

# Year 2004

## VCE

### Further Mathematics

### Trial Examination 2



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**STUDENT NUMBER****Letter**

Figures									
Words									

# VICTORIAN CERTIFICATE OF EDUCATION 2004

## 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
2	2

##### Modules

Number of modules	Number of modules to be answered
5	3

#### Directions to students

##### Materials

Question and answer book of 22 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,  $\pi$ ,  $e$ , 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:  $I = \frac{PrT}{100}$

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:  $\pi r^2$

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.

	<b>Page</b>
<b>Core</b>	2
<b>Module</b>	
Module 1: Number patterns and applications .....	6
Module 2: Geometry and trigonometry .....	10
Module 3: Graphs and relations .....	14
Module 4: Business-related mathematics .....	17
Module 5: Networks and decision mathematics .....	20



**Question 1**

The resource manager of a tramways board in a certain city is responsible for trying to predict the number of claims for workers' compensation. The manager believes that the more money they spend on safety procedures, the fewer workers' compensation claims they will receive. To test this theory, the manager collects the following data.

Year	Number of Workers' Compensation Claims	Spending on Safety Procedures in thousands of dollars
1996	36	8
1997	56	4
1998	40	6
1999	60	2
2000	44	6
2001	52	4
2002	52	4
2003	44	6

a. Which of the two variables is the dependent variable?

---

1 mark

b. Find the equation of the least squares regression line. Give each value to one decimal place.

Number of workers' compensation claims =  -  × spending on safety procedures.

2 marks

c. Use this equation to find how much money they will need to spend so that there will be no compensation claims? Give your answer to the nearest thousand of a dollar.

---

1 mark

**Question 2**

The following table shows the lengths in hours of 20 consecutive home visits by an electrician and a plumber.

Time Spent on House Visit	
Electrician	Plumber
0.7	4.8
0.9	3.2
2.8	0.7
1.6	0.8
2.8	4.1
1.4	1.6
3.0	4.3
1.1	3.4
1.2	8.9
0.8	0.3
0.5	1.4
0.6	6.4
4.8	1.2
2.0	4.9
2.4	3.0
2.7	2.2
1.0	2.0
0.6	5.3
1.0	6.1
5.2	1.7

a. At what percentage of houses did the plumber spend less than 1.4 hours?

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1 mark

b. At what percentage of houses did the electrician spend at least 3 hours?

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1 mark

Question 2 (continued)

c. Complete the following back to back stem and leaf plot for the given data.

Electrician	Stem	Plumber
	0	3 7 8
	1	2 4 6 7
	2	0 2
	3	0 2 4
	4	1 3 8 9
	5	3
	6	1 4
	7	
	8	9

2 marks

d. Find the median number of hours spent at each house by the plumber.

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1 mark

e. Find the mean number of hours spent at each house by the plumber.

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1 mark

f. Would the mean or median be a better measure of the centre of the distribution for the plumber?  
Give a reason for your answer.

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2 marks

**Question 2 (continued)**

**g.** Describe the distribution for the electrician.

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1 mark

**h.** What is the interquartile range for the electrician?

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2 marks

**End of Core**

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

**Question 1**

It is expected that the number of people watching the women's basketball at the Olympic Games will increase by 1,400 each day that the women's basketball is played.

- a. How many people would be expected to watch the women's basketball on the fourth day of play if 12,600 attended on the first day?

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1 mark

- b. Write the above information as a difference equation.

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1 mark

- c. In fact, the number of people wanting tickets to the women's basketball for the first three days followed the rule  $t_{n+1} = 3t_n - 20,000$   $t_1 = 12,600$   
How many people wanted tickets for the third day?

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1 mark

**Question 1. (continued)**

- d.** If the number of people who attended the gymnastics on day one was 8,000, and if this number increased by 3% each day, how many people attended the gymnastics on the seventh day?

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2 marks

**Question 2**

Mark and Aroula are going to sell cordial at the Olympic games. They make their cordial concentrate using lemon juice and water, where the ratio of lemon juice to water is 3:5.

- a. What percentage of their cordial concentrate is water?

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1 mark

- b. If they wish to prepare 5,600 litres of the cordial concentrate, how many litres of lemon juice will they need?

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1 mark

- c. Aroula plans to mix 200 ml of the cordial concentrate with water to make up 1 litre of drink to sell to her customers.

- (i) How many millilitres of water will she need to mix with each 200 ml of cordial concentrate?

