General Mathematics 2019 v1.2

IA2 sample marking scheme

September 2021

Examination (15%)

This sample has been compiled by the QCAA to model one possible approach to allocating marks in an examination. It matches the examination mark allocations as specified in the syllabus (~ 60% simple familiar, ~ 20% complex familiar and ~ 20% complex unfamiliar) and ensures that a balance of the objectives are assessed.

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 all Unit 3 topics
2. comprehend mathematical concepts and techniques drawn from all Unit 3 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 3 topics.

Queensland Government
Queensland Curriculum & Assessment Authority
For all Queensland schools
210878

Instrument-specific marking guide (ISMG)

Criterion: Foundational knowledge and problem-solving

Assessment objectives

The student work has the following characteristics:	Cut-off	Marks
• 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
• 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
• 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
• 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
• 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
• infrequent selection, recall and use of facts, rules, definitions and procedures; basic comprehension and communication of some mathematical concepts and techniques; some description of the reasonableness of solutions; and infrequent application of mathematical concepts and techniques.	> 27%	5
	> 20%	4
• 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
• 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
• does not satisfy any of the descriptors above.		0

Task

See IA2 sample assessment instrument: Examination (15%) (available on the QCAA Portal).

Sample marking scheme

Criterion	Marks allocated	Provisional marks
Foundational knowledge and problem-solving	15	—
Total	**15**	**—**

The annotations are written descriptions of the expected response for each question and are related to the assessment objectives.

Note: ✓ = $\frac{1}{2}$ mark

Marking scheme

Combined paper consisting of simple familiar, complex familiar and complex unfamiliar questions.

Question 1 (4 marks) SF

Q1

1. recall and use facts and procedures

3. organise and present information

		Gender		
		Female	**Male**	**Total**
Provider	Fonestar	12	6	18
	Telcall	19	13	32
	Alternative	4	6	10
	Total	35	25	60

Set up two-way frequency table ✓✓

Substitute given values ✓✓

Calculate other 6 values ✓✓✓✓

Question 2 (4.5 marks) SF

Q2

1. recognise particular features of information

2. understand and identify the critical elements

a. A: positive and perfect ✓✓
B: negative and moderate ✓✓
C: positive and strong ✓✓

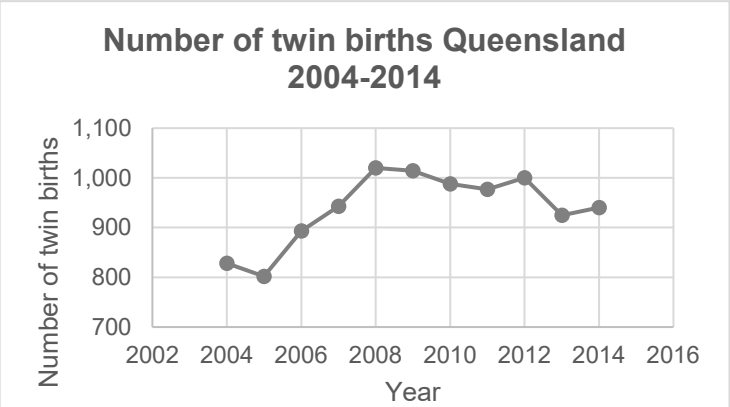
b. A: 1 ✓
B: –0.3 ✓
C: 0.8 ✓

Question 3 (4.5 marks) SF

Q3
2. understand purpose and identify techniques

3. organise and present information in graphical form

a.



axes labelled ✓✓
scale ✓
points plotted ✓✓
connected line graph ✓✓

3. describe a mathematical model

b. Steady increase initially ✓ then levels out and decreases slightly.✓

Question 4 (4 marks) SF

Q4
1. select, recall and use rules/ definitions
2. identify relevant techniques
3. communicate using everyday language

a. Common difference, $d = 8.5 - 6 = 2.5$, $d = 11 - 8.5 = 2.5$ ✓✓
Since there is a common difference of $\$2.50$ between successive terms, then the total fares form an arithmetic sequence. ✓✓

