General Mathematics marking guide

Sample external assessment 2020

Paper 2: Complex familiar and Complex unfamiliar (40 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.

Queensland Government | Queensland Curriculum & Assessment Authority

For all Queensland schools

Introduction

The Queensland Curriculum and Assessment Authority (QCAA) has developed mock external assessments for each General senior syllabus subject to support the introduction of external assessment in Queensland.

An external assessment marking guide (EAMG) has been created specifically for each mock external assessment.

The mock external assessments and their marking guides were:

- developed in close consultation with subject matter experts drawn from schools, subject associations and universities
- aligned to the external assessment conditions and specifications in General senior syllabuses
- developed under secure conditions.

Purpose

This document consists of an EAMG and an annotated response.

The EAMG:

- 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.

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.

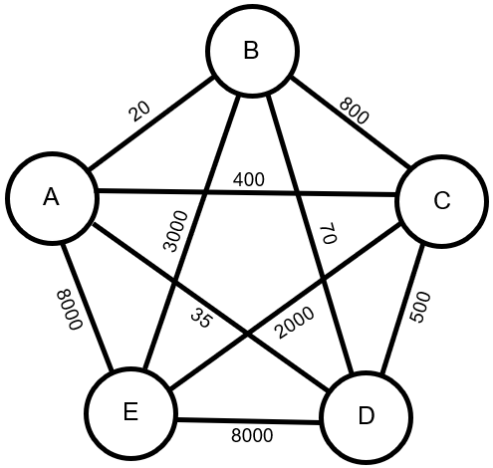
External assessment marking guide

Short response

Question 1 (4 marks)

Sample response	The response
Sara travels from Sydney to Johannesburg Departs Syd 6:15 Sat Syd time Travel +14:18 Arrive Joh 20:33 Sat Syd time UTC correction – 8:00 12:33 Sat Joh time	correctly determines the arrival time in Johannesburg **[1 mark]** correctly determines the local time in Johannesburg **[1 mark]**
Marcus arrives in Johannesburg from Lima Arrive Joh 12:33 Sat Joh time Travel –18:15 Departs Lima 18:18 Fri Joh time UTC correction – 7:00 11:18 Fri Lima time	determines local time and day in Lima **[1 mark]**
Marcus left Lima at 11:18am Friday local time.	shows logical organisation communicating key steps **[1 mark]**

Question 2 (4 marks)

Sample response	The response
a)  	correctly constructs the network **[1 mark]**
b) AB, AC, AD, CE Path Length AB 20 AC 400 AD 35 CE 2000 Total 2455 $Total\ Cost = 2455 \times 2.5$ $= 6137.5$ It will cost \$6 137.50.	correctly identifies the minimum spanning tree **[1 mark]** determines total length **[1 mark]** determines minimum cost with units **[1 mark]**

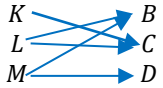
Question 3 (4 marks)

Sample response	The response
Two-way table **Hours** | **Year 7** | **Year 12** ≤ 2 | 15 | 2 2 to ≤4 | 53 | 11 > 4 | 4 | 4 TOTAL | **72** | **17**	correctly represents the data in a two-way table **[1 mark]**
Percentage two-way table **Hours** | **Year 7** | **Year 12** ≤ 2 | 20.8% | 11.8% 2 to ≤4 | 73.6% | 64.7% > 4 | 5.6% | 23.5% TOTAL | **100%** | **100%**	correctly represents the data in a percentage two-way table **[1 mark]**
The data suggests that there is an association between the hours spent practising the musical instrument each week and the student age group. Older students practise more overall than younger students.	suggests the presence of an association **[1 mark]**
94% of Year 7 students practise less than 4 hours each week compared to 76% of Year 12 students. 88% of Year 12 students practise more than two hours each week compared to only 79% of Year 7 students.	provides reasons to support conclusion **[1 mark]**

Question 4 (3 marks)

