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Maths NQF Level 4

MATHEMATICS –NQF Level 4		
CONTENT	**LEARNING OUTCOME**	**CAMI LINK**
1.1 **Work with Complex numbers**	• Perform addition, subtraction, multiplication and division on complex numbers in standard form (includes i-notation) NOTE: Leave answers with positive argument. • Perform multiplication and division on complex numbers in polar form • Use De Moivre's theorem to raise complex numbers to powers (excluding fractional powers) • Convert the form of complex numbers where needed to enable performance of advanced operations on complex numbers (a combination of standard and polar form may be assessed in one expression)	**5.10.1.1** **5.10.1.2** **5.10.1.3** **5.10.1.4** **5.10.2.1** **5.10.2.2** **5.10.2.3** **5.10.2.4**
1.2 **Solve problems using complex numbers**	• Solve identical complex numbers in rectangular / standard form using the concept of simultaneous equations • Use complex numbers to solve equations that cannot be solved using the real number system by applying: - factorization - quadratic formula	
2.1 **Work with algebraic expressions using the remainder and factor theorems**	• Use and apply die remainder and the factor theorem - find the remainder - prove that an expression is a factor	**5.1.1.1** **5.1.1.2** **5.1.2.1** **5.1.2.2**

	- find an unknown variable in order to make an expression, a factor or to leave a remainder • Factorize third degree polynomials including examples that require the factor theorem. (Long division or any other method may be used)	**5.1.1.3** **5.1.2.3** **5.1.2.4**
2.2 **Sketch and interpret information for graphs of the inverse of a function**	• Determine the equations of the inverses of the functions: - $y = ax + q$ - $y = ax^2$ - $y = a^x; a > 0$ ($y = a^x$ may be left with x as the subject of the formula. Note: no logarithms required) • Sketch the graphs of the inverse of the functions: - $y = ax + q$ - $y = ax^2$ - $y = a^x; a > 0$ NOTE: Sketching the graphs using point-by-point plotting is an option. • Obtain the equation of any of the following inverse graphs given as a sketch. - $y = ax + q$ - $y = ax^2$ - $y = a^x; a > 0$ • Identify characteristics as listed below with respect to the following functions and their	**6.7.6.2**

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	inverses.
	- $y = ax + q$
	- $y = ax^2$
	- $y = a^x; a > 0$
	  o Domain and range
	  o Intercepts with axes
	  o Turning points, minima and maxima
	  o Asymptotes
	  o Shape and symmetry
	  o Functions or non functions
	  o Continuous or discontinuous
	  o Intervals at which a function increases / decreases	

2.3 **Linear programming**	• Find and formulate the linear constraints from given problems • Solve linear programming problems by optimizing a function in two variables, subject to one or more linear constraints, using the search line method	**5.3.4.4** **5.3.4.5**

2.4
Instantaneous rate of change
	• Establish the derivatives of the following functions from first principles:
	  o $f(x) = b$
	  o $f(x) = ax + b$
	  o $f(x) = ax^2 + b$
	  o $f(x) = x^3$
	  o $f(x) = ax^3$
	  o $f(x) = \frac{1}{x}$
	  o $f(x) = \frac{a}{x}$
		5.6.4.1
		5.6.4.2

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	NOTE: the binomial theorem does not form part of the curriculum. • Find the derivatives of the functions in the form: ○ $f(x) = ax^n$ ○ $f(x) = a\ln kx$ ○ $f(x) = ae^{kx}$ ○ $f(x) = a\sin kx$ ○ $f(x) = a\cos kx$ ○ $f(x) = a\tan kx$ Where $f(x) = ax^n$ $\quad f'(x) = nax^{n-1}$ $f(x) = \ln kx$ $\quad f'(x) = \frac{k}{x}$ $f(x) = e^{kx}$ $\quad f'(x) = ke^{kx}$ $f(x) = a\sin kx$ $\quad f'(x) = ka\cos kx$ $f(x) = a\cos kx$ $\quad f'(x) = -ka\sin kx$ Examples to include are $3x^2$; $\frac{3}{x^{-3}}$; $2\ln 3x$; $\frac{1}{2}e^{-2x}$; $2\sin 3x$; $\frac{1}{3}\cos\frac{x}{2}$; $-4\tan x$; etc. • Use the constant, sum and/or difference, product, quotient and chain rules for differentiation NOTE: Combinations of rules in the same problem are excluded. • Find the equation of the tangent to a graph at a specific point • Solve practical problems involving rates of change. (Note: velocity and acceleration may be included)	**5.6.4.3** **5.6.4.4** **5.6.4.5** **5.6.4.7** **8.9.6.1** **8.9.6.2** **5.7.1.2** **5.7.5.2**

