



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



## ATAR course examination, 2023

### 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

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### 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	52	35
Section Two: Calculator-assumed	8	8	100	97	65
<b>Total</b>					100

## Instructions to candidates

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2023: 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 answers 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.

**Section One: Calculator-free****35% (52 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.

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**See next page**

Question 1

(8 marks)

A survey was conducted by a film studio executive of filmgoers' favourite genres. The categories chosen were action, drama and comedy. The information is displayed in the table below.

		Genre			Total
		Action	Drama	Comedy	
Age (years)	1–10	40	45		125
	11–20	17		43	86
	21–30		25		125
Total			96	113	336

(a) Complete the two-way table above. (3 marks)

(b) Identify the response variable for these data. (1 mark)

(c) The incomplete two-way percentaged table is shown below.

		Genre			Total
		Action	Drama	Comedy	
Age (years)	1–10		36		
	11–20		30		
	21–30	56		24	
Total					

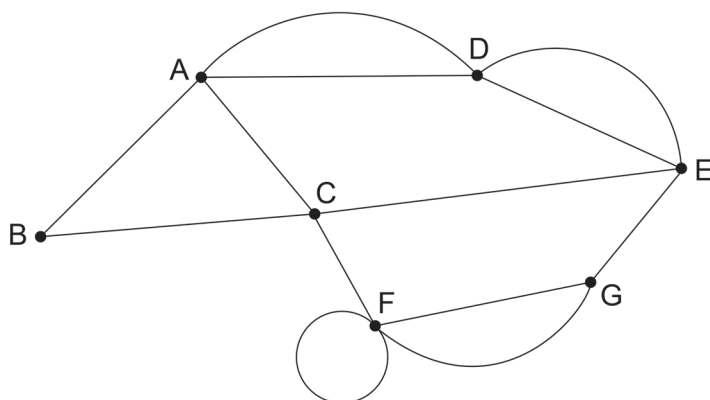
(i) Complete the table above by using either row percentages **or** column percentages, as appropriate. (3 marks)

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

Question 2

(9 marks)

The network shown below is for walking tracks around a wildlife sanctuary. Located at each vertex is an undercover area with picnic tables and viewing stations for visitors.



(a) Complete the adjacency matrix for the network shown.

(3 marks)

	A	B	C	D	E	F	G
A	0	1	1	2	0	0	0
B	1	0	1	0	0	0	0
C	1	1	0	_____	_____	_____	_____
D	2	0	0	_____	_____	_____	_____
E	0	0	1	_____	_____	_____	_____
F	0	0	1	_____	_____	_____	_____
G	0	0	0	_____	_____	_____	_____

(b) Identify the feature of the adjacency matrix that indicates it is an undirected graph. (1 mark)

(c) List all possible open paths of length two starting from G.

(3 marks)

(d) Each morning before visitors are admitted, all fences along walking tracks between vertices must be checked for safety. Is it possible to carry out the safety check with an Eulerian trail, a semi-Eulerian trail or neither? Justify your answer.

(2 marks)

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## Question 3

(9 marks)

From January 1, 2020, a company offered its employees an income package with a starting wage of \$4000 per month, paid at the end of each month. Also, as an incentive to stay with the company, there was a monthly increase of \$50 each month.

(a) Determine a recursive rule for the monthly wage. (2 marks)

(b) Deduce a simplified rule for the  $n^{\text{th}}$  term of the monthly wage. (2 marks)

(c) Determine the monthly wage for December 2020. (2 marks)

The company has decided to make the monthly increase \$60 from the end of December 2023.

(d) Calculate the monthly wage for March 2024. (3 marks)

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**Question 4**

**(4 marks)**

The following tables show activities and their completion requirements for a project to build a shearing shed.

Activity	Activity description
A	Design the shearing shed
B	Prepare the site
C	Purchase materials
D	Construct the frame and walls
E	Install roof and windows
F	Add ventilation and insulation
G	Build the shearing stand
H	Install electrics
J	Paint and finish the shed
K	Install shearing equipment

Requirements
A, B and C start the project together
D starts when A is completed
E starts when B is completed
F starts when C is completed
G starts when D and E are completed
J starts when F is completed
H starts when D, E and F are completed
K starts when G, H and J are completed

Draw the project network for the information given in the tables.

