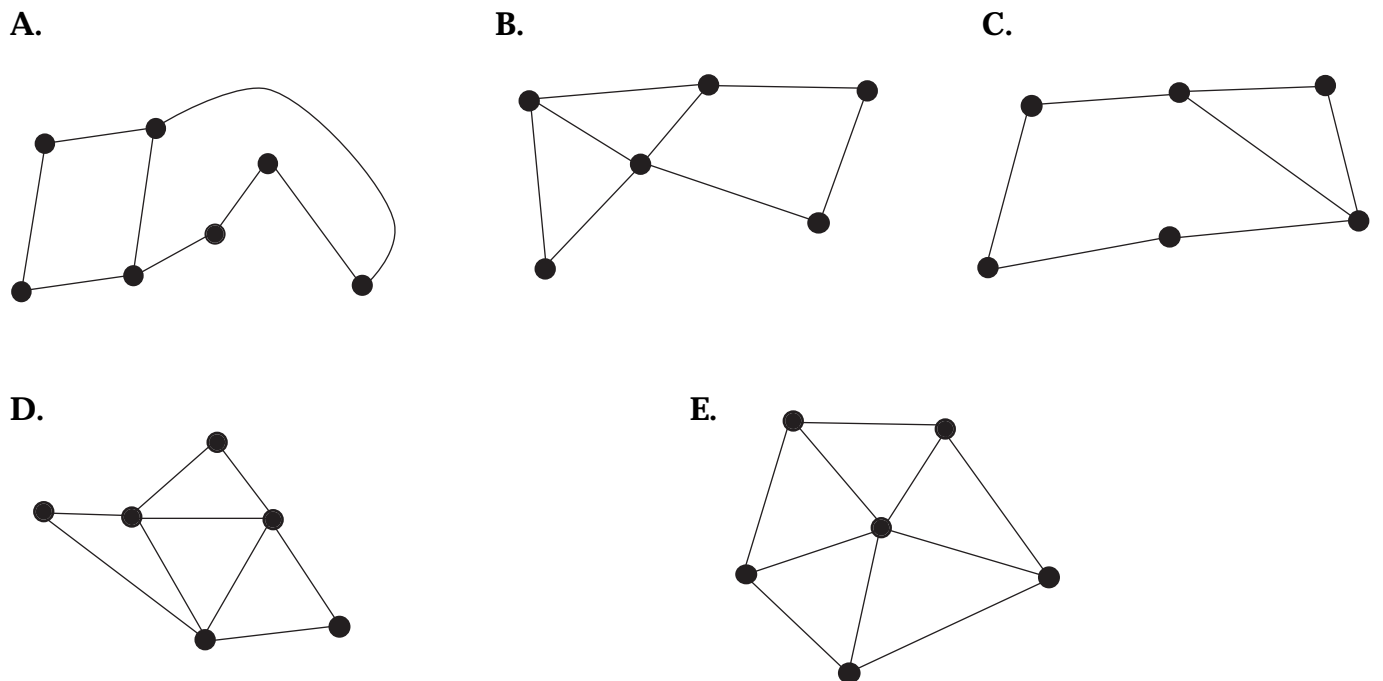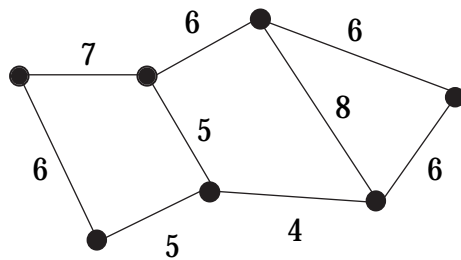
Question 4

The sum of the weights of the minimum spanning tree of the weighted graph given above is

A. 28
B. 32
C. 33
D. 34
E. 35

Question 5
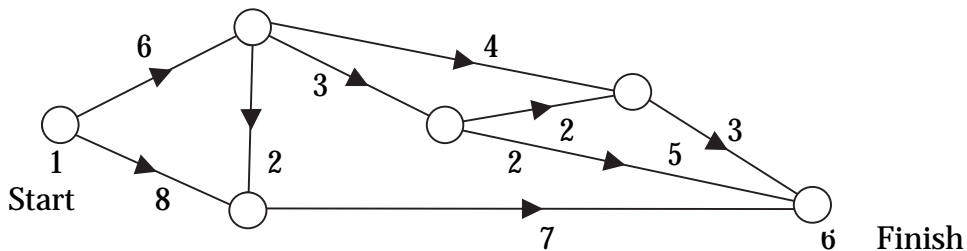
The maximum flow in the network linking the start to the finish is

