



The Mathematical Association of Victoria

2001

FURTHER MATHEMATICS

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 on the multiple choice answer sheet provided.

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

A formula sheet is attached.

These questions have been produced to assist students in their preparation for the 2001 Further Mathematics Examination 1. The questions and associated answers and solutions do not necessarily reflect the views of the Victorian Curriculum and Assessment Authority (VCAA) Assessing Panels. The Association gratefully acknowledges the permission of the VCAA to reproduce the formula sheet.

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Further Mathematics Formulas

Business-related mathematics

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

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

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

annuities: $A = PR^n - \frac{Q(R^n - 1)}{R - 1}$, where $R = 1 + \frac{r}{100}$

Geometry and trigonometry

area of a triangle: $\frac{1}{2}bh$

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

area of circle: r^2

volume of sphere: $\frac{4}{3}r^3$

volume of cone: $\frac{1}{3}r^2h$

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

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

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

Graphs and relations

Straight line graphs

gradient: $m = \frac{y_2 - y_1}{x_2 - x_1}$

equation: $y - y_1 = m(x - x_1)$ gradient-point form

$y = mx + c$ gradient-intercept form

$\frac{y - y_1}{x - x_1} = \frac{y_2 - y_1}{x_2 - x_1}$ two-point form

Number patterns and applications

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

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

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

linear difference equations: $t_n = at_{n-1} + b = a^{n-1} t_1 + b \frac{(a^{n-1} - 1)}{a - 1}, a \neq 1$
 $= a^n t_0 + b \frac{(a^n - 1)}{a - 1}$

Networks and decision mathematics

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

Statistics

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

END OF FORMULA SHEET

MULTIPLE CHOICE ANSWER SHEET

Student Name: _____

Circle the letter that corresponds to each correct answer.

Section A	Section B		
Compulsory	Answer three different modules. Show each module selected by ticking the appropriate box.		
	Module:	Module:	Module:
	<input type="checkbox"/> Number patterns <input type="checkbox"/> Geometry and trigonometry <input type="checkbox"/> Graphs and relations <input type="checkbox"/> Business related mathematics <input type="checkbox"/> Networks and decision mathematics	<input type="checkbox"/> Number patterns <input type="checkbox"/> Geometry and trigonometry <input type="checkbox"/> Graphs and relations <input type="checkbox"/> Business related mathematics <input type="checkbox"/> Networks and decision mathematics	<input type="checkbox"/> Number patterns <input type="checkbox"/> Geometry and trigonometry <input type="checkbox"/> Graphs and relations <input type="checkbox"/> Business related mathematics <input type="checkbox"/> Networks and decision mathematics
1. A B C D E	1. A B C D E	1. A B C D E	1. A B C D E
2. A B C D E	2. A B C D E	2. A B C D E	2. A B C D E
3. A B C D E	3. A B C D E	3. A B C D E	3. A B C D E
4. A B C D E	4. A B C D E	4. A B C D E	4. A B C D E
5. A B C D E	5. A B C D E	5. A B C D E	5. A B C D E
6. A B C D E	6. A B C D E	6. A B C D E	6. A B C D E
7. A B C D E	7. A B C D E	7. A B C D E	7. A B C D E
8. A B C D E	8. A B C D E	8. A B C D E	8. A B C D E
9. A B C D E	9. A B C D E	9. 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 A

Specific instructions for Section A

Section A consists of 13 questions.

Answer **all** questions in this section.

A correct answer scores 1, an incorrect answer scores 0. No mark will be given for a question if two or more letters are circled for that question. Marks will not be deducted for incorrect answers and you should attempt every question in this section.

Core : Data analysis

Question 1

Which one of the following is an example of categorical data?

- A. The cost of a computer in dollars
- B. The number of points scored by a basketballer
- C. The nationalities of a group of Olympic athletes
- D. The diameters of mass produced steel rods
- E. The number of people catching a bus

Question 2

A basketballer compiled the number of points she had scored in each of her 8 most recent matches as follows

14 , 17 , 20 , 9 , 16 , 41 , 13 , 11

The most appropriate measure of centre for this data would be

- A. the median
- B. the mean
- C. the interquartile range
- D. the standard deviation
- E. the mode

Question 3

The following frequency table shows the number of minutes late that a student was to school over a series of 16 days

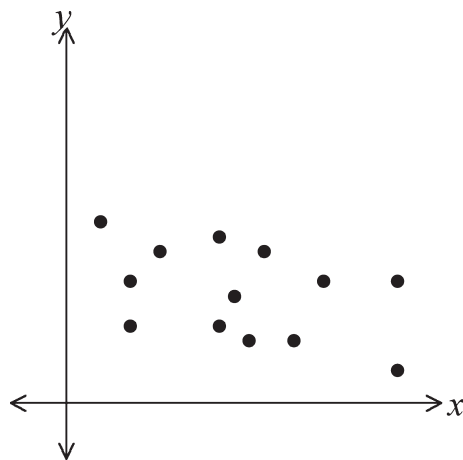
Minutes late	0	1	2	3	4
Frequency	1	1	7	3	4

The mean number of minutes late for this student is

- A. 1.8
- B. 2
- C. 2.3
- D. 2.5
- E. 2.9

Question 4

The value of Pearson's correlation coefficient (r) for the following scatterplot would be closest to



- A. -0.4
- B. -0.8
- C. 0.4
- D. 0.8
- E. Pearson's r is not appropriate for this data

Question 5

The heights of a group of students are found to be symmetrical (bell-shaped) with mean of 160 cm and standard deviation of 10 cm. Approximately 2.5% of these students will have a height which is

