



Western Australian Certificate of Education Sample Examination, 2016

Question/Answer Booklet

MATHEMATICS APPLICATIONS

Section One: Calculator-free

Please place your student identification label in this box

Student Number: In figures

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In words

Time allowed for this section

Reading time before commencing work: five minutes
Working time for section: fifty minutes

Number of additional
answer books used:
(if applicable)

Materials required/recommended for this section

To be provided by the supervisor

This Question/Answer Booklet
Formula Sheet

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener,
correction fluid/tape, eraser, ruler, highlighters

Special items: nil

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.



Structure of this paper

Section	Number of questions available	Number of questions to be answered	Working time (minutes)	Marks available	Percentage of exam
Section One: Calculator-free	8	8	50	50	35
Section Two: Calculator-assumed	13	13	100	96	65
Total					100

Instructions to candidates

- The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2016*. Sitting this examination implies that you agree to abide by these rules.
- Write your answers in this Question/Answer Booklet.
- You must be careful to confine your response to the specific question asked and to follow any instructions that are specified to a particular question.
- Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
 - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
 - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.
- Show all your working clearly.** Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two marks, valid working or justification is required to receive full marks. If you repeat any question, ensure that you cancel the answer you do not wish to have marked.
- It is recommended that you **do not use pencil**, except in diagrams.
- The Formula Sheet is **not** to be handed in with your Question/Answer Booklet.

See next page

Section One: Calculator-free

35% (50 Marks)

This section has **eight (8)** questions. Answer **all** questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

- Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
- Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.

Working time: 50 minutes.

Question 1

(7 marks)

- (a) The shopping bus for senior citizens has been operating for three months. The increase in the number of senior citizens using the bus is described by the recursive equation:

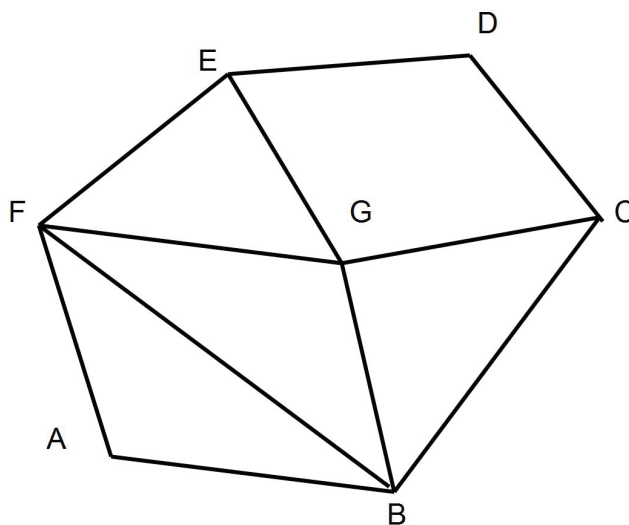
$$T_{n+1} = T_n + 12, \quad T_3 = 43$$

- (i) Determine the number of senior citizens who will use the bus in the fourth month. (1 mark)
- (ii) Determine T_1 and describe what it represents. (2 marks)
- (b) The number of recycling bins emptied monthly was growing at a rate of nine extra bins each month. In the first month of last year there were 550 bins emptied.
- (i) Display the terms of the sequence for the number of bins emptied each month for the first 4 months of last year. (1 mark)
- (ii) Deduce a non-recursive rule to describe T_n , the n^{th} term. (2 marks)
- (iii) Determine T_{50} . (1 mark)

See next page

Question 2

(7 marks)



- (a) Verify that Euler's formula works for this network. (2 marks)

- (b) Determine the degree of each vertex in the network above and use the table to record your results. (2 marks)

