

General Mathematics 2019 v1.2

IA3: Sample assessment instrument

Examination — short response (15%)

This sample has been compiled by the QCAA to assist and support teachers in planning and developing assessment instruments for individual school settings.

Student name

Student number

Teacher

Exam date

Marking summary

Criterion	Marks allocated	Provisional marks
Foundational knowledge and problem-solving	15	
Overall	15	

Conditions

Unit	Unit 4: Investing and networking
Topic/s	Topic 1: Loans, investments and annuities Topic 2: Graphs and networks Topic 3: Networks and decision mathematics
Time	2 hours + 5 minutes perusal
Other	Only the QCAA formula sheet must be provided. Notes are not permitted. Use of technology is required; schools must specify the technology used.

Instructions

- Show all working in the space provided.
- Write responses using blue or black pen.
- Unless otherwise instructed, all numerical answers should be given to two decimal places.
- Use additional pages if you require more space for your responses, noting the page number of the question.
- To cancel an incorrect response, rule a single diagonal line through your work. If you fail to do this, your original response will be marked.
- Use of a scientific calculator is permitted.

Question 1 (6 marks) SF

Anna invests \$12 000 in an account where she earns 3.2% p.a., compounded quarterly.

- a. Develop a recurrence relation that can be used to describe the value of her investment at the end of each quarter.
- b. Using the recurrence relation, determine the value of the investment after one year.
- c. Using the compound interest formula, calculate how much the investment will be worth six years from when it was first invested.

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Question 2 (3 marks) SF

Halim borrows \$50 000 from a bank at 6.6% p.a. adjusted monthly. He is required to make a regular monthly repayment of \$750. Determine how much he still owes on the loan after three months.

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Question 3 (4 marks) SF

Cameron borrows \$24 000 from a bank at 9% p.a. compound interest, adjusted monthly. The loan is to be repaid in five years. A spreadsheet was used to determine the monthly repayment, indicated in cell B4 below.

	A	B
1	Balance	
2	Interest rate	
3	Periods	
4	Monthly repayment	-\$498.20

- a. Fill in the missing information in the cells above.
- b. State the formula used to calculate the monthly repayment.
- c. Determine the total amount that will need to be repaid on the loan.

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Question 4 (4 marks) SF

Mrs Papas needs to borrow \$350 000 and has a choice of two home loans.

- Option 1 is a reducible interest loan at 4.71% p.a. over 25 years, with fixed fortnightly repayments.
- Option 2 is a reducible interest loan with monthly repayments of \$2500 for 18 years.

The bank manager tells Mrs Papas that she will save at least \$60 000 over the lifetime of the loan if she chooses Option 2.

Evaluate the reasonableness of the bank manager's claim.

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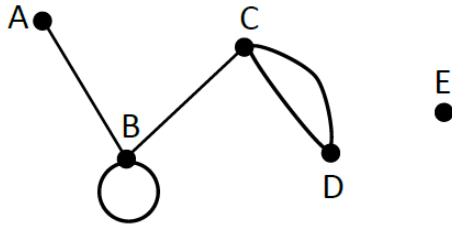
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Question 5 (1.5 marks) SF

Consider the graph below:



- a. How many edges are shown in the graph?
- b. How many loop edges are shown in the graph?
- c. Which vertex has a loop edge?

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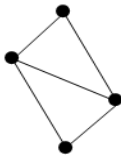
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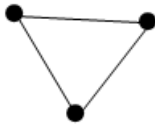
Question 6 (3 marks) SF

Identify each of the following graphs as either simple, connected, complete, bipartite or a combination of these.

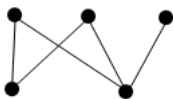
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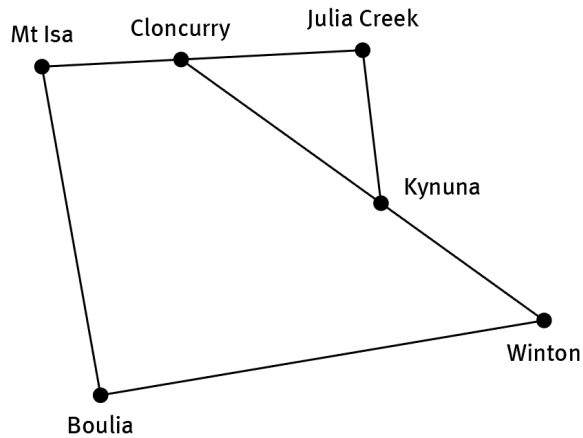
b.



c.



Question 7 (3 marks) SF



Using the above map, determine:

- a. the number of edges directly connected to Kynuna
- b. the town/s adjacent to Mount Isa
- c. the vertices with the highest degree and the degree of those vertices.

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Question 8 (4 marks) SF

Australia is divided into eight states and territories.