- A. less than 150 cm
- B. equal to 160 cm
- C. greater than 160 cm
- D. greater than 170 cm
- E. greater than 180 cm

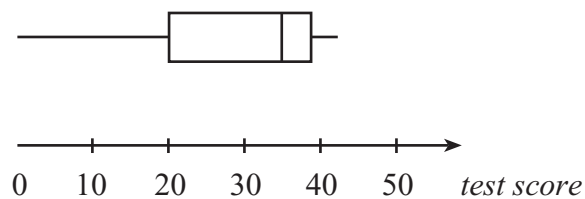
Question 6

In a study of the variables stress level and exam performance, Pearson's correlation coefficient was found to be -0.7 . From this we can conclude that

- A. students who are stressed will get a maximum of 70% for the exam
- B. 49% of the variation in performance can be explained by variation in stress
- C. 70% of the variation in performance can be explained by variation in stress
- D. as stress levels fall, exam performance tends to decline
- E. increased stress causes students to perform at a lower level in exams

Question 7

A boxplot was drawn for the results of 80 students on a maths test, as shown below.



The boxplot could best be described as being

- A. positively skewed
- B. negatively skewed
- C. symmetric
- D. representative of a weak group of students
- E. representative of a strong group of students

Questions 8 and 9 relate to the following information

In a study of students' results for mathematics at the end of Years 9 and 10 it was found that the Year 10 result could be predicted from the Year 9 result using the least squares regression equation

$$\text{Year 10 result} = 1.835 \times \text{Year 9 result} - 48.75$$

Question 8

Which one of the following statements is definitely correct ?

- A. All students performed better in Year 9 than in Year 10
- B. A student obtaining 50 in Year 9 would be predicted to obtain 43 in Year 10
- C. The scatterplot of Year 10 results versus Year 9 results has a negative slope
- D. The correlation coefficient would be in excess of 0.9
- E. This group of students worked harder in Year 10 than in Year 9

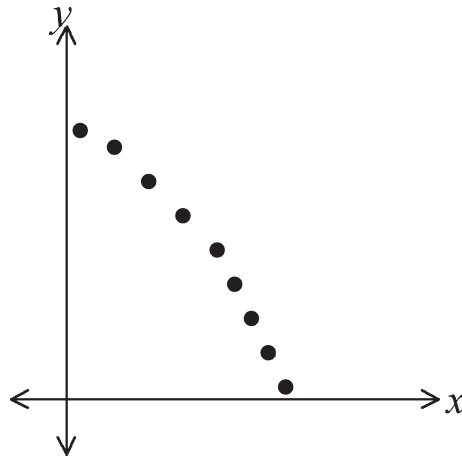
Question 9

One student, Angela, obtained 62 in Year 9 and 60 in Year 10. A predicted score using the above equation was calculated for Angela. The residual value for Angela's Year 10 result is closest to

- A. -5
- B. -2
- C. 0
- D. 2
- E. 5

Question 10

The relationship between variables y and x can be seen in the following scatterplot.



In order to linearise the data which one of the following could be used?

- A. the least squares regression line
- B. a line of best fit 'by eye'
- C. an x^2 transformation
- D. a $\frac{1}{x}$ transformation
- E. a $\log y$ transformation

Question 11

The seasonal indices for summer and winter at Regina's cake shop are shown in the table:

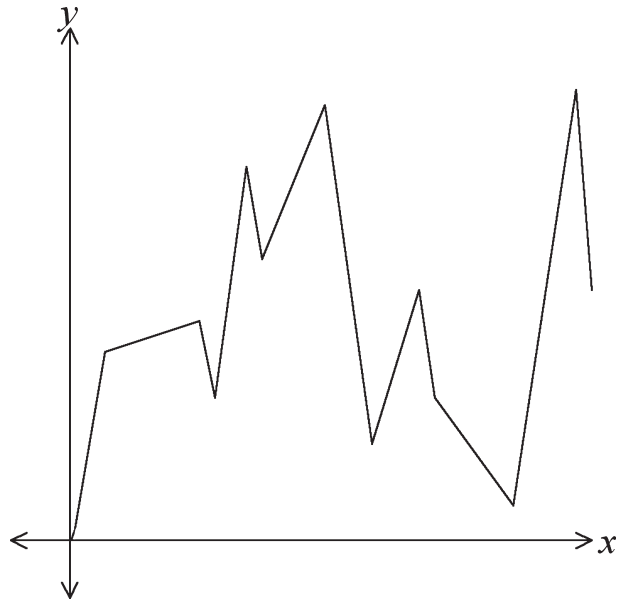
Season	Summer	Autumn	Winter	Spring
Seasonal Index	0.87		1.04	

Which one of the following statements is true?

- A. Sales in autumn must be greater than the yearly average
- B. Sales in summer are the lowest of the 4 seasons
- C. The highest sales must take place in either autumn or spring
- D. Sales in autumn and spring must be equal
- E. Sales in spring must be greater than sales in summer

Question 12

A time series plot for a set of data has the following graph.



This time series graph could best be described as

- A. essentially random
- B. increasing trend
- C. decreasing trend
- D. seasonal
- E. cyclic

Question 13

The given data represents the number of fatalities on the roads of Steertown from 1990 to 1997.

Year	1990	1991	1992	1993	1994	1995	1996	1997
Fatalities	14	8	6	0	4	7	8	3

In order to smooth the data a 2 point **centred** moving average is calculated. Using this approach the smoothed value for the number of fatalities in 1993 will be

- A. 0
- B. 2
- C. 2.5
- D. 3
- E. 3.5

Section B**Specific instructions for Section B**

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

You should select 3 modules and answer **all** questions within the modules selected on the answer sheet provided for multiple choice questions. Indicate each module selected on the answer sheet for multiple choice questions by ticking the corresponding box.