Vertex	A	B	C	D	E	F	G
Degree							

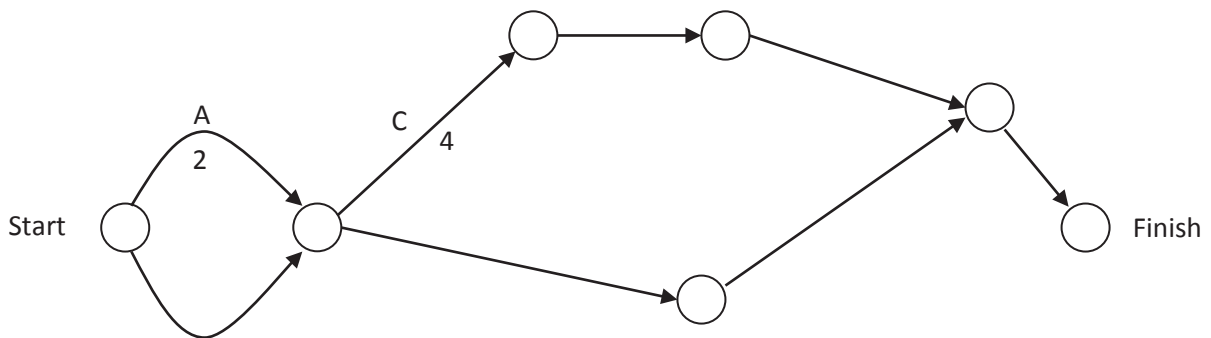
- (c) This network forms a semi-Eulerian trail.
- (i) What property of the vertices supports the claim that this network forms a semi-Eulerian trail? (1 mark)
- (ii) Explain what is meant by a semi-Eulerian trail. (1 mark)
- (iii) Describe a semi-Eulerian trail by listing the vertices of the trail in the order visited. (1 mark)

Question 3

(4 marks)

Activities 'A', 'B', 'C' ..., 'H' are required to build a small extension to an existing house. The estimated completion times (in weeks) for these activities are shown in the table below.

Activity	Completion time (weeks)	Predecessor(s)
A	2	-
B	3	-
C	4	B, A
D	4	B, A
E	8	C
F	6	D
G	2	E
H	3	F, G



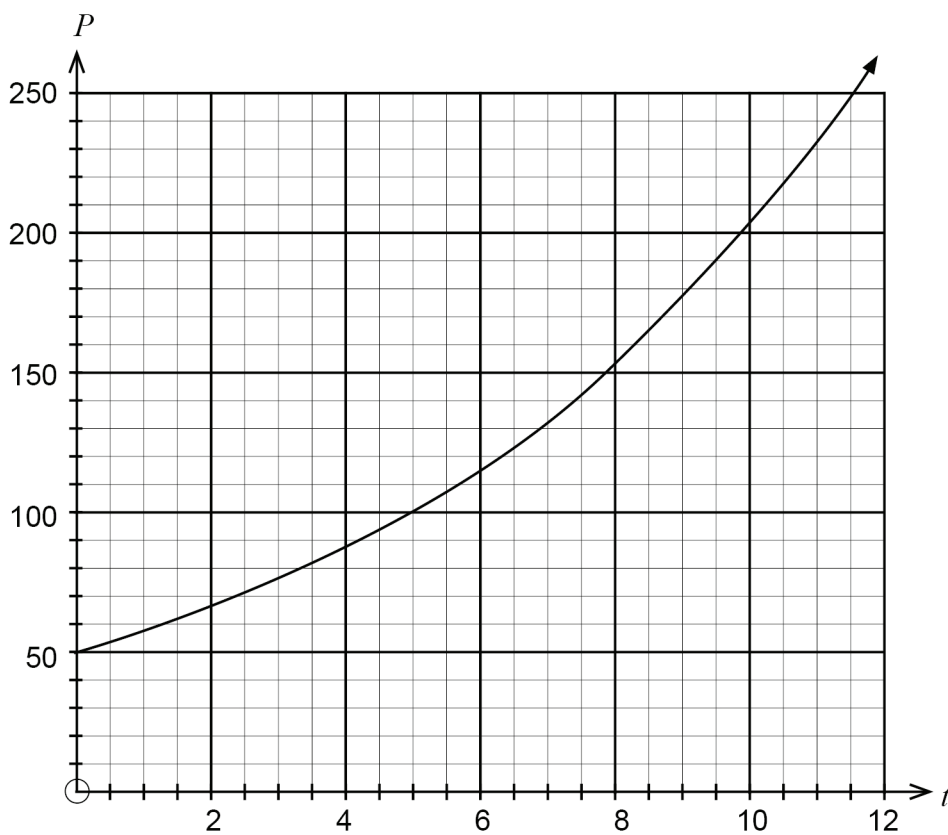
- (a) Complete the project network by labelling the arcs. (1 mark)
- (b) State the critical path. (1 mark)
- (c) State the minimum number of weeks required to build the extension. (1 mark)
- (d) What is the maximum number of weeks by which CEG can be reduced before there is a change to the critical path? (1 mark)

