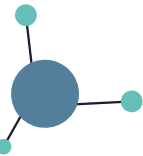
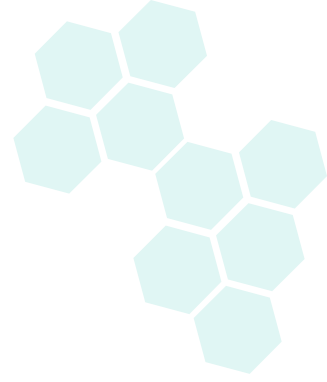


# Molecular Genetics





- (a) Outline the relationships among DNA, genes and chromosomes
  
- (a) State that DNA is a double helix comprising two strands of nucleotides, each nucleotide formed of a sugar, a phosphate group and one of four different bases
  
- (a) State the rule of complementary base pairing
  
- (a) State that each gene:
  - Is a sequence of nucleotides, as part of a DNA molecule
  - Codes for one polypeptides
  - Is a unit of inheritance





# DNA- Nucleotide

Deoxyribonucleic acid (DNA) is a molecule that carries genetic code which is used to synthesise specific polypeptides

DNA has a double helix structure that comprises of two strands of nucleotides linked together that run in opposite direction

Each nucleotide consists of:

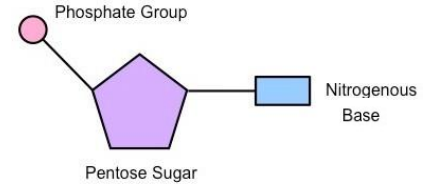
- A deoxyribose sugar
- A phosphate group
- A base containing nitrogen

There are **four types of nitrogenous bases**:

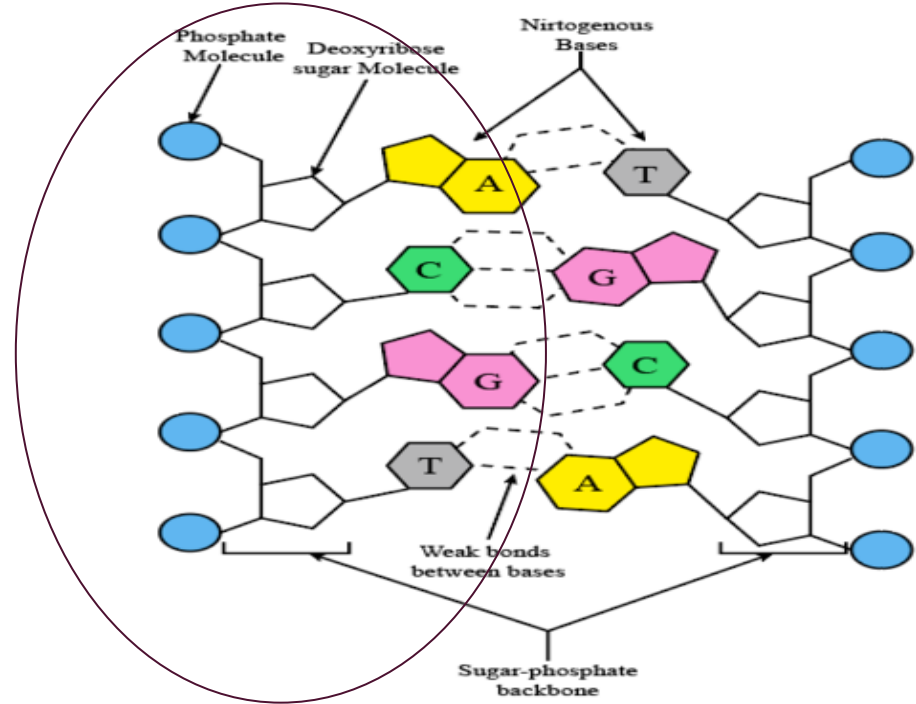
- Adenine (A)
- Guanine (G)
- Cytosine (C)
- Thymine (T)

Rule of complementary base pairing:

