

Year 2002

VCE

Further Mathematics

Trial Examination 2



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STUDENT NUMBER**Letter**

Figures									
Words									

VICTORIAN CERTIFICATE OF EDUCATION 2002

FURTHER MATHEMATICS

Trial Written Examination 2 (Analysis task)

Reading time: 15 minutes

Total writing time: 1 hour 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

Core

Number of questions	Number of questions to be answered
3	3

Modules

Number of modules	Number of modules to be answered
5	3

Directions to students

Materials

Question and answer book of 26 pages.

Working space is provided throughout the book.

There is a detachable sheet of miscellaneous formula supplied.

You may bring to the examination up to four pages (two A4 sheets) of pre-written notes.

You may use an approved scientific and/or graphics calculator, ruler, protractor, set-square and aids for curve-sketching.

The task

Detach the formula sheet from the book during reading time.

Please ensure that your **student number** is written in the space provided on the front cover of this book.

Answer **all** questions in the core and in each of the three chosen modules.

The marks allotted to each part of each question are indicated at the end of the part.

The core is worth 15 marks. Each module is worth 15 marks. There is a total of 60 marks available for the examination.

You need not give numerical answers as decimals unless instructed to do so. Alternative forms may involve, for example, π , e , surds or fractions.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

All written responses should be in English.

FURTHER MATHEMATICS

Written examinations 1 and 2

FORMULA SHEET

Directions to students

Detach this formula sheet during reading time.

This formula sheet is provided for your reference.

Further Mathematics Formulas

Business-related mathematics

simple interest: $I = \frac{\text{Pr } T}{100}$

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

hire purchase: effective rate of interest = $\frac{2n}{n+1}$ x 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: πr^2

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

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

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

Specific Instructions

This task paper consists a core and five modules. Students should answer **all** questions in the core and then select **three** modules and answer **all** questions within the modules selected.

		Page
Core		2
Module		
Module 1:	Number patterns and applications	7
Module 2:	Geometry and trigonometry	10
Module 3:	Graphs and relations	15
Module 4:	Business-related mathematics	18
Module 5:	Networks and decision mathematics	21

The following information refers to questions 1 and 2

Question 1

In a comparative study at a major maternity hospital, the age at birth of 13 first-pregnancy mothers in 1980 was compared with the age at birth of 13 first-pregnancy mothers in 2000. The results were as follows.

Age at birth of first-pregnancy mothers in 1980	Age at birth of first-pregnancy mothers in 2000
31	24
26	18
27	27
19	24
21	33
33	29
17	36
24	26
21	41
22	28
36	32
22	40
25	35

- a. Find the range for each of the two groups of mothers

First pregnancy 1980:

1 mark

First pregnancy 2000:

1 mark

- b. Find the standard deviation of the ages of the 1980 group of first time mothers to two decimal places.

First pregnancy 1980:

1 mark

- c. The standard deviation in the ages for the 2000 group of first time mothers is 6.05. Comment on the age of first pregnancy mothers in 1980 as compared to those in 2000 with regard to range and standard deviation.

2 marks

Question 2

- a.** Find the median for both sets of data.

1980

2000

1 mark

- b.** Find the interquartile range for both sets of data

1980 _____

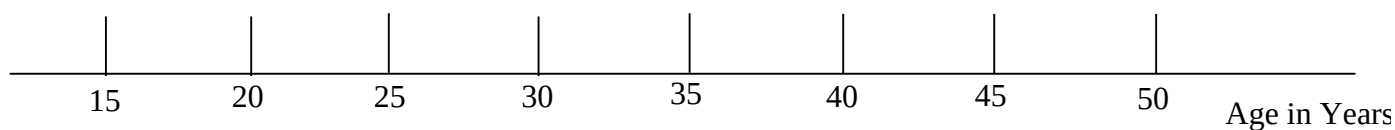
2000 _____

2 marks

- c.** Draw a box plot for each of the two sets of data on the axis below.

