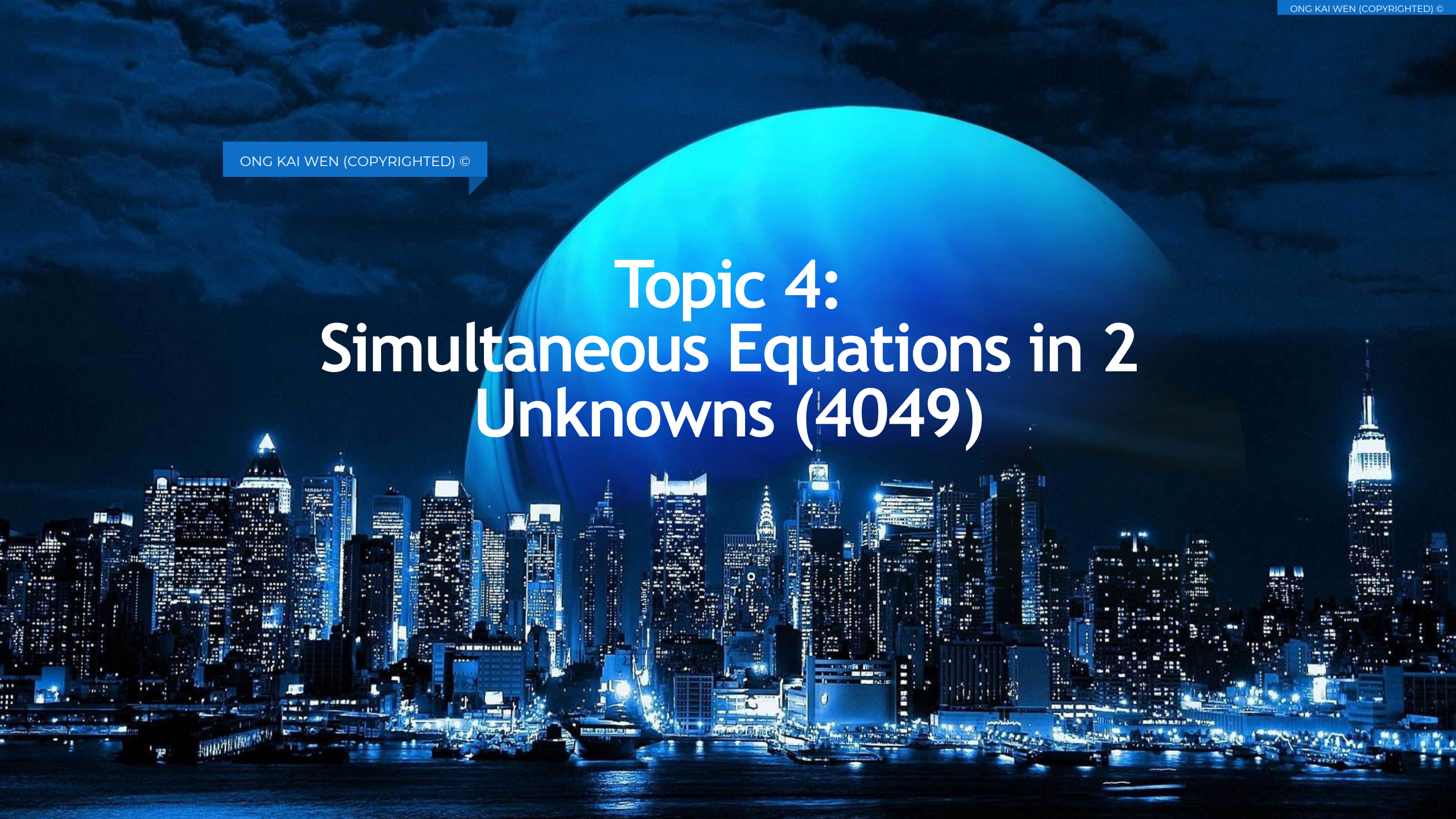

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Topic 4: Simultaneous Equations in 2 Unknowns (4049)

THE ABOUT

CHAPTER ANALYSIS

- Solving simultaneous equations in two variables by substitution, with one of the equations being a linear equation