Sample response	The response
Compare using effective interest rates $i_e = \left(1 + \frac{i}{n}\right)^n - 1$ Option 1 2.4% + 0.5% = 2.9% p.a. paid quarterly $i_e = \left(1 + \frac{0.029}{4}\right)^4 - 1$ $= 0.029316902$ ≈ 0.0293 An effective interest rate of 2.93% p.a.	correctly calculates the effective interest rate for increasing the interest rate **[1 mark]**
Option 2 2.4% pa paid monthly $i_e = \left(1 + \frac{0.024}{12}\right)^{12} - 1$ $= 0.024265767$ ≈ 0.0243 An effective interest rate of 2.43% p.a.	correctly calculates the effective interest rate for interest paid monthly **[1 mark]**
Option 1 is the better investment because it offers the higher effective interest rate.	determines better option **[1 mark]**

Question 5 (8 marks)

Sample response	The response
a) Total Cost Matrix $\begin{array}{c\|ccc} & B & C & D \\ K & 196 & 62 & 203 \\ L & 150 & 60 & 147 \\ M & 127 & 77 & 111 \end{array}$ Subtract the minimum from each row $\begin{array}{c\|ccc} & B & C & D \\ K & 134 & 0 & 141 \\ L & 90 & 0 & 87 \\ M & 50 & 0 & 34 \end{array}$ Only 1 line so, Subtract the minimum from each column $\begin{array}{c\|ccc} & B & C & D \\ K & 84 & 0 & 107 \\ L & 40 & 0 & 53 \\ M & 0 & 0 & 0 \end{array}$ Only 2 lines so, Add 40 to each element in each line $\begin{array}{c\|ccc} & B & C & D \\ K & 84 & 40 & 107 \\ L & 40 & 40 & 53 \\ M & 40 & 80 & 40 \end{array}$ Subtract 40 from every element $\begin{array}{c\|ccc} & B & C & D \\ K & 44 & 0 & 67 \\ L & 0 & 0 & 13 \\ M & 0 & 40 & 0 \end{array}$ 3 lines so,  	correctly uses the row and column reduction method **[1 mark]** uses the Hungarian algorithm **[1 mark]** determines the bipartite graph **[1 mark]**

Sample response	The response
Therefore: Kate makes the chair (KC) Luca makes the bookcase (LB) Marcel makes the desk (MD)	identifies who builds each piece of furniture **[1 mark]** shows logical organisation communicating key steps **[1 mark]**
b) Checking all combinations $KB + LC + MD$ $= 196 + 60 + 111$ $= 367$ $KB + LD + MC$ $= 196 + 147 + 77$ $= 420$ $KC + LB + MD$ $= 62 + 150 + 111$ $= 323$ $KC + LD + MB$ $= 62 + 147 + 127$ $= 336$ $KD + LB + MC$ $= 203 + 150 + 77$ $= 430$ $KD + LC + MB$ $= 203 + 60 + 127$ $= 390$	correctly identifies the six possible options **[1 mark]** calculates cost of the six options **[1 mark]**
Kate making the chair, Luca the bookcase and Marcel the desk is the cheapest option at $323.	evaluates reasonableness of solution **[1 mark]**

Question 6 (3 marks)

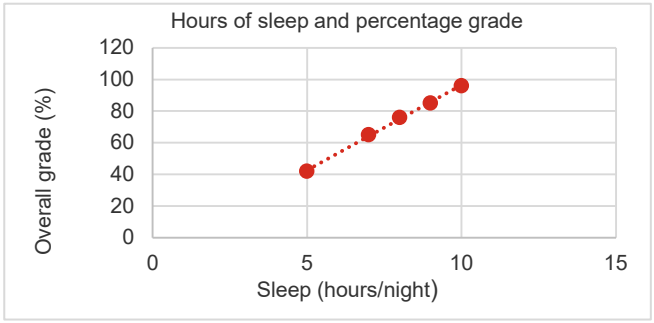
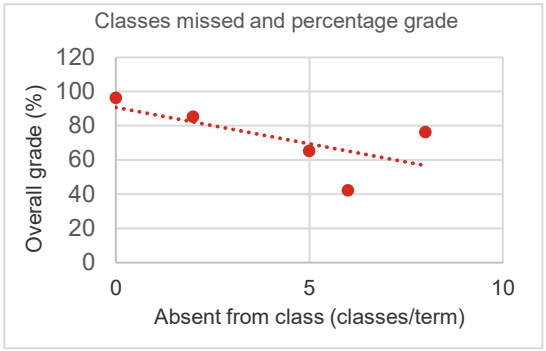
Sample response	The response
At midnight, the date goes forward by a day but changing sides of the date line would also forward the date by another day. The result was in 2011, after midnight, Samoa went forward 2 days, skipping December 30th altogether. The time and date became 12:01am, December 31st, 2011.	correctly explains the effect of the date line change **[1 mark]** correctly determines the time **[1 mark]** correctly determines the date including the year **[1 mark]**