A. 11
B. 13
C. 14
D. 17
E. 18

Question 6
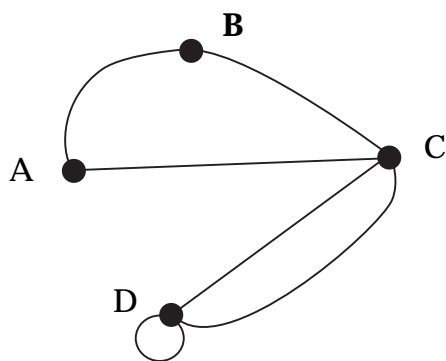
A matrix corresponding to the graph is

A.

$$
\begin{array}{cccc} A & B & C & D \end{array}
$$
$$
\begin{bmatrix} 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 2 \\ 0 & 0 & 2 & 1 \end{bmatrix}
$$

B.

$$
\begin{array}{cccc} A & B & C & D \end{array}
$$
$$
\begin{bmatrix} 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 2 \\ 0 & 0 & 2 & 1 \end{bmatrix}
$$

C.

$$
\begin{array}{cccc} A & B & C & D \end{array}
$$
$$
\begin{bmatrix} 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 2 \\ 0 & 0 & 2 & 2 \end{bmatrix}
$$

D.

$$
\begin{array}{cccc} A & B & C & D \end{array}
$$
$$
\begin{bmatrix} 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 2 \\ 0 & 0 & 2 & 2 \end{bmatrix}
$$

E.

$$
\begin{array}{cccc} A & B & C & D \end{array}
$$
$$
\begin{bmatrix} 2 & 2 & 4 & 3 \\ 2 & 0 & 1 & 0 \\ 4 & 1 & 0 & 2 \\ 3 & 0 & 2 & 2 \end{bmatrix}
$$

Question 7
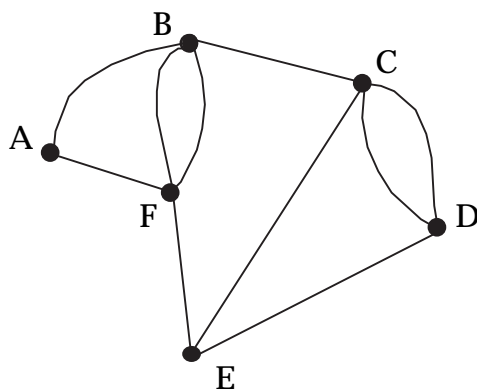
Which of the following is not true about the graph above?

A. The graph is a planar graph.
B. The graph is a complete graph.
C. The graph is a connected graph.
D. The graph contains a Euler path.
E. The graph contains a Hamiltonian circuit.

The following information refers to questions 8 and 9

The directed graph below represents a manufacturing process. The activities in this process, and the time in hours that they take, are marked on the edges of the graph.
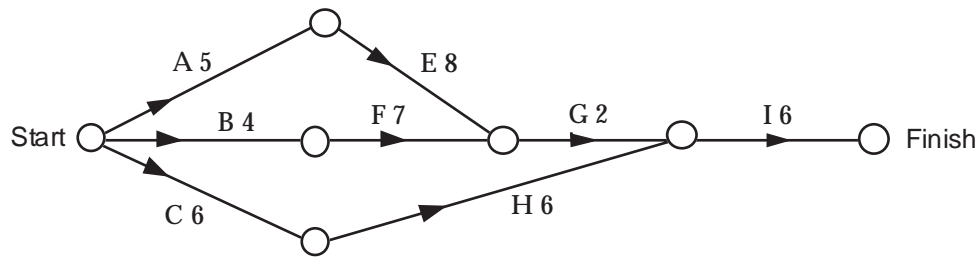
Question 8

The earliest time, in hours, for activity I to begin is

A. 11
B. 12
C. 13
D. 14
E. 15

Question 9

The critical path for the completion of this process is

A. C H I
B. B D H I
C. A E G I
D. B F G I
E. A F H I

Trial Examination 1 Answers & Solutions

Part I (Multiple-choice) Answers

SECTION A: Core : Data analysis

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

Module 1: Number patterns and applications

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

Module 2: Geometry and trigonometry

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

Module 3: Graphs and relations

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

Module 4: Business related mathematics

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

Module 5: Networks and decision mathematics

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

Solutions

SECTION A: Core : Data analysis

Question 1   [A]

