



Government of **Western Australia**
School Curriculum and Standards Authority



ATAR course examination, 2020

Question/Answer booklet

MATHEMATICS APPLICATIONS

Section One: Calculator-free

Place one of your candidate identification labels in this box.
Ensure the label is straight and within the lines of this box.

WA student number: In figures

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In words

Time allowed for this section

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

Number of additional
answer booklets 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 material. 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 examination
Section One: Calculator-free	6	6	50	47	35
Section Two: Calculator-assumed	10	10	100	105	65
Total					100

Instructions to candidates

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2020: Part II Examinations*. Sitting this examination implies that you agree to abide by these rules.
2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.
3. You must be careful to confine your answer to the specific question asked and to follow any instructions that are specified to a particular question.
4. 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.
5. It is recommended that you do not use pencil, except in diagrams.
6. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.
7. The Formula sheet is not to be handed in with your Question/Answer booklet.

See next page

Section One: Calculator-free

35% (47 Marks)

This section has **six** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Working time: 50 minutes.

Question 1

(5 marks)

The owner of a bicycle shop recorded the type of repairs he made to bicycles with different purchase prices.

		Purchase price			Total
		Less than \$500	From \$500 to \$1000	Greater than \$1000	
Type of repair	Wheels and tyres	36	6	18	60
	Gears and brakes	20	12	8	40
	Frame and suspension	15	2	3	20

- (a) Identify the explanatory variable for the table above. (1 mark)

The percentages in each row of the following table show the proportion of bicycles with different purchase prices requiring that type of repair.

- (b) Complete the table. (2 marks)

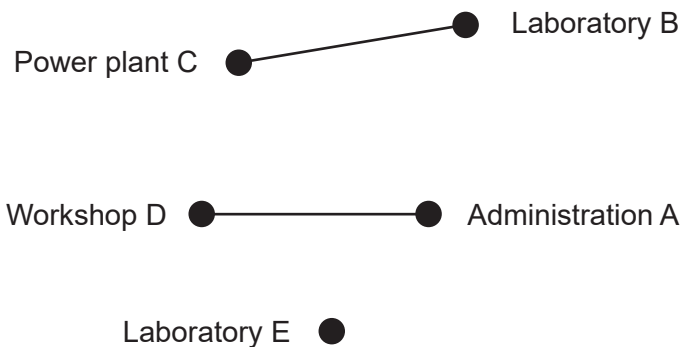
		Purchase price			Total
		Less than \$500	From \$500 to \$1000	Greater than \$1000	
Type of repair	Wheels and tyres		10		100
	Gears and brakes		30	20	100
	Frame and suspension	75			100

- (c) Using the information from the table in part (b), describe **one** association between these variables. (2 marks)

Question 2

(8 marks)

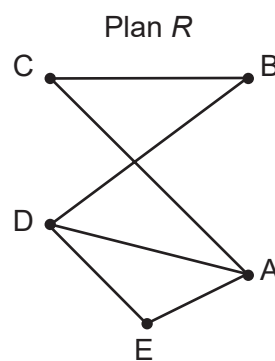
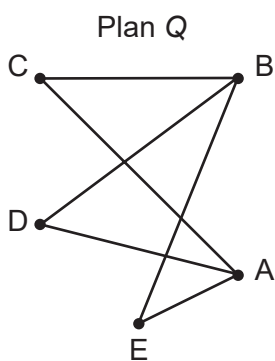
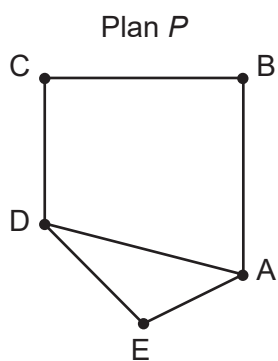
A small research facility consists of five buildings with walkways represented by the edges in this network:



- (a) Determine the smallest number of edges (walkways) to be added to ensure that the network is
- (i) connected (1 mark)
 - (ii) complete (1 mark)
 - (iii) planar with 4 regions. (2 marks)

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Three different plans for completing the network with the addition of four walkways are shown:



(b) State which, if any, of these plans has a graph that is

(i) bipartite (1 mark)

(ii) Eulerian (1 mark)