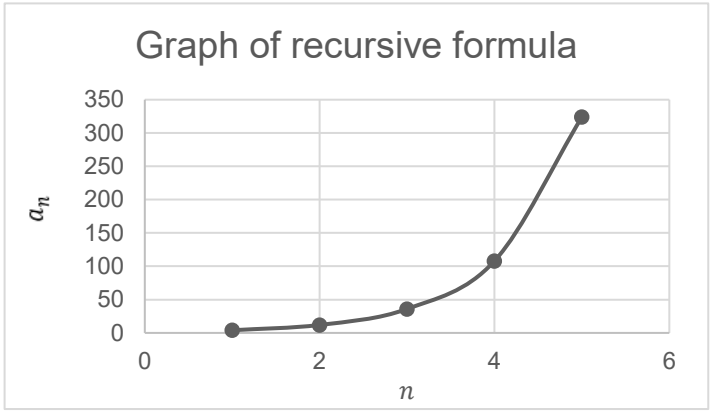
b. Using $t_n = 6 + 2.5(n-1)$ ✓
$t_{35} = 6 + 2.5(35-1)$ ✓
$t_{35} = 91$ ✓
The predicted fare for a 35-kilometre taxi ride will cost \$91. ✓

Question 5 (5 marks) SF

Q5
1. select rules and put them into effect

a. $a_2 = 3a_1$
$a_2 = 3 \times 4 = 12$ ✓
$a_3 = 3a_2$
$a_3 = 3 \times 12 = 36$ ✓

b.



axes labelled ✓
scale ✓
points plotted ✓✓
smooth line graph ✓✓

2. comprehend mathematical concepts and techniques

3. organise and present information in graphical form

3. communicate using everyday language

c. Exponential model ✓ showing increasing bacterial population.✓

Q6

1. recognise particular features; perform calculations

Question 6 (5 marks) SF

a. Port Vila (17°S, 168°E) ✓✓✓✓ *accept tolerance* $\pm 1°$

b. Angular distance = 42° – 9° = 33° ✓✓

c. Distance = 33 × 111.2 ✓✓

= 3669.6 km ✓

= 3670 km ✓

Question 7 (6.5 marks) SF

Q7

1. select, recall and use facts and procedures

2. comprehend mathematical concepts and techniques

3. organise and present information in symbolic form; use mathematical symbols and conventions

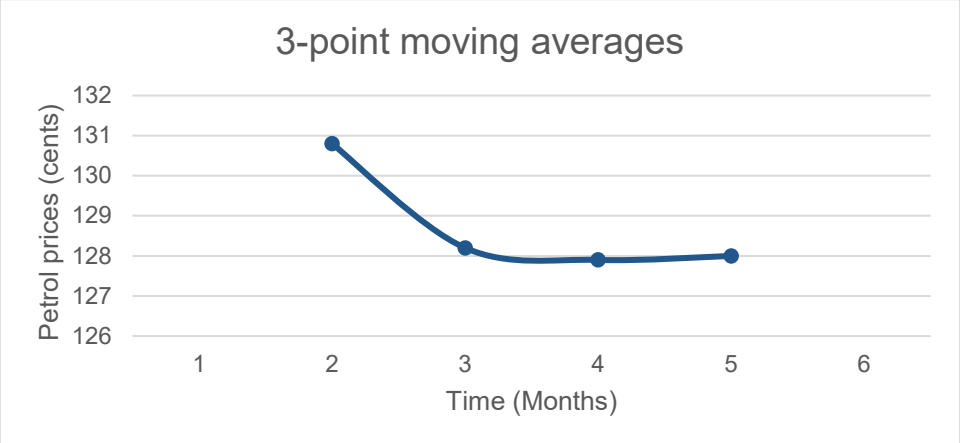
a.