95% of scores will be within 2 standard deviations of the mean i.e. between 16 and 44. Therefore 5% remains which will mean 2.5% below 16 and 2.5% above 44

Question 2   [B]

There are 20 values therefore the median will be midway between the 10th and 11th values. From the table the 10th value is 2 and the 11th is 3, so the median will be 2.5

Question 3   [C]

The missing seasonal index for quarter 4 is 0.99 (since the indices must add to 4). Therefore the only false statement is that sales for quarter 2 were closest to the yearly average when quarter 4's index shows that this one is closest to 1

Question 4   [C]

The upper quartile can be seen from this boxplot to be greater than 50.
Since 25% of the values are greater than the upper quartile, then more than a quarter of the results are greater than 50

Question 5   [C]

The coefficient of determination is the square of Pearson's r

$$r^2 = (-0.6)^2 = 0.36$$

Question 6   [A]

For a large group of children of a particular age the distribution should be symmetrical

Question 7   [E]

The mean is 61.444… whereas the median is 61. Therefore the mean is greater than the median

Question 8   [D]

63 females were surveyed of whom 33 intended to vote for the opposition

$$\frac{33}{63} \times \frac{100}{1} \text{ is close to } 52\%$$

Question 9   [E]

If transforming the x axis, the upper end of the scale needs to be compressed which could be achieved by either $\log x$ or $\dfrac{1}{x}$

If transforming the y axis again the scale needs to be compressed which suggests either $\log y$ or $\dfrac{1}{x}$. The only one which is clearly unsuitable is y^2

Question 10   [A]

When a residual plot displays no systematic pattern, this suggests that the original model is appropriate as random variation only is being displayed.

Question 11   [B]

The value for May when using 3 point smoothing is the median of the values for April, May and June. The median of 15, 13 and 20 is equal to 15

Question 12   [B]

Parallel boxplots are appropriate whenever displaying the relationship between a numerical variable and a 2 or more level categorical variable

Question 13   [B]

The median point of each group of 3 must first be found.
The line is drawn parallel to a line joining the 2 extreme median points then moved one third of the way towards the middle point

---

SECTION B:

Module 1: Number patterns and Applications

Question 1   [C]

Jake receives $18,000 which is 3 parts of the total inheritance.

One part is worth $\dfrac{\$18,000}{3} = \$6,000$

Simon receives 4 parts so Simon receives
$\$6,000 \times 4 = \$24,000$

Question 2   [C]

Mechanical advantage =

$\dfrac{\text{Distance of applied force from fulcrum, } x}{\text{Distance of load from fulcrum}}$

So $6 = \dfrac{x}{25}$

Hence $x = 6 \times 25$
           $= 150$ cm.

The total length of the lever is
$25 + 150 = 175$ cm.
                $= 1.75$ metres

Question 3   [E]

Silver : Copper = 37 : 3
Hence $10 : x = 37 : 3$

$$\frac{x}{10} = \frac{3}{37}$$
$$x = \frac{3 \times 10}{37}$$
$$= \frac{30}{37}$$
$$= 0.8108 \text{ grams}$$
$$= 0.8108 \times 1000 \text{ mg}$$
$$= 811 \text{ mg}$$

Question 4   [D]

The sequence 8, 10, 14, …. is
(i) not arithmetic : $10 - 8 = 2$ and
      $14 - 10 = 4$; the difference is not the same.
(ii) not geometric : $10/8 = 1.25$ and
      $14/10 = 1.4$; the ratio is not the same.