2000

1980



2 marks

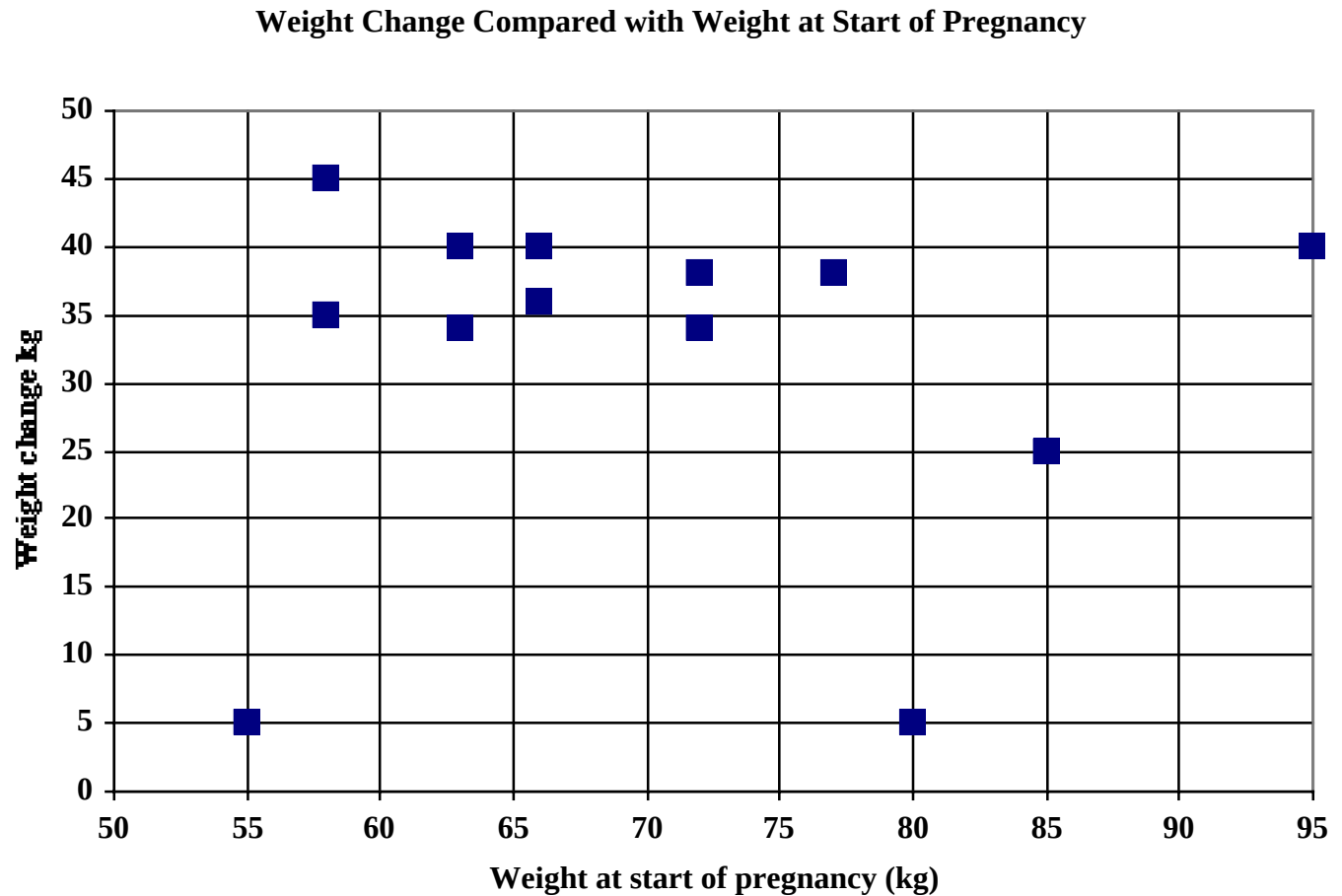
Question 2 (continued)

- d. Comment on the differences between the two box plots.