A correct answer scores 1, an incorrect answer scores 0. No mark will be given for a question if two or more letters are circled for that question. Marks will not be deducted for incorrect answers and you should attempt every question within each module selected.

Module 1 : Number patterns and applications**Question 1**

Which one of the following sequences is an arithmetic sequence?

- A. 0.1, 0.02, 0.003, ...
- B. $\frac{2}{3}, \frac{3}{4}, \frac{4}{5}, \dots$
- C. 1.03, 2.06, 3.09,
- D. $\frac{1}{3}, -1, 3, \dots$
- E. $\frac{4}{5}, \frac{6}{5}, \frac{9}{5}, \dots$

Question 2

A formula to give the n^{th} term of the sequence 8, 12, 18, 27,, is

- A. $t_n = 8 + 6(n - 1)$
- B. $t_n = 8 \times 4^{n-1}$
- C. $t_n = 8 \times \left(\frac{2}{3}\right)^{n-1}$
- D. $t_n = 8 \times \left(\frac{3}{2}\right)^{n-1}$
- E. $t_n = 2t_{n-1} - 4 ; t_1 = 8$

Question 3

The sum of the first 32 terms of the arithmetic sequence $-101, -92, -83, -74, \dots$ is

- A. -7696
- B. 1419
- C. -1076
- D. 178
- E. 1232

Question 4






The profit of \$57 120 from a business is to be divided amongst the owners Jun, Georgia and Brad in the ratio 11 : 9 : 14.

Brad's share of the profit will be

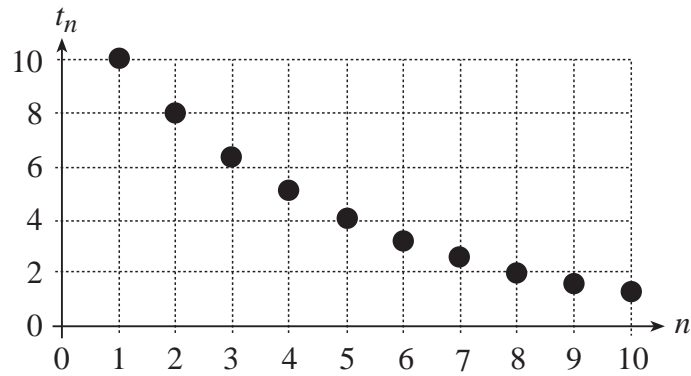
- A. \$3000
- B. \$3818.18
- C. \$18 480
- D. \$21 000
- E. \$23 520

Question 5

Two towns are 24 kilometres apart. This distance is represented as 7.2 centimetres on a map. Which one of the following simple scales would apply to this map?

- A.  10 km
- B.  10 km
- C.  12 km
- D.  12 km
- E.  12 km

Question 6



The terms of a sequence have been graphed above. The sequence would be

- A. arithmetic with $d < 0$
- B. geometric with $0 < r < 1$
- C. geometric with $r < 0$
- D. geometric with $r > 1$
- E. defined by the difference equation $t_n = t_{n-1} - 2 ; t_1 = 10$

Question 7

One litre of a 10% drug mixture is to be diluted with water to make a 4% drug mixture. The amount of water that needs to be added to make this 4% drug mixture is

- A. 0.4 litres
- B. 4 litres
- C. 3 litres
- D. 1.5 litres
- E. 2.5 litres

Question 8

A phone call costs \$2.24 for the first minute then the cost **reduces by 60%** for each subsequent minute.

The maximum cost, to the nearest cent, of a phone call using this price structure is

- A. \$2.33
- B. \$2.39
- C. \$3.58
- D. \$3.73
- E. \$5.60

Question 9

The difference equation $t_n = 4t_{n-1} - 6$; $t_1 = m$ has produced the sequence $m, 6, n, 66, \dots$
The values of m and n respectively are

- A. 3 and 30
- B. 0 and 12
- C. 3 and 18
- D. 2 and 18
- E. 2 and 12

Module 2 : Geometry and trigonometry

Question 1

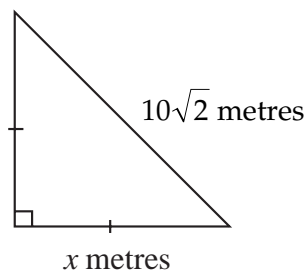
A direction of N 42° W expressed as a True Bearing is

- A. 42° T
- B. 222° T
- C. 258° T
- D. 312° T
- E. 318° T

Question 2

In the diagram given below, the value of x is

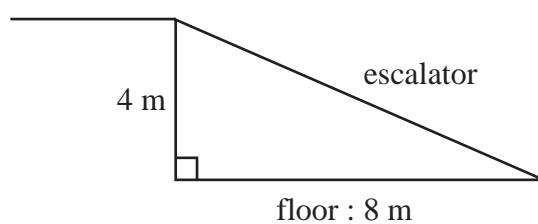
- A. $5\sqrt{2}$ m
- B. 8 m
- C. $\sqrt{20}$ m
- D. 10 m
- E. 20 m



Question 3

From the diagram given the **angle of decline** from the top of the escalator to the bottom floor is closest to