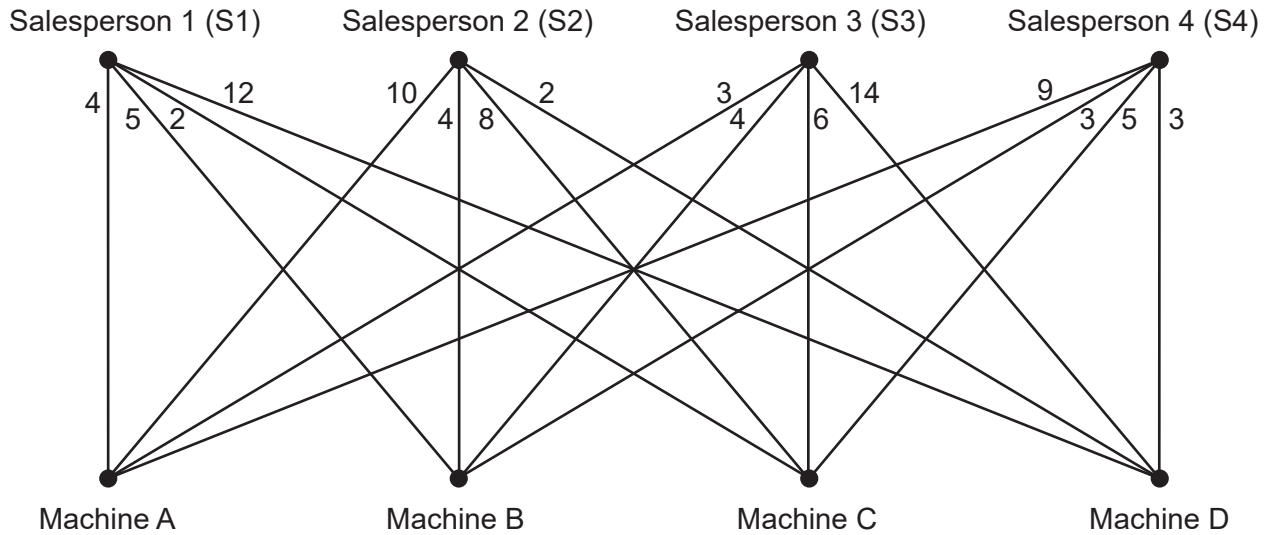
(iii) a Hamiltonian cycle. (2 marks)

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Question 3

(8 marks)

The bipartite graph below shows the average number of sales per day of four specialist pieces of machinery by four salespersons. The salespersons went through a rotation process of spending a number of full days selling only one type of machine before moving to the next. The company that makes these machines wants to maximise the sales by allocating the sales of each machine to only one person.



- (a) Complete the matrix below showing the information from the bipartite graph. (1 mark)

	A	B	C	D
S1	4	5	2	12
S2	10	4	8	2
S3	3	4		
S4				

- (b) Show use of the Hungarian algorithm to allocate each salesperson to a specialist machine in order to maximise sales. The allocation is to be written in the table below. (5 marks)

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Salesperson	1	2	3	4
Machine				

- (c) How many more sales are made by using the allocation in part (b) compared to the allocation: S1 – A, S2 – B, S3 – C and S4 – D? (2 marks)

