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

ATAR course examination, 2021

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

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	7	7	50	52	35
Section Two: Calculator-assumed	9	9	100	94	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 2021: 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% (52 Marks)**

This section has **seven** 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)**

Hanai is a successful college basketball player. His coach has warned him that he will lose his scholarship if he scores 54% or below on a weekly assessment. On his first three weekly assessments he scored 84%, 81% and 78% respectively.

Assume Hanai's weekly assessments continue to follow this pattern.

(a) Deduce a rule for the n^{th} term of this sequence. (2 marks)

(b) Determine Hanai's score on his sixth weekly assessment. (1 mark)

(c) Predict when Hanai will lose his scholarship. (2 marks)

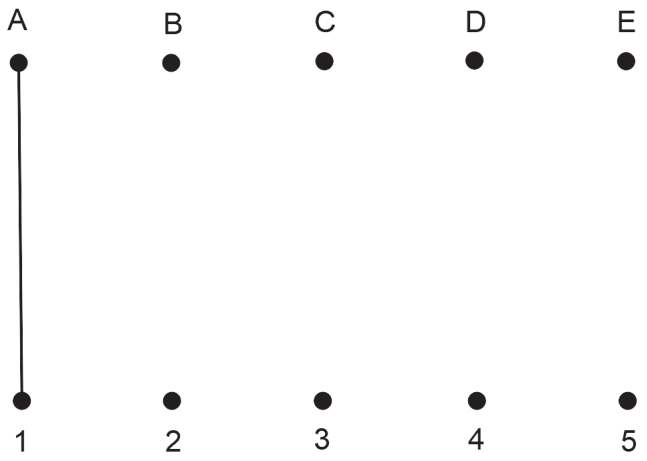
Question 2 **(10 marks)**

A construction company uses five different machines and has five employees who operate those machines.

The adjacency matrix below shows each of the five employees (A, B, C, D, E) and the five machines they are trained to operate. These are the only machines they may use.

Machine	Employee A	B	C	D	E
1	1	0	0	1	0
2	0	0	0	0	1
3	1	1	0	0	0
4	0	0	1	0	1
5	0	0	1	1	0

(a) Draw the adjacency matrix as a bipartite graph. The A1 connection has already been drawn on the graph. (2 marks)



(b) Does the bipartite graph in part (a) represent

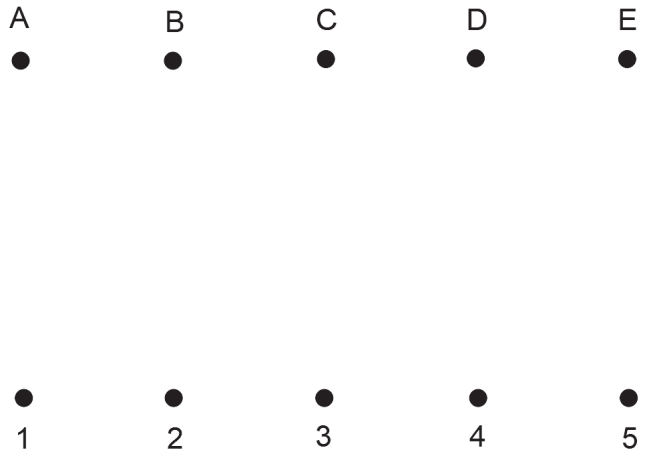
(i) a planar graph? (1 mark)

(ii) a connected graph? (1 mark)

(c) Explain why the bipartite graph in part (a) is a simple graph. (2 marks)

See next page

(d) Complete the table below to show how an allocation of all employees to a machine could be achieved. (2 marks)



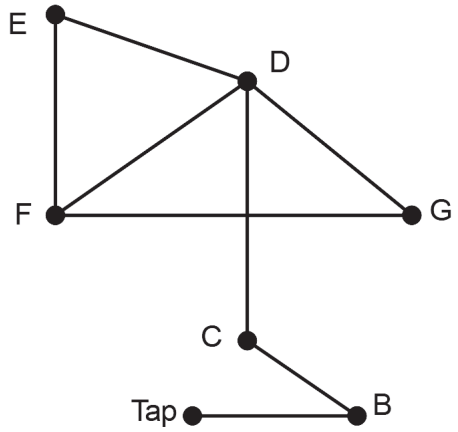
Employee	A	B	C	D	E
Machine					

(e) The company foreman decides to allocate Employee E to Machine 4. Explain what effect this will have to the allocation of the remaining employees to the machines. (2 marks)

See next page

Question 3 **(6 marks)**

The graph below shows the current network of reticulation pipes in Tarik's garden.