- A. 63°
- B. 27°
- C. 30°
- D. 60°
- E. 20°



Question 4

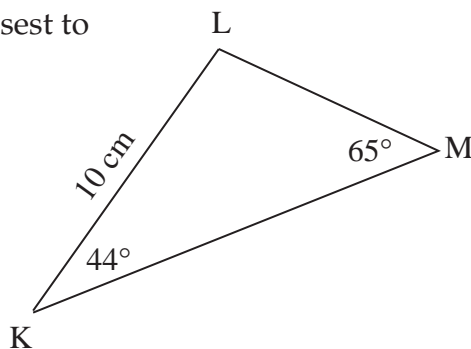
A photographic film with dimensions 35×35 mm is developed as a 21×21 cm photograph. The area is enlarged by a factor of

- A. 3
- B. 6
- C. 36
- D. 27
- E. 9

Question 5

In $\triangle KLM$, the length of \overline{LM} is closest to

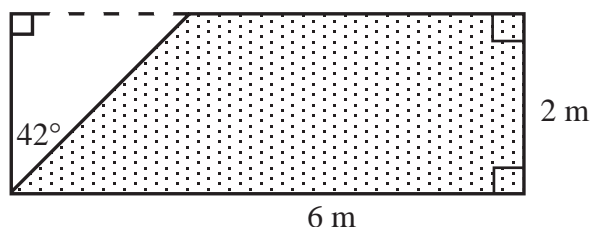
- A. 7.7 cm
- B. 10.4 cm
- C. 7.2 cm
- D. 13.9 cm
- E. 6.9 cm



Question 6

The area (to one decimal place) of the following shaded region is

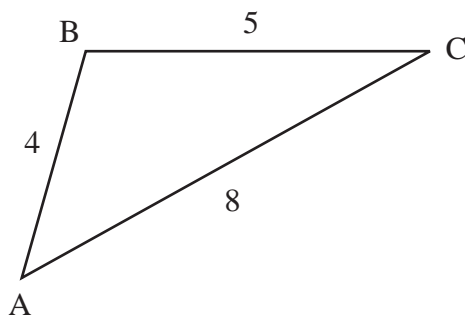
- A. 10.2 m²
- B. 12.0 m²
- C. 10.0 m²
- D. 6.0 m²
- E. 1.8 m²



Question 7

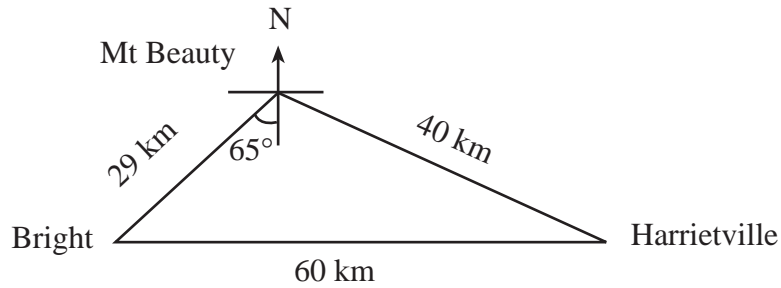
In $\triangle ABC$, the size of $\angle B$ can be found using:

- A. $\cos^{-1}\left(\frac{4^2 + 5^2 - 8^2}{2 \times 5 \times 8}\right)$
- B. $\cos^{-1}\left(\frac{5^2 + 4^2 - 8^2}{2 \times 5 \times 4}\right)$
- C. $\cos^{-1}\left(\frac{8^2 + 4^2 - 5^2}{2 \times 4 \times 8}\right)$
- D. $\cos^{-1}\left(\frac{25 + 8 - 64}{2 \times 5 \times 4}\right)$
- E. $\cos^{-1}\left(\frac{8^2 + 5^2 - 4^2}{2 \times 5 \times 8}\right)$



Question 8

In a country region, three towns are located as shown.

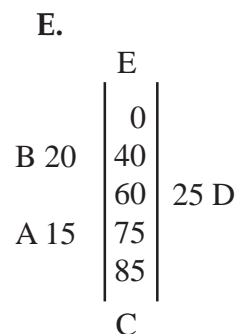
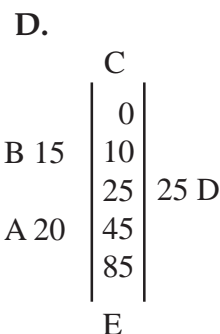
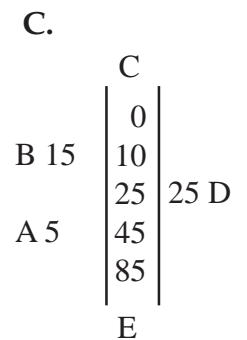
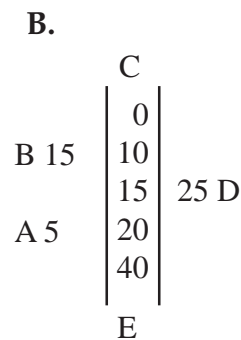
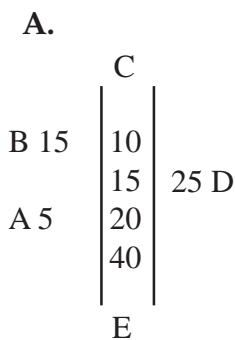
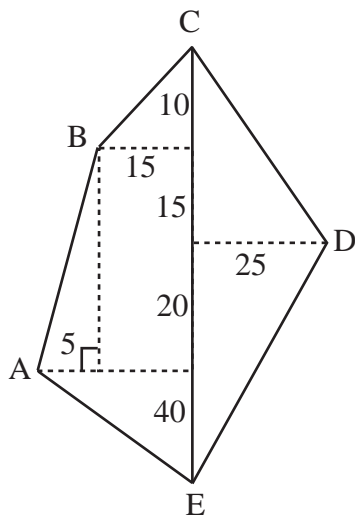


The direction from Mt Beauty to Harrietville is closest to

- A. S45°E
- B. S50°E
- C. S55°E
- D. S60°E
- E. S65°E

Question 9

Below is a scale drawing of a plot of land on an outback property. If a surveyor uses traverse offset surveying, with a base line from C to E, which of the following surveyor's notes matches the plot of land?