2 marks

Question 3

The mothers' weight gain during pregnancy and their weight when they became pregnant were compared and the results are shown in the scatter plot below.



- a. Why would it be inappropriate to use a regression line for this data?

1 mark

- b. If the data were such that a regression line could be found with the equation ,
 $\text{Weight Change} - 2 \times \text{Weight at Start of Pregnancy} + 130 = 0$, what can be said about the rate
 at which the weight is changing?

1 mark

Question 3 (continued)

- c. If the data were such that the coefficient of determination could be calculated to be 0.36, then find Pearson's product moment correlation coefficient.

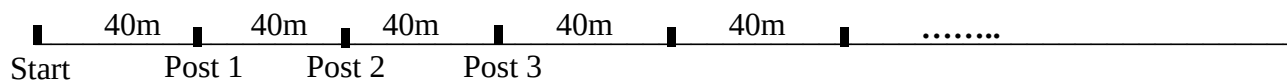
1 mark

End of Core

If you choose this module, all questions are to be answered.

Question 1

The Year 12 class at Princewood Secondary College is going to run for a charity. The class consists of some students who are very capable athletes and some students who find running difficult. So that all the students can participate, the Physical Education staff devises a relay where all students line up at the starting post. The students position themselves in a straight line from weakest runner at the front to best runner at the back. Posts are set out at 40m. intervals from the starting position.



The first student runs to the first post and back to the start. The second student then runs to the second post and back to the start and then the third student runs to the third post and back to the start and so on until all the students in the class have completed the run.

a. How far does the second competitor run?

1 mark

b. How far does the tenth competitor run?

1 mark

c. How far does the n th competitor run?

1 mark

Question 1. (continued)

- d. If the students run a total of 18,480 m, how many posts are there?

3 marks

Question 2

- a. The students are sponsored at 50 cents for every metre they run, and all students completed the run assigned to them. What is the ratio of the amount of money raised by Tam who ran to the 15th post compared with the amount of money raised by Tess who ran to the 5th post?

2 marks

- b. If Tam can run twice as fast as Tess, and if Tess took 6 minutes to run her race, how long did Tam take to run his race?

2 marks

Question 3



The posts are now repositioned, so that the distance between the posts is 0.3 times the distance between the previous two posts, and the distance between the start and the first post remains 40 m.

- a. What is the distance between the 5th and 6th posts? Give your answer to two decimal places.

2 marks

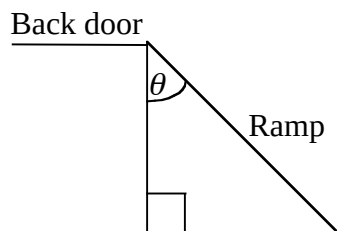
- b. If the first student runs to the first post and back to the start, and then the second student runs to the second post and back to the start and so on, what is the total distance run by the first 4 students? Give your answer to two decimal places.

3 marks

End of Module 1

If you choose this module, all questions are to be answered.

Question 1



Bethany and Grant have just moved into their new home. They have a ramp going from the bottom of their back door down to the back yard. The length of the ramp is 1.2m and the angle of depression is 15° . If the yard is level,

- a. What is the size of the angle θ ?

1 mark

- b. What is the height of the bottom of the back door above the ground?
Give your answer to two decimal places.

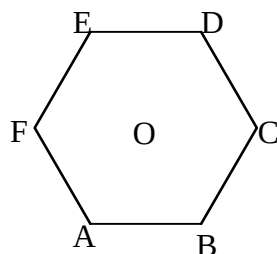
1 mark

- c. How far does the ramp extend from the back door into the back yard?
Give your answer to two decimal places.

1 mark

Question 2.

- a.** In the back yard between the ramp and the back fence, there is a spa pool which is a regular hexagon in shape.



If O is the centre of the hexagon and the length of each side is 2.2m

- i** Find $\angle AOB$

1 mark

- ii.** Find the length of AO.