Sequence A is geometric with r = 0.01
Sequence B is arithmetic with d = 30
Sequence C is geometric with r = 0.75
Sequence E is geometric with r = –0.8

Question 5   [B]

The sequence is arithmetic with
a = 185 and d = –6
Hence $t_n = 185 + (n - 1) \times -6$
Substitute n = 17 :-
  $t_{17} = 185 + 16 \times -6$
       $= 89$

To find the sum use Sn = $\frac{n}{2}(a+l)$

So $S_{17} = (17/2)(185 + 89)$
$\phantom{So S_{17}} = 2329$

Alternatively use the calculator in Sequence mode :-

TABLE will give the required values :-

Question 6   [C]

$t_5 = ar^4$
$4 = a \times 2^4$

$a = \dfrac{4}{2^4}$

$ = \dfrac{1}{4}$

$t_{12} = ar^{11}$
$\phantom{t_{12}} = 1/4 \times 2^{11}$
$\phantom{t_{12}} = 512$

Alternatively :-

$t_{12} = ar^{11} = ar^4 \times r^7 = t_5 \times r^7$
$\phantom{t_{12} = ar^{11}} = 4 \times 2^7$
$\phantom{t_{12} = ar^{11}} = 512$

Question 7   [A]

The sequence is geometric with

$a = 100$ and $\quad r = \dfrac{-40}{100} = \dfrac{-2}{5} \quad S_\infty = \dfrac{a}{1-r}$

$\phantom{a = 100 and r = \frac{-40}{100}} = \dfrac{100}{1 - \left(\frac{-2}{5}\right)}$

$\phantom{a = 100 and r = \frac{-40}{100}} = \dfrac{100}{\frac{7}{5}}$

$\phantom{a = 100 and r = \frac{-40}{100}} = \dfrac{500}{7}$

$\phantom{a = 100 and r = \frac{-40}{100}} = 71\frac{3}{7}$

Question 8   [B]

$t_1 = 6$
$t_2 = 2 \times t_1 + 5 = 2 \times 6 + 5 = 17$
$t_3 = 2 \times t_2 + 5 = 2 \times 17 + 5 = 39$
$t_4 = 2 \times t_3 + 5 = 2 \times 39 + 5 = 83$ etc

The sequence is increasing (so it cannot be A or D) and the increase is getting larger as n increases.
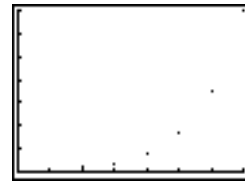
It is not arithmetic as there is not a common difference between the terms so this rules out graph C where the points are increasing at a constant rate.

The points in graph E are increasing but the increase is getting smaller as n increases. Alternatively using the calculator in **Seq**uence mode :-

and graphing the values :-

Question 9   [B]

The solution is found by substituting the values $a = 2$, $b = 5$ and $t_1 = 6$ in the formula :-

$t_n = a^{n-1} \times t_1 + \dfrac{b(a^{n-1} - 1)}{a - 1}$

$t_n = 2^{n-1} \times 6 + \dfrac{5(2^{n-1} - 1)}{2 - 1}$

$ = 2^{n-1} \times 6 + 5(2^{n-1} - 1)$

$ = 2^{n-1} \times 6 + 5 \times 2^{n-1} - 5$

$ = 11 \times 2^{n-1} - 5$

Alternatively values of n can be substituted into the solutions given in A to E to see which one gives the sequence 6, 17, 39, 83, …….

Module 2: Geometry and Trigonometry

Question 1   [B]

The triangle is isoceles with two equal angles. The third angle A is given as 30° and so the other two equal angles are 75°

$180° - 30° = 150° \quad 150° \div 2 = 75°$

Question 2   [D]

Using Pythagoras' Theorem

$c^2 = a^2 + b^2$ and substituting, we get

$7^2 = x^2 + 4^2$ and transposing

$x^2 = 7^2 - 4^2$

$x = \sqrt{7^2 - 4^2}$

Question 3   [C]

The height of the large triangle is 3*h* compared to *1h* for the small triangle giving a linear ratio of 3:1. The area ratio is linear ratio squared or 9:1. As the shaded area those not include the small triangle the the ratio is reduced to 8:1.

Question 4   [A]

$c = \sqrt{7^2 + 24^2} = 25$

$\tan \theta = \dfrac{9}{25}$

Question 5   [A]

Using cosine rule

$c^2 = a^2 + b^2 - 2 \times a \times b \times \cos C°$

$c^2 = 110^2 + 130^2 - 2 \times 110 \times 130 \times \cos 50° \quad c^2 = 10616.274$

$c = \sqrt{10616.274}$

$c = 103.03 \approx 100$ metres

Question 6   [A]