Question 4

(6 marks)

Scientists were trying to increase the population P of a rare species of fish, so they placed a number of fish in a small lake and monitored the population monthly.

- (a) A graph of the fish population is shown below. Use the graph to determine the
- (i) number of fish originally placed in the lake. (1 mark)
 - (ii) month during which the population of the fish first exceeded 200. (1 mark)



- (b) The scientists discovered that the population of the fish, P , increased according to the rule:

$$P = 50 \times 1.15^t, \text{ where } t \text{ was the time in months after the fish were placed in the lake.}$$

Complete the next **two** rows of the table below. (1 mark)

Time (number of months after fish placed in the lake)	Calculation	Population
1	50×1.15	58
2	$50 \times 1.15 \times 1.15$	66
		76
		87

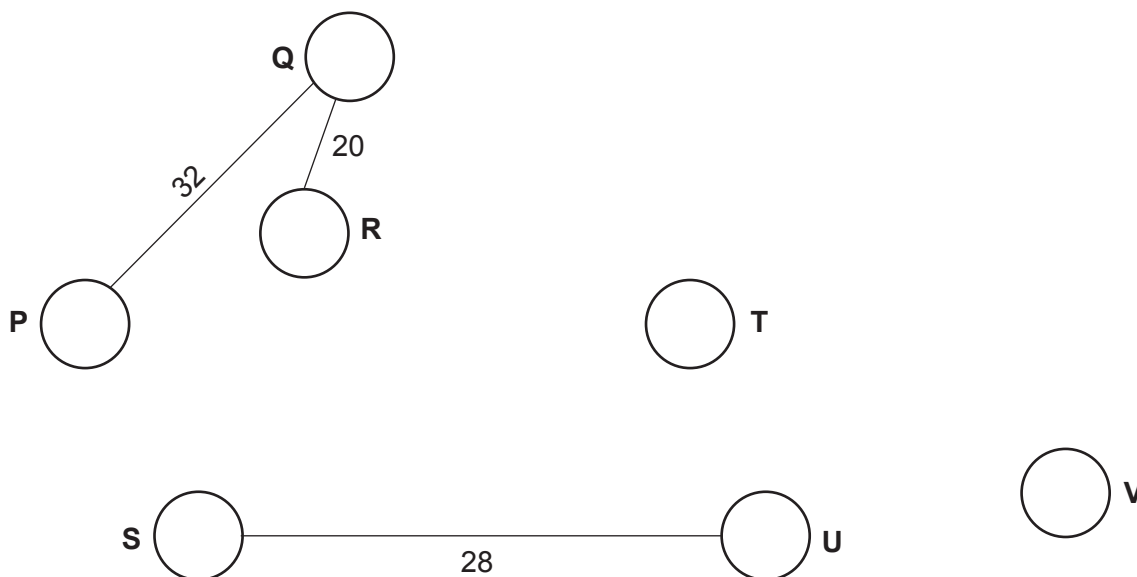
- (c) Use the information presented in part (b) to determine the rate of growth of the fish population. (2 marks)
- (d) Describe the long-term growth of the fish population in the lake. (1 mark)