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1 mark

- (ii) What is the ratio of the volume of cordial concentrate to the volume of water added? Give your answer in simplified terms.

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1 mark

**Question 3**

- a. The Soft Seat Company is asked to produce 8,100 seats for the swimming at the Olympic Games. They decide to make 50 seats each day. How many days will they take to complete the project?

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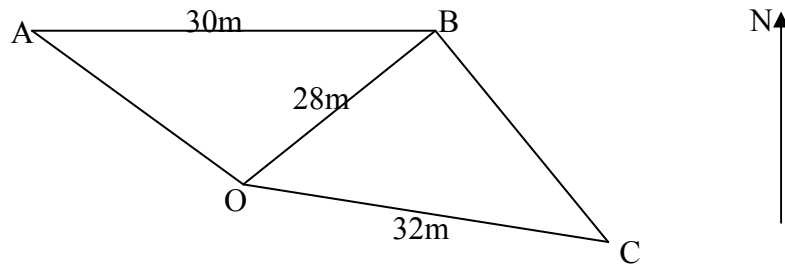
1 mark





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

Question 1



From a point O, A is  $320^{\circ}\text{T}$ , B is  $61^{\circ}\text{T}$ , and C is  $154^{\circ}\text{T}$ .  $AB = 30\text{m}$ ,  $BO = 28\text{m}$  and  $CO = 32\text{m}$ .

- a. Find the size of angle BOC

1 mark

- b. Find the area of triangle BOC. Give your answer to three decimal places.

1 mark

- c. Find the length of BC. Give your answer to two decimal places.

1 mark

Question 1 (continued)

d. Find angle AOB

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1 mark

e. Find angle BAO, giving your answer to the nearest degree.

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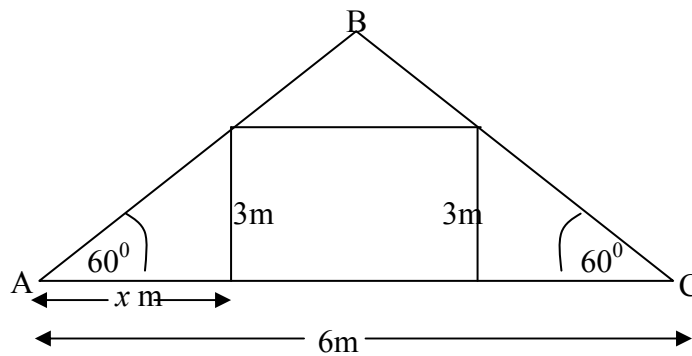
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2 marks

Question 2



The roof of Andrea's attic is shown above. The sloping edges of the roof make an angle of  $60^\circ$  with the floor of the attic.

a. What is the length of the sloping edge AB?

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1 mark

Question 2 (continued)

Andrea wishes to build a room in this attic with walls 3 m high.

- b. Find  $x$ , the distance of the wall from A, in metres. Give your answer to 2 decimal places.

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2 marks

- c. If the width of the attic, AC, is 6m, find the width of the room to two decimal places.

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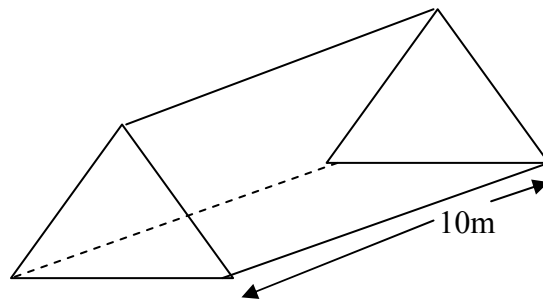
1 mark

- d. What is the maximum height of the attic? Give your answer to two decimal places.

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2 marks



- e. The attic has a depth of 10 metres. Find the area of the ceiling of the room that Andrea has built. Give your answer in square metres to one decimal place.

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1 mark

**Question 2 (continued)**

f. What will be the volume of the space above the ceiling? Give your answer in cubic metres to two decimal places.