Time (months)	Price (cents)	3-point moving average (rounded to 1dp)
1	132.4	–
2	129.5	$\frac{132.4 + 129.5 + 130.4}{3} = 130.8$ ✓
3	130.4	$\frac{129.5 + 130.4 + 124.6}{3} = 128.2$ ✓
4	124.6	$\frac{130.4 + 124.6 + 128.7}{3} = 127.9$ ✓
5	128.7	$\frac{124.6 + 128.7 + 130.7}{3} = 128.0$ ✓
6	130.7	–

correct procedure ✓✓

b.

3. organise and present information in graphical form



axes labelled ✓✓ *points plotted* ✓✓ *scale* ✓ *smooth line graph unnecessary but no penalty if included*

3. communicate using everyday language

c. Initially decreasing ✓ and then levels off ✓

Question 8 (4 marks) SF, (4 marks) CF

Q8

1. select, recall and use procedures to put them into effect, performing calculations with technology

a. $\frac{21}{45} \times 100\%$ ✓✓

$\approx 47\%$ ✓✓

b. $\frac{12}{36} \times 100\%$ ✓✓

$\approx 33\%$ ✓✓

5. justify procedures and decisions by constructing mathematical arguments

3. organise and present information

c.

		Preferred sport	
		Cricket	Volleyball
School section	Junior school	67%	43%
	Senior school	33%	57%
		100%	100%
		✓✓	✓✓

Clearly labelled two-way frequency table ✓

4. interpret mathematical results in the context of the situation

The data suggests that students who prefer volleyball are more likely to be Senior school students (57% > 43%) and students who prefer cricket are twice as likely to be Junior school students (67% is approximately double 33%). ✓ ✓

4. evaluate the reasonableness of solutions

A comparison of the percentages for preferred sport in the Junior and Senior schools suggests there is an association between the variables. ✓

Question 9 (6 marks) CF

Q9

2. comprehend mathematical concepts and techniques

a. A quarter of 20 000 L is removed every 15 minutes.

$t_1 = 20\,000$ ✓ at 0 minutes

$t_2 = 20\,000 \times \frac{3}{4}$

$= 15\,000$ after one 15-minute interval

$r = 0.75$ ✓

2. identify and articulate relevant concepts and techniques

$t_n = t_1 r^{n-1}$ ✓

$t_n = 20000(0.75)^{n-1}$ ✓

Let $t_n = 500$ ✓

$500 = 20\,000(0.75)^{n-1}$

$0.025 = (0.75)^{n-1}$ ✓✓ Method to find $\boldsymbol{n}$

5. justify procedures and decisions by explaining mathematical reasoning

n	$(0.75)^{n-1}$	
10	0.075	need to lose more, so try $n = 15$
15	0.018	lost too much, so try $n = 14$
14	0.024	slightly too low, so try $n = 13$
13	0.032	

4. evaluate the reasonableness of solutions; interpret results in the context of the solution

So $t_{13} = 20\,000(0.75)^{12}$

$t_{13} = 633.5$

$t_{14} = 20\,000(0.75)^{13}$ ✓✓ Find $\boldsymbol{n}$

$t_{14} = 475.1$

∴ 14 terms would be too long and 13 terms would be too short

Term 14 occurs after thirteen 15-minute intervals — after 3 hours and 15 minutes ✓

Term 13 occurs after twelve 15-minute intervals — after 3 hours ✓

The pump can only run for a little over 3 hours to reduce the water in the tank to 500 litres. ✓

Question 10 (6 marks) SF, (3 marks) CF

Q10

1. recall facts

2. identify relevant techniques

4. interpret mathematical results in the context of the situation

5. justify decisions by explaining mathematical reasoning

a. Response variable is Number of complete laps ✓✓and explanatory variable is the Age. ✓✓

b. Using the calculator yields: y-intercept ≈ 11.76 ✓✓and slope ≈ –0.14. ✓✓

c. The y-intercept of 11.76 represents the information at age zero and it appears that approximately 11–12 laps were being completed and that's nonsensical.✓✓ The slope of –0.14 represents the decreasing rate at which the number of laps is being completed as the athletes age which would make absolute sense because as we age we are generally not as physically fit to run further. ✓✓

d. If the correlation coefficient is –0.91 this is a strong, negative, linear relationship. ✓✓

e. A negative correlation coefficient indicates a downward trend in the data and the value of 0.91 indicates a strong correlation between age and number of laps as the closer to 1 the value is, the stronger the association. ✓✓ Therefore, this correlation coefficient indicates as age increases the number of laps decreases in a strong direction. ✓✓