- a. Use an adjacency matrix to represent the number of land borders between the states and territories.
- b. Create a graph to represent this, with the vertices representing the states and territories, and the edges representing the borders.

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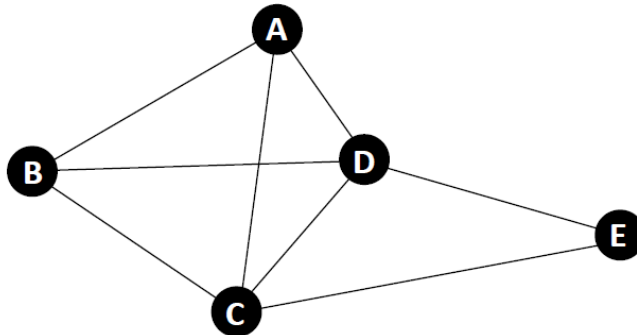
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Question 9 (8, 2.5 marks) SF, CU

The Edwards family is on holiday in England and wishes to visit five castles. A map of the castle locations is shown below, with the vertices representing the castles and the edges representing the roads connecting the castles.



- a. Determine a Hamiltonian cycle that the family can follow.
- b. List the roads (or edges) that the family does not travel on.
- c. Determine a Euler trail that the family can follow to visit each castle. Justify decisions made using mathematical reasoning.
- d. Assuming all road lengths are 2 kilometres, the family can walk at a speed of 5 kilometres per hour, and they spend 30 minutes at each castle, determine the latest time they can start the walk to complete it by 5 pm.

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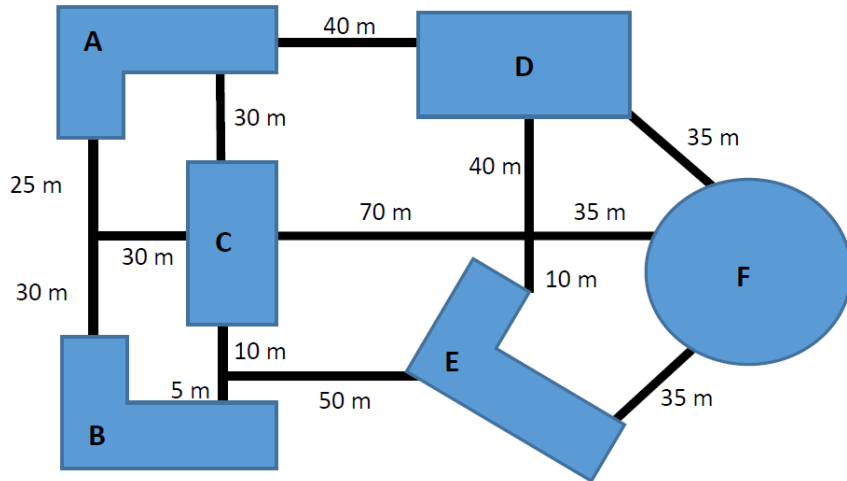
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Question 10 (6.5 marks) CU

The map below shows the possible locations of covered walkways in a new school. The lengths of each section are shown. Erecting the walkways costs \$180 per metre. In addition, at each point that the walkway connects to a building, it needs to connect to the stormwater system, which costs \$1220 for each connection (e.g. Building A has three possible connections to the stormwater system).

For the initial construction, only some of the walkways will be built. This initial construction must allow for students to walk to any building, using the walkways and other buildings, without getting wet during a storm.



Develop the cheapest quote for the initial construction. Justify decisions made using mathematical reasoning.

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A series of horizontal dotted lines for writing.

Question 11 (3 marks) SF

Ms Nguyen is doing a major upgrade of her home computer network. The table below represents the length (in metres) of cable that she will need to connect the rooms of her house.

	B	C	D	E
A	14	7	15	10
B	–	12	9	3
C	–	–	11	9
D	–	–	–	7

- a. Draw the minimum spanning tree for this network.
- b. Calculate the total length of the minimum spanning tree.

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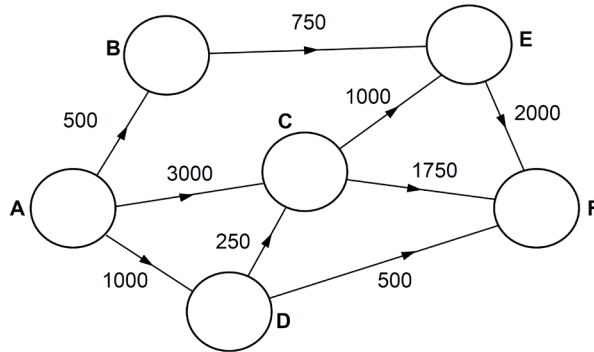
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Question 12 (3 marks) CF

The network below shows the maximum rate of water flow (in litres per minute) through a system of water pipes from a source at A to a sink at F.



