KIRWAN STATE HIGH SCHOOL	SUBJECT: MATHEMATICAL METHODS	UNIT: 3

Unit Description	Unit Objectives
In Unit 3, students will develop mathematical understandings and skills to solve problems relating to: • Topic 1: The logarithmic function 2 • Topic 2: Further differentiation and applications 2 • Topic 3: Integrals. Logarithmic laws and definitions are developed and used. Logarithmic functions are explored graphically and algebraically. The study of calculus continues with the derivatives of exponential, logarithmic and trigonometric functions and their applications, together with some differentiation techniques and applications to optimisation problems and graph sketching. Integration, both as a process that reverses differentiation and as a way of calculating areas and the fundamental theorem of calculus, is introduced.	Students will: 1. select, recall and use facts, rules, definitions and procedures drawn from all Unit 3 topics 2. comprehend mathematical concepts and techniques drawn 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.

Assessment Plan:

Task	%	Objectives to be assessed	Conditions	Date
IA1 – Internal Assessment 1 PSMT *Topic 2: Further differentiation & Applications 2*	20	As above – all objectives included on assessment item	4 weeks – including 3 hours of class time	Term 1 Week 5
Task	**%**	**Objectives to be assessed**	**Conditions**	**Date**
IA2 – Internal Assessment 2 Examination – *representatively sample all Unit 3 topics*	15	As above – all objectives included on assessment item	Closed Book QCAA formula sheet provided Technology Free Technology Active 120 minutes + 5 minutes perusal	Term 2 Week 2

Monitoring and Reviewing:

Strategies for Monitoring Student Progress	Date	Planned Reviews at Key Intervals	Date
Student Summary Rule book – separate book following through all units Proficiency scales KNOW and be able to DO tables (KDT) Regular vocabulary review, HW – weekly review, Formative items Common mistakes recognition Use of online support – Education Perfect, Khan Academy, Text-based online support Graphic organisers – e.g. mind maps, Frayer model, KWL (what I know, what I want to know, what I have learnt)		10 minute review (weekly quiz) during one lesson a week Mathspace quizzes - weekly Formative items	Each week Week 5 Week 10

Underpinning Factors:

Guaranteed Vocabulary:		Literacy Skills	21st Century Skill/s
index form logarithmic form power logarithm of a product logarithm of a quotient logarithm of a power transformation translation solver (Excel) residual minimise average error parameter exponential function limit Euler's number parameter domain range logarithmic function domain range differentiation rules (product, quotient, chain)	sinusoidal function tangent equation of tangent stationary point average velocity instantaneous velocity stationary point derivative integrate stationary point derivative displacement velocity indefinite integral integration by recognition definite intergral acceleration marginal value instantaneous rate of change	**Written** ▪ using technical / procedural vocabulary ▪ using conventions (symbols, abbreviations) e.g. - $\log_a b$, $\log_a(xy) = \log_a x + \log_a y$ - $\log_a\left(\frac{x}{y}\right) = \log_a x - \log_a y$, $\log_a x^c = c\log_a c$ - Excel solver and formulas, including changing variable cells $B$1:$D$1, set objective f1 - e, $\frac{d}{dx}e^x = \lim_{h\to 0}\frac{e^x(e^h-1)}{h} = e^x\lim_{h\to 0}\frac{e^h-1}{h}$, $\ln(\mathrm{x})$, $f'(x)$ - $\frac{d}{dx}e^{f(x)} = f'(x)e^{f(x)}$ - $\frac{d}{dx}\sin(x) = \cos(x)$, $\int\frac{1}{ax+b}dx = \frac{1}{a}\ln(ax+b)+c$ - $\int_0^4 v(t)dt = s(t)\vert_0^4$, $\int_a^b f(x)dx = F(b) - F(a)$ - $\sum_i f(x_{i)}\,\delta x_i$, $\lim_{n\to\infty}\sum_{i=1}^{n} f(x)\delta x_i$ - $s'(t) = v(t)$, $v'(t) = a(t)$ - interval $\left[\frac{\pi}{2}, \pi\right]$ **Oral** ▪ articulating patterns and generalisations – putting thoughts into words **Visual** ▪ using graphs, tables	**Critical thinking** - analytical thinking - problem solving - decision making - reflecting and evaluating **Creative thinking** - seeing new links **Communication** - using language, symbols and texts **Collaboration and teamwork** - relating to others - participating and contributing **ICT skills** - accessing and analysing information

		Numeracy Skills	Cognitive Verbs
		▪ calculating decimals ▪ developing an understanding of the meaning of logarithmic functions and how they can be applied in real-life situations ▪ recognising and using patterns and relationships ▪ choosing and using digital tools ▪ handling information., e.g. graphs, tables ▪ making decisions and judgments (critical orientations)	Retrieval and Comprehension: review, use, define, find, recognise, explain, identify, provide, sketch, comprehend, describe, students understand, recall Analysis: apply, consider, identify errors, determine, compare, distinguish Knowledge Utilisation: prove, investigate, develop, determine, discuss, evaluate, explore, make conjectures

TEACHING AND LEARNING PLAN:

Hours/Weeks	Unit Objectives	Subject Matter	Learning Experiences [reflecting DQ 3, 4, 5 and 6]	Possible Resources
Unit 3 *Weeks1, 2* Term 4 Weeks 5, 6 8 hours (6 lessons)	1, 2, 3, 4, 5, 6	**Logarithmic laws and logarithmic functions** • establish and use logarithmic laws and definitions • interpret and use logarithmic scales such as decibels in acoustics, the Richter scale for earthquake magnitude, octaves in music, pH in chemistry • solve equations involving indices with and without technology • recognise the qualitative features of the graph of $y=\log_a(x)$ ($a>1$), including asymptotes, and of its translations $y=\log_a(x)+b$ and $y=\log_a(x+c)$ • solve equations involving logarithmic functions with and without technology • identify contexts suitable for modelling by logarithmic functions and use them to solve practical problems; verify and evaluate the usefulness of the model using qualitative statements and quantitative analysis.	Refer to QCAA TLAP	Textbook Maths Quest Mathematical Methods Units 3&4 (Jacaranda) Digital version also available
Unit 3 *Weeks 3-9* Term 4 (*Yr11*) Weeks 6- 8 + Term 1 (*Yr12*) Weeks 1- 4 29 hours (18 lessons) + (PSMT 3 lessons)		**Further differentiation and applications 2** **Calculus of exponential functions (8 hours)** • estimate the limit of $\frac{a^h-1}{h}$ as $h\to0$ using technology, for various values of $a>0$ • recognise that e is the unique number a for which the above limit is 1 • define the exponential function e^x • establish and use the formula $\frac{d}{dx}(e^x) = e^x$ and $\frac{d}{dx}\left(e^{f(x)}\right) = f'(x)e^{f(x)}$ • identify contexts suitable for mathematical modelling by exponential functions and their derivatives and use the model to solve practical problems; verify and evaluate the usefulness of the model using qualitative statements and quantitative analysis. **Calculus of logarithmic functions (8 hours)** • define the natural logarithm $\ln(x)=\log_e(x)$ • recognise and use the inverse relationship of the functions $y=e^x$ and $y=\ln(x)$ • establish and use the formulas $\frac{d}{dx}(\ln(x)) = \frac{1}{x}$ and $\frac{d}{dx}(\ln(f(x)) = \frac{f'(x)}{f(x)}$ • use logarithmic functions and their derivatives to solve practical problems. **Calculus of trigonometric functions (8 hours)** • establish the formulas $\frac{d}{dx}\sin(x) = \cos(x)$, and $\frac{d}{dx}\cos(x) = -sin(x)$, by numerical estimations of the limits and informal proofs based on geometric constructions • identify contexts suitable for modelling by trigonometric functions and their derivatives and use the model to solve practical problems; verify and evaluate the usefulness of the model using qualitative statements and quantitative analysis • use trigonometric functions and their derivatives to solve practical problems; including trigonometric functions of the form $y=\sin(f(x))$ and $y=\cos(f(x))$. **Differentiation rules (5 hours)** • select and apply the product rule, quotient rule and chain rule to differentiate functions; express derivatives in simplest and factorised form.		

Unit 3 *Weeks 10-14* Term 1 Weeks 5 - 9 18 hours (13 lessons)	1, 2, 3, 4, 5, 6	**Integrals** **Anti-differentiation (9 hours)** • recognise anti-differentiation as the reverse of differentiation • use the notation $\int f(x)dx$ for anti-derivatives or indefinite integrals • establish and use the formula $\int x^n\,dx=\frac{1}{n+1}x^{n+1}+c$ for $n\neq-1$ • establish and use the formula $\int e^x\,dx=e^x+c$ • establish and use the formulas $\int\frac{1}{x}dx=\ln(x)+c$, for $x>0$ and $\int\frac{1}{ax+b}dx=\frac{1}{a}\ln(ax+b)+c$ • establish and use the formulas $\int\sin(x)dx=-\cos(x)+c$ and $\int\cos(x)dx=\sin(x)+c$ • understand and use the formula for indefinite integrals of the form • $\int f(x)+g(x)dx=\int f(x)dx+\int g(x)dx$ • determine indefinite integrals of the form $\int f(ax+b)dx$ • determine $f(x)$, given $f'(x)$ and an initial condition $f(a)=b$ • determine the integral of a function using information about the derivative of the given function (integration by recognition) • determine displacement given velocity in linear motion problems. **Fundamental theorem of calculus and definite integrals (3 hours)** • examine the area problem, and use sums of the form, to estimate the area under the curve $y=f(x)$ $\Sigma_i f(x_i)\ \delta x_i$ • use the trapezoidal rule for the approximation of the value of a definite integral numerically • interpret the definite integral $\int_a^b f(x)dx$ as area under the curve $y=f(x)$ if $f(x)>0$ • recognise the definite integral $\int_a^b f(x)dx$ as a limit of sums of the form $\Sigma_i f(x_i)\ \delta x_i$ • understand the formula $\int_a^b f(x)dx=F(b)-F(a)$ and use it to calculate definite integrals. **Applications of integration (6 hours)** • calculate the area under a curve • calculate total change by integrating instantaneous or marginal rate of change • calculate the area between curves, with and without technology • determine displacements given acceleration and initial values of displacement and velocity.		
Term 1 + 2 Weeks 10/1		Review all topics in Unit 3		
Term 2 Week 1	1, 2, 3, 4, 5, 6	IA2 – Internal Assessment Item 2 *Representatively sample all Unit 3 topics* *60 min Technology Active & 60 min Technology Free*		