Question 11 (4 marks) SF, (3 marks) CF

Q11

1. select and use rules and procedures

1. perform calculations using technology

2. understand the meaning and purpose of learnt mathematics

3. use mathematical conventions and present information in symbolic form

a. Angular distance = 148° + 128°

= 276° ✓✓

Shortest angular distance = 360° – 276°

= 84° ✓✓

Shortest distance = 84 × 111.2 cos 70° ✓✓

= 3194.74 km ✓✓

b. Tiksi is east therefore ahead in time of Deadhorse.

D (148°W) T (128°E)

Angular difference = 276° ✓

Hours difference = $\frac{276°}{15}$ (as 15° = 1 hour difference) ✓

= 18.4 ✓

≈ 18 hours (rounded to the nearest hour) ✓

4. interpret mathematical results in the context of the situation

(10 am – 18 hours) 10 am

Deadhorse time = 10 am – 18 hours

= 4 pm previously ✓

∴ When it's 10 am Monday in Tiksi, it will be 4 pm Sunday in Deadhorse. ✓

Question 12 (9 marks) CU

Q12

1. select recall and use definitions and procedures

Determine the seasonal index for the fourth quarter.

Let $s =$ the seasonal index for the fourth quarter

$0.86 + 0.79 + 1.21 + s = 4$ ✓

$\therefore 2.86 + s = 4$

$\therefore \quad s = 1.14$ ✓

3. use mathematical terminology, symbols and conventions

Deseasonalised figures for 2017:

$\text{First quarter} = \frac{2245}{0.86} = 2610.47$ ✓✓

$\text{Second quarter} = \frac{2038}{0.79} = 2579.75$ ✓

$\text{Third quarter} = \frac{3110}{1.21} = 2570.25$ ✓

3. communicate using everyday language

$\text{Fourth quarter} = \frac{2907}{1.14} = 2550$ ✓

Entering the first quarter as $x = 1$, 2nd quarter as $x = 2$,✓ … as the explanatory variable and the deseasonalised figures for 2017 as the response variable into the calculator ✓, the following results were obtained:

5. justify procedures and decisions by explaining mathematical reasoning

$a = 2625.345$ ✓ and $b = -19.091$ ✓

The least squares regression line is of the form:

$y = a + bx$ ✓

$y = 2625.345 - 19.091x$ ✓✓

6. analyse the context of the problem and make decisions about the techniques used to develop a solution

Fourth quarter of 2018 equates to $x = 8$ and substituting into equation gives:

$y = 2625.345 - 19.091 \times 8$ ✓

$y = 2472.617$ ✓

∴ The predicted sales of newspapers for the fourth quarter of 2018 is:

$2472.617 \times 1.14 = 2818.78$ ✓

$= 2819$ ✓

Q13 1. select, recall and use facts and procedures 2. understand the meaning and purpose of the learnt mathematics 3. present information in symbolic form 6. analyse the context of the problem and make decisions about the techniques used to develop a solution	**Question 13 (7 marks) CU** $t_1 = 186$ ✓ (collected from school) $t_{11} = 546$ ✓ (collected from school and 10 houses) Find n when $t_n = 1500$ $t_n = t_1 + (n-1)d$ When $t_{11} = 546$, $546 = 186 + (11-1)d$ ✓✓ $360 = 10d$ ✓ $\therefore d = 36$ ✓✓ To collect garbage from school and 35 houses, $n = 36$✓ $t_{36} = 186 + (36-1)36$✓✓ $= 186 + 35 \times 36$ $= 1446$ ✓✓ $1446 < 1500$✓ So, the truck will be able to collect the garbage at the 35th house. ✓