YEAR 4 EXPRESS ADDITIONAL MATHEMATICS

GCE 'O' Level Subject Code: 4049

Textbook: Additional Mathematics 360 [2nd Edition, Vol A and B) (Marshall Cavendish)]

TERM 1	**UNIT 1 TRIGONOMETRIC IDENTITIES AND EQUATIONS (CHP 11)**
	1.1 : To learn about the Addition Formulae, sin(A $\pm$ B), cos(A $\pm$ B) and tan(A $\pm$ B) and how to simplify expressions, prove identities and solve equations involving these
	1.2 : To derive the Double Angle Formulae, sin2A, cos2A and tan2A from the Addition Formulae and use them to simplify expressions, prove identities and solve equations
	1.3 To use the Double Angle Formulae and Addition Formulae to solve equations involving sin*pA*, cos*pA* and tan*p*A where *p* is a constant (Eg $\frac{1}{2}$, 4, 6 etc)
	1.4 R Formulae To learn that the R formula is another way to express equations of the form: $a\sin x \pm b\cos x = c, c \neq 0$ $a\cos x \pm b\sin x = c, c \neq 0$
	1.5 To express $\boldsymbol{a\cos\theta \pm b\sin\theta}$, $\boldsymbol{a\sin\theta \pm b\cos\theta}$ in the form $R\cos(\theta \mp \alpha)$ or $R\sin(\theta \pm \alpha)$.
	1.6 To apply the expressions to solve equations
	1.7 To find the maximum and minimum values of expressions like $a\cos\theta \pm b\sin\theta$, $a\sin\theta \pm b\cos\theta$ and variations of these.
	UNIT 2: DIFFERENTIATION (CHP 12)
	2.1 $\boldsymbol{\delta x}$ ***and*** $\boldsymbol{\delta y}$ are notations used to represent small changes. The limiting process which leads to $\boldsymbol{\frac{dy}{dx}}$ comes from taking $\boldsymbol{\delta x \to 0}$
	2.2 To state and use the formula for differentiation of ax^n
	2.3 To state and use the chain rule for differentiation
	2.4 To state and use the product rule for differentiation
	2.5 To state and use the quotient rule for differentiation
	Unit 3 Tangents, Normals and Rates of Change(CHP 13)
	3.1 To state the relation between gradient function and $\frac{dy}{dx}$.
	3.2 To find the gradient of a curve at a particular point using $\frac{dy}{dx}$
	3.3 To find the equation of the tangent to the curve at a given point
	3.4 To find the gradient and equation of the normal to a curve at a given point

	3.5 To solve problems involving tangents and normals using $\frac{dy}{dx}$
	3.6 Definition of an **increasing and a decreasing function**
	3.7 To use $\frac{dy}{dx}$ to identify increasing and decreasing functions
	3.8 To state the sign of $\frac{dy}{dx}$ in the domain where the function is increasing/decreasing
	3.9 To find the range of values x for which the function is increasing/decreasing
	3.10 RATES OF CHANGE - To state the relation between the rate of change and $\frac{dy}{dx}$.
	3.11 To apply chain rule which gives the relationship between the rates of change
	3.12 To solve various problems involving rates of change
TERM 2	**UNIT 4 : MAXIMA AND MINIMA (CHP 14)**
	4.1 To define "stationary point" of a curve and state the types of stationary points, including points of inflexion
	4.2 To find the stationary points of a function using $\frac{dy}{dx}$
	4.3 To use the 1st derivative test to determine the nature of a stationary point
	4.4 To use the 2nd derivative test to determine the nature of a stationary point
	4.5 To state the advantages and disadvantages of the 1st & 2nd derivative tests
	4.6 To solve problems involving stationary points & use of derivative tests
	4.7 To solve maximum/minimum value word problems and use the derivative tests to discriminate the values found
	4.8 To sketch simple graphs by considering turning points, x-intercepts and y-intercepts
	UNIT 5 : DIFFERENTIATIONOF TRIGONOMETRIC, EXPONENTIAL AND LOGARITHMIC FUNCTIONS (CHP 15)
	5.1 To state the derivatives of sine functions: i) y = sin x, ii) y = sin (ax+b), (iii) y = $\sin^k x$
	5.2 To state the derivatives of cosine functions: i) y = cos x, ii) y = cos (ax+b), (iii) y = $\cos^k x$
	5.3 To state the derivatives of tangent functions: i) y = tan x, ii) y = tan (ax+b), (iii) y = $\tan^k x$
	5.4 To use the different rules of differentiation to differentiate various trigonometric functions
	5.5 To use trigonometric differentiation in problems involving applications of differentiation, e.g. rates of change, stationary values, etc
	5.6 To derive the derivative of the exponential function $y=ke^{f(x)}$
	5.7 To state the derivatives of log functions: i) y = ln x, ii) y = ln f(x)
	5.8 To use the rules of differentiation to differentiate various Exponential and logarithmic functions
	5.9 To use exponential and logarithmic differentiation in problems involving applications of differentiation