- Adenine always pair with thymine
- Cytosine always pair with guanine

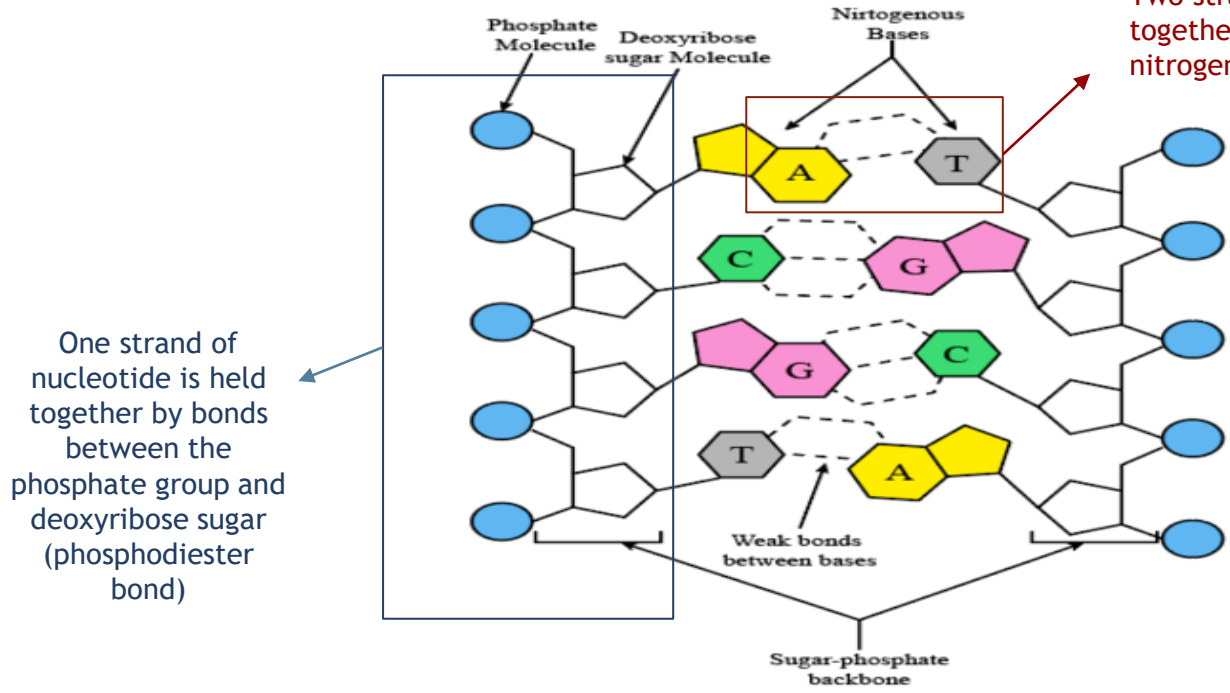


## One strand of nucleotide





# DNA- Nucleotide

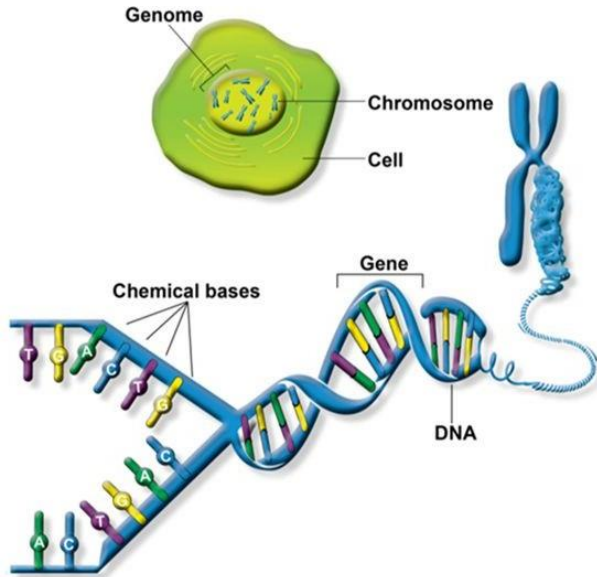


Two strands of nucleotides are held together by bonds between the nitrogenous bases (hydrogen bond)

