

General Mathematics marking guide

External Assessment

Paper 1: Technology-Free (48 marks)

Paper 2: Technology-Active (33 marks)

Assessment Objectives

This assessment instrument is used to determine student achievement in the following objectives:

1. select, recall and use facts, rules, definitions and procedures drawn from Units 3 and 4
2. comprehend mathematical concepts and techniques drawn from Units 3 and 4
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 Units 3 and 4.

Purpose

This document consists of a marking guide and a sample response.

The marking guide:

- provides a tool for calibrating external assessment markers to ensure reliability of results
- indicates the correlation, for each question, between mark allocation and qualities at each level of the mark range
- informs schools and students about how marks are matched to qualities in student responses.

The sample response:

- demonstrates the qualities of a high-level response
- has been annotated using the marking guide.

Mark Allocation

Where a response does not meet any of the descriptors for a question or a criterion, a mark of '0' will be recorded.

Where no response to a question has been made, a mark of 'N' will be recorded.

Allow FT mark/s — refers to 'follow through', where an error in the prior section of working is used later in the response, a mark (or marks) for the rest of the response can still be awarded so long as it still demonstrates the correct conceptual understanding or skill in the rest of the response.

This mark may be implied by subsequent working — the full mathematical reasoning and/or working, as outlined in the sample response and associated mark, is not explicitly stated in the student response, but by virtue of subsequent working there is sufficient evidence to award the mark/s.

Marking Guide

Paper 1

Multiple Choice

Question	Response
1	A
2	A
3	C
4	B
5	B
6	A
7	B
8	C
9	B
10	A
11	C
12	D
13	D
14	A
15	B

Short Response

Q	Sample response	The response:
16	$15^{\circ}W \rightarrow 75^{\circ}E = 90^{\circ}$ difference $90^{\circ} = 6$ hours. $\therefore 3:30am - 6 \text{ hours} = 9:30pm$ the previous day.	<ul style="list-style-type: none"> Recognise that only latitude influences time difference, and the calculates the degree difference [1 mark] Calculates the difference in hours from the degrees. [1 mark] States new time, and specifically mentions the previous day. [1 mark]

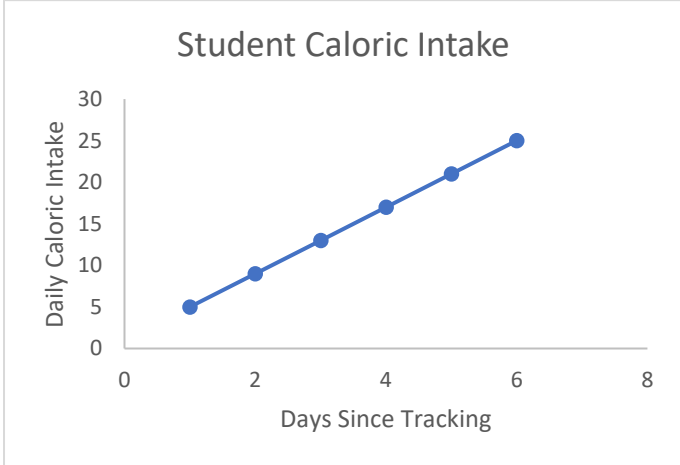
Q	Sample response	The response:
17	For Bank A, $i_{eff} = 4.76\%$ For Bank B, $i_{eff} = 4.71\%$ Bank A is better, as a higher effective rate will bring a greater return of cash.	<ul style="list-style-type: none"> Calculates effective rate for both banks [1 mark] Compares both options, and selects with correct reasoning [1 mark]

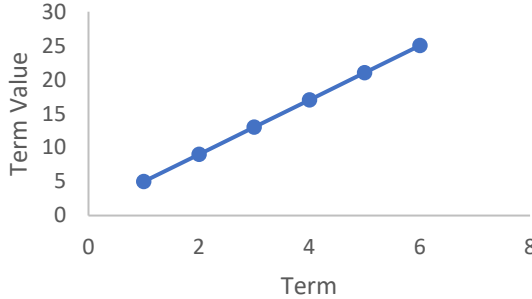
Q	Sample response	The response:
18	$A = \frac{5000\left(\left(1 + \frac{0.038}{12}\right)^{96} - 1\right)}{\frac{0.038}{12}}$ $A = \$559,923.55$	<ul style="list-style-type: none"> • Correctly applies future annuity formula [1 mark] • Correct future value [1 mark]

Q	Sample response	The response:
19	<p><i>AGE</i></p> <p>with a value of $5 + 9 = 15$</p>	<ul style="list-style-type: none"> • States the path [1 mark] • States the shortest path value [1 mark] • Logic mark for notations on graph [1 mark]