Question 5

(6 marks)

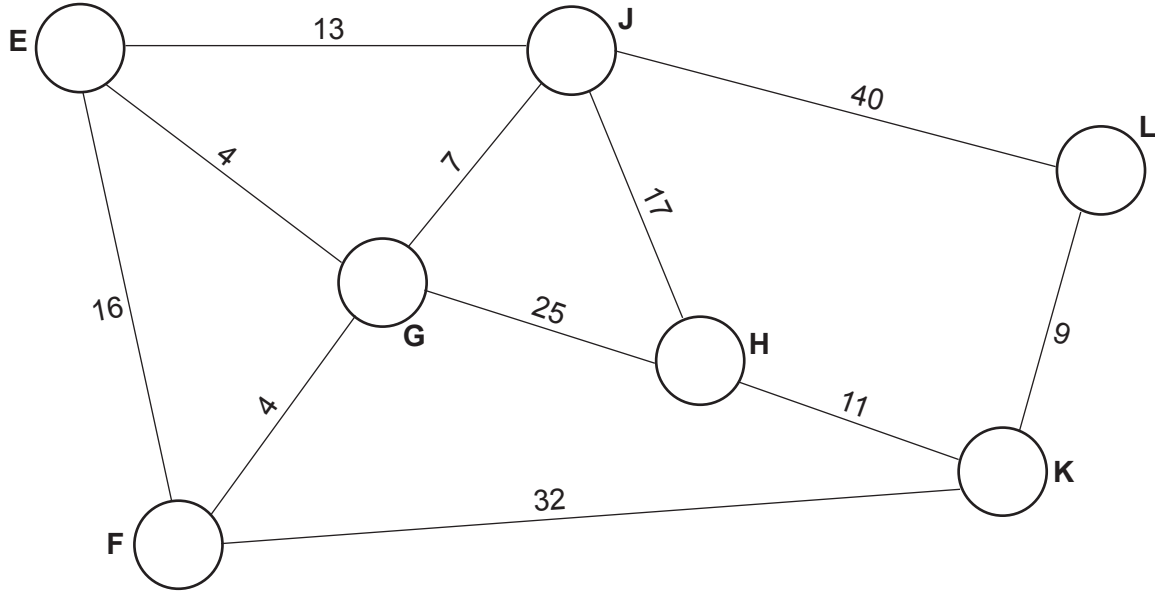
The table below shows travel times (in minutes) along lines of a rail network connecting stations at 'P', 'Q', 'R', 'S', 'T', 'U' and 'V'. The diagram (which is not drawn to scale) shows the positions of the stations.

P	-						
Q	32	-					
R	28	20	-				
S	23	-	-	-			
T	-	34	18	21	-		
U	-	-	-	28	16	-	
V	-	64	-	-	29	23	-
	P	Q	R	S	T	U	V



- (a) Complete the diagram by drawing all the rail lines in the network. Label the lines with the travel times. (2 marks)

- (b) A second rail network connecting stations 'E', 'F', 'G', 'H', 'J', 'K' and 'L', with travel times between the stations given in minutes, is shown below.



A maintenance worker based at Station E needs to travel to each other station in turn, without visiting any station more than once. The worker will finish the trip at a different station to the origin E.

- (i) What is the name given to such a path which each vertex is included only once? (1 mark)
- (ii) One possible path is E F G J H K L. What is the travel time for this path? (1 mark)
- (iii) Use the letters of the vertices to complete two other possible paths. (2 marks)
 - Path 1: E G
 - Path 2: E J

Question 6

(6 marks)

Some students were studying statistics and were involved in various projects to collect and analyse data.

- (a) One student, Amy, wanted to find an answer to the question:

‘Do students in my school tend to travel a long way to school?’

Amy planned to survey ten Year 12 students in her class.