Using the sine rule

$\dfrac{x}{\sin 20°} = \dfrac{40}{\sin 120°}$

$x = \dfrac{40}{\sin 120°} \times \sin 20°$

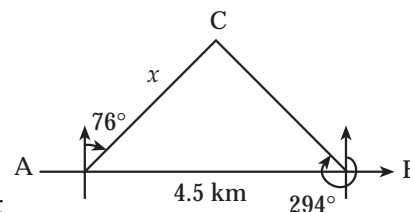$x = \dfrac{40 \sin 20°}{\sin 120°}$

Question 7   [C]

Using sine rule

294 - 270 = 24

90 - 76 = 14

$180 - 14 - 24 = 142$

$\dfrac{4.5}{\sin 142°} = \dfrac{x}{\sin 24°}$

$x = \dfrac{4.5}{\sin 142°} \times \sin 24°$

x = 2.972924 ... 2.97 km

Question 8   [D]

First offset is 4 units to the right, 20 units from A
Second offset is 4 units to the right, 30 from A
Third offset is 6 units to the left, 30 from A
Point B is 40 units from A.

Question 9   [A]

4 litres = 4000 ml
Linear scale is 1:20
Area scale factor is $1^2:20^2$ or 1:400

Paint for model surface area = $\dfrac{1}{400} \times 4000 = 10$ml

Module 3 : Graphs and relations

Question 1   [B]

The equation is of the form $y = mx + c$ where $m = 0$ (since parallel to x axis) and $c = 2$ (as graph must cut the y axis at 2) $\Rightarrow y = 2$

Question 2   [B]

The graph is of y versus x^2 and the y intercept can be seen to be greater than $0 \Rightarrow y = mx^2 + c$

Question 3   [D]

When the point (1,0) is substituted into $x - 2y = -2$, we obtain $1 - 0 = -2$ which is obviously untrue
The answer could be found also by checking a table of values off the calculator

Question 4   [C]

The line has a positive slope of $\dfrac{rise}{run} = \dfrac{3}{4}$ and a y

intercept of -3

$$y = \frac{3}{4}x - 3$$
$$4y = 3x - 12$$
$$3x - 4y = 12$$

Question 5   [C]

The answer is where the change in speed will be greatest i.e the greatest slope irrespective of whether the ride is speeding up or slowing down

Question 6   [A]

From the graph, the book that is 2 days late does not incur a fine at all whereas the book that is 3 days late incurs a $1 fine
The total in fines that Jeff must pay is $1

Question 7   [B]

By substitition, when $x = 0$, y $= -5$ and when y = 0, $x = 1$

Question 8   [A]

The region is entirely in the first quadrant
$\Rightarrow x \geq 0$ and $y \geq 0$

The shaded region is below the line
$y = x \Rightarrow y \leq x$

The shaded region is below the line
$x + y = 4 \Rightarrow x + y \leq 4$

Question 9   [B]

By substitution of the point $(2, -3)$ into the equations to see which pair holds

---

Module 4 : Business Related Mathematics

Question 1   [C]

For less than $5 000 and between 1 and 5 years a return of 1.6% is offered.

Question 2   [E]

Total Amount = deposit + weekly paymnets

$$= \$110 + \$12 \times 104$$
$$= \$110 + \$1248$$
$$= \$1358$$

Question 3   [C]

Depreciation $ = 22.5\% \times \$24000$

$$= \frac{22.5}{100} \times 24000$$
$$= \$5400$$

Value $_{\text{after 1 year}}$ = Purchase price – Depreciation $
$$= \$24\,000 - \$5\,400$$
$$= \$\,18\,600$$

Question 4   [B]

The Balance is **growing** at a **constant rate** of $170 per year. This is a **simple interest saving** account.
$2620 increases by $170 to $2790
$2790 increases by $170 to $2960 and so on.

Question 5   [A]

Hales Bank
$$SI = \frac{PRT}{100} = \frac{2000 \times 8 \times 5}{100} = \$800$$

Countrybank
$$SI = \frac{PRT}{100} = \frac{2000 \times 10 \times 4}{100} = \$800$$

Interest earned is the same,therefore there is no final payout difference,$0.