(a) Using Euler's formula, stating the number of vertices, edges and faces, show that the graph is planar. (2 marks)

The water needs to travel from the tap and through all pipes.

(b) List a possible route for the water. (1 mark)

(c) What is the mathematical term for the route listed in part (b)? (1 mark)

(d) Tarik would like to increase the water pressure by removing one edge (pipe).

(i) Identify any edge that **cannot** be removed. (1 mark)

(ii) What is the name given to the type of edge identified in part (d)(i)? (1 mark)

See next page

Question 4 **(9 marks)**

A public opinion survey was conducted on the statement ‘our overwhelming dependence on computers is a good thing’, with partial results being shown in the table below.

		Opinion			
		Agree	**Disagree**	**Undecided**	**Total**
Age	**20–39 years**	40	28		80
	40–59 years	38		20	100
	60–79 years	20		18	
	Total				230

(a) Complete the table above. (3 marks)

(b) Identify the response variable. (1 mark)

(c) Use the template below to construct a percentaged two-way frequency table showing **either** column or row percentages as appropriate, to investigate if there is an association between age and opinion. (4 marks)

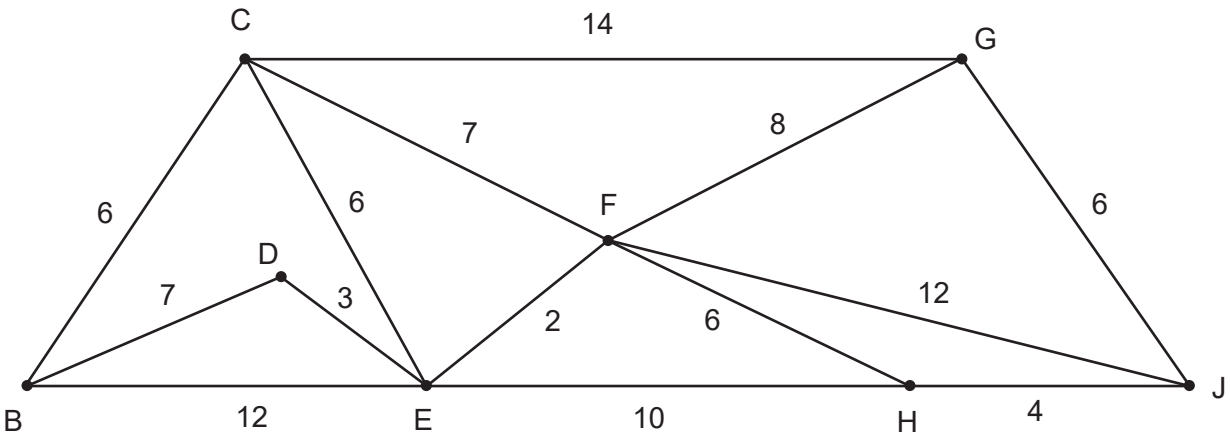
		Opinion			
		Agree	**Disagree**	**Undecided**	
Age	**20–39 years**				
	40–59 years				
	60–79 years				

(d) State an association that can be observed from the percentaged two-way frequency table. (1 mark)

See next page

Question 5 **(8 marks)**

The network below shows the relative distances, in hundreds of metres, between wi-fi hotspots around a university campus.



The control room for this system of hotspots is located at B. A problem has been reported with the hotspot at J.

(a) A technician is sent from the control room to solve the problem at J. To get there as quickly as possible, she wants to use the shortest path, travelling from hotspot to hotspot. Determine the required path and its length. (3 marks)

