Year 2005

VCE

Further Mathematics

Trial Examination 2

KILBAHA MULTIMEDIA PUBLISHING	**TEL: (03) 9817 5374**
PO BOX 2227	**FAX: (03) 9817 4334**
KEW VIC 3101	**chemas@chemas.com**
AUSTRALIA	www.chemas.com

STUDENT NUMBER **Letter**

Figures									
Words									

VICTORIAN CERTIFICATE OF EDUCATION 2005

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 23 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: $I = \frac{\Pr T}{100}$

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

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

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

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.

Question 1

A family wishing to sell their home, investigates the number of houses sold by two real estate firms, M. T. Hooker and U. R. Goode over a certain number of months. The data they collected is shown in the following back to back stem and leaf.

M. T. HOOKER	Stem	U. R. GOODE
9	6	8 9
7 7 6 6	7	0 4 7
9 8 7 5 4 3 0 0 0	8	1 1 1 3 3 3 4 4 5 7
1	9	

a. How many months were investigated by the family?

1 mark

b. Describe the shape of the distribution of the data for U. R. Goode.

1 mark

c. What is the median number of houses sold each month by U. R. Goode over the time of the investigation?

1 mark

d. What is the interquartile range for the M. T. Hooker data?

1 mark

e. What is the mean number of houses sold each month by M. T. Hooker?

1 mark

f. Which of the two firms has an outlier? What is this outlier?

2 marks

Question 2

The I – Help – U Bank wishes to determine the relationship between interest rates and the number of new houses commenced. The data collected by the bank over the last ten years is given in the table below.

Year	Interest Rate(%)	Number of new houses commenced ('000)
1995	17	11
1996	15	13
1997	12	14
1998	10	18
1999	12	15
2000	13	14
2001	10	17
2002	8	21
2003	7	23
2004	6	25

a. Of the two variables being compared, interest rate and number of new houses commenced, which one is the independent variable?

____

____

1 mark

b. Complete the least squares regression equation for the interest rate and the number of new houses commenced. Give your answers to one decimal place.

Number of new houses commenced = ☐ + ☐ × interest rate.

2 marks

c. What would you expect the interest rate to be if the number of new houses commenced in a particular year was 8000? Give your answer to the nearest whole percent.

____

____

____

1 mark

Core

Question 2(continued)

d. Find Pearson's correlation coefficient for this data. Give your answer to 2 decimal places.

1 mark

e. Explain what this correlation coefficient tells you about interest rates and the number of new houses commenced.

1 mark

f. If the regression equation for the interest rate and the number of thousands of new houses commenced in another ten year period was

number of new houses = $50 - 2 \times$ interest rate

then complete the following sentence.

As interest rate increases by one percent then the number of new houses commenced [ ]

by [ ]

2 marks

End of Core

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

Question 1

Phoebe is a member of the Keep Fit Gym. When she has a session on the bike she finds she uses 55 cals/hr if she sets the bike on level 3. Each time she increases the level by one, the number of extra calories used per hour is increased by 15.

a. How many calories per hour would she use with the bike set at level 4?

1 mark

b. Phoebe wants to ride the bike for one hour and use 370 calories. What level does she need for the setting on the bike?

2 marks

Module 1 Number patterns and applications

Question 2.

Phoebe finds that when she uses the weights at the gym, the number of calories burned each minute can be given by $C_{n+1} = 1.5C_n$ where $C_1 = 4$

a. Write down the first three terms of this sequence.

---

1 mark

b. Name the type of sequence.

---

1 mark

c. How many minutes would Phoebe need to use the weights to burn 300 calories. Give your answer to the nearest minute.

---

2 marks

d. Sophie finds that when she works with weights, the number of calories she burns each minute can be given by $C_{n+1} = 1.05C_n + 1.325$ where $C_1 = 5$. Find the general equation, C_n in terms of n.

---

2 marks

Module 1 Number patterns and applications

Question 3

Phoebe has a one litre bottle of an energy drink called *Sportade*. When the level of her drink falls to 0.5 litres, she refills her bottle with water.

a. Set up an equation showing the amount, A, of *Sportade* remaining in her bottle after n refills.

