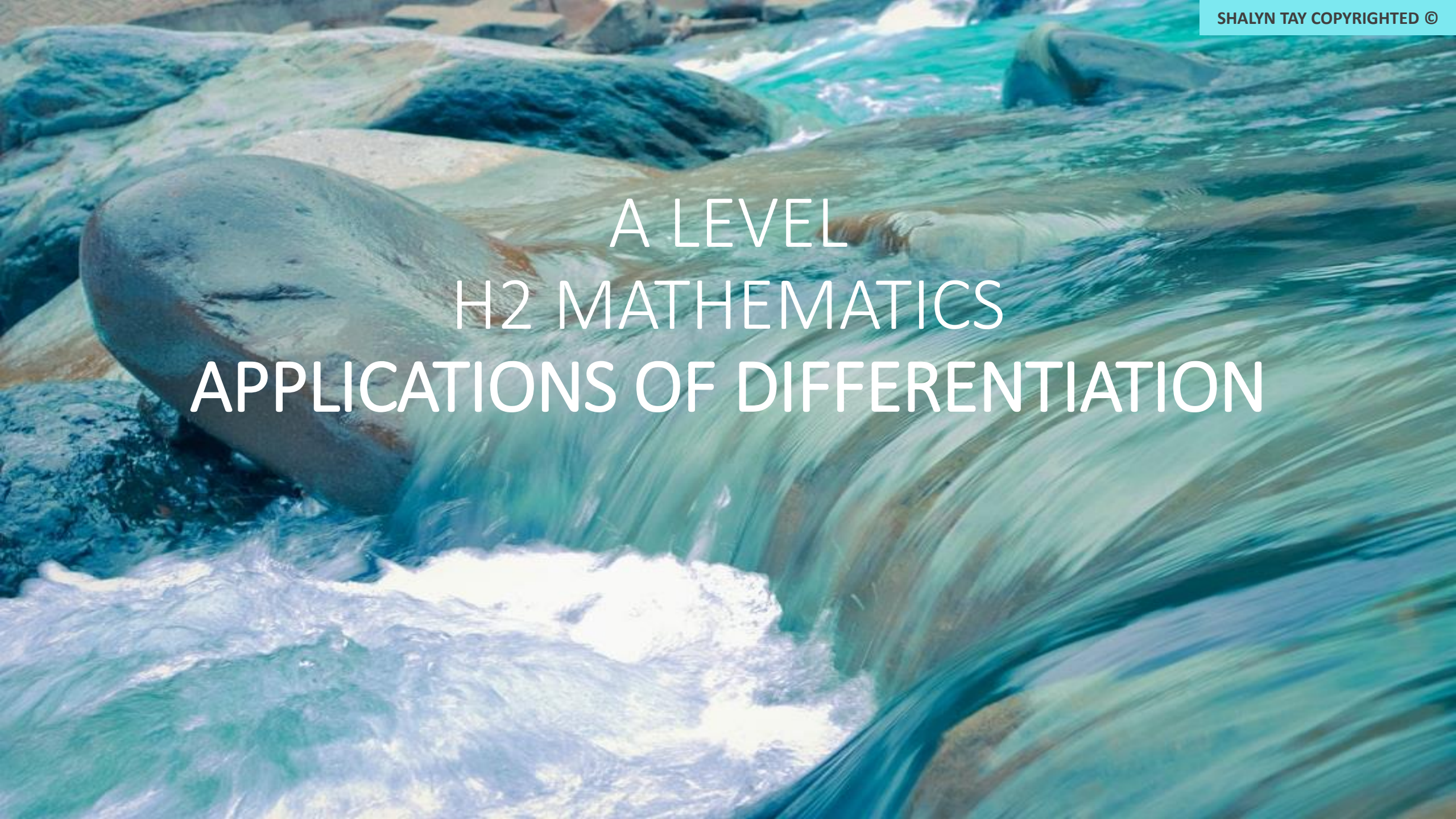


A LEVEL
H2 MATHEMATICS
APPLICATIONS OF DIFFERENTIATION

CHAPTER ANALYSIS

MASTERY

- Strictly Increasing / Decreasing & Concavity
- Stationary Points, Turning Points & Points of Inflection
- Tangents & Normals
- Maximisation & Minimisation
- Rates of Change