Question 6   [D]

P = $360   R = 8% pa   T = 3years

$$A = P + SI$$
$$= P + \frac{PRT}{100}$$
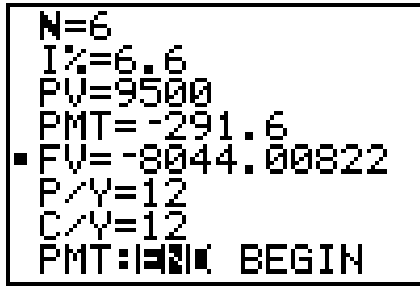$$= 360 + \frac{360 \times 9 \times 3}{100}$$

Question 7   [A]

Paid in full therefore Amount owing = A = $0
Principal Amount (borrowed) = P = $150 000
Compounding factor = R

$$R = 1 + \frac{7.5/12}{100} = 1 + 0.00625 = 1.00625$$

Question 8 [E]

Using the Finance TVM solver in graphics calculator gives the following outcome.

```
N=6
I%=6.6
PV=9500
PMT=-291.6
■FV=-8044.00822
P/Y=12
C/Y=12
PMT:■BEGIN
```

$8 044 is the balance after 6 months.

Question 9 [B]

Depreciation Amount = $8 500 – $1 000
                                   = $7 500

Rate of Depreciation = $7 500 over 6 years
                                   = $1 250 per year

Module 5 : Networks and decision mathematics

Question 1 [D]

Vertices – Edges + Faces (Regions) = 2
$$10 - \text{Edges} + 17 = 2$$
$$27 - \text{Edges} = 2$$
$$27 - 2 = \text{Edges}$$
$$\text{Number of edges} = 25$$
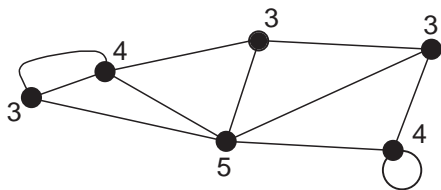
Question 2 [D]

The degree of each vertex is marked on the diagram above.

Total = 3 + 4 + 3 + 3 + 5 + 4
       = 22

Question 3 [D]

An Euler circuit must go along each edge once only and start and finish at the same vertex.
All the vertices on a graph with an Euler circuit will have an even degree.
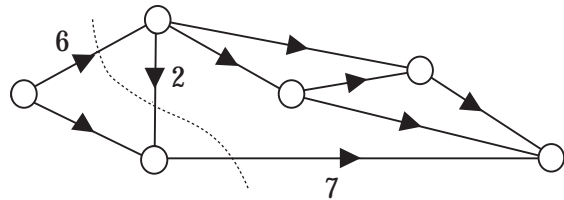The only graph with this property is D.

Question 4 [B]

A minimum spanning tree for a weighted graph is a spanning tree (contains all the vertices) where the sum of the weights of the edges is a minimum
A minimum spanning tree for this graph is
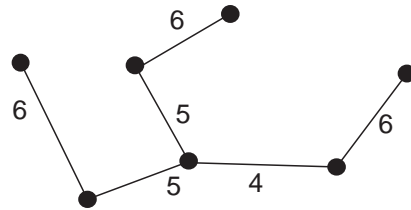
The sum of the weights is 32

Question 5 [B]

Maximum flow = Capacity of the minimum cut that produces zero flow from start to finish.

Capacity of cut = 6 + 7 = 13
The capacity of the edge with weight 2 is against the flow and therefore is not counted.

Question 6 [D]

The numbers in the matrix refer to the connections between vertices.

A to A ,	0 connections
A to B, B to A;	1 connection
A to C, C to A;	1 connection
A to D, D to A;	0 connections
B to B	0 connections
B to C, C to B	1 connection
B to D, D to B	1 connection
C to C	0 connections
C to D, D to C	2 connections
D to D	2 connection

Question 7   [B]

A complete graph is a graph with edges connecting all pairs of vertices. This is not a complete graph.

A. : A planar graph has no edges crossing so this is a planar graph.

C. : It is a connected graph because there are no isolated vertices.

D. : You can go over all the edges once only, eg. starting at D and finishing at F, so there is a Euler path.

E. : A Hamiltonian circuit goes through each vertex once only and starts and ends on the same vertex. It is possible to do this.

Question 8   [E]

Activity 'I' cannot start until all the other tasks are completed.   The time that will allow all activities to be completed (except I) is the time to go from A to E to G $= 5 + 8 + 2 = 15$ hours.

Question 9   [C]

The critical path contains all the activities that, if delayed, will affect the finishing time of the process. The critical path has the maximum total weight from start to finish.
Hence A E G I is the critical path.