CHAPTER 3: INDICES

Chapter Analysis

- Laws of Indices
- Zero and Negative Indices
- Fractional Indices
- Solving Equations Involving Indices
- Use of Standard form, $\mathrm{A} \times 10^{\mathrm{n}}$, where $1 \leq A < 10$.
- Applications of Indices to Compound Interest

Laws of Indices

Property	Indices Law
Same Base	$a^m \times a^n = a^{m+n}$
	$\frac{a^m}{a^n} = a^{m-n}$
	$(a^m)^n = a^{mn}$
Same Power	$a^m \times b^m = (ab)^m$
	$\frac{a^m}{b^m} = \left(\frac{a}{b}\right)^m$

The 5 laws of indices focuses on "same base" and "same power"

Common Mistake

$$a^m + b^m = (a+b)^m$$ ✗

Many students get confused and use the above in their solutions! However, this is INCORRECT

By substituting values of $a = 1$, $b = 2$ and $m = 3$

$$\text{LHS} = 1^3 + 2^3 = 9$$

$$\text{RHS} = (1+2)^3 = 27$$

$$\text{LHS} \neq \text{RHS}$$

Zero and Negative Indices

- Zero Indices: $x^0 = 1$

It doesn't matter what is the value of x, if the power is 0, it will always be equals to 1.

- Negative Indices: $a^{-n} = \frac{1}{a^n}$

*To switch the signs of the power from negative to positive and vice versa, we just need to "bring it to the other side" (e.g. from numerator to denominator)

Example:

1) $\frac{1}{a^{-2}} = a^2$: To turn the power from negative to positive, we just need to bring it from the denominator to numerator.

2) $\frac{1}{a^2} = a^{-2}$: To turn the power from positive to negative, we just need to bring it from the numerator to denominator.

Fractional Indices

- $\sqrt[n]{a^m} = a^{\frac{m}{n}}$

Rule of thumb: As long as you see a root/surd, the power will always be a fraction. The power inside the surd will be the numerator, while the power outside the surd will be the denominator.

Example: $\sqrt[3]{a^8} = a^{\frac{8}{3}}$

Solving Equations Involving Indices

Worked Example A1.7.3

Solve the equation

$$27^{2x-1} = 3^2(3^x)$$

[S4 TKGS P1/2011 PRELIM Qn 10(a)]

Solution

$$27^{2x-1} = 3^2(3^x)$$

$$3^{3(2x-1)} = 3^{2+x}$$

Comparing powers,

$$\therefore 3(2x-1) = 2+x$$

$$6x - 3 = 2 + x$$

$$5x = 5$$

$$x = 1$$

Things to take note when solving equations involving indices:

1) Always make the base the same so that we can compare the powers.
2) Try to make the bases into the simplest form (e.g., prime factors such as 2,3,5 etc.)
3) It will be a bonus if you can remember the basic perfect squares and cubes. It will help!

Standard Form

- Standard form is where the number is expressed in the form of:

$A \times 10^{n}$, where $1 \leq A < 10$.

Value (in terms of 10^x)	Prefix	Symbol
10^{-12}	pico -	p
10^{-9}	nano -	n
10^{-6}	micro -	μ
10^{-3}	milli -	m
10^{-2}	centi -	c
10^{-1}	deci -	d
10^{3}	kilo -	k
10^{6}	mega -	M
10^{9}	giga -	G
10^{12}	tera -	T

Tip:

- When you go from a higher prefix to lower, you multiply.
- When you from a lower prefix to higher, you divide.

Application of Indices to Compound Interest

- Simple Interest: $\frac{P \times R \times T}{100}$

  $where\ P\ is\ the\ principal\ amount, R\ is\ the\ interest\ rate\ and\ T\ is\ the\ number\ of\ periods$

- Compound Interest: $P(1+\frac{R}{100})^n$

  $where\ P\ is\ the\ principal\ amount, R\ is\ the\ interest\ rate\ and\ n\ is\ the\ number\ of\ compounding\ periods.$

- If compounding frequency is more than once a year, we must change the interest rate and number of compounding periods accordingly*

Example:

Worked Example A10.1.1

Darby invested \$**5 400** in a bank that pays $\boldsymbol{m}$% interest per annum which is compounded half yearly. If she received \$**5 847.89** after **2.5 years**, calculate the value of $\boldsymbol{m}$

[S4 HIHS P1/2015 PRELIM Qn 10]

- The new interest rate will be $\frac{m}{2}$, since it is compounded half yearly.
- The number of compounding periods will be 2.5 x 2 = 5 since its compounded half yearly, the amount will be compounded twice a year.