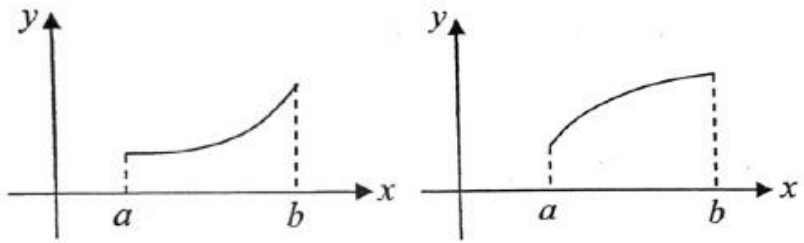
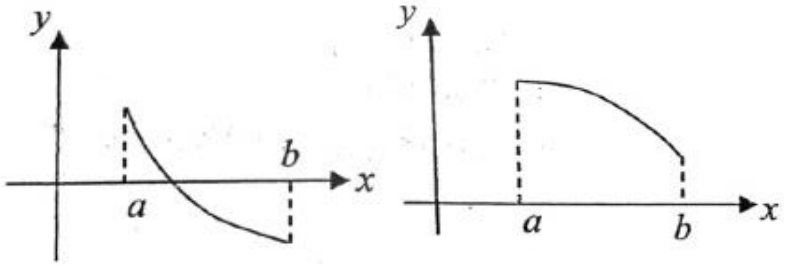
EXAM

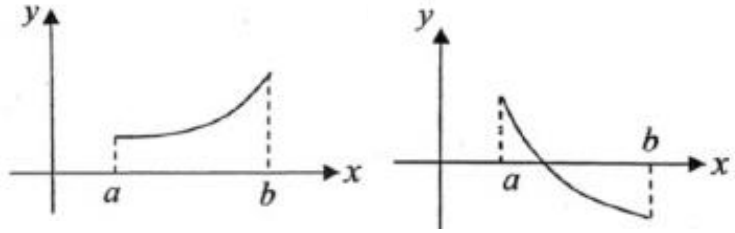
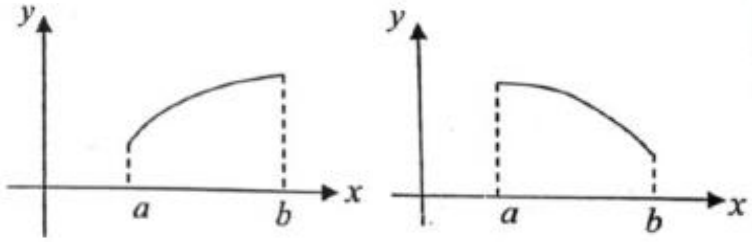
- Differentiation techniques need to be strong
- Most concepts already learnt in Secondary School Additional Mathematics
- Stationary points relevant in graphing techniques

WEIGHTAGE

- High weightage, more than 10% of paper
- Appears every year, 2-3 questions, especially maximization/minimization and rate of change questions

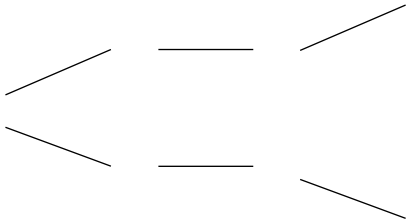
Strictly Increasing / Decreasing & Concavity

Function	$f'(x)$	Graph
Increasing	> 0	 Function is strictly increasing over the interval (a, b)
Decreasing	< 0	 Function is strictly decreasing over the interval (a, b)

Concavity	$f''(x)$	Graph
Concave Up Minimum	> 0	 Function is concave up over the interval (a, b)
Concave Down Maximum	< 0	 Function is concave down over the interval (a, b)

Stationary Points, Turning Points & Points Of Inflection

Method 1: First Derivative Test

x	x^- x x^+	x^- x x^+	x^- x x^+
$\frac{dy}{dx}$	+ve 0 -ve	-ve 0 +ve	+ve 0 +ve -ve 0 -ve
Shape			
Nature of Stationary Point	Maximum	Minimum	Point of Inflection

Method 2: Second Derivative Test

Nature of Stationary Point	$f''(x)$
Maximum	> 0
Minimum	< 0

In general, we know a point is stationary when $\frac{dy}{dx} = 0$. However, questions usually ask for the nature of stationary points. This is also useful when drawing graphs in graphing techniques.

Tangents & Normals

Equation of Tangent: $y - y_1 = m\,(x - x_1)$

Equation of Tangent: $y - y_1 = -\frac{1}{m}\,(x - x_1)$

Maximisation & Minimisation
(Guidelines)

1. Denote each changing quantity by a variable
2. Write a formula for quantity to be maximized/minimized
3. Express formula from Step (2) in terms of 1 variable only
4. Differentiate and equate derivative to 0 for stationary values
5. Use first or second derivative test to justify if is maximum/minimum
6. Answer question

Rate of Change

$\frac{dy}{dt} > 0 \Longrightarrow$ y increases with time

$\frac{dy}{dt} < 0 \Longrightarrow$ y decreases with time

Chain Rule: $\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx}$

Rate of Change
(Guidelines)

1. Denote each changing quantity by a variable
2. Find equations relating the variables
3. Use chain rule to link up derivatives
4. Write down values of variables and given rates of change
5. Solve for unknown rate

Note: Contextual questions, important to practice different types. Guidelines are generic.

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