Question 4

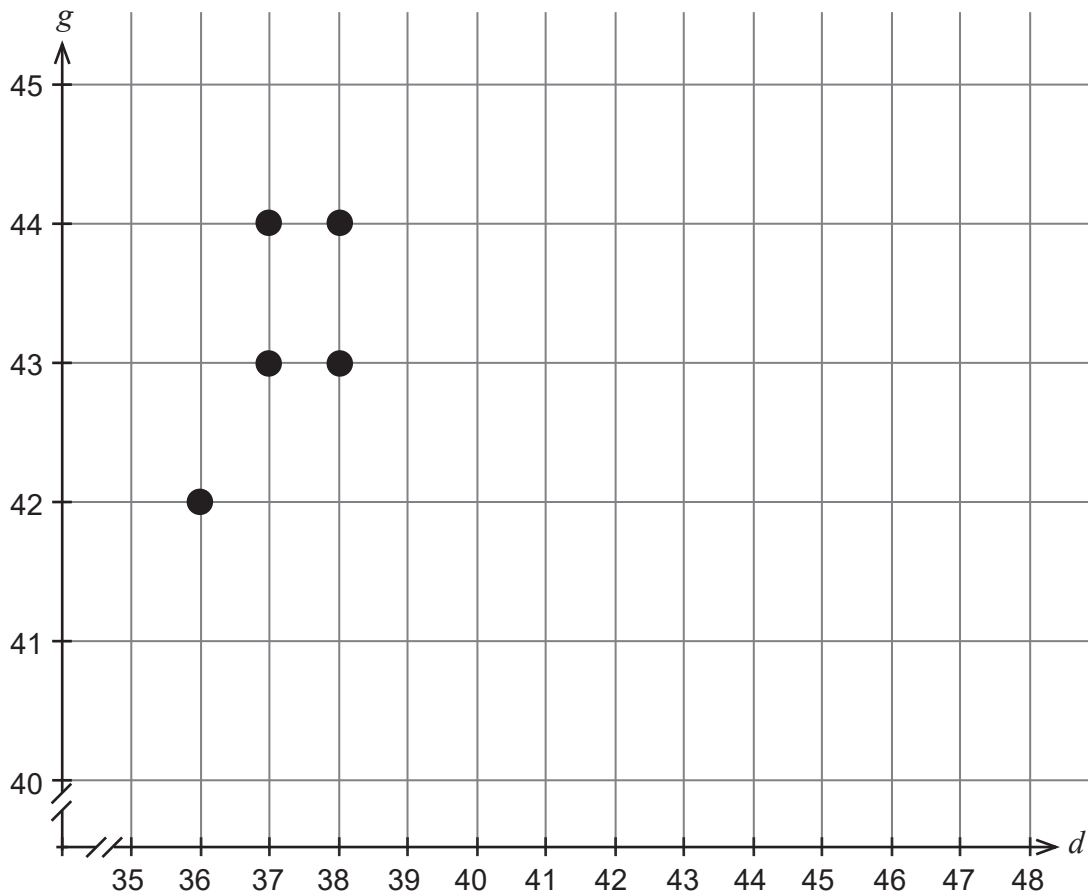
(11 marks)

The table shows data comparing the gestation period (in days) with the birth weight (in grams) for ten Tasmanian possums.

Gestation period in days (d)	36	37	37	38	38	42	43	44	44	45
Birth weight in grams (g)	42	43	44	43	44	41	42	43	41	42

(a) Plot the last five data points on the axes below.

(2 marks)



The correlation coefficient for these observations is approximately -0.6 and the least-squares line is $g = -0.17d + 49$.

(b) Describe what this correlation suggests about the general pattern of association between gestation period and birth weight. (2 marks)

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- (c) Determine the coefficient of determination for these data. (1 mark)
- (d) State the meaning of the coefficient of determination in the context of the question. (1 mark)
- (e) Use the least-squares line to predict the birth weight of a possum after 40 days gestation. (1 mark)
- (f) Comment on the validity of this prediction. (2 marks)
- (g) Is there any statistical evidence to support the research view that a higher birth weight will cause a shorter gestation period? Justify your answer. (2 marks)