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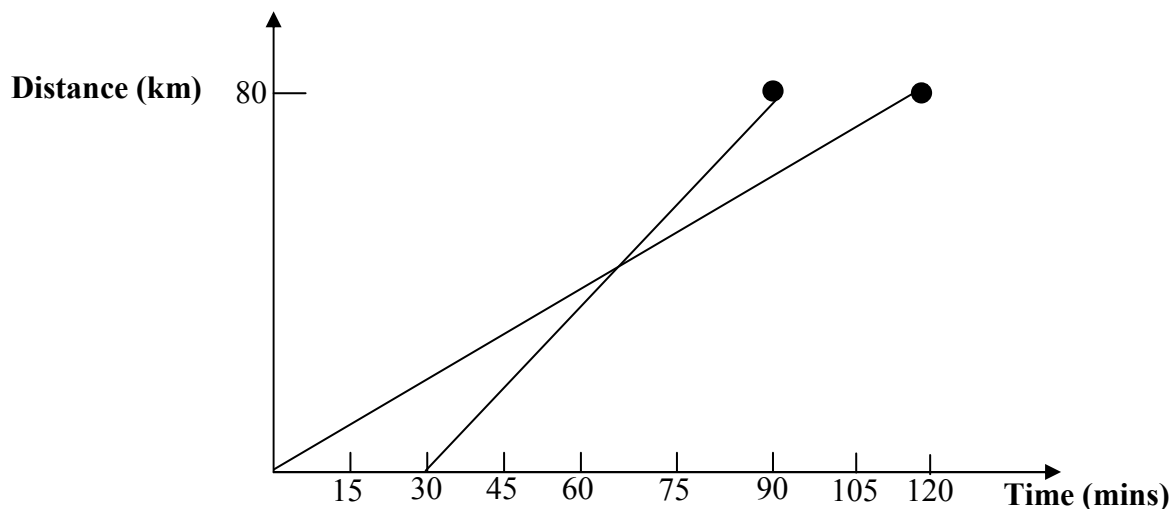
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2 marks

**End of Module 2**

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

**Question 1**



Two towns A and B are 80 km. apart. Sam leaves town A, 30 minutes after Kim.

- a. How long does it take Sam to reach town B?

---

1 mark

- b. What is Kim's speed for the trip in km/hr

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1 mark

**Question 2**

A teacher is buying some books for a prize giving ceremony. The cost of the art books is \$30 each and the cost of the science books is \$15 each.

The teacher buys  $x$  art books and  $y$  science books.

- a. Write down an expression for the cost of all the books in terms of  $x$  and  $y$

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1 mark

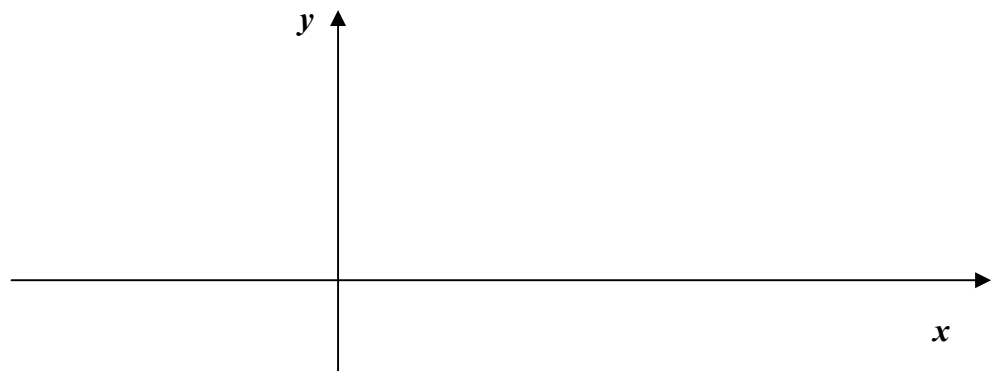
**Question 2 (continued)**

**b.** The maximum number of art books required is 6. The total number of art and science books required is at least 7. The number of art books must be greater than or equal to one less than the number of science books. At least one science book must be bought. Using this information, set up four inequations in the spaces below.

- (i) \_\_\_\_\_
- (ii) \_\_\_\_\_
- (iii) \_\_\_\_\_
- (iv) \_\_\_\_\_

4 marks

**c.** On the axes below, sketch the inequalities and show the region that satisfies all the constraints.



4 marks



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

**Question 1**

Harry wants to buy a car that costs \$15,700. The dealer offers him terms of 15% cash deposit and then a flat rate of 12.5% p.a. paid on the balance over 6 years.

- a. What is the value of the cash deposit that Harry must pay the dealer?

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1 mark

- b. How much interest will Harry pay?

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2 marks

- c. Harry agrees to repay the money in equal monthly instalments over 6 years. How much will he repay each month?

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2 marks

- d. What is the effective interest rate that Harry is paying?