	UNIT 6 : INTEGRATION (CHP 16)
	6.1 To understand that integration is anti-differentiation or the inverse of differentiation
	6.2 To integrate single algebraic terms using the rule: $\int ax^n\, dx = \frac{ax^{n+1}}{n+1} + c$, $n \neq -1$
	6.3 To integrate sums or differences of simple algebraic terms
	6.4 To integrate linear functions using the rule: $\int (ax + b)^n\, dx = \frac{(ax+b)^{n+1}}{a(n+1)} + c$, $n \neq -1$
	6.5 To use the rule : $\int \frac{1}{ax+b}\, dx = \frac{1}{a}\ln(ax+b) + c$
	6.6 To find an expression for y if $\frac{dy}{dx} = f(x)$ is given
	6.7 To find the equation of a curve whose gradient function and a particular point are given
	6.8 To define definite integrals as $\frac{d}{dx}[F(x)] = f(x) \Rightarrow \int_a^b f(x)dx = F(b) - F(a)$
	6.9 To apply the results $\int_a^a f(x)dx = 0, \int_a^b f(x)dx = -\int_b^a f(x)dx$, $\int_a^b f(x)dx = \int_a^c f(x)dx + \int_c^b f(x)dx$
	6.10 To evaluate definite integrals of simple functions
	6.11 To integrate trigonometric functions using the results: (i) $\int \sin(ax+b)\, dx = -\frac{1}{a}\cos(ax+b) + c$ (ii) $\int \cos(ax+b)\, dx = \frac{1}{a}\sin(ax+b) + c$ (iii) $\int \sec^2(ax+b)\, dx = \frac{1}{a}\tan(ax+b) + c$.
	6.12 To find the definite and indefinite integrals of simple trigonometric functions
	6.13 To integrate simple exponential functions: $\int e^{ax+b}\, dx = \frac{1}{a}e^{ax+b} + c$
	6.14 To find definite and indefinite integrals involving 11.13
	Unit 7 : APPLICATIONS OF INTEGRATION (CHP 17)
	7.1 To understand definite integration as a Riemann Sum of the area under the curve
	7.2 To find the area bounded by the curve y = f(x), the x-axis and the lines x = a and x = b: $A = \int_a^b f(x)dx$
	7.3 To find the area bounded by the curve x = g(y), the y-axis and the lines y = c and y = d: $A = \int_c^d g(y)dy$.
	7.4 To apply 12.2, 12.3, to the trigonometric and exponential functions

	UNIT 8 : KINEMATICS (CHAPTER 18)
	8.1 To state the relation between i) velocity & displacement as v = $\frac{ds}{dt}$, ii) acceleration & velocity as a = $\frac{dv}{dt}$
	8.2 (i) To use differentiation to find i) velocity-time function given the displacement-time function, (ii) the acceleration-time function given the velocity-time function.
	8.3 To comprehend the terms i) momentarily at rest, ii) average velocity, iii) distance travelled in the nth second, iv) total distance travelled
	8.4 To find maximum i) displacement, ii) velocity from given function
	8.5 To solve problems involving differentiation on motion of particle along a straight line
TERM 3	**8.6** To state the relation between i) displacement & velocity as s = $\int$ v dt , ii) velocity & acceleration as v = $\int$ a dt
	8.7 To find i) displacement-time function given the velocity-time function, ii) the velocity-time function given the acceleration-time function.
	8.8 To solve problems involving differentiation and integration on motion of particle along a straight line.
	8.9 To sketch the displacement-time, velocity-time and acceleration-time graphs
	8.10 To find the velocity from the displacement-time graph using differentiation
	8.11 To find the acceleration from the velocity-time graph using differentiation
	8.12 To find the displacement from the velocity-time graph using integration
	8.13 To find the velocity from the acceleration-time graph using integration
	UNIT 9: PLANE GEOMETRY (CHAPTER 19)
	9.1 Prove geometrical results using line and angles properties like : perpendicular lines, parallel lines, similar triangles
	9.2 Prove geometrical results using the angle properties of triangles, special quadrilaterals and circles
	9.3 Prove geometrical results by applying Midpoint Theorem
	9.4 Prove geometrical results by applying Alternate Segment Theorem
TERM 4	**Revision for Prelims**