- (i) Write one question that she could ask the students so that she could gather data to answer her question. (1 mark)
- (ii) State one way in which she could improve her data collection. (1 mark)
- (b) Another student, Matthew, was investigating the means by which students travelled to school. He gathered the following data, which came from the 2013 survey in the CensusAtSchool Australia project.

Method of travel to school (%)

Method of travel	WA	Aust
Bicycle	5.9	3.4
Boat/Ferry	0.5	0.5
Bus	26.2	25.4
Car	41.1	46
Skateboard/Scooter/Rollerblades	2.7	1.3
Train/Tram	2.4	4.8
Walk	20.5	18.2
Other	0.6	0.4
Total	100	100

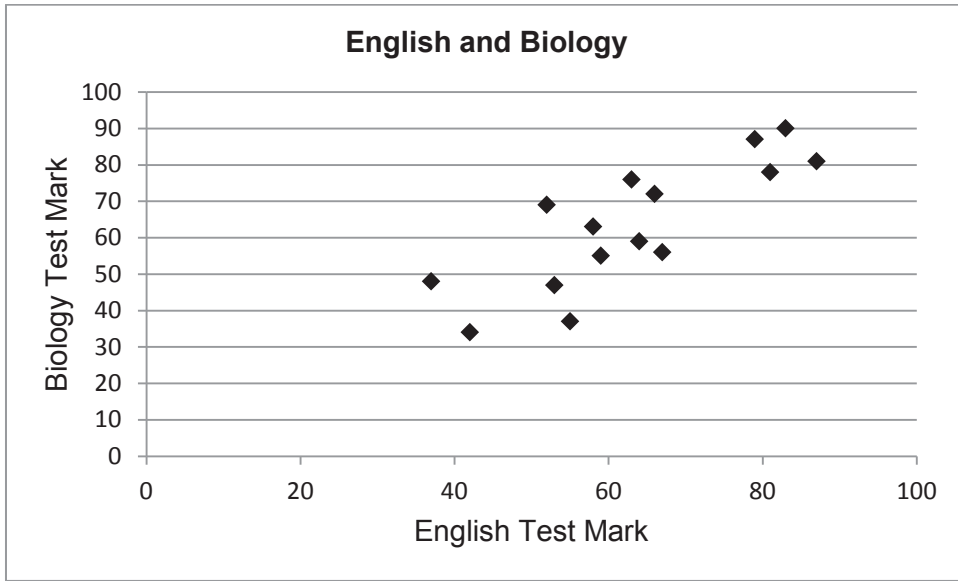
- (i) What type of graph would be suitable to show a comparison between the different methods of travel within Western Australia? (1 mark)

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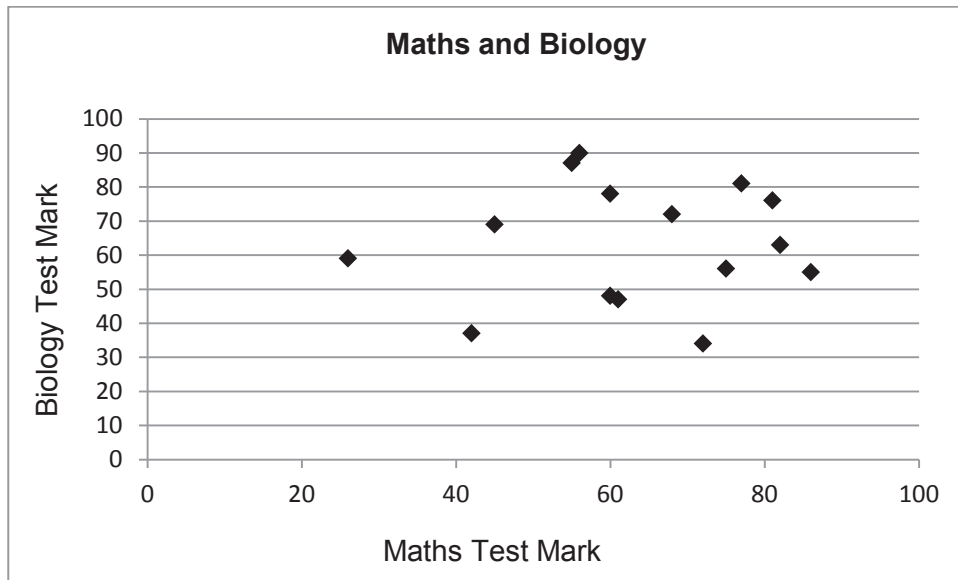
- (ii) Matthew concluded that the low percentage of students riding to school was due to the roads being too dangerous. Suggest another reason that might account for the low percentage of students riding to school. (1 mark)