1 mark

b. How much *Sportade* remains in the mixture after three refills?

1 mark

c. What is the least number of refills for the mixture to be at least 95% water?

2 marks

d. 150 mL of full strength *Sportade* is diluted with 1250 mL of distilled water.

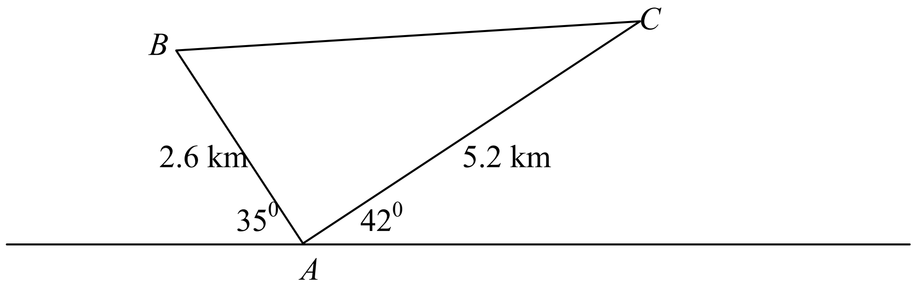
What is the strength of the resulting drink? Give your answer to the nearest tenth of a percent.

2 marks

End of Module 1

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

Question 1



A large triangular recreational park, *ABC*, is to be built in the outer Melbourne suburbs.
AB = 2.6 km, *AC* = 5.2 km, *AB* makes an angle of 35^0 with the horizontal road and *AC* makes an angle of 42^0 with the same road.

a. A map of this park is drawn by the surveyor with a scale of 1:25,000. What is the length in centimetres of the line on the map representing *AC*? Give your answer to one decimal place.

1 mark

b. What is the size of angle *BAC*?

1 mark

c. What is the real length of *BC* in kilometres? Give your answer to one decimal place.

1 mark

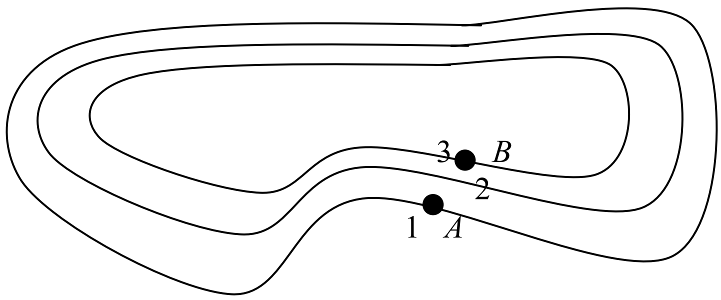
Question 1(continued)

d. What is the area of the recreational park, *ABC*, in square kilometres?
Give your answer to one decimal place.

1 mark

Question 2

At one end of the recreational park there is to be a playground. This section of the park is not level, so the surveyor draws the following contour map in preparation for designing the playground.



Two points *A* and *B* are marked, with the direct distance from *A* to *B* being 3 metres.

a. What is the average slope of the land in this part of the park?
Give your answer to two decimal places.

1 mark

Question 2(continued)

b. Wide steps are to be built going from *A* to *B*. A giant slippery slide is to be placed so that a vertical ladder, one metre high is to be built at *B* leading up to the top of the slippery slide. The child will then slide down to *A*. What length of slide is required? Give your answer to 2 decimal places.

2 marks

c. What angle will the slide make with the vertical? Give your answer to the nearest degree.