2 marks

- b.** From a point V, 2.3 m vertically above O, a canvas awning VBC is constructed to give protection from the prevailing wind. A steel frame joins V to B and V to C.

- i.** Find the length of the steel frame VB. Give your answer to one decimal place.

1 mark

Question 2 (continued)

- ii.** Find $\angle VBC$ to the nearest degree

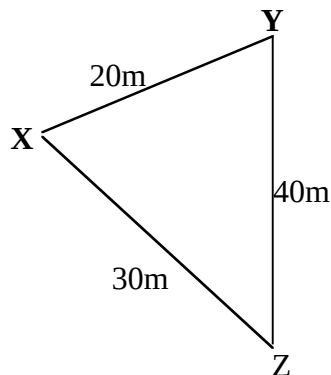
2 marks

- iii.** Find the area of the canvas required for the awning VBC. Give your answer to the nearest square metre.

1 mark

Question 3.

Bethany wants to measure the shortest distance from the centre of the bottom of the ramp, **X**, to the back fence but she cannot do this because the spa with its awning is in the way. Instead, she measures the distance from **X** to two points **Y** and **Z** on the fence. She finds $\mathbf{XY} = 20\text{m}$ and $\mathbf{XZ} = 30\text{m}$. The distance from **Y** to **Z** is 40m.



- a.** Find the angle $\mathbf{XYZ}$ to the nearest degree

2 marks

- b.** Find the shortest distance from **X** to the fence. Give your answer to one decimal place.

1 mark

Question 3 (continued)

- c. If the shortest distance from **X** to the fence is **XQ**, find the length **QZ**. Give your answer to one decimal place.

2 marks

End of Module 2

If you choose this module, all questions are to be answered.

Question 1

A garment manufacturer produces x dresses and y pairs of slacks in a week.

- a. Write an inequation showing the values that x could have.

1 mark

- b. Write an inequation showing the values that y could have.

1 mark

- c. The manufacturing department is divided into two sections, cutting and assembly. The cutting room can hold a maximum of 15 employees and the assembly section can use a maximum of 30 employees. If the employees work a 40 hour week,

- i What is the maximum number of hours available for work each week by the cutters?

1 mark

- ii What is the maximum number of hours available for work each week by the assemblers?

1 mark

- d. The time required to cut the pieces for a dress is two hours and the time required to cut the pieces for a pair of slacks is one hour. Write a linear inequation showing the constraints on the cutting section for a week.

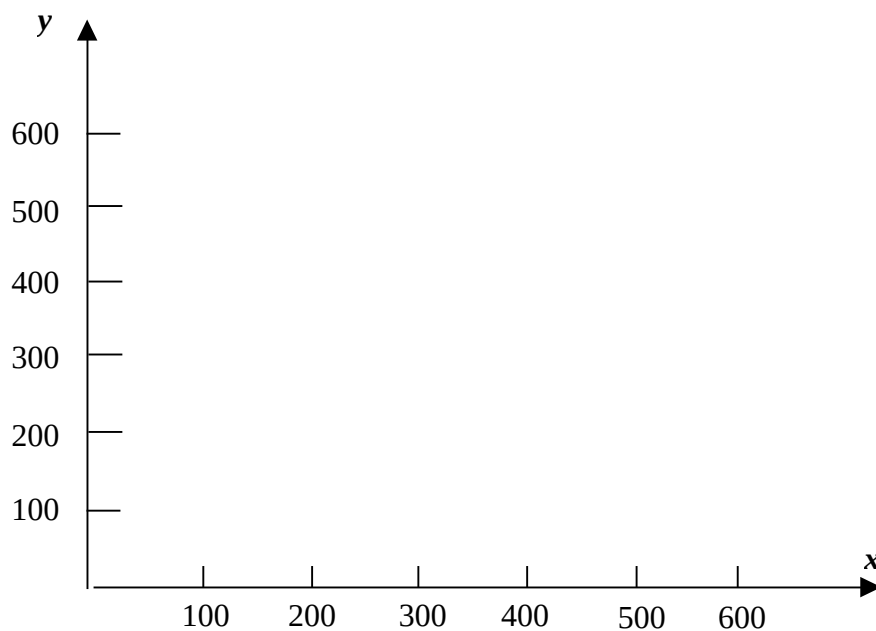
1 mark

- e. The time required to assemble a dress is two hours and the time required to assemble a pair of slacks is three hours. Write a linear inequation showing the constraints on the assembly section for a week.