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07

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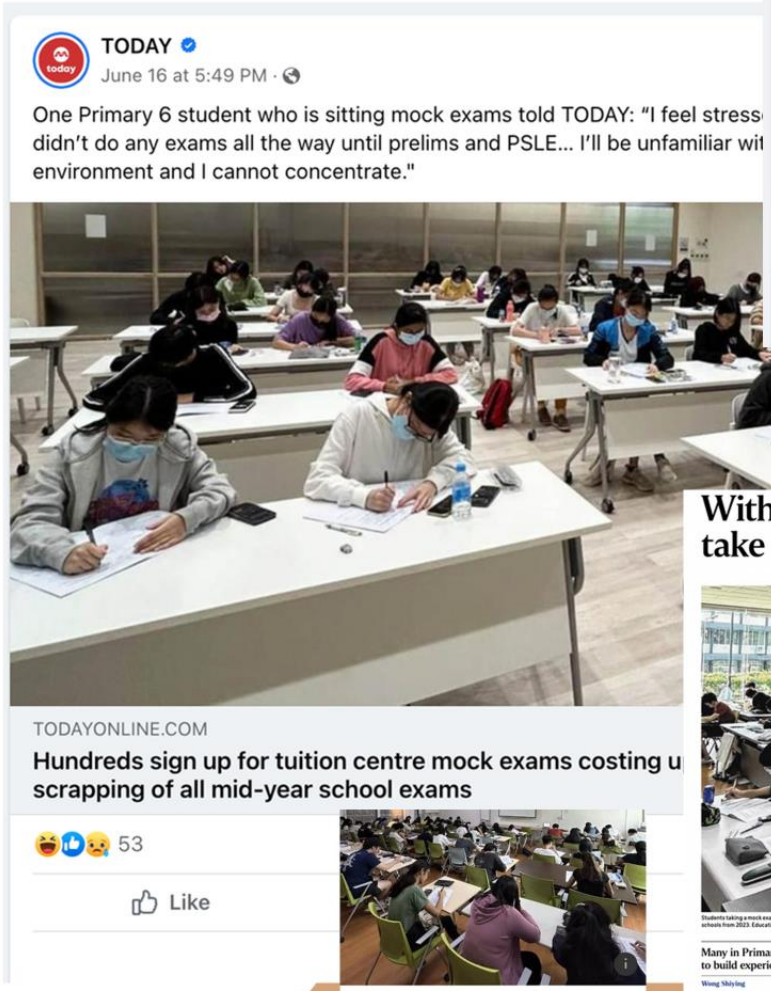

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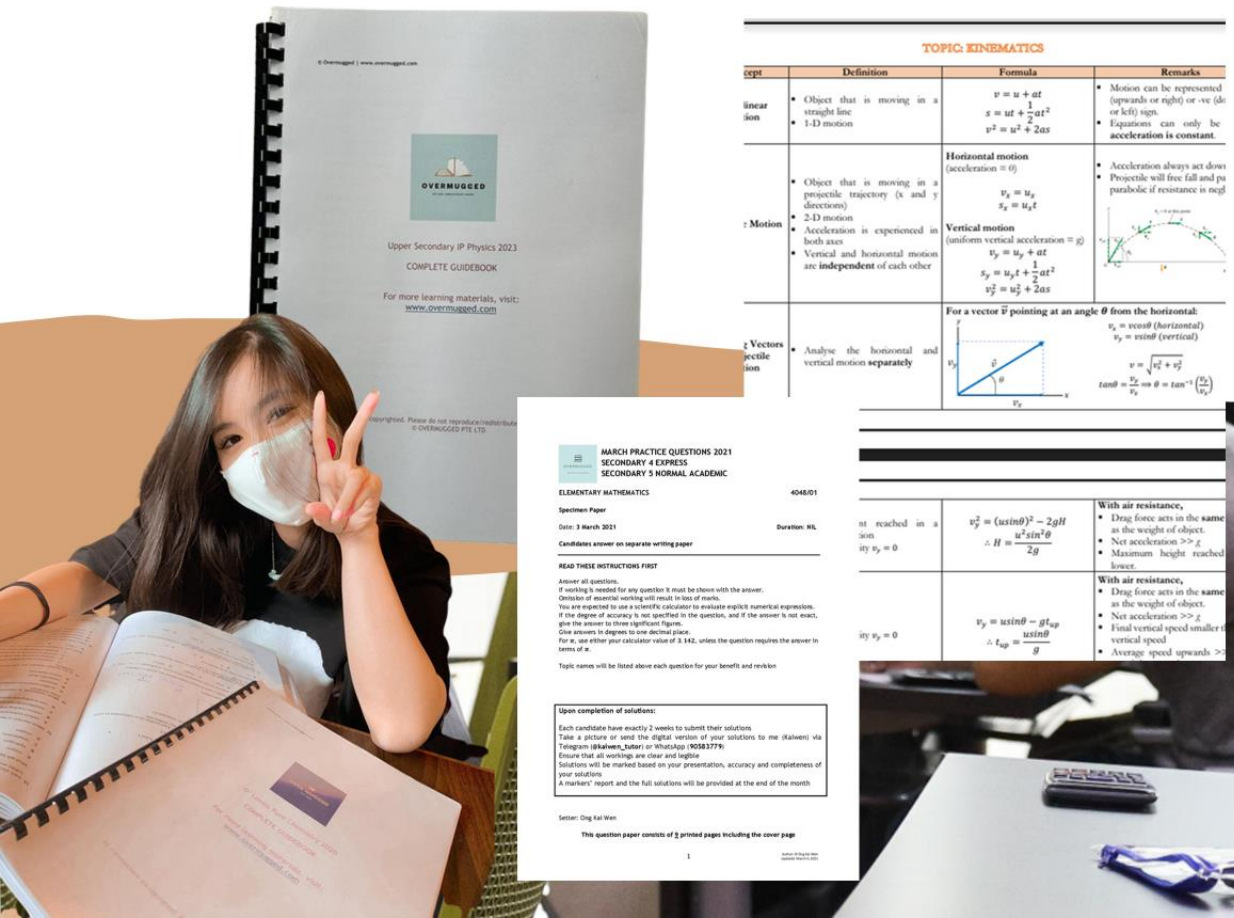

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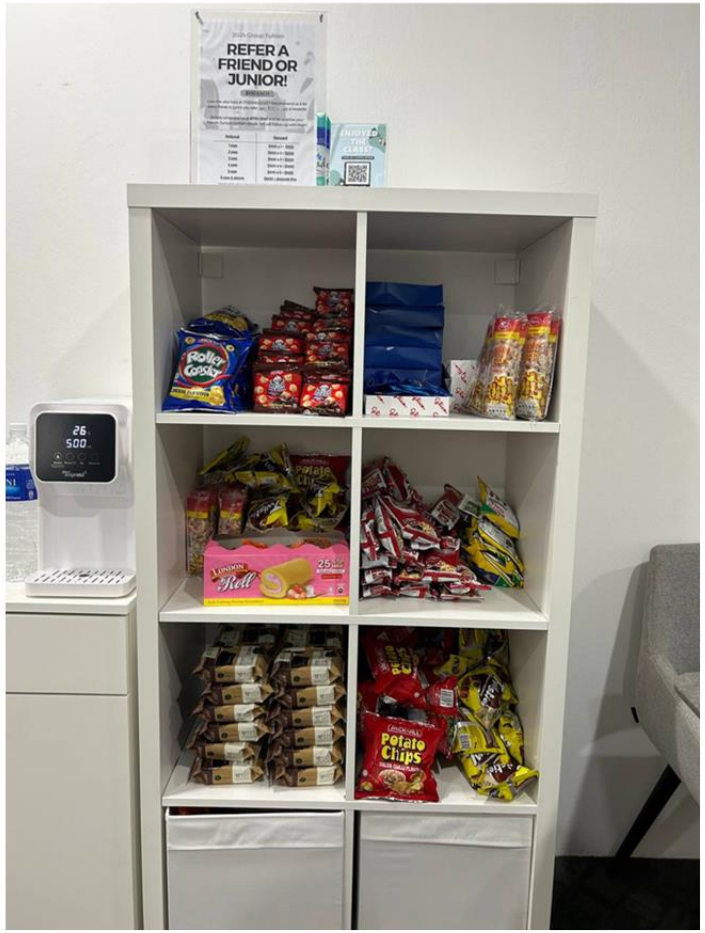

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Key highlight: March Holiday Cohesion Program

TERM 3: MAY – JUL

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TERM 4: AUG – OCT

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Key highlight: Mock Exams, Science Practical Assessment

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