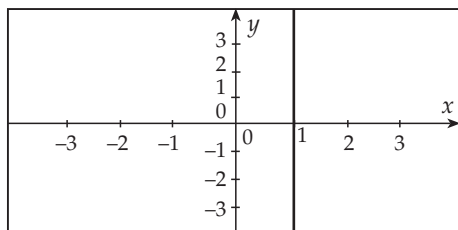


Module 3 : Graphs and relations

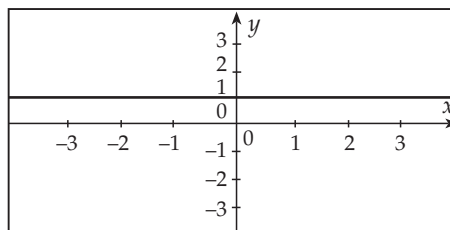
Question 1

Which one of the following graphs represents the relation $x = 1$?

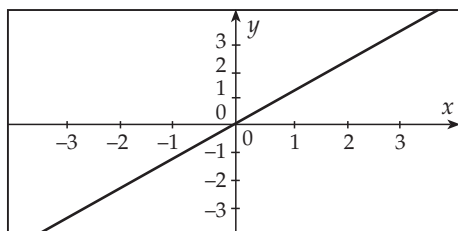
A.



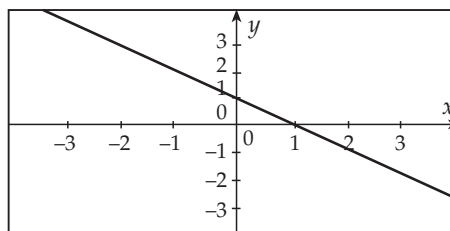
B.



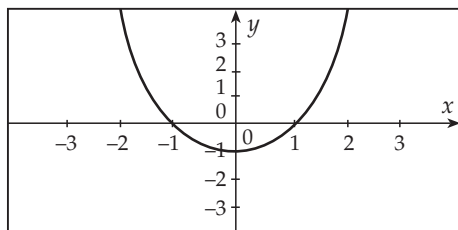
C.



D.



E.



Question 2

The gradient of the straight line $3x - 3y = 6$ is

- A. 6
- B. -1
- C. 3
- D. -3
- E. 1

Question 3

Jim's taxis charge a fixed fee (flagfall) of \$3.80 and \$0.45 per kilometre. Binh travelled by taxi to work and was charged \$12.80 for the trip. The number of kilometres of Binh's journey was

- A. 4
- B. 16
- C. 20
- D. 24
- E. 36.9

Question 4

The solution to the simultaneous equations

$$3x - 4y = 16$$

and $x + 5y = -1$ is

- A. $x = 4, y = -1$
- B. $x = 3, y = -2$
- C. $x = -1, y = 5$
- D. $x = 2, y = -4$
- E. $x = 1, y = -5$

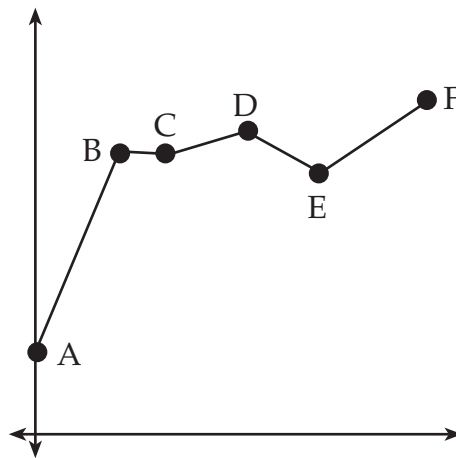
Question 5

Phil had a set of data for 2 variables x and y . He wanted to see if there was a relationship of the form $y = kx^2$ that represented the data. Which one of the following would prove that the relationship was of this form?

- A. Plotting y versus x and obtaining a curve
- B. Plotting y versus x^2 and obtaining a straight line
- C. Plotting y versus x and obtaining a straight line
- D. Plotting y^2 versus x^2 and obtaining a curve
- E. Plotting y^2 versus x^2 and obtaining a straight line

Question 6

Consider the following line segment graph.



The gradient is greatest in the segment joining points

- A. A and B
- B. B and C
- C. C and D
- D. D and E
- E. E and F

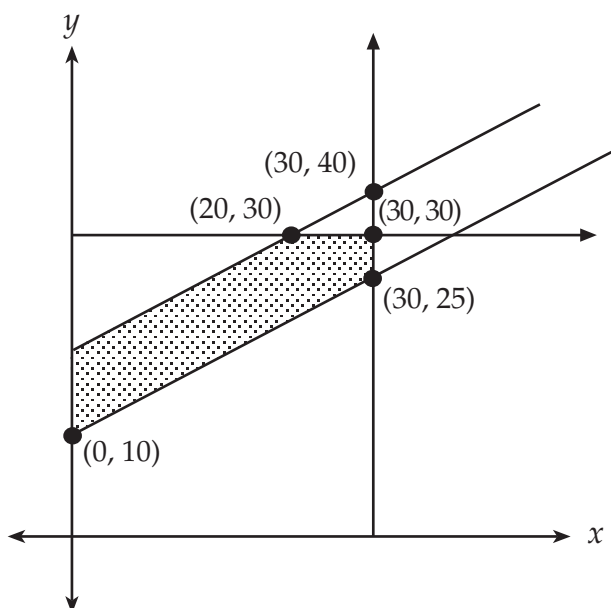
Question 7

For which one of the following linear relations does y decrease as x increases?