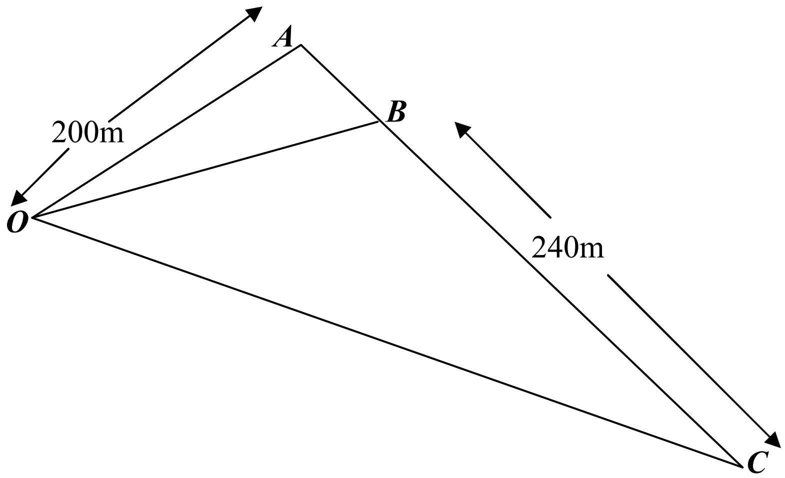
1 mark

d. A child, 30cm. tall when sitting down, is sitting on the top of the slide and watching a dog 40cm. high, standing on the ground at A. What is the angle of depression?
Give your answer to the nearest degree.

1 mark

Question 3

In a flat area of the recreational park, three exercise bars, *A*,*B* and *C* are to be erected.



The bearing of both *B* and *C* from *A* is 135^0. The bearings of *A* and *B* from another point *O* are 030^0 and 110^0 respectively. $OA = 200$m and $BC = 240$m.

a. Find angle ABO and angle OAB.

2 marks

b. What is the distance from *O* to *B*? Give your answer to one decimal place.

1 mark

Question 3(continued)

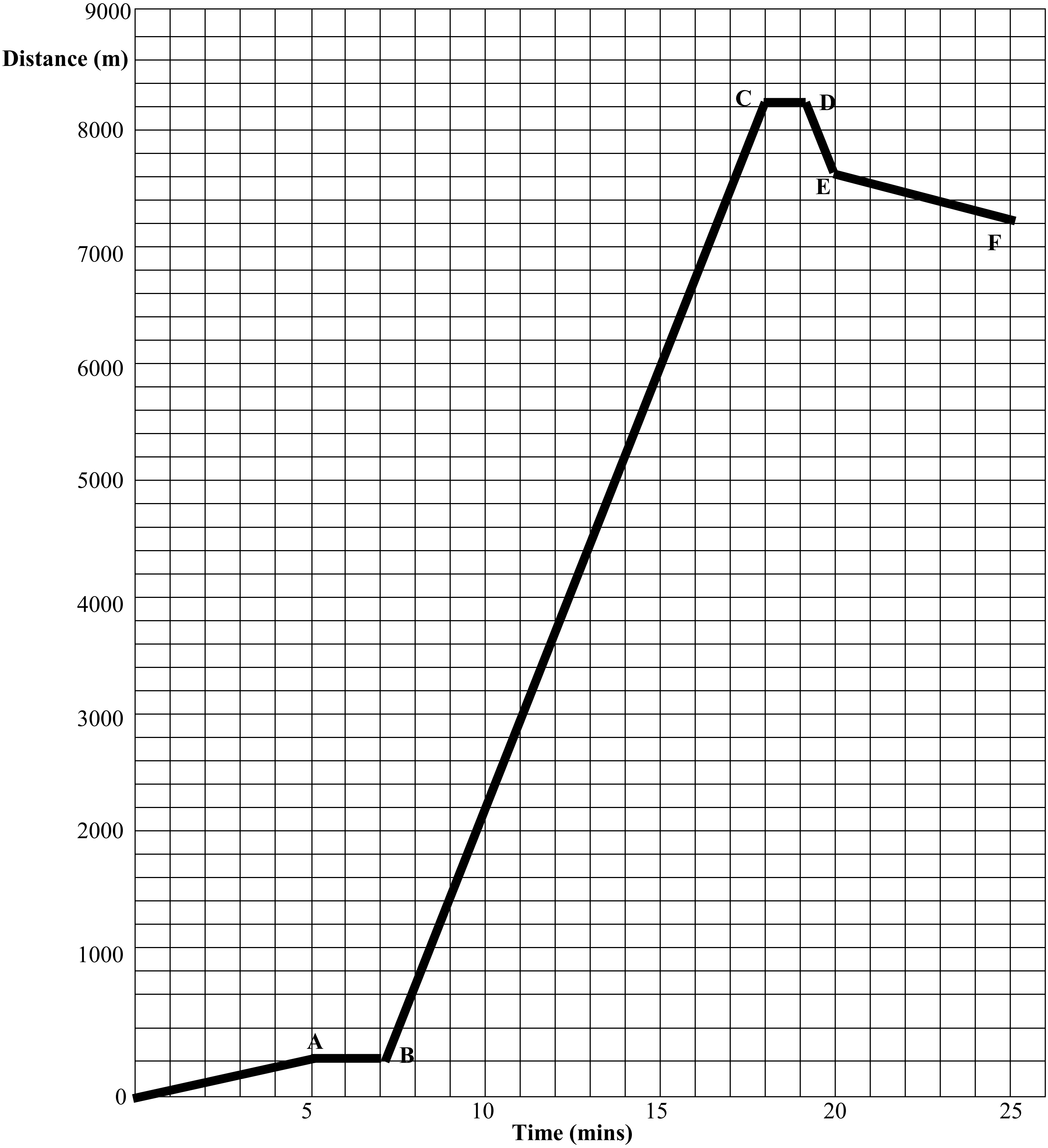
c. What is the bearing of C from O? Give your answer to the nearest degree.