Question 7 (7 marks)

Sample response	The response
Let $n =$ the number of years since 2010 For Chris: $t_1 = 67\,500$ and $t_8 = 84\,300$ Find d $t_n = t_1 + (n-1)d$ $84\,300 = 67\,500 + 7d$ $\therefore 16\,800 = 7d$ $\therefore 2\,400 = d$	correctly determines the parameter d **[1 mark]**
Rule for Chris $t_n = t_1 + (n-1)d$ $t_n = 67500 + 2400(n-1)$ $t_n = 2400n + 65100$	correctly determines the model for Chris **[1 mark]**

Sample response	The response
For Sam: $t_5 = 79\,500$ and $t_9 = 87\,900$ Find d $t_n = t_1 + (n-1)d$ $87900 = t_1 + 8d$ … equation 1 $79500 = t_1 + 4d$ … equation 2 Use elimination method equation 1 – equation 2 $\therefore\ 8400 = 4d$ $\therefore\ 2100 = d$ Find t_1 Sub d into equation 1 $\therefore 87900 = t_1 + 8(2100)$ $\therefore 87900 = t_1 + 16800$ $\therefore\ t_1 = 71100$	correctly determines the parameters d and t_1 **[1 mark]**
Rule for Sam $t_n = t_1 + (n-1)d$ $t_n = 71100 + 2100(n-1)$ $t_n = 2100n + 69000$	correctly determines the model for Sam **[1 mark]**
When will they earn the same? $2400n + 65100 = 2100n + 69000$ $300n = 3900$ $n = 13$	determines when they earn the same **[1 mark]**
Therefore, they will earn the same in 2023, so Chris will earn more in 2024.	determines year **[1 mark]**
	shows logical organisation communicating key steps **[1 mark]**

Question 8 (3 marks)

Sample response	The response
	correctly sketches a graph for 'Hours of sleep' **[1 mark]**
	correctly sketches a graph for 'Classes missed' **[1 mark]**
From the graphs, it is can be observed that: • there is a very strong positive correlation between hours of sleep and overall percentage grades • there is a strong negative correlation between the number of times a student is absent from class and overall percentage grades I would advise getting plenty of sleep has a stronger impact on improving grades than attending all classes. However, doing both would be likely to have the greatest impact.	determines the better predictor using a mathematical argument **[1 mark]**

Question 9 (4 marks)

Sample response	Mark
Seasonally adjust 2017 data | | 2015 | 2016 | 2017 | |---|---|---|---| | **Summer** | 96.77 | 101.61 | 102.42 | | **Autumn** | 98.04 | 101.96 | 103.92 | | **Winter** | 100.00 | 101.39 | 104.17 | | **Spring** | 100.97 | 102.91 | 103.88 |	correctly seasonally adjusts the 2017 data **[1 mark]**
Using the above as y data and incrementing each season from 1 to 12 (Summer 2015 to Spring 2017) as the x data to find the following rule. $y = 0.5992x + 97.609$	develops model for all the data **[1 mark]**
Mean rainfall by season in 2025 / Multiply by SI (round to whole no.) $y(41) = 122.1762$ → 151 $y(42) = 122.7754$ → 125 $y(43) = 123.3746$ → 89 $y(44) = 123.9738$ → + 128 493	calculates 2025 rainfall for each season **[1 mark]**
In 2025 we forecast 151 mm of rain in Summer, 125 mm of rain in Autumn, 89 mm of rain in Winter and 128 mm of rain in Spring.	shows logical organisation communicating key steps **[1 mark]**