One strand of nucleotide is held together by bonds between the phosphate group and deoxyribose sugar (phosphodiester bond)



# DNA, Gene & chromosome



## DNA

- A molecule carrying genetic information

## Gene

- A specific segment of DNA / a specific sequence of nucleotides as part of a DNA molecule
- **A basic unit of inheritance**-- plays a crucial role in determining an organism's traits
- “Contains instructions for making a protein”: codes for one polypeptide through the process of transcription and translation
- Eg a DNA molecule contains **eye colour gene** which codes for **pigment protein** that gives our iris colour

## Chromosomes

- DNA double helix **wraps around proteins** to form a compact structure known as a chromosome
- Each chromosome contains many genes
- Humans have 46 chromosomes

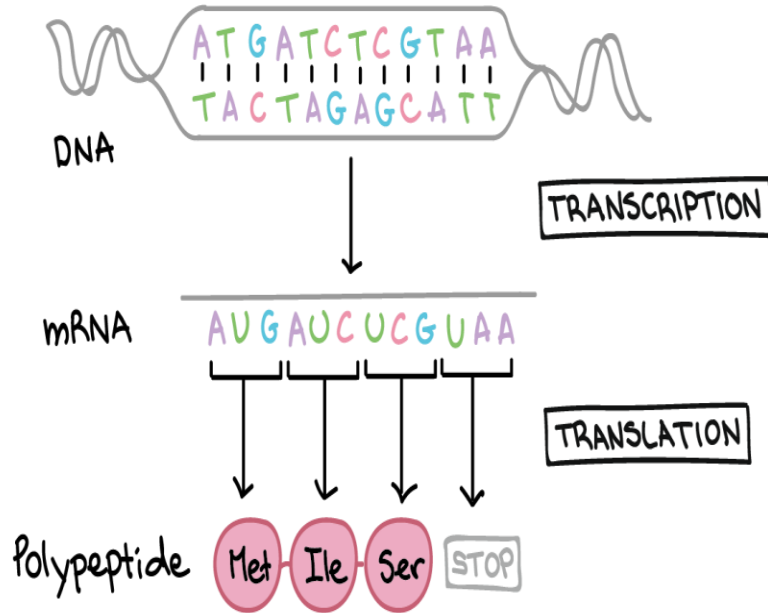


(e) State that DNA is used to carry the genetic code, which is used to synthesise specific polypeptides (details of transcription and translation are not required)





# transcription & translation



**Transcription** is the process by which the DNA template is used to make a single-stranded molecule called messenger RNA (mRNA) by complementary base pairing

**Translation** is the process by the ribosome reads the sequence of mRNA codons to make a polypeptide, which will fold into a protein



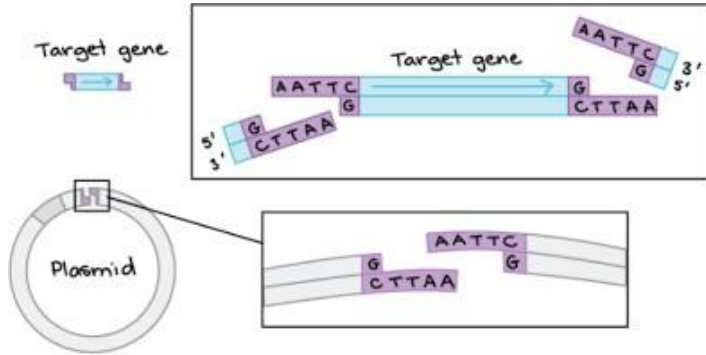
(f) State that genes may be transferred from the cells of one organism to the cells of another to form transgenic organisms







# Genetic Engineering



- **Genetic engineering** is used to transfer genes from the cells of one organism to the cells of another to form transgenic organisms
- The transferred gene can express itself in the recipient organism.