Q	Sample response	The response:
20	<p>Shows evidence of all 4 cuts</p> <p>Calculates all 4 cuts as 38, 40, 41, 36</p> <p>Calculates minimum cut as $36L/sec$</p> <p>Answers in appropriate units</p>	<ul style="list-style-type: none"> • Logic evidence of cuts [1 mark] • Calculates all 4 cuts [1 mark] • Identifies minimum cut as maximum flow [1 mark] • Includes appropriate unit of measurement in solution [1 mark]

Q	Sample response	The response:
21	<p>Minimum Tree is connected by lines: AB, AF, GF, FH, BC, CE, DE</p> <p>Minimum Spanning Tree = 63 ∴ the minimum cost is \$63,000</p>	<ul style="list-style-type: none"> • Graphical minimum spanning tree [1 mark] • Calculates minimum spanning tree [1 mark] • States minimum cost [1 mark] • Logic of applying Prim's Algorithm [1 mark]

Q	Sample response	The response:
22		<ul style="list-style-type: none"> • Includes connected points in correct location [1 mark] • Applies appropriate axis scales [1 mark] • Names axis and graph titles appropriately [1 mark]

Q	Sample response	The response:														
23	<p>$t_1 = 5, t_2 = 9, t_3 = 13, t_4 = 17, t_5 = 21, t_6 = 25$</p> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">First 6 Terms Graphically Displayed</p>  <table border="1"> <caption>Data points from the graph</caption> <thead> <tr> <th>Term</th> <th>Term Value</th> </tr> </thead> <tbody> <tr><td>1</td><td>5</td></tr> <tr><td>2</td><td>9</td></tr> <tr><td>3</td><td>13</td></tr> <tr><td>4</td><td>17</td></tr> <tr><td>5</td><td>21</td></tr> <tr><td>6</td><td>25</td></tr> </tbody> </table> </div> <p>$t_n = 5 + 4(n - 1)$</p> <p>$t_{22} = 5 + 4(21)$</p> <p>$t_{22} = 89$</p>	Term	Term Value	1	5	2	9	3	13	4	17	5	21	6	25	<ul style="list-style-type: none"> <li>• States first 6 terms [1 mark] <li>• Graphs first 6 terms [1 mark] <li>• Determines rule in form [1 mark] <li>• Applies rule correctly [1 mark] <li>• Correctly answers t_{22} [1 mark]
Term	Term Value															
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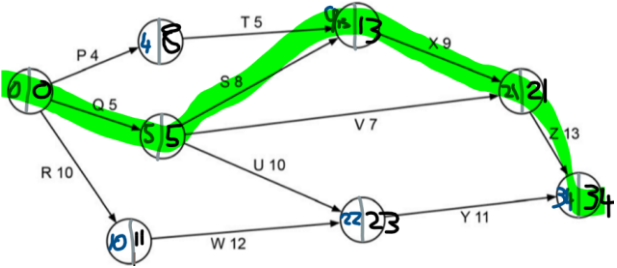
Q	Sample response	The response:
24	<p>Add flight time 8: 15pm Tuesday + 6 hours 20 minutes = 2: 35am Wednesday.</p> <p>Add time difference 2: 35am Wednesday – 2 hours = 12: 35am Wednesday.</p> <p>∴ local date and time of arrival is 12: 25am on Wednesday</p>	<ul style="list-style-type: none"> • Calculates flight time [1 mark] • Calculates time zone [1 mark] • States local time and date [1 mark]

Q	Sample response	The response:
25	$A_n = A_{n-1} \times \left(1 + \frac{0.075}{12}\right) - 500.95$ $A_0 = 25000$ $A_1 = 24655.30$ <p>...</p> $A_6 = 22899.21$ <p>∴ amount remaining to pay on loan after 6 months is \$22,899.21</p>	<ul style="list-style-type: none"> • States recurrence relation [1 mark] • States A_0 as \$25,000 [1 mark] • Calculates A_1 using recurrence [1 mark] • Calculates and states the amount remaining after 6 months [1 mark]

Paper 2

Short Response

Q	Sample response	The response:
1	<p>A semi-Eulerian trail doesn't exist because more than 2 vertices in the graph contain an odd degree vertex.</p> <p>Adds 1 line between two of the 4 vertices with an odd degree</p> <p>The minimum number of edges required would be 1 edge. It must link between 2 of the 4 odd degree vertices, as this makes the degree of these 2 vertices even. Now left with only 2 vertices with an odd degree, providing the existence of a semi-Eulerian trail</p>	<ul style="list-style-type: none">• Provides correct reasoning for why doesn't exist [1 mark]• Graphically adds only 1 line between 2 of the vertices with odd degree [1 mark]• Justifies why only 1 edge is added [1 mark]• Justifies why a semi-Eulerian trail now exists [1 mark]