1 mark

Question 1 (continued)

- f. On the graph below, draw the two lines and shade the region which satisfies the constraints found in **a**, **b**, **d** and **e**.



3 marks

- g. Find the point of intersection of the two lines in the above graph.

2 marks

Question 2

- a. If the profit on a dress is \$60 and the profit on a pair of slacks is \$40, write down the equation for the profit, P , in terms of x and y on these items for the week.

1 mark

- b. How many dresses and pairs of slacks should be made each week to maximize the profit?

3 marks

End of Module 3

Module 4 Business-related mathematics

If you choose this module, all questions are to be answered.

Question 1

Kate's employer pays superannuation at a rate of 7% of the employee's salary. If Kate's salary is \$35,000 per annum

- a. How much does the employer pay into the I Trust U superannuation account for Kate for the year.

1 mark

- b.
i. If this amount is left in the superannuation account for two years, what will its value be if the I Trust U superannuation fund pays compound interest at a rate of 10% per annum?

1 mark

- ii. If the money had been left in the same superannuation account for a total of 20 years, what would its value be?

1 mark

- c. The employer pays 7% of \$35,000 into Kate's superannuation fund on the 1st January each year for the three years Kate works for the firm.

- i. How many years will the payment made by the employer in Kate's second year of employment have been in the fund when Kate leaves her job on 1st January?

1 mark

- ii. How many years will the payment the employer makes in Kate's third year be in the fund by the time Kate leaves?

1 mark

Question 1 c (continued)

- iii. What will be the total value of Kate's superannuation with the I Trust U fund at the end of her three years' employment?

2 marks

Question 2

Kate decides to open an account for her next overseas holiday in four years' time. She has calculated that she will need \$6,000. If the interest is 8% per annum and is added quarterly

- a. What is the quarterly interest rate?

1 mark

- c. How much will Kate need to place in the account now if she is not going to add more money at later dates?

2 marks

Question 2 (continued)

- d.** Mark also wants to save \$6,000 for a holiday in four years' time. He decides to put a certain amount of money in an account on the 1st January each year for four years. If this account pays 10% flat rate interest and Mark pays \$P into the account each year, how much interest will he earn in terms of P?

3 marks

- d.** How much money will Mark need to put in the account each year to achieve his goal?

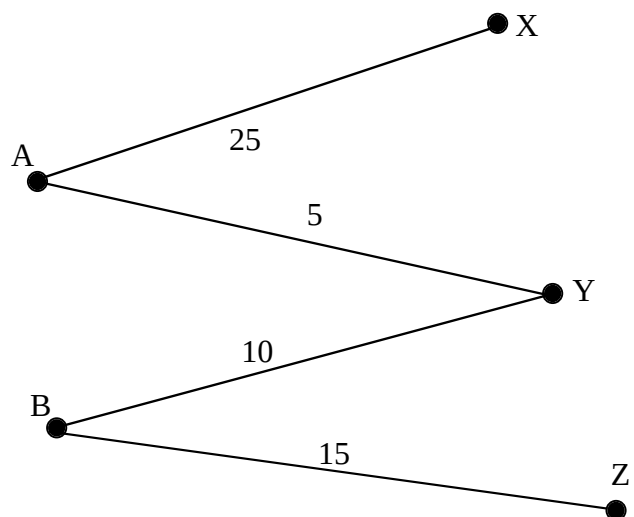
2 marks

End of Module 4

If you choose this module, all questions are to be answered.