Calculate how long it will take to fill a 450-kilolitre tank connected to the sink at F, assuming the maximum flow rate of water.

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Question 13 (5.5 marks) CF

A business owner wishes to assign three jobs to three different teams in her organisation. The estimated costs (in millions of dollars) of assigning a particular team to a particular job are shown in the table below.

	Job 1	Job 2	Job 3
Team A	12	17	11
Team B	11	20	7
Team C	8	16	5

Because of time constraints, assume each team can accept one job only.

- a. Determine the best allocation of teams to minimise the cost.
- b. Discuss the reasonableness of your solution by considering the original assumption made.

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Dotted lines for student response.

Question 14 (2, 4 marks) SF, CF

Consider the activity table below.

Activity letter	Immediate predecessor	Duration (weeks)
A	–	4
B	–	5
C	A	3
D	A	3
E	B, C	2

- a. Construct a network diagram using this information.
- b. Determine any activities that could be delayed or extended, and by how long, without affecting the minimum project completion time. Justify all decisions made using mathematical reasoning.

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Extra working page

A series of 24 horizontal dotted lines providing a workspace for calculations or writing.

Examination marks summary

Question	Simple familiar (SF)	Complex familiar (CF)	Complex unfamiliar (CU)
1	6		
2	3		
3	4		
4			4
5	1.5		
6	3		
7	3		
8	4		
9	8		2.5
10			6.5
11	3		
12		3	
13		5.5	
14	2	4	
Totals	37.5	12.5	13

Instrument-specific marking guide (IA3): Examination — short response (15%)

Criterion: Foundational knowledge and problem-solving

Assessment objectives

1. select, recall and use facts, rules, definitions and procedures drawn from all Unit 4 topics
2. comprehend mathematical concepts and techniques drawn from all Unit 4 topics
3. communicate using mathematical, statistical and everyday language and conventions
4. evaluate the reasonableness of solutions
5. justify procedures and decisions by explaining mathematical reasoning
6. solve problems by applying mathematical concepts and techniques drawn from all Unit 4 topics

The student work has the following characteristics:	Cut-off	Marks
<ul style="list-style-type: none"> consistently correct selection, recall and use of facts, rules, definitions and procedures; authoritative and accurate command of mathematical concepts and techniques; astute evaluation of the reasonableness of solutions and use of mathematical reasoning to correctly justify procedures and decisions; and fluent application of mathematical concepts and techniques to solve problems in a comprehensive range of simple familiar, complex familiar and complex unfamiliar situations. 	>93%	15
	>87%	14
<ul style="list-style-type: none"> correct selection, recall and use of facts, rules, definitions and procedures; comprehension and clear communication of mathematical concepts and techniques; considered evaluation of the reasonableness of solutions and use of mathematical reasoning to justify procedures and decisions; and proficient application of mathematical concepts and techniques to solve problems in simple familiar, complex familiar and complex unfamiliar situations. 	>80%	13
	>73%	12
<ul style="list-style-type: none"> thorough selection, recall and use of facts, rules, definitions and procedures; comprehension and communication of mathematical concepts and techniques; evaluation of the reasonableness of solutions and use of mathematical reasoning to justify procedures and decisions; and application of mathematical concepts and techniques to solve problems in simple familiar and complex familiar situations. 	>67%	11
	>60%	10
<ul style="list-style-type: none"> selection, recall and use of facts, rules, definitions and procedures; comprehension and communication of mathematical concepts and techniques; evaluation of the reasonableness of some solutions using mathematical reasoning; and application of mathematical concepts and techniques to solve problems in simple familiar situations. 	>53%	9
	>47%	8
<ul style="list-style-type: none"> some selection, recall and use of facts, rules, definitions and procedures; basic comprehension and communication of mathematical concepts and techniques; inconsistent evaluation of the reasonableness of solutions using mathematical reasoning; and inconsistent application of mathematical concepts and techniques. 	>40%	7
	>33%	6
<ul style="list-style-type: none"> infrequent selection, recall and use of facts, rules, definitions and procedures; basic comprehension and communication of some 	>27%	5

The student work has the following characteristics:	Cut-off	Marks
mathematical concepts and techniques; some description of the reasonableness of solutions; and infrequent application of mathematical concepts and techniques.	>20%	4
<ul style="list-style-type: none"> isolated selection, recall and use of facts, rules, definitions and procedures; partial comprehension and communication of rudimentary mathematical concepts and techniques; superficial description of the reasonableness of solutions; and disjointed application of mathematical concepts and techniques. 	>13%	3
	>7%	2
<ul style="list-style-type: none"> isolated and inaccurate selection, recall and use of facts, rules, definitions and procedures; disjointed and unclear communication of mathematical concepts and techniques; and illogical description of the reasonableness of solutions. 	>0%	1
<ul style="list-style-type: none"> does not satisfy any of the descriptors above. 		0



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