MASTERY

- Relatively straight forward chapter
- 1 **key** concept

EXAM

- Concepts usually tested as a stand-alone topic but conceptually can be tested in other topics (Coordinate Geometry, Equations & Inequalities etc.…)
- Easy to make careless mistakes if not weary on substitution and expansion in Algebra

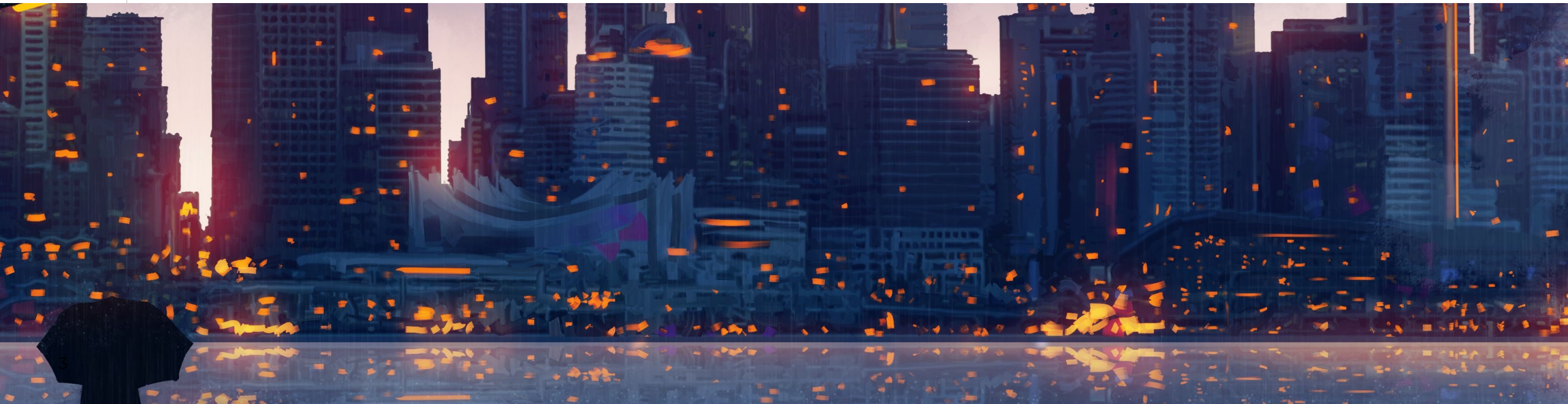
WEIGHTAGE

- Medium overall weightage
- Tested consistently every year
- Typically, an 6m question, 1 question in one of the papers

KEY CONCEPT

Assumed Knowledge: Linear Equations (E-Math)

Non-Linear Equations



Example:

Solve the following simultaneous equations

$y - 2x = 1 \ldots\ldots\ldots (1)$
$y - 4x = -3 \ldots\ldots\ldots (2)$

Solution

From Equation (1),
$y = 1 + 2x \ldots\ldots\ldots (3)$

Substitute Equation (3) into Equation (1)
$(1 + 2x) - 4x = -3$
$x = 2$

Substitute $x = 2$ into Equation (3),
$y = 1 + 2(2)$
$= 5$

Take Note

Questions asking for the points of intersection between 2 lines is also using simultaneous equations

Simultaneous Equations

Set of equations that have common unknowns

Linear Equations [Assumed knowledge from E-Math]

2 known methods to solving

Elimination [Not recommended unless obvious]

- Multiply or divide either one or both linear equations by a constant so that they can contain an identical term
- Eliminate the identical term by subtracting or adding the equations to obtain an equation with only one unknown
- Use this equation to solve for the unknown and substitute the result into either one of the original equations to solve for the other unknown

Substitution

- Express one of the unknowns in one of the linear equations in terms of the other unknown
- Substitute the transformed equation into the other linear equation to obtain an equation with only one unknown
- Use this equation to solve for the unknown and substitute the result into either one of the original equations to solve for the other unknown

Example:

Solve the following simultaneous equations

$3x^2 + y^2 = 28 \ldots\ldots\ldots (1)$
$3x + y = 8 \ldots\ldots\ldots (2)$

Solution

From Equation (2),
$y = 8 - 3x \ldots\ldots\ldots (3)$

Substitute Equation (3) into Equation (1)
$3x^2 + (8 - 3x)^2 = 28$
$3x^2 + 64 - 48x + 9x^2 = 28$
$12x^2 - 48x + 36 = 0$
$x^2 - 4x + 3 = 0$
$(x - 1)(x - 3) = 0$
$x = 1 \quad \text{or} \quad x = 3$

Substitute $x = 1$ into Equation (3)
$y = 8 - 3(1)$
$= 5$

Substitute $x = 3$ into Equation (3)
$y = 8 - 3(3)$
$= -1$

Non-linear Equations

Solved using the substitution method

Substitution

- Express one of the unknowns in one of the linear equations in terms of the other unknown
- Substitute the transformed equation into the other linear equation to obtain an equation with only one unknown
- Use this equation to solve for the unknown and substitute the result into either one of the original equations to solve for the other unknown

Common Mistakes

When dealing with fractions:

$$\left(\frac{x+2}{3}\right)^2 + 3y = 7 \quad (1)$$

$$\left(\frac{x^2+4x+4}{9}\right) + 3y = 7 \quad (2)$$

$$x^2 + 4x + 4 + 9(3y) = 9(7) \quad (3)$$

...

- Many students will forget to **square** the denominator when dealing with fractions **[Step 2]**
- Many students will forget to use **algebraic identities** when expanding the numerator **[Step 2]**
- Many students will forget to multiply the denominator to **EVERY** single term in the equation to get rid of the denominator **[Step 3]**

Non-Linear Equations

Personal advice:

$$2y = 2x^3 - 5x^2$$

$$-4x = -y - 3$$

ALWAYS use the linear equation and make one of the unknowns there the subject. Never use the non-linear equation

In the example above, clearly the circled equation is easier as we do not need to deal with squares in the non-linear equation

If possible, try to avoid making fractions and using fractions during the substitution phase. This is due to the fact that many students always make careless mistakes when manipulating with fractions

In the example above, making y the subject will be easier than x as it does not deal with fractions

In the unfortunate event that fractions are unavoidable, then remember that when removing the denominators, it must be multiplied to every single term in the equation

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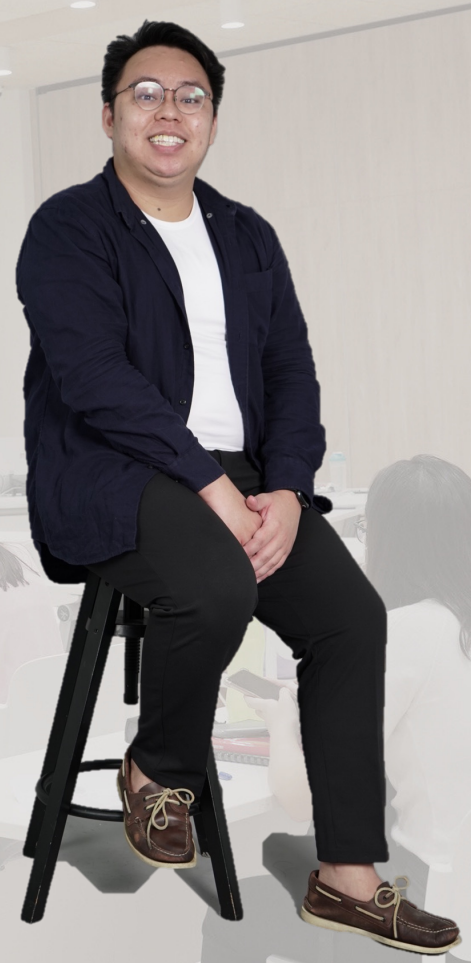