Question 1

A clock manufacturing company has two factories, A and B, and three retail outlets, X, Y and Z. The following is a graph showing distribution of the clocks from the factories to the retail outlets.



- a. How many clocks were supplied by factory A?

1 mark

- b. How many clocks were sent to the retail outlet, Y?

1 mark

Question 1.(continued)

c.

	X	Y	Z
A	\$12	\$10	\$3
B	\$8	\$9	\$7

The table above shows the cost of transporting one clock from each of the factories to each of the retail outlets.

What would be the best way to distribute the clocks from the factories to the retail outlets in order to minimize the cost? The factories must still supply the same total number of clocks and the retail outlets must still receive their required number of clocks.

2 marks

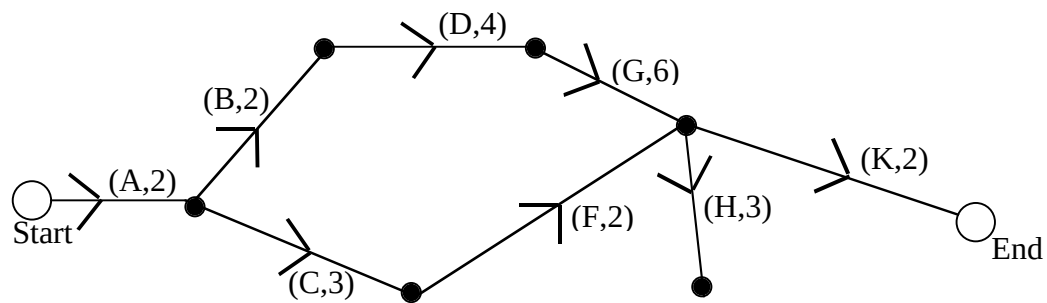
- d.** What would be the minimum transportation cost of all these clocks distributed from factories A and B?

1 mark

Question 2.

ACTIVITY	DURATION (DAYS)	IMMEDIATE PREDECESSORS
A	2	–
B	2	A
C	3	A
D	4	B
E	1	D
F	2	C,E
G	6	D
H	3	F,G
I	7	C,E
J	5	H,I
K	2	F,G

The incomplete network for the project set out in the above table is shown below.



Draw and label activities E,I and J on the above graph.

1 mark

Question 2.(continued)

b. What is the earliest time that activity I can start?

1 mark

c. What is the latest time activity K can start?

1 mark

e. What is the float time for activity K?

1 mark

f. State the critical path for this network

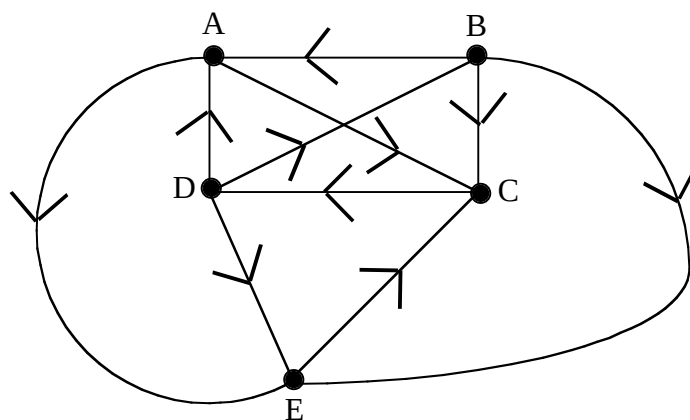
1 mark

Question 3.

- a. In a round robin competition, each team plays every other team once. How many games will have to be played if there are 10 teams competing?

2 marks

- b. The results of a round robin between 5 teams can be graphed as shown below. In this graph B has defeated A.



Complete the following adjacency matrix where 1 represents a win in the round robin described above, and 0 represents a loss or a team playing itself.

	A	B	C	D	E
A	0	0	1		
B					
C					
D					
E					

1 mark

Question 3.(continued)

- c. Rank the five teams from best to worst, giving reasons for your answer.

2 marks

END OF QUESTION AND ANSWER BOOK

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