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1 mark



**Question 2**

Amanda sees the same car as Harry and her bank agrees to offer her a loan of \$15,700 for 6 years at 14% p.a. interest. The bank agrees to debit the interest monthly over 6 years.

- a. What is the monthly interest rate? Give your answer to two decimal places.

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1 mark

- b. In the formula  $A = PR^n - \frac{Q(R^n - 1)}{R - 1}$

- (i) What is the value of  $R$ ? Give your answer to four decimal places.

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1 mark

- (ii) What is the value of  $n$ ?

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1 mark

- c. How much will Amanda have to repay each month?

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2 marks

- d. How much interest does Amanda pay?

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1 mark

**Question 2 (continued)**

After Amanda has made her agreed repayments to the bank for 2 years, she finds that she can afford to increase her repayments by an extra \$50 per month.

- e. How much does Amanda owe the bank at the end of 2 years?

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1 mark

- f. How long altogether will it now take Amanda to repay her loan of \$15,700?

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2 marks

**End of Module 4**

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

**Question 1**

$$\begin{bmatrix} 0 & 2 & 0 & 1 \\ 2 & 0 & 2 & 1 \\ 0 & 2 & 2 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix}$$

- a. Draw a network to match the above matrix.

1 mark

- b. What can be said about a network that has only zeros in the leading diagonal?

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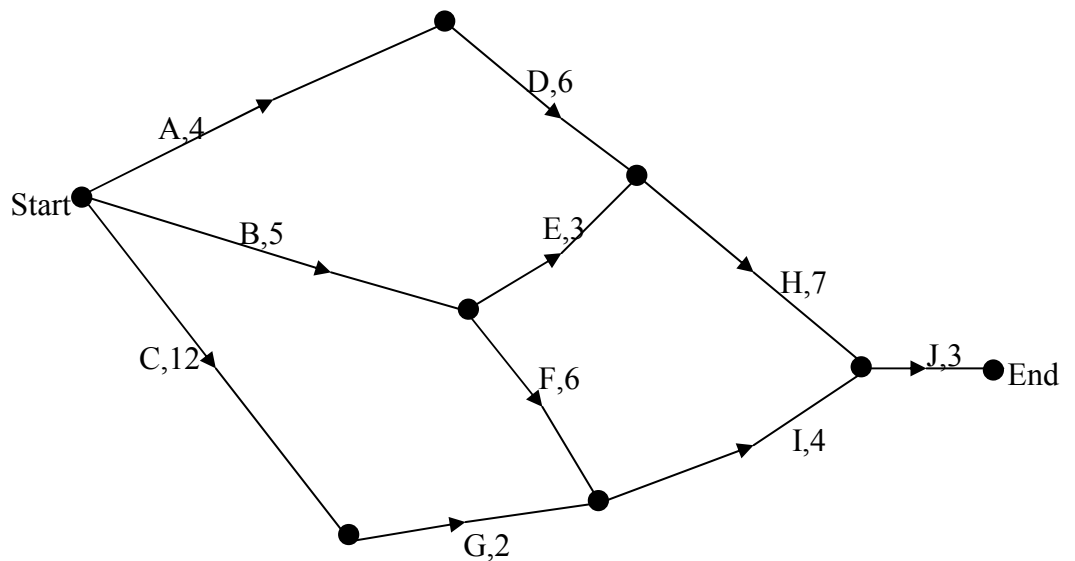
1 mark

- c. What can be said about a network whose matrix is not symmetrical about the leading diagonal?

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1 mark

Question 2



The network for building a garage is shown above with the duration for each activity, A to J given in days.

a. Complete the following table by filling in the blank boxes.

ACTIVITY	IMMEDIATE PREDECESSORS	Earliest Start Time	Latest Start Time
A	–	0	1
B	–	0	3
C	–	0	0
D	A	4	5
E	B	5	8
F	<input type="text"/>	<input type="text"/>	<input type="text"/>
G	C	12	12
H	D,E	10	<input type="text"/>
I	<input type="text"/>	<input type="text"/>	14
J	<input type="text"/>	<input type="text"/>	<input type="text"/>

9 marks

**Question 2 (continued)**

**b.** What is the float time for activity E?

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1 mark

**c.** What is the critical path for building this garage?

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1 mark

**d.** What is the length of the critical path?

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1 mark

**END OF QUESTION AND ANSWER BOOK**  
**Further Mathematics Trial Examination 2**

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