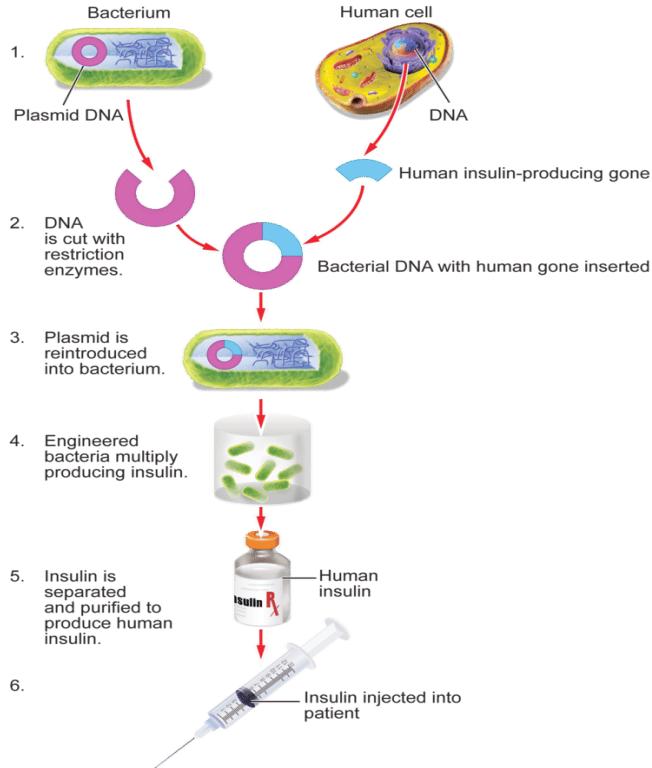


(g) Briefly explain how a gene that controls the production of human insulin can be inserted into bacterial DNA to produce human insulin in medical biotechnology





# Genetic engineering



## Transfer of human insulin gene into bacteria E.coli

- 1) Human insulin gene is isolated by adding **restriction enzyme** that cuts the gene, producing sticky ends.
  - 2) **Plasmid from E.coli** is cut with the **same restriction enzyme**. This produces sticky ends **complementary** to those of the insulin gene.
  - 3) Mix the plasmid with the DNA fragment containing the human insulin gene. The human insulin gene will bind to the plasmid by **complementary base pairing** between their sticky ends, forming **recombinant plasmid**
  - 4) Add the enzyme **DNA ligase** to seal the nick.
  - 5) Mix the recombinant plasmid with E.coli bacterium. **Heat shock or electric shock** is applied to open up pores on the cell surface membrane of the bacterium for plasmid to enter. The E.coli that contains this recombinant plasmid is a transgenic bacterium
  - 6) The transgenic bacteria are placed in **large fermenters under optimal conditions** for growth and reproduction. Fermenter consists of:
    - a nutrient broth containing glucose water and salts
    - Optimal temp = 37 degree celsius
    - Optimal pH
    - Air supply for aeration
    - Stirrer to mix substances evenly
- 1) At the end of fermentation, insulin protein is **extracted and purified** before it can be used.



(h) Discuss the possible benefits and ethical considerations of genetic engineering, in medicine and production of economically important plants and animals





# Benefits of genetic engineering

## Human insulin production



Low cost and high yield production: medicine becomes more affordable



Lesser risk of contamination compared to insulin obtained from the pancreas of animals.



Does not induce allergic response or immune rejection in the patient as the insulin produced is identical to human insulin.



Ethical concerns of vegetarians or religious groups can be overcome.



# Benefits of genetic engineering

## Agriculture



Genes that allow crops to **survive in harsh environment** such as drought or reduce maturation period can be introduced into crops, which can increase food production



Lower cost for farmer which can be passed on to the consumers



Genetically modified crops with enhanced nutritional value can be used to supply nutrients to people



Genetic engineering enables development of crops capable of producing **insecticidal proteins**. This may reduce environmental pollution as less pesticides are used.



**Pesticide resistance genes** can be introduced into crops so that crops will not be affected by pesticides use, increasing survival of crops



# Risks of genetic engineering



Insect pests may develop resistance to the poison produced by the plant.



Useful insects such as insects that help with pollination such as butterfly and bees may be killed indiscriminately by the toxins produced by GM crops



Pest-resistance may be spread to weeds through cross-pollination, producing super weed



Upset the ecological balance.