- A. $y = 2$
- B. $y = 3 + 2x$
- C. $y = 3 - 2x$
- D. $2x - y = 6$
- E. $2x - y = -6$

Question 8

The shaded region (boundaries included) represents the feasible region for a linear programming problem.

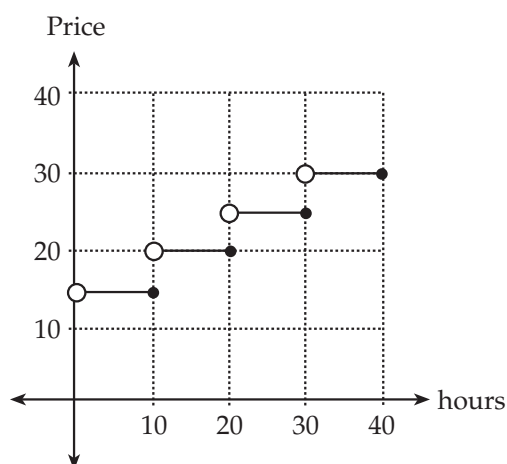


If the objective function is $A = 3x - y$, then the maximum value of A for this region occurs at the point with co-ordinates

- A. $(0, 20)$
- B. $(20, 30)$
- C. $(30, 25)$
- D. $(30, 30)$
- E. $(30, 40)$

Question 9

Internet service provider, Sharknet, has a price structure for usage per month that can be represented by the following step diagram



Wendy and Roger are a couple. Each has a **separate account** with Sharknet as the Internet service provider. In the first month, Wendy used the Internet for 10 hours and Roger used the Internet for 1 hour. The **total** charge for Wendy and Roger for one month is

- A. \$15
- B. \$30
- C. \$35
- D. \$40
- E. \$70

Module 4 : Business related mathematics

Question 1

A summary of compound interest rates offered by several banks is as follows:

BANK	Compound Interest Offered
Bank A	Compounded monthly at 0.5%
Bank B	Compounded monthly at 0.6%
Bank C	Compounded quarterly at 2.0%
Bank D	Compounded bi-annually at 3.8%
Bank E	Compounded annually at 7.5%

The best rate of compound interest offered is by

- A. Bank A
- B. Bank B
- C. Bank C
- D. Bank D
- E. Bank E

Question 2

A car depreciates by \$5 000 in its first year. If the purchase price was \$30 000 then the rate of depreciation in the first year, expressed as a percentage, is closest to

- A. 6 %
- B. 10 %
- C. 16 %
- D. 17 %
- E. 20 %

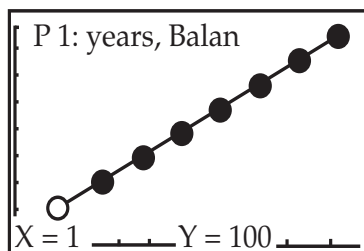
Question 3

A car depreciates by 10% per annum using the reducing balance method. If the car was purchased for \$80 000, then its value after the **second** year would be

- A. \$ 15 200
- B. \$ 16 000
- C. \$ 64 000
- D. \$ 64 800
- E. \$ 72 000

Question 4

The following is a graph of an Account Balance as seen on a graphics calculator.



The best model to match this graph is

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

Question 5

An advertisement for a term deposit states that if \$5 000 is invested for 3 years, the interest earned is \$1 000. The rate of interest per annum is closest to

- A. 6.7 %
- B. 6.3 %
- C. 10 %
- D. 15 %
- E. 20 %

Question 6

Wendy invested \$1 000 in a bank for 3 years earning 8 % per annum, compounded quarterly. The amount in her account at the end of the three years can be calculated using

- A. 1000×1.08^3
- B. 1000×1.02^{12}
- C. $\frac{1000 \times 8 \times 3}{100}$
- D. $1000 + \frac{1000 \times 8 \times 3}{100}$
- E. 1000×0.8^3

Question 7

Anthony took out a personal loan of \$ 50 000 to be paid in full over 10 years in monthly instalments of \$1 450.75. After 2 years, Anthony used the annuities formula to obtain the following expression to calculate the balance owing

$$A = 50\,000 \times 1.005^{24} - \frac{1450.75(1.005^{24} - 1)}{0.005}$$

The interest rate per annum charged for this loan is

- A. 1.005 %
- B. 5.0 %
- C. 6.0 %
- D. 10.0 %
- E. 12.06 %

Question 8

A car is on sale for \$ 8 200 with hire purchase finance offering no deposit and 60 equal monthly instalment payments. If the interest charged is 5 % per annum, what is the monthly instalment?

- A. \$136.67
- B. \$143.50
- C. \$164.00
- D. \$167.67
- E. \$170.83

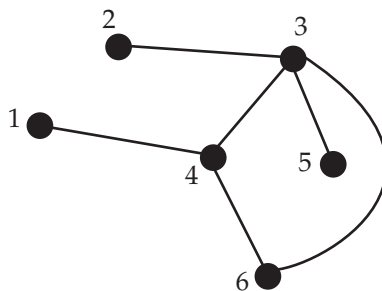
Question 9

A photocopier depreciates at the rate of \$ 2.50 per ream of paper copied (where a ream is 500 sheets). Its previous year bookvalue was \$12 500. If the machine copied 1.2 million sheets in the past year, its new bookvalue is