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	• Draw graphs of cubic functions by determining:
	  ○ Y-intercept
	  ○ Roots (x-intercepts)
	  ○ Turning points using derivatives
	
	• Determine / prove maximum and minimum turning points by making use of second order derivatives (Only: quadratic and cubic functions)
	
	• Determine the point of intersection of cubic graphs by using second order derivatives
		5.7.3.1
		5.7.3.2
		5.7.3.7
		5.7.4.2

2.5 **Integrals and finding areas under curves by using intergration**	• Find the integrals of the following: $\int ax^n dx$ $\int \frac{a}{x} dx$ $\int ae^{kx} dx$ $\int a \sin kx.dx$ $\int a \cos kx.dx$ $\int a \sec^2 kx.dx$ Where $\int ax^n dx = \frac{ax^{n+1}}{n+1} + c$ $\int \frac{a}{x} dx = a \ln x + c$ $\int ae^{kx} dx = \frac{ae^{kx}}{k} + c$ $\int a \sin kx.dx = \frac{-a \cos kx}{k} + c$	**5.8.1.1** **5.8.1.2** **5.8.1.3** **5.8.1.4**

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	$\int a\cos kx.dx = \frac{a\sin kx}{k} + c$ NOTE: ○ Simplifications may be required where necessary ○ Integrals of polynomials may be assessed ○ Integration by parts is excluded • Use the upper and lower limits to calculate definite integrals • Determine the area under a curve by: ○ Working from a given graph or by sketching a graph ○ Working with an area bounded by a curve, the x-axis, an upper and lower limit ○ Splitting the area into two intervals when the graph crosses the x-axis NOTE: ○ Integrals with respect to the x-axis only ○ Areas between two curves are excluded ○ The y-axis (x = 0) may be used as an upper or lower limit	**5.8.1.5** **5.8.1.6** **5.8.1.7**
3.1 **Use the Cartesian co-ordinate system to derive and apply equations**	• Use the Cartesian co-ordinate system to derive and apply the equation of a circle (any centre) • Use the Cartesian co-ordinate	**8.9.4.1** **8.9.4.2** **8.9.5.1**

	system to derive and apply the equation of a tangent to a circle given a point on the circle NOTE: - Straight lines to be written in the following forms only: $y = mx + c$; $y - y_1 = m(x - x_1)$; and/or $ax + by + c = 0$ (general form) - Learners are expected to know and be able to use as an axiom "the tangent to a circle is perpendicular to the radius drawn to the point of contact"	
3.2 **Explore, interpret and justify geometric relationships**	• Use geometry of straight lines and triangles to solve problems and to justify relationships in geometric figures. Concepts to include are: • Angles of a triangle • Exterior angles • Straight lines • Vertically opposite angles • Corresponding angles • Co-interior angles and • Alternate angles State and apply the following theorems: • If a line is drawn from the centre of a circle to the midpoint of a chord, then that line is perpendicular to the chord. • If a line is drawn from the centre to the circles perpendicular to the chord, then it bisects the chord	**8.3.2.1** **8.3.2.2** **8.3.3.1** **8.3.3.2** **8.2.2.1** **8.2.2.2** **8.2.3.1** **8.2.3.2** **8.2.5.1** **8.2.5.2** **8.5.2** **8.5.3** **8.5.4.1** **8.5.4.2** **8.5.5.1** **8.5.5.2** **8.5.6** **8.5.7**

	• If an arc subtends an angle at the centre of the circle and at any point on the circumference, then the angle at the centre is twice the measure of the angle at the circumference • If the diameter of a circle subtends an angle at the circumference, then the angle at the centre is twice the measure of the angle at the circumference • If an angle subtended by a chord at a point on the circumference is a right angle, the chord is a diameter • Angle in the same segment of a circle are equal • The opposite angles of a cyclic quadrilateral is supplementary • An exterior angle of a cyclic quadrilateral is equal to the interior opposite angle • If the exterior angle of a quadrilateral is equal to the interior opposite angle the quadrilateral will be a cyclic quadrilateral • If a tangent to a circle is drawn, then it is perpendicular to the radius at the point of contact • If a line is drawn perpendicular to a radius at the point where the radius meets the circle, then it is a tangent to the circle • If two tangents are drawn from the same point outside a circle then they are equal in	**8.5.8** **8.5.9**

