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Queensland Curriculum and Assessment Authority

Mathematical Methods 2025 v1.2

IA2: Sample assessment instrument

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	sample only
Student number	sample only
Teacher	sample only
Exam date	sample only

Marking summary

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

Conditions

Technique	Examination — short response
Unit	Unit 3: Further calculus and introduction to statistics
Topic/s	Topic 1: Differentiation of exponential and logarithmic functions Topic 2: Differentiation of trigonometric functions and differentiation rules Topic 3: Further applications of differentiation
Time	90 minutes + 5 minutes perusal
Seen / Unseen	Unseen
Other	The teacher must provide the QCAA Mathematical Methods formula book. QCAA-approved calculator must be used. Students must not bring notes into the examination.

Instructions

Please answer on separate lined paper.

Question 1 (2 marks)

Simple familiar

Solve $\left(e^x - 2\right)\left(e^x - 3\right) = 0$. Leave your answer as exact values.

Question 2 (13 marks)

Simple familiar

Determine the derivative of the following functions:

a. $f\left(x\right) = e^x + \sin\left(2x\right)$

b. $f\left(x\right) = e^{\sin(x)}$

c. $f\left(x\right) = \cos^3\left(x\right)$

d. $f\left(x\right) = x + x\ln\left(x\right)$ (give answer in simplest form).

Question 3 (10 marks)

Simple familiar

Use $f\left(x\right) = \ln\left(3x - 2\right)$ and $g\left(x\right) = -4\cos\left(0.5x\right) + 2$

a. Sketch $f\left(x\right)$ clearly labelling any intercepts and asymptotes

b. Determine $f'\left(x\right)$

c. Determine $g'\left(x\right)$

d. Evaluate the reasonableness of the claim that there are points where $f(x)$ and $g(x)$ have the same gradients over the domain $1 \le x \le 8$.

Question 4 (8 marks)

Simple familiar

Rabbit population can be modelled by the function $n(t) = Ae^{0.55t}$, $t \geq 0$, where t is time in years, $n(t)$ is the population size at time t, and A is the initial size of the population.

Rabbits were introduced to a small island eight years ago. The current rabbit population on the island is estimated to be 4200.

a. What was the initial size of the rabbit population?

b. Estimate the population 12 years after the rabbits were introduced.

c. Determine $n'(t)$

d. Determine when the population is increasing at a rate of 250,000 rabbits per year.

e. Evaluate the reasonableness of the claim that the population of rabbits will reach 1,000,000 within 20 years of their introduction to the island.

Question 5 (6 marks)

Complex familiar

Use an analytical approach to determine the coordinates of the stationary point of the function

$f(x) = \dfrac{\ln(2x)}{x}, x > 0$.

Question 6 (5 marks)

Complex familiar

A particle is moving along the x-axis. Its position (m) is given by $x(t) = e^t \sin(t)$ where t is the time (s), $0 \leq t \leq 2\pi$. Use an analytical approach to determine all possible values of t when the acceleration is equal to 0.

Question 7 (5 marks)

Complex unfamiliar

Show that

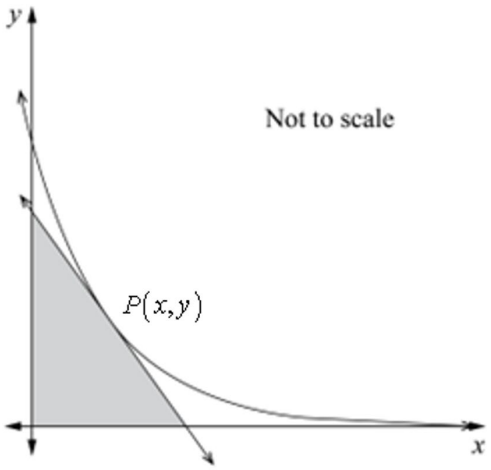
$f(a) - f'(a) = 3$

where $f(x) = 3x^5 - 5x^4 + kx$, k is a real number, and $(a, f(a))$ is the point of inflection of function $f(x)$.

Question 8 (6 marks)

Complex unfamiliar

A tangent is drawn at the point $P(x, y)$ on the graph of the function $y = e^{2-x}$ as shown.



Determine the point where the area of the shaded triangle is a maximum.

Examination marks summary

Question	Simple familiar (SF)	Complex familiar (CF)	Complex unfamiliar (CU)
1	2		
2	13		
3	10		
4	8		
5		6	
6		5	
7			5
8			6
Total	**33**	**11**	**11**
Percentage	**60%**	**20%**	**20%**

Instrument-specific marking guide (IA2): Examination — short response (15%)

Foundational knowledge and problem-solving	Cut-off	Marks
The student response has the following characteristics:		
• consistently correct recall and use of mathematical knowledge; authoritative and accurate communication of mathematical knowledge; astute evaluation of the reasonableness of solutions; use of mathematical reasoning to correctly justify procedures and decisions; and fluent application of mathematical knowledge to solve problems in a comprehensive range of simple familiar, complex familiar and complex unfamiliar situations	>93%	15
	>87%	14
• correct recall and use of mathematical knowledge; clear communication of mathematical knowledge; considered evaluation of the reasonableness of solutions; use of mathematical reasoning to justify procedures and decisions; and proficient application of mathematical knowledge to solve problems in simple familiar, complex familiar and complex unfamiliar situations	>80%	13
	>73%	12
• thorough recall and use of mathematical knowledge; communication of mathematical knowledge; evaluation of the reasonableness of solutions; use of mathematical reasoning to justify procedures and decisions; and application of mathematical knowledge to solve problems in simple familiar and complex familiar situations	>67%	11
	>60%	10
• recall and use of mathematical knowledge; communication of mathematical knowledge; evaluation of the reasonableness of some solutions; some use of mathematical reasoning; and some application of mathematical knowledge to make progress towards solving problems in simple familiar situations	>53%	9
	>47%	8
• some recall and use of mathematical knowledge; and basic communication of mathematical knowledge	>40%	7
	>33%	6
• infrequent recall and use of mathematical knowledge; and basic communication of some mathematical knowledge	>27%	5
	>20%	4
• isolated recall and use of mathematical knowledge; and partial communication of rudimentary mathematical knowledge	>13%	3
	>7%	2
• isolated and inaccurate recall and use of mathematical knowledge; and disjointed and unclear communication of mathematical knowledge.	>0%	1
The student response does not satisfy any of the descriptors above.		0