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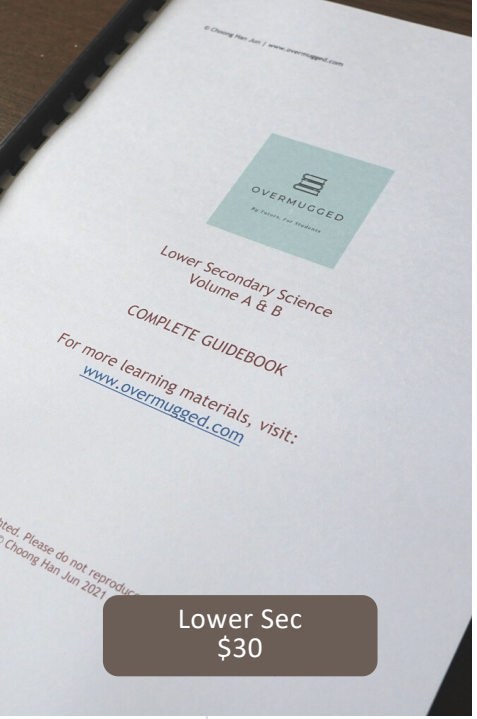

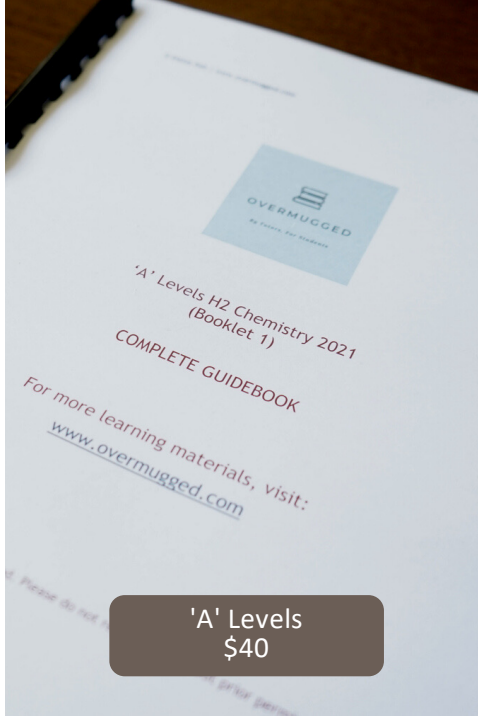

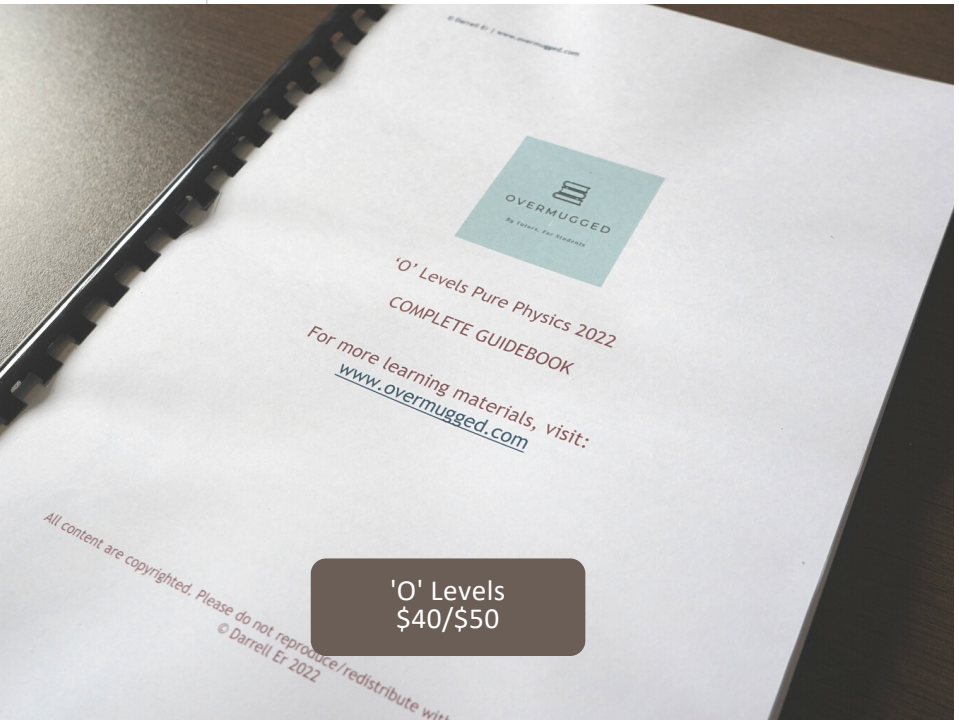

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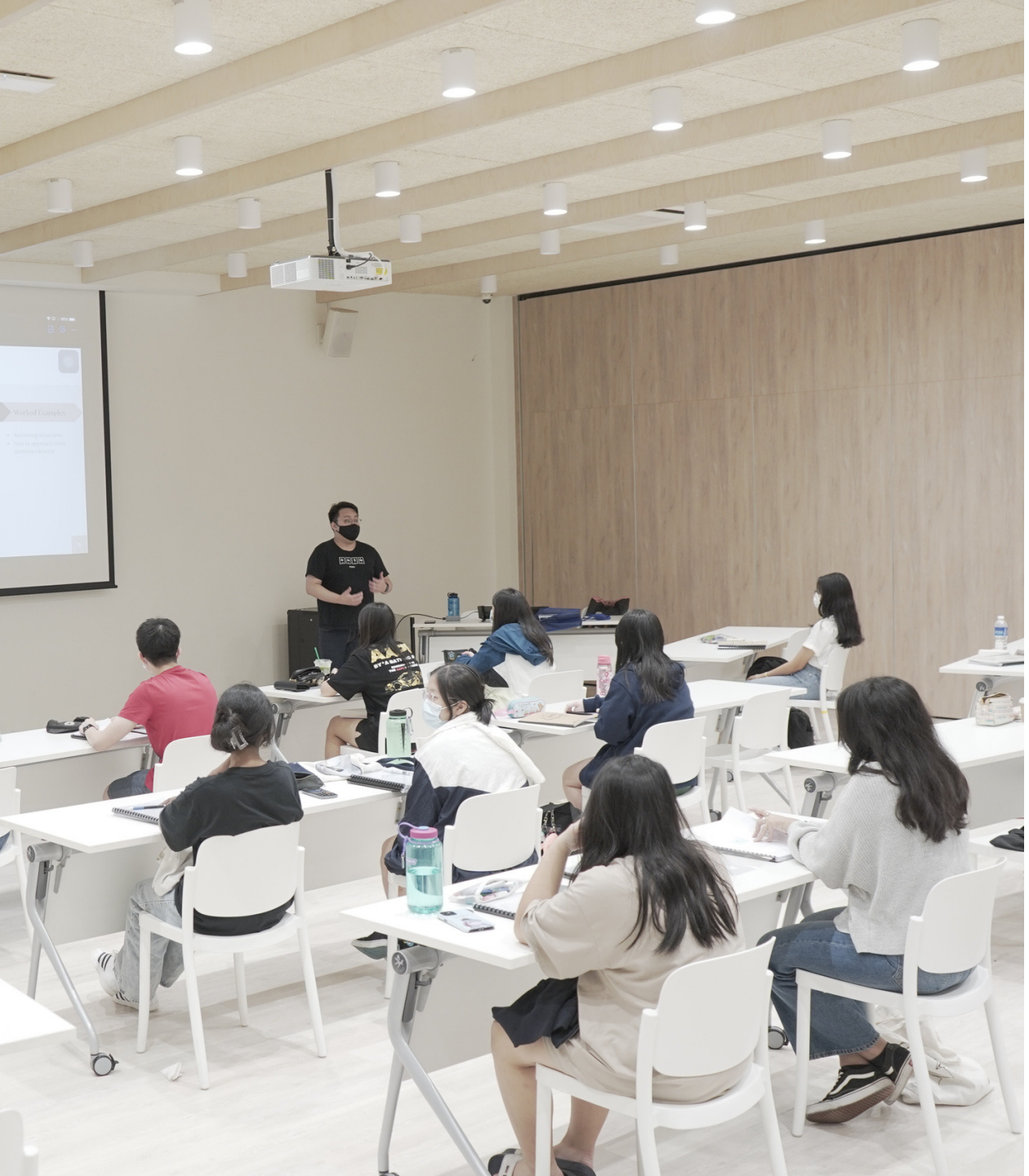

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