- A. \$6 500
- B. \$6 000
- C. \$1 250
- D. \$11 250
- E. \$11 900

Module 5 : Networks and decision mathematics

Question 1

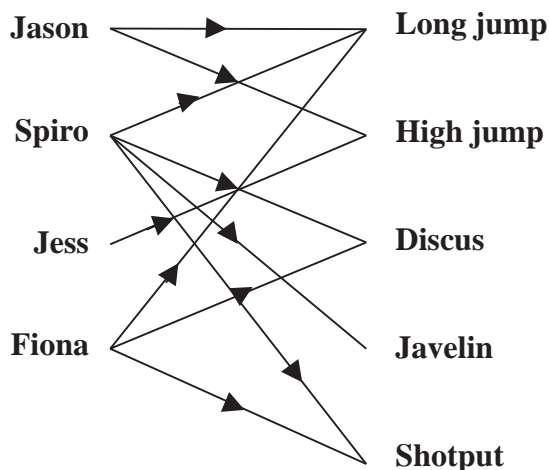


Which of the following statements is true about the graph above?

- A. The graph is a complete graph.
- B. The graph is a directed graph.
- C. The graph is a tree.
- D. The graph is a weighted graph.
- E. The graph is a simple graph.

Question 2

The following bi-partite graph shows athletes' preferences for four types of events.

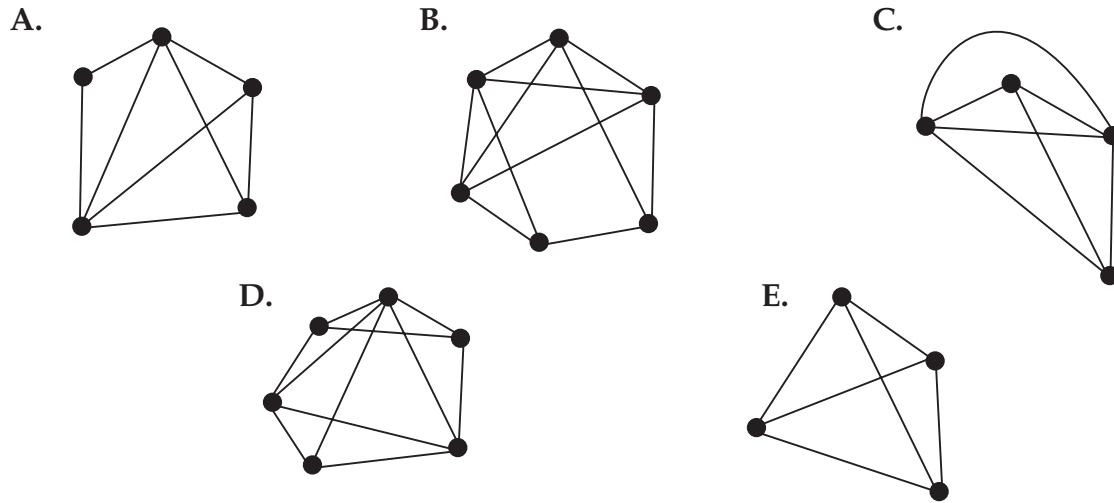


Which one of the following does **not** follow from the graph?

- A. Javelin throwing is the event with the least number of participants.
- B. More of the athletes prefer long jump than any other event.
- C. Spiro has entered more events than any of the other athletes.
- D. None of the athletes have entered both high jump and javelin.
- E. Fiona and Jess have both entered the high jump.

Question 3

Which one of the following could **not** be drawn as a planar graph?



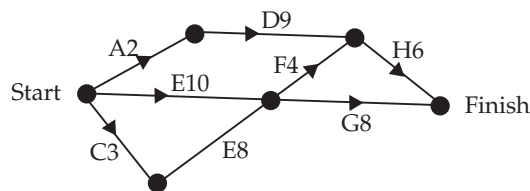
Question 4

A planar graph has seven faces and seven vertices. The number of edges on this graph is

- A. 8
- B. 10
- C. 12
- D. 14
- E. 16

Question 5

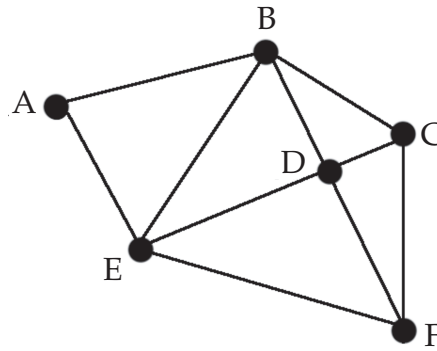
The following directed graph charts a project with activities and their completion times (in days) displayed on the arcs of the graph.



Taking the start of the project as Day 1, the latest time that activity H can begin is day

- A. 12
- B. 14
- C. 15
- D. 16
- E. 17

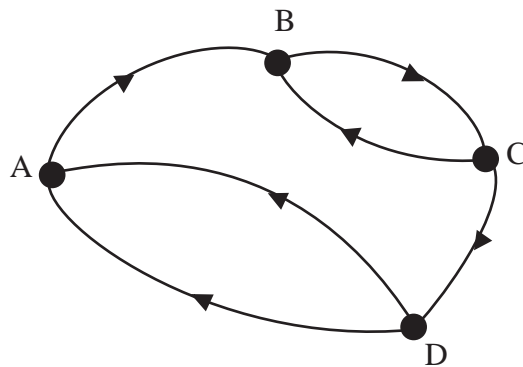
Question 6



Which one of the following is **not** true for the graph above?

- A. The sum of the degrees of the graph is even.
- B. It is possible to form a Hamiltonian path.
- C. It is possible to form a Euler path starting at C and finishing at F.
- D. If the path from E to F was omitted then an Euler circuit can be formed.
- E. It is possible to form a Hamiltonian circuit.