Q	Sample response	The response:
2	<p>Calculates the earliest state times Calculates the latest finish times Determines the critical path.as QSXZ, with a completion time of 34 days.</p>  <p>A 5-day delay to activity Q will affect the minimum completion time, by 5 days, as the activity lies on the critical path, resulting in 39 days as minimum completion.</p>	<ul style="list-style-type: none"> Calculates EST and LFT [1 mark] Determines critical path and minimum completion time [1 mark] Explains that 5-day delay will influence completion time [1 mark] Justifies new minimum completion time to be 39 days. [1 mark]

Q	Sample response	The response:
3	<p>Route A is longitude then latitude</p> $D = (111.2 \times 38.81^\circ) + (111.2 \times 41.96^\circ \times \cos(1^\circ))$ <p>$D = 8980.91km$, with $T = 10.57$ hours</p> <p>Route B is latitude, then longitude</p> $D = (111.2 \times 41.98^\circ \times \cos(37.81^\circ)) + (111.2 \times 38.81^\circ)$ <p>$D = 8001.33km$, with $T = 9.41$ hours</p> <p>Route B, going latitude then longitude, is faster by approximately 1 hour. With this reasoning, plane 2 will land in Singapore first.</p>	<ul style="list-style-type: none"> • Calculates the distance for plane 1 [1 mark] • Calculates the distance for plane 2 [1 mark] • Calculates the time difference [1 mark] • Justifies that plane 2 reaches Singapore first [1 mark] • Logical flow of solution [1 mark]

Q	Sample response	The response:
4	$i_{eff} = \left(1 + \frac{0.024}{12}\right)^{12} - 1$ $i_{eff} = 2.43\% \text{ prior to offer}$ $i_{eff} = \left(1 + \frac{0.0243}{2}\right)^2 - 1$ $i_{eff} = 2.44\% \text{ after the offer}$ <p>Considering per \$10,000 using the compound interest formula, you will be more profitable with accepting this new offer by \$2 per \$10,000 per year.</p> <p>Considering just profitability, accepting this deal is better, however, considering your time to make this deal worthwhile, it is redundant unless at extremely high scale.</p>	<ul style="list-style-type: none"> Recognise and use effective interest to compare [1 mark] Calculate both effective interest rates [1 mark] Compare with a unit value of dollar to comment on reasonability [1 mark] State which is more profitable and justify how much profit [1 mark] Logical flow of solution [1 mark]

Q	Sample response				The response:
5		Male	Female	Total	<ul style="list-style-type: none"> Put results in a two-way table [1 mark] Calculates conditional probabilities of homeowners and gender [1 mark] States that an association exists [1 mark] Describe association between home ownership [1 mark]
	Live Parents	34	11	45	
	Rent	20	26	46	
	Own Home	1	8	9	
	Total	55	45	100	
	<p>Of the homeowners, 11% are male while 89% are female.</p> <p>With this much disparity in results, there is an association between gender and homeownership, where females are more likely to own homes.</p>				

Q	Sample response	The response:
6	<p>Max flow is 38 cars/minute from A to H.</p> <p>The claim of road C to F being used inefficiently is true, as this road has the capacity to flow 34 cars per minute, which is almost equivalent to the maximum flow through the entire network.</p> <p>Furthermore, the flow from C to F is 34, while the flow out of F is 33. The roads from town F need development.</p> <p>Future infrastructure needs to consider the tail-end of this network, as it has lower road efficiency, specifically for roads leading out from F, F to H, F to H and F to E.</p> <p>This will utilise the flow of traffic from road C to F, and increase the maximum flow for the traffic between towns.</p>	<ul style="list-style-type: none"> • Calculates the maximum flow of network [1 mark] • Recognises that claim is true due to large flow in C to F [1 mark] • Recognises that the flow from C to F exceeds the flow out from F [1 mark] • Uses these observations to make comments regarding future infrastructure improvements of network. [1 mark] • Make specific recommendation to increasing flow out from F [1 mark]

Q	Sample response				The response:
7		Team A	Team B	Team C	<ul style="list-style-type: none"> • Constructs matrix [1 mark] • Correctly applies row and column reduction [1 mark] • Constructs Bipartite graph [1 mark] • Recognise 2 correct allocations [1 mark] • Provides both possibilities of allocation [1 mark] • Correctly calculates 15 hours [1 mark] • Logical Flow of solution [1 mark]
	Job 1	7	9	10	
	Job 2	2	4	4	
	Job 3	4	7	4	
	Row & Column Reduction:				
		Team A	Team B	Team C	
	Job 1	0	0	3	
	Job 2	0	0	2	
	Job 3	0	1	0	
	<p>Construct Bipartite Graph of</p> <p>A to 1,2,3</p> <p>B to 1,2</p> <p>C to 3</p> <p>Recognise that 2 allocations provide a minimum time and they are:</p> <p>A on 1, B on 2, C on 3</p> <p>A on 2, B on 1, C on 3</p> <p>Minimum completion time is 15 hours.</p>				

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