- (c) Another student Libby, was investigating the relationship between students' marks in various subjects. Her results were displayed as follows.

Graph A: English and Biology test marks



Graph B: Maths and Biology test marks



Possible correlation coefficients: -0.8 0.79 -1 0.12 0.45

Which of the given correlation coefficients is closest to what Libby should get for:

- (i) Graph A? (1 mark)
 (ii) Graph B? (1 mark)

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Question 7

(9 marks)

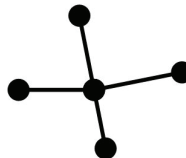
(a) (i) Complete the table for the following trees.

(2 marks)

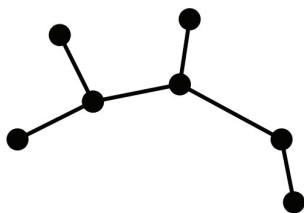
Tree A



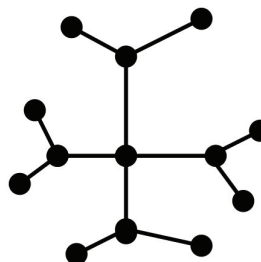
Tree B



Tree C



Tree D



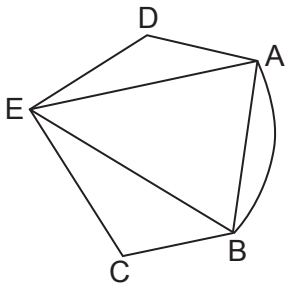
Tree	A	B	C	D
Number of vertices (v)				
Number of edges (e)				

(ii) What appears to be the relationship between the number of vertices (v) and the number of edges (e) in the trees? (1 mark)

(b) All trees are planar. Why? (1 mark)

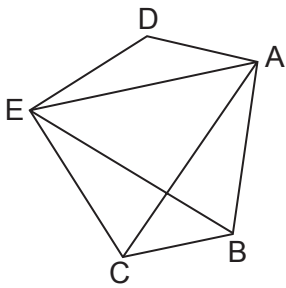
(c) Draw an adjacency matrix for the following network:

(3 marks)



(d) Draw a planar version of the following network:

(2 marks)



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Question 8

(5 marks)

The following matrix shows the time (in minutes) taken for three students to complete three cleaning tasks. The rows in order represent the three students – Ruby, Vera and Andrew. The columns in order represent cleaning the desks, chairs and lockers.

$$\begin{bmatrix} 6 & 10 & 50 \\ 8 & 5 & 40 \\ 10 & 15 & 30 \end{bmatrix}$$

- (a) Present this matrix as a labelled and weighted bipartite graph. (2 marks)

- (b) Why is the graph called a complete bipartite graph? (1 mark)

- (c) How long would Ruby take to clean her desk, chair and locker? (1 mark)

- (d) Who would take the shortest time to clean a chair? (1 mark)

End of questions

Additional working space

Question number: _____

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ACKNOWLEDGEMENTS

Section One

Question 6 (b) Data source: Australian Bureau of Statistics. (2013). *CensusAtSchool. 2013 National Summary Tables*. Retrieved 29 December, 2013, from www.abs.gov.au/websitedbs/CaSHome.nsf/Home/2013+CensusAtSchool+Summary+Data#T11. Used under a Creative Commons Attribution 2.5 Australia licence.

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