3 marks

End of Module 2

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

Question 1



The above graph shows the distance travelled by Omar in the local triathlon.
In the triathlon he had to swim, then cycle and last of all run to the finish line.

Question 1(continued)

a. What length of time elapsed between his finishing his swim and starting on the cycling section of the triathlon?

1 mark

b. How long did it take him to complete the triathlon?

1 mark

c. What was the length of the cycling section of the triathlon?

1 mark

d. What was the length of the running section of the triathlon?

1 mark

e. What distance was he from the start when he finished the triathlon?

1 mark

f. For what length of time was he actually running?

1 mark

g. What was his speed during the bike race? Give your answer in km/hr to one decimal place.

2 marks

Question 2

A manufacturer of prizes for sporting events produces trophies, silver plates and medals. He employs sufficient people to produce 1000 prizes per month, of which no more than 600 are silver plates. The manufacturer makes a profit of $80 on a trophy, $100 on a silver plate and $40 on a medal. He makes ***x*** trophies, ***y*** silver plates and ***z*** medals per month.

a. Write down an equation for the number of medals produced each month in terms of ***x*** and ***y***

___

___

1 mark

Given that one of the constraints is $x + y \leq 1000$, write down another three constraints for this manufacturer.

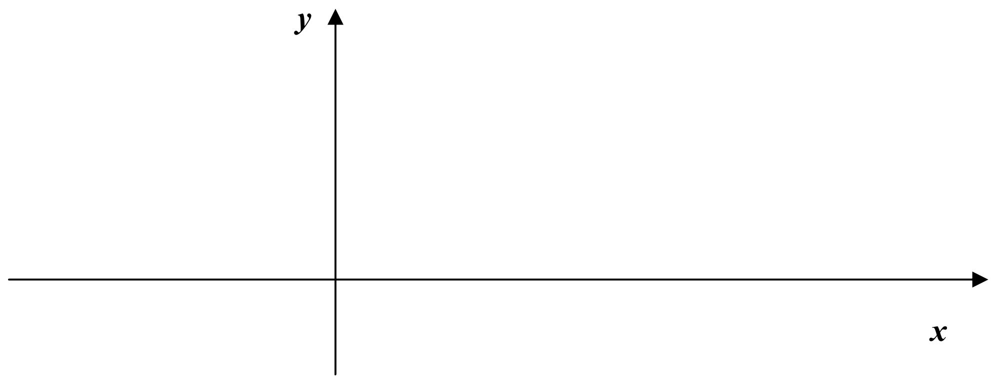
(i)___

(ii)___

(iii)___

1 mark

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



2 marks

d. Write down the equation for the profit in terms of ***x*** and ***y***.

___

___

___

___

1 mark

Question 2(continued)

e. What is the maximum profit the manufacturer can make on these items each month?