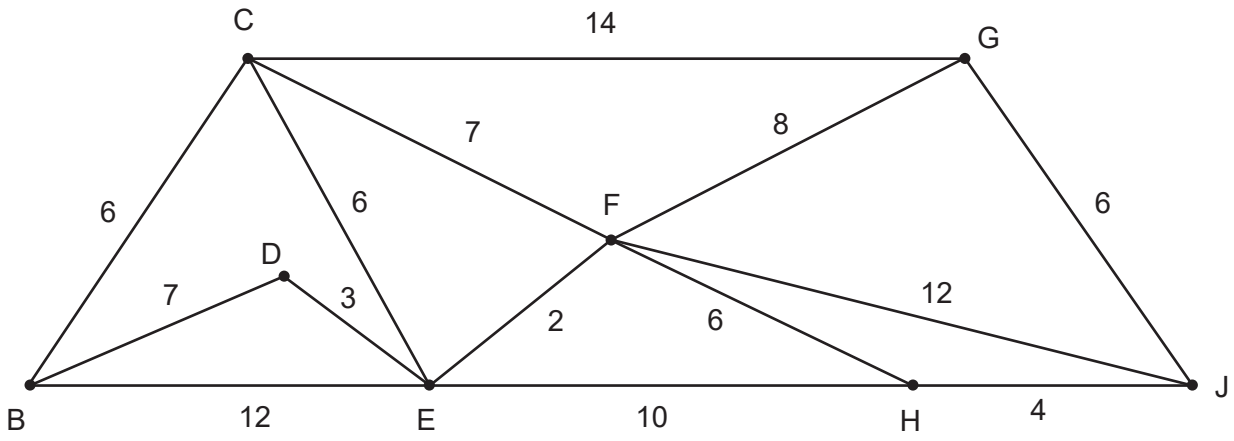
(b) A second technician is sent from the control room to J to help resolve the problem. The technician uses an open path travelling from hotspot to hotspot. If the technician travels 2700 metres, determine the path he used. (1 mark)

See next page

(c) After repairs have been made, all hotspots need to be checked. A technician is sent from the control room, travelling to all hotspots once only, and finishing back at the control room.

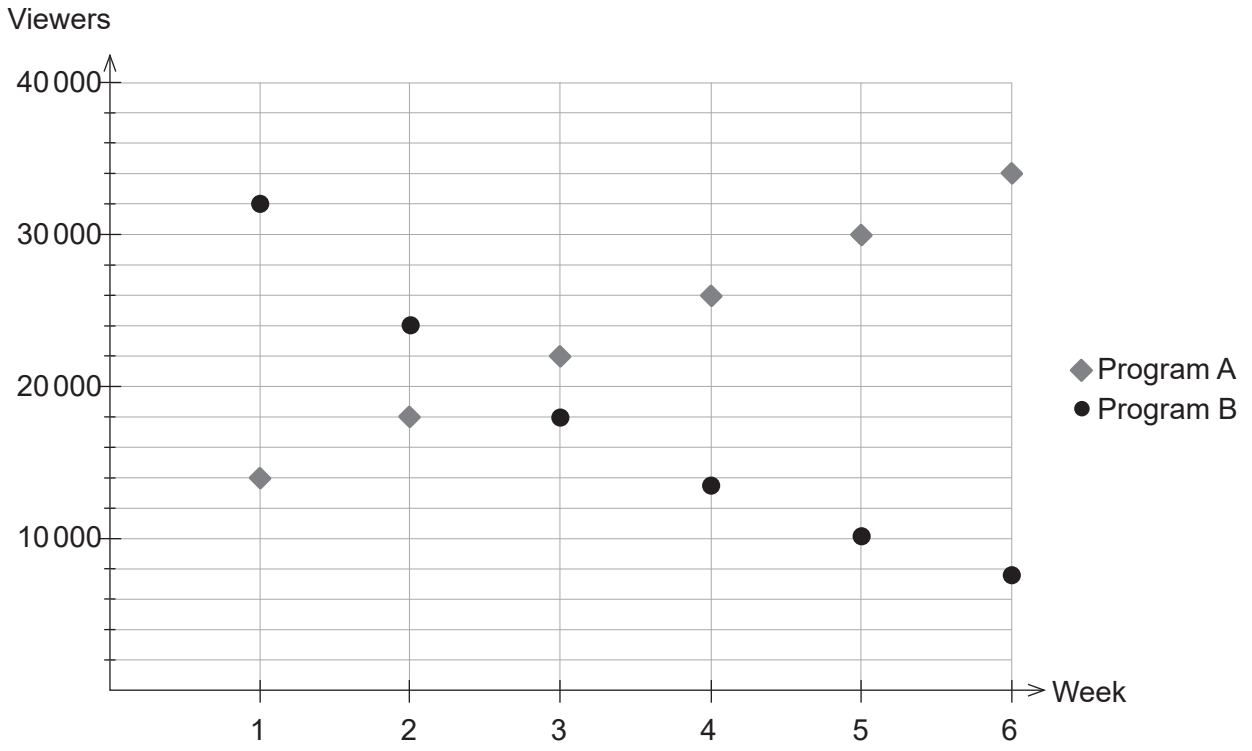
(i) State the name given to this type of path. (2 marks)

(ii) Determine the length of the shortest path possible and state the path used. (2 marks)



Question 6 **(7 marks)**

A television network programmer was analysing the number of viewers for two children's programs over a period of several weeks, to decide which program should be given the better time slot. The viewing numbers, displayed on the graph below, formed an arithmetic sequence and a geometric sequence.