Potential health concerns including allergen transfer, transfer of antibiotic resistance, unknown health effects.



World food production would be controlled by a few biotechnology companies.



Companies produce GM plants that produce sterile seeds means farmers have to purchase new seeds every year, which is a burden to the farmers



# Ethical implications of genetic engineering



Unnatural to mix genes across species/ tampering with nature



GM food labelling is not mandatory in some countries. Consumers might be unaware that they are purchasing and consuming GM products.



GM food might not have been adequately tested, which means the long term impact it has on human is unknown



Genetic engineering may lead to class distinctions. Only individuals with sufficient financial means can afford certain gene technologies.



Morally wrong to exploit animals for medical research, especially when the animals are designed to suffer.



# MEET THE OVERMUGGED TEAM

## MEET OUR ALL-STAR TUTORS

All our tutors have between **7-13 years of teaching experience** and have guided countless batches of students to excel at 'O' Levels & 'A' Levels.

UNLOCK YOUR FULL POTENTIAL.



# 07

## LOCATIONS

We have classes across 7 locations in Singapore, with **3 main branches**.

# 20+

## TUTORS

We have a team of 20+ tutors, each specialising in their respective subjects.

# 70%

## RESULTS

About **70%** of OVERMUGGED students score an A1/A2 at 'O' Levels/ 'A' Levels.

# 700+

## STUDENT UNDER OUR CARE

We have about 700+ students under our care which we work closely with on a week-on-week basis!

# SOME STATS

## SG FASTEST GROWING TUITION BRAND

We believe in uplifting the student community!



OVERMUGGED, 'O' Levels Channel  
6,214 subscribers



OVERMUGGED, 'A' Levels Channel  
2,778 subscribers

One of SG largest Telegram student community

# LEADERS IN THE CHANGING EDUCATION LANDSCAPE

FEATURED ON STRAITS TIMES


Our efforts to go out of our way to support our students were captured by local new publications.

OVERMUGGED was SG first tuition center to host large scale mock exam!

Our student's needs come first!

**TODAY** June 16 at 5:49 PM · 🌐

One Primary 6 student who is sitting mock exams told TODAY: "I feel stress didn't do any exams all the way until prelims and PSLE... I'll be unfamiliar w/ environment and I cannot concentrate."



**TODAYONLINE.COM**  
**Hundreds sign up for tuition centre mock exams costing up to \$1000, scrapping of all mid-year school exams**

👍❤️😬 53

👍 Like




**P6 and Sec 4 students flock to tuition centres for mock exams after scrapping of school midterms**



**Vulcan Post** 12h · 🌐

**Overmugged** launched a tuition subscription plan for 'O' Levels subjects to make education more affordable and accessible, and has achieved a six-figure revenue in its first year.



**VULCANPOST.COM**  
**OVERMUGGED: This 28-year-old built S'pore's first online tuition subscription service**

You and 8 others

👍 Like

💬 Comment

🔗 Share

1 comment 5 shares

## With midterms scrapped, students take mock exams at tuition centres



**Many in Primary 6 and Secondary 4 seek to build experience ahead of national exams**

**Wong Shying**

With the scrapping of all mid-year school exams, many Primary 6 and Secondary 4 students are flocking to tuition centres for mock exams to build experience ahead of the national exams.

At the Vulcan Post, we have seen a significant increase in the number of students signing up for our mock exam service since the mid-year exams were scrapped. This is a clear indication that students are looking for ways to stay on top of their studies and build confidence in their abilities.

Our mock exam service is designed to provide students with a realistic experience of the national exams. We offer a wide range of subjects and topics, and our experienced teachers provide detailed feedback and support to help students improve their performance.

By participating in our mock exams, students can identify their strengths and weaknesses, and receive targeted support to help them succeed. This is a valuable opportunity for students to build confidence and experience ahead of the national exams.

At Overmugged, we are committed to providing high-quality education and support to our students. Our mock exam service is just one of the ways we are helping students succeed in their studies.