	length • The angle between the tangent to the circle and a chord drawn from the point of contact is equal to an angle in the alternate segment (tan-chord theorem) NOTE: Proofs of the above theorems are excluded.	
3.3 **Solve problems by constructing and interpreting trigonometric models**	• Use the following compound identities: $\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \cos\alpha\sin\beta$ $\cos(\alpha \pm \beta) = \cos\alpha\cos\beta \mp \sin\alpha\sin\beta$ to derive and apply the following double angle identities: $\sin 2\alpha = 2\sin\alpha\cos\alpha$ $\cos 2\alpha = \begin{cases}\cos^2\alpha - \sin^2\alpha \\ 2\cos^2\alpha - 1 \\ 1 - 2\sin^2\alpha\end{cases}$ • Determine the specific solutions of trigonometric expressions using compound and double angle identities without using a calculator. (e.g. sin 120° , cos 75° etc) • Use compound angle identities to simplify trigonometric expressions and to prove trigonometric equations • Determine the specific solutions of trigonometric equations by using knowledge of compound angles and	**7.5.4.1** **7.5.4.2** **7.5.4.3** **7.5.4.9**

	identities NOTE: ○ Solutions: [0°;360°] ○ Identities limited to: $\tan\theta = \frac{\sin\theta}{\cos\theta}$; $\sin^2\theta + \cos^2\theta = 1$ ○ Double and compound angle identities are included NOTE: Radians are excluded • Solve problems from a given diagram in two and three dimensions by applying the sine and cosine rule. NOTE: Area formula and compound angle identities are excluded.	**7.7.5.1** **7.7.5.2**
4.1 **Represent, analyze and interpret data using various techniques**	• Identify situations or issues that can be dealt with through statistical methods RANGE: Data given should include problems relating to health, social, economic, cultural, political and environmental issues. • Discuss the use of appropriate and efficient methods to record, organize and interpret given data by making use of: - manageable data sample sizes (less or equal to 10) and which are representative of the population - graphical representations and numerical summaries	

	which are consistent to the data, and clear and appropriate to the situation and target audience - compare different representations of given data • Justify and apply statistics to answer questions about problems	
4.2 **Use variance and regression analysis to interpolate and extrapolate bivariate data**	• Calculate : - variance and - standard deviation manually for small sets of data only • Interpret the meaning of variance and standard deviation for small sets of data only • Represent bivariate numerical data as a scatter plot • Identify intuitively whether a linear, quadratic or exponential function would best fit the data • Draw the intuitive line of best fit RANGE: o Data given should include problems related to health, social, economics, cultural, political and environmental issues o For small sets of data only (limited to 8)	

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	• Use least squares regression method to determine a function which best fits a given set of bivariate data • Use the regression line to predict the outcomes of a given problem	
4.3 **Use experiments, simulation and probability distribution to set and explore probability models**	• Explain and distinguish between the following terminology/events: o Probability o Dependent events o Independent events o Mutually exclusive o Mutually inclusive o Complimentary events • Make predictions based on validated experimental or theoretical probabilities taking the following into account o P(S) = 1 (where S is the sample space) o Disjoint (mutually exclusive) events, and is therefore able to calculate the probability of either of the events occurring by applying the addition rule for disjoint events: P(A or B) = P(A) + P(B) o Complementary events and is therefore able to calculate the probability of an event not occurring o P(A or B) = P(A) + P(B) – P(A and B) (where events are events within a sample space) o Correctly identify	**10.2.4** **10.2.5** **10.2.6**

	dependent and independent events (e.g. from two-way contingency tables or Venn diagrams) and therefore appreciate when it is appropriate to calculate the probability of two independent events occurring by applying the product rule for independent events: P(A and B) =P(A).P(B) • Draw Tree diagrams, Venn diagrams and complete contingency two-way tables to solve probability problems (where events are not necessarily independent) RANGE: ○ Venn diagrams to be limited to two subsets ○ Tree diagrams where the sample space is manageable (not more than 15 possible outcomes) • Interpret and clearly communicate results of the experiments correctly in terms of real context	
5.1 **Use mathematics to plan and control financial instruments**	• Use simple and compound growth formulae $A = P(1+i.n)$ and $A = P(1+i)^n$ and $A = P(1+\frac{r}{100 \times m})^{t \times m}$ to solve problems, including interest, hire-purchase and inflation	**10.7.1.1** **10.7.1.2** **10.7.1.3** **10.7.1.4**

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	• Understand, use and interpret tax tables • Use simple and compound decay formulae , $A = P(1-i.n)$ and $A = P(1-i)^n$, to solve problems (straight line depreciations and depreciation on a reducing balance)	**10.7.2.3** **10.7.2.5**

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