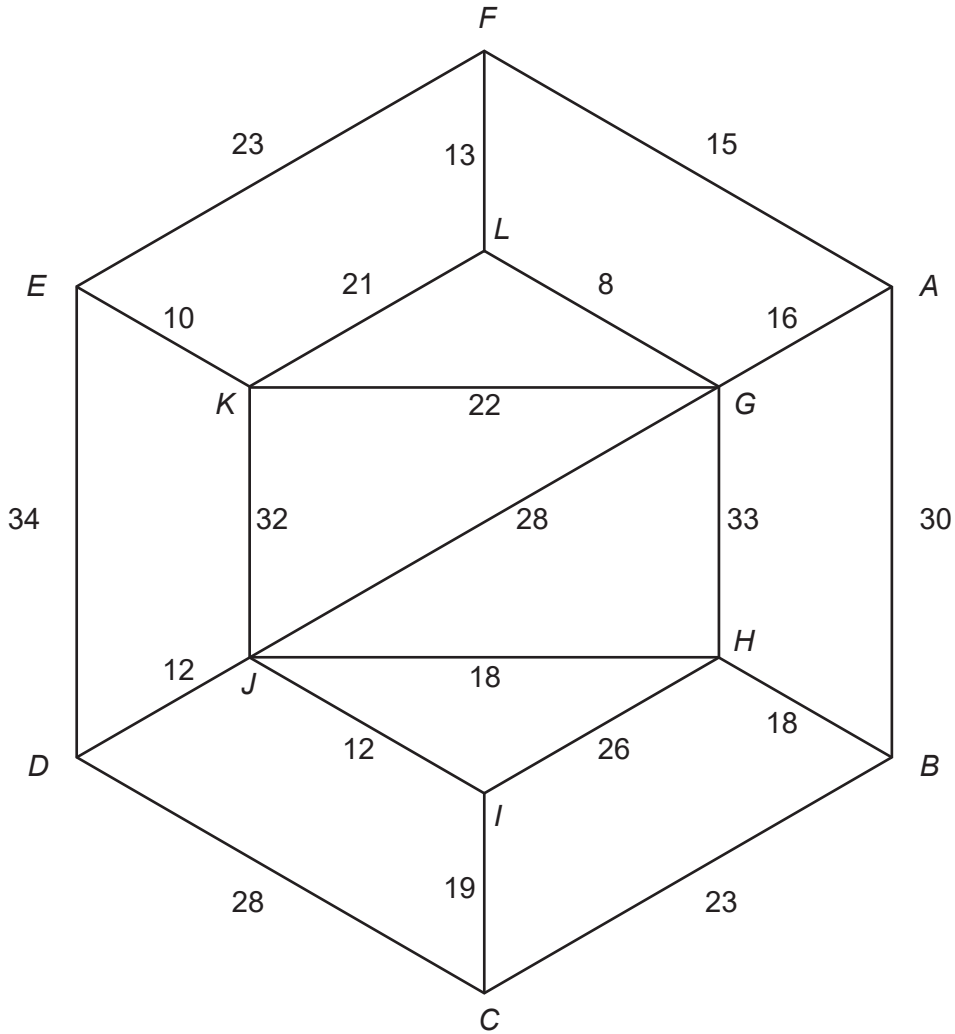
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Question 5

(7 marks)

A communication wi-fi network is to be installed to service a shopping centre connecting 12 shops located at vertices $A, B, C, D, E, F, G, H, I, J, K$ and L . The only practical connections between vertices are shown on the following network.

The number on each edge is the quoted price, in hundreds of dollars, for the direct link between the vertices.

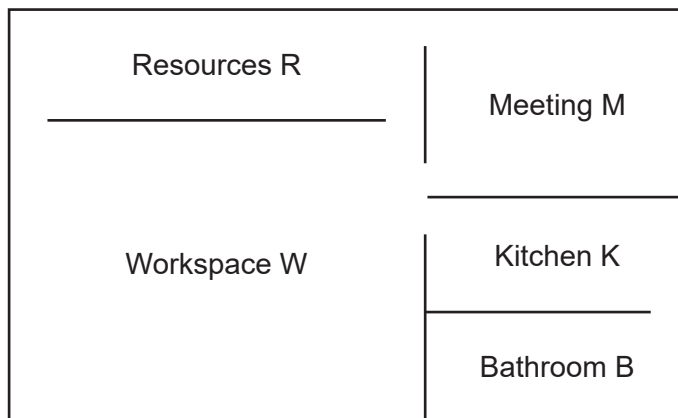


- (a) A minimal spanning tree is to be used to determine the minimum cost of this installation.
 - (i) Show clearly on the network the minimum spanning tree solution. (3 marks)
 - (ii) Determine the minimum cost. (2 marks)

Question 6

(8 marks)

A small business office has five separate areas connected by doorways shown as gaps in this diagram:



This adjacency matrix below represents the number of doorways directly between each area:

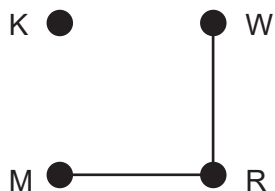
$$\begin{matrix}
 & \begin{matrix} B & K & M & R & W \end{matrix} \\
 \begin{matrix} B \\ K \\ M \\ R \\ W \end{matrix} & \begin{bmatrix} 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & Y \\ 0 & X & 1 & 2 & 0 \end{bmatrix}
 \end{matrix}$$

- (a) State the meaning of the zero entries in the matrix. (1 mark)

- (b) Determine the value of X and Y . (2 marks)

- (c) Describe how the total number of doorways for each area can be found from the adjacency matrix. (1 mark)

- (d) Complete this network with vertices corresponding to the office areas and the edges representing the doorways. (3 marks)



- (e) Determine how many different routes there are between the meeting room and the workspace that pass through exactly two doorways. (1 mark)

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Supplementary page

Question number: _____

Supplementary page

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