1 mark

f. Explain why the manufacturer should discontinue making medals.

1 mark

End of Module 3

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

Question 1

Jing Wei borrowed \$15,000 to buy a car worth \$20,000 at a simple interest of 0.5% per month.

a. What was the interest rate per annum?

1 mark

b. What was the interest paid by Jing Wei if she took 8 years to repay the money?

1 mark

c. What was the total amount that Jing Wei paid for the car?

1 mark

d. It was estimated that after eight years, the value of the car would be \$4,000.
Assuming a flat rate depreciation, what is the amount of depreciation each year?

2 marks

Question 2

Alan also purchased a car worth $20,000. He paid a $7,000 deposit and then monthly repayments of $222 for 8 years.

a. How much did Alan pay in total for the car?

1 mark

b. How much interest did he pay?

1 mark

c. What was his flat rate of interest per annum?
Give your answer to the nearest whole percent.

1 mark

d. What was his effective interest rate per annum? Give your answer to one decimal place.

1 mark

Question 3

Indira also bought a car valued at \$20,000. She paid a \$3,000 deposit and borrowed the remainder of the money at 6.5% interest per annum, adjusted monthly. She agreed to repay the money in monthly instalments over 8 years. The monthly repayments can be calculated using the formula

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

a. What values of P, R and n would be used to find the monthly repayments? Give the value of R to three decimal places.

$P =$ ☐ $R =$ ☐ $n =$ ☐

2 marks

b. What is Indira's monthly repayment? Give your answer to the nearest cent.

1 mark

c. After making this repayment for 2 years, Indira gets some extra money that enables her to double her repayments. How much less than the 8 years will it take her to repay her loan? Give your answer to the nearest month.

1 mark

End of Module 4

Module 5 Networks and decision mathematics

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

Question 1

Several activities listed as A to G are necessary to build a school.
The following table has been drawn up by the building manager.

Activity	**Predecessor(s)**	**Duration (Weeks)**
A	–	12
B	–	9
C	A	4
D	A	31
E	D,F	25
F	B,C	14
G	B,C	11
H	E,G	5

a. What activities must be completed before activity E can commence?

____

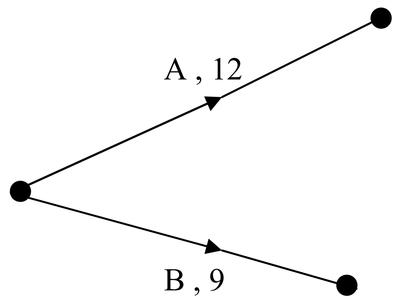
1 mark

b. What is the length of time it takes to complete activity B?

____

1 mark

c. Complete the following network for all the activities necessary to build the school.



3 marks

Question 1 (continued)

d. List the activities that make up the critical path for this network.

2 marks

e. What is the shortest time, in weeks, that this project can take?

1 mark

f. What is the earliest time that activity E can commence?

1 mark

g. What is the latest starting time for activity F?

1 mark

h. What is the float time for activity F?

1 mark

Module 5 Networks and decision mathematics

Question 2

Wayne, Xavier, Yolande and Zeta work in a factory making blazers. There are four activities to making a blazer, namely, cut out the material, stitch the seams, put on the braid and attach the pockets. The time in minutes taken by three of these four factory workers to perform these different activities is given in the table below.

	Cut Out	**Seams**	**Braid**	**Pockets**
Wayne	16	17	10	5
Xavier				
Yolande	18	20	12	12
Zeta	15	18	6	9

a. Complete the above table if Xavier takes 4 minutes less than Yolande to sew pockets, 1 minute more than Zeta to stitch seams, 6 minutes more than Zeta to sew braid and 2 minutes more than Wayne to cut out.

1 mark

b. Find the task that should be assigned to each worker so that the blazers are made in the shortest possible time. Perform the Hungarian Algorithm to do this, and show your working.

3 marks

Question 2 (continued)

c. What is the minimum time these four people will take to make a blazer if they are given these allocated tasks?

1 mark

END OF QUESTION AND ANSWER BOOK
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