Question 7



Which one of the following matrices would represent the directed graph above?

A.

		To _____			
		A	B	C	D
From	A	0	1	2	0
	B	1	0	2	0
	C	0	2	0	1
	D	2	0	1	0

B.

		To _____			
		A	B	C	D
From	A	0	1	0	1
	B	1	0	1	0
	C	0	1	0	1
	D	1	0	1	0

C.

		To _____			
		A	B	C	D
From	A	0	1	0	1
	B	0	0	2	0
	C	0	2	0	1
	D	1	0	1	0

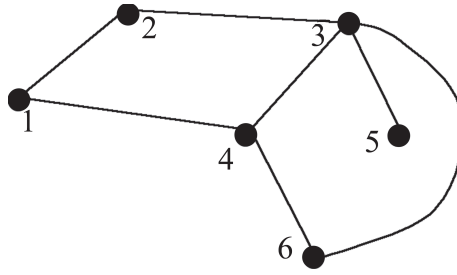
D.

		To _____			
		A	B	C	D
From	A	0	1	0	0
	B	0	0	1	0
	C	0	1	0	1
	D	2	0	0	0

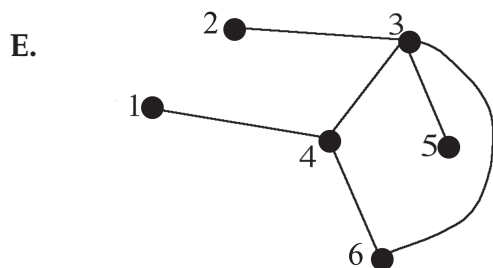
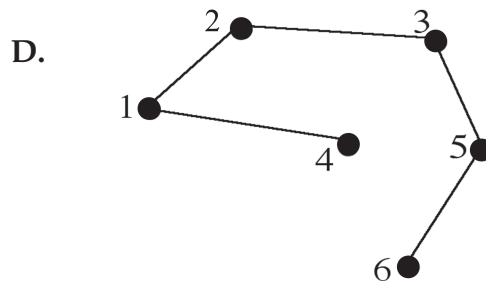
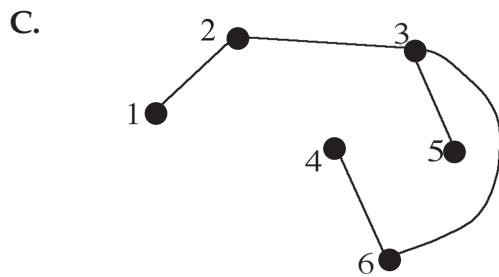
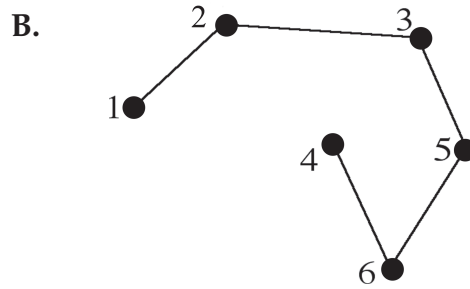
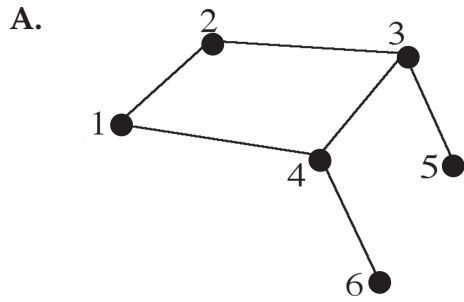
E.

		To _____			
		A	B	C	D
From	A	0	0	0	2
	B	1	0	1	0
	C	0	1	0	0
	D	0	0	1	0

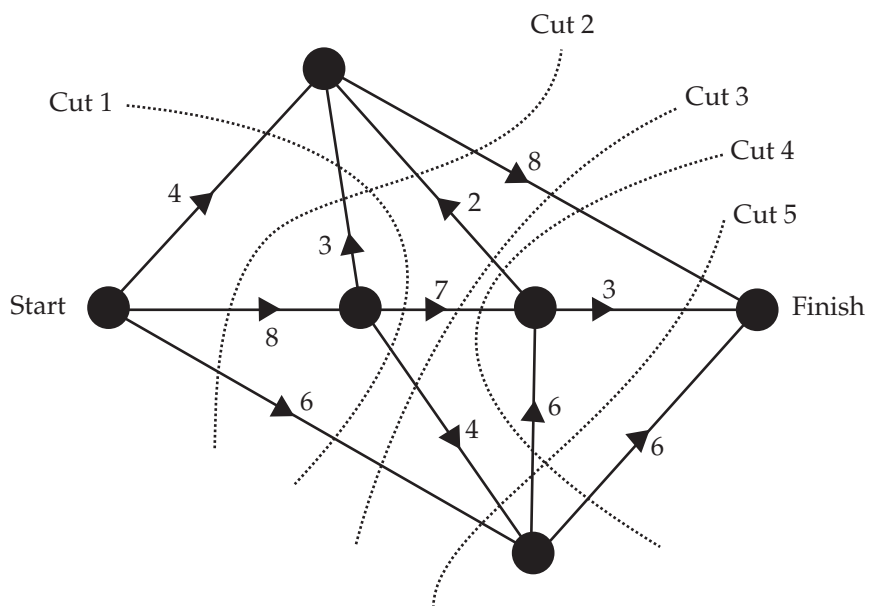
Question 8



Which one of the following is a spanning tree for the network above?



Question 9



In the graph above which one of the cuts shown has capacity 27 ?

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