(a) Write a recursive rule for the arithmetic sequence. (2 marks)

(b) Using the first two data points, deduce a rule for the n^{th} term of the geometric sequence. (2 marks)

See next page

(c) Explain which program should be given the better time slot. (2 marks)

(d) Determine the number of viewers for the more successful program in Week 8. (1 mark)

See next page

Question 7 **(7 marks)**

The ages in years, and salaries in thousands of dollars ($'000), of eight employees at a company are shown below. The equation of the least-squares line for these data is $y = 0.2x + 38$.

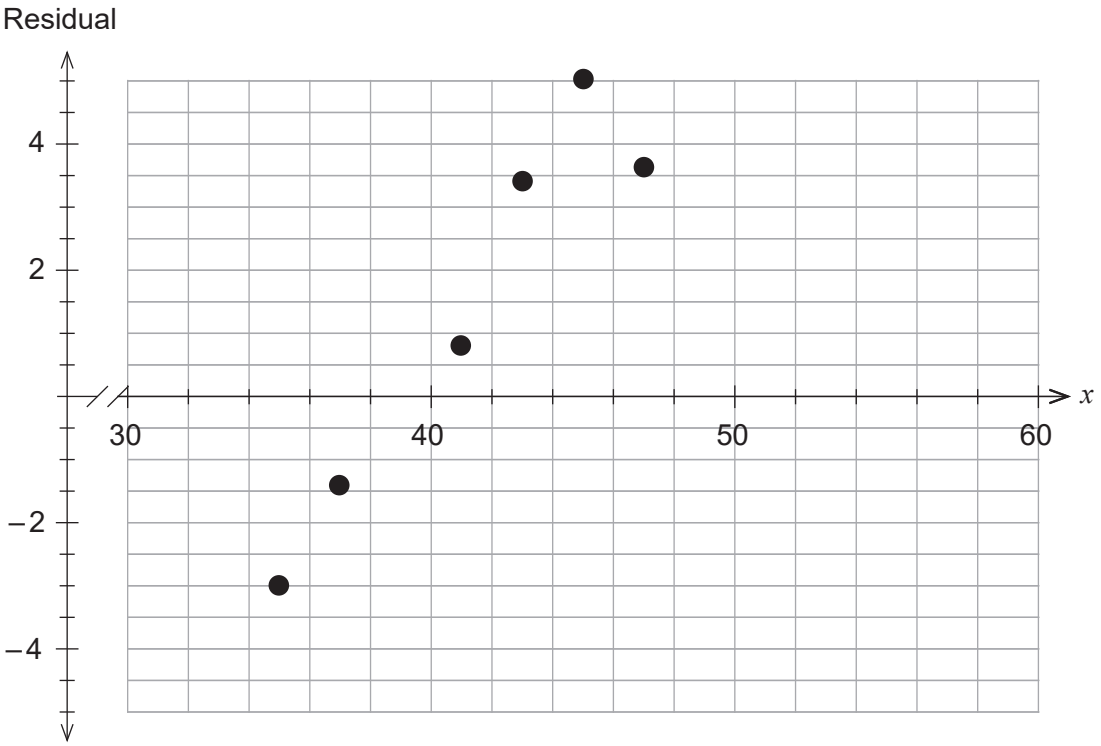
Age (x)	35	37	41	43	45	47	53	55
Salary (y)	42	44	47	50	52	51	49	45

The table below shows the predicted y-values, obtained from the equation of the least-squares line, and the corresponding residuals.

x	y	**Predicted y-value**	**Residual**
35	42	45.0	–3.0
37	44	45.4	–1.4
41	47	46.2	0.8
43	50	46.6	3.4
45	52	47.0	5.0
47	51	47.4	3.6
53	49	48.6	0.4
55	45	**A**	**B**

(a) Determine the value of **A** and **B**. (2 marks)

(b) Plot the last two residuals on the graph below. (2 marks)



(c) Justify, using the residual plot in part (b), whether the least-squares line is a good model for these data. (2 marks)

The calculated correlation coefficient for these data is 0.42.

(d) Describe how this supports your response in part (c). (1 mark)

End of section

Supplementary page

Question number: _____

Supplementary page

Question number: _____

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