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Question 5

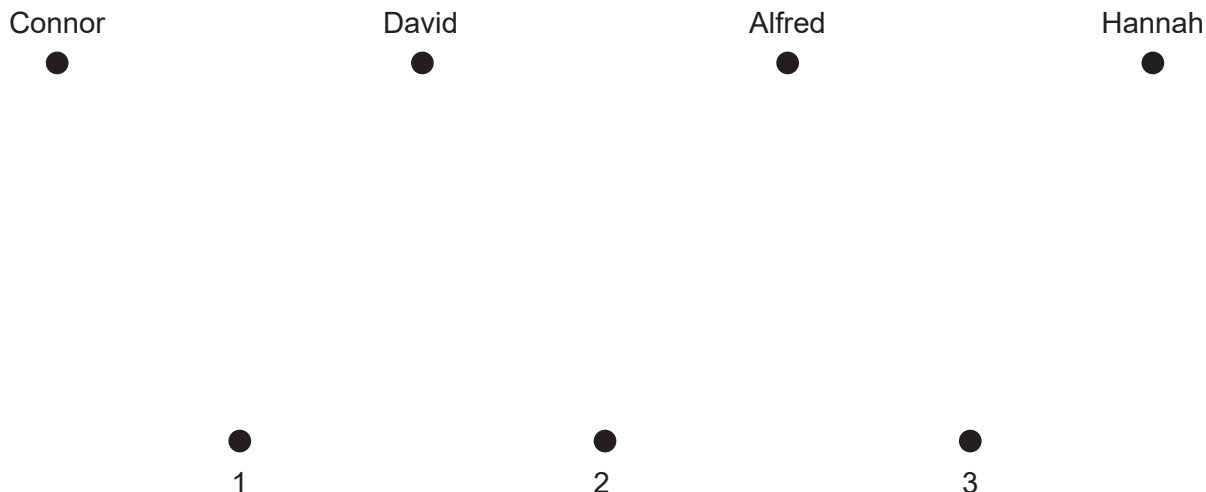
(10 marks)

Four camp leaders, Connor, David, Alfred and Hannah, are responsible for setting up the camp site for the upcoming school camp. Today there are three tasks available. Each task will only have one camp leader assigned to it.

The number of hours each camp leader takes to complete each task is shown in the table below.

		Task		
		1	2	3
Camp leader	Connor	7	5	8
	David	3	8	5
	Alfred	9	6	7
	Hannah	8	8	6

- (a) Draw a weighted bipartite graph showing all the possible allocations for each of the camp leaders. (2 marks)



- (b) Complete the 4 x 4 matrix below to represent the allocation of tasks to camp leaders. (2 marks)

7			
		5	
9			

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- (c) Use the Hungarian algorithm to determine the allocation of camp leader to the task that will minimise the time taken. (4 marks)

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- (d) Show the task allocated to each camp leader and calculate the total time taken to complete all tasks. (2 marks)

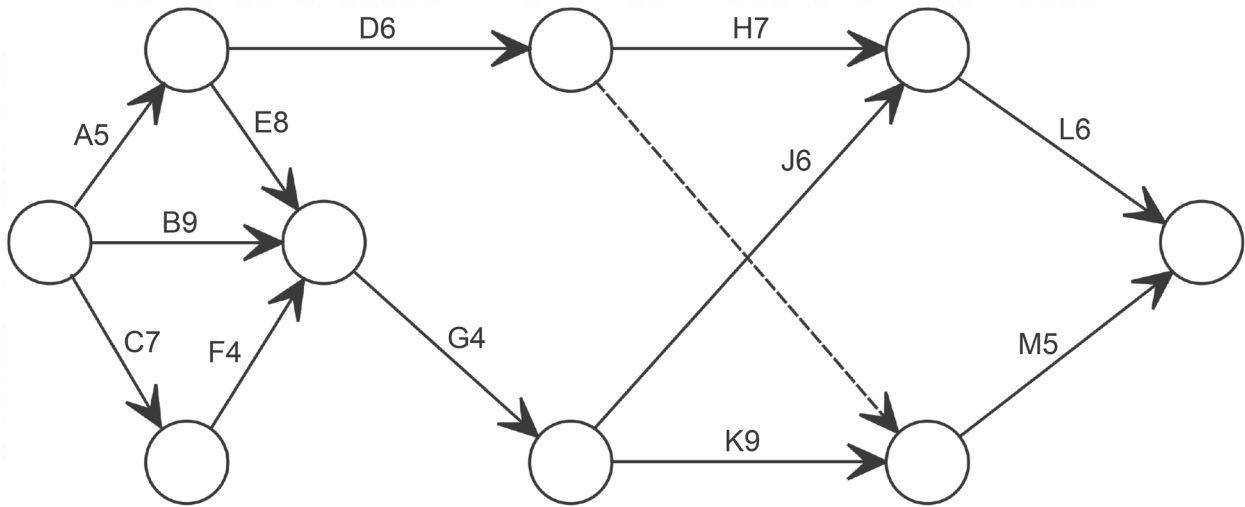
Camp leader	Connor	David	Alfred	Hannah
Task				

Total time: \_\_\_\_\_

Question 6

(12 marks)

A landscape architect has produced the following project network for the development of a community market garden. The digraph shows the order of completion of the various tasks and their expected completion time in hours.



(a) Complete the immediate predecessor/s column in the table below.

(3 marks)

Task	Time (hours)	Immediate predecessor/s
A	5	
B	9	
C	7	
D	6	
E	8	
F	4	
G	4	
H	7	
J	6	
K	9	
L	6	
M	5	

- (b) Determine the critical path and the minimum completion time for the project. Workings must be shown to verify your answer. (3 marks)
- (c) Determine which task/s have a float time of exactly 2 hours. (2 marks)
- (d) Describe why Task D can be delayed by 6 hours and not affect the minimum completion time. (2 marks)
- (e) Due to the release of a new piece of technology for reticulation control, Task G is no longer required. Redraw the network showing how the removal of Task G will change the configuration of the network. Task times are **not** required to be shown. (2 marks)

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Supplementary page

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