**OVERMUGGED** is a tuition subscription service that provides students with access to a wide range of educational resources, including mock exams, live classes, and personalized support. We are proud to be the first online tuition subscription service in Singapore, and we are committed to providing the highest quality of education and support to our students.

# OUR LOCATIONS



## **BUKIT TIMAH**

**Tan Kah Kee**

2 min walk from Tan Kah Kee MRT.



## **Kovan**

**Upper Serangoon Road**

5min walk from Kovan MRT.



## **MARINE PARADE PARKWAY CENTER**

Upcoming TE line in 2024.



## **TOA PAYOH CLASSROOM**

Conveniently located near Toa Payoh MRT



## **JURONG EAST CLASSROOM**

Right beside Jurong East MRT



## **WOODLANDS CLASSROOM**

Right beside Woodlands MRT



## **TAMPINES READY IN 2024**

Right beside Tampines MRT



# OUR SECRET TO PRODUCE TOP RESULTS?

**CONSISTENT HARD WORK,**  
**OVER A LONG PERIOD OF TIME.**

We work hard consistently alongside you,  
week in, week out.

**We grind hard when no one is watching**  
because we know that when it comes time for  
exams, we will be one cut above the rest.

# LEARNING RESOURCES

IF YOU THOUGHT THE FREE MATERIALS ARE GOOD,  
Wait till you see the resources our own students get!



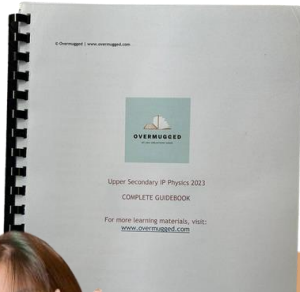
## WEEKLY WORKSHEETS

Topical, Thematic, Mock Test, Mock Exam,  
Prelim Prep, Practical Prep



## EXCLUSIVE CHEATSHEETS

Revision booklets, extra cheatsheets,  
Practical Assessment booklet



TOPIC: KINEMATICS			
Type	Definition	Formula	Remarks
Linear Motion	Object that is moving in a straight line. 1-D motion	$v = u + at$ $s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$	<ul style="list-style-type: none"> <li>Motion can be represented (upwards or right) or -ve (down or left) sign.</li> <li>Equations can only be used if acceleration is constant.</li> </ul>
2-D Motion	Object that is moving in a plane. Acceleration is experienced in both axes. Vertical and horizontal motion are independent of each other.	<b>Horizontal motion</b> (acceleration = 0) $v_x = u_x$ $s_x = u_x t$ <b>Vertical motion</b> (uniform vertical acceleration = g) $v_y = u_y + at$ $s_y = u_y t + \frac{1}{2}at^2$ $v_y^2 = u_y^2 + 2as$	<ul style="list-style-type: none"> <li>Acceleration always acts down.</li> <li>Parabola will fall and go parabolic if resistance is negligible.</li> </ul>
v Vectors	Analyse the horizontal and vertical motion separately.	For a vector $\vec{v}$ pointing at an angle $\theta$ from the horizontal: $v_x = v \cos(\theta)$ (horizontal) $v_y = v \sin(\theta)$ (vertical) $v = \sqrt{v_x^2 + v_y^2}$ $\tan \theta = \frac{v_y}{v_x} = \tan^{-1} \left( \frac{v_y}{v_x} \right)$	

**MARCH PRACTICE QUESTIONS 2021**  
SECONDARY 4 EXPRESS  
SECONDARY 3 NORMAL ACADEMIC

**ELEMENTARY MATHEMATICS** 408081

Specimen Paper  
Date: 8 March 2021  
Candidates answer on separate writing paper.

**READ THESE INSTRUCTIONS FIRST**

Answer all questions.  
A scientific calculator is permitted for this section.  
You are expected to use a scientific calculator to evaluate lengthy numerical expressions, if the degree of accuracy is not specified in the question, use 3 for the answer to your calculation, give the answer to three significant figures.  
Give answers in degrees to one decimal place.  
For a question your observation score of 4 or 5, unless the question requires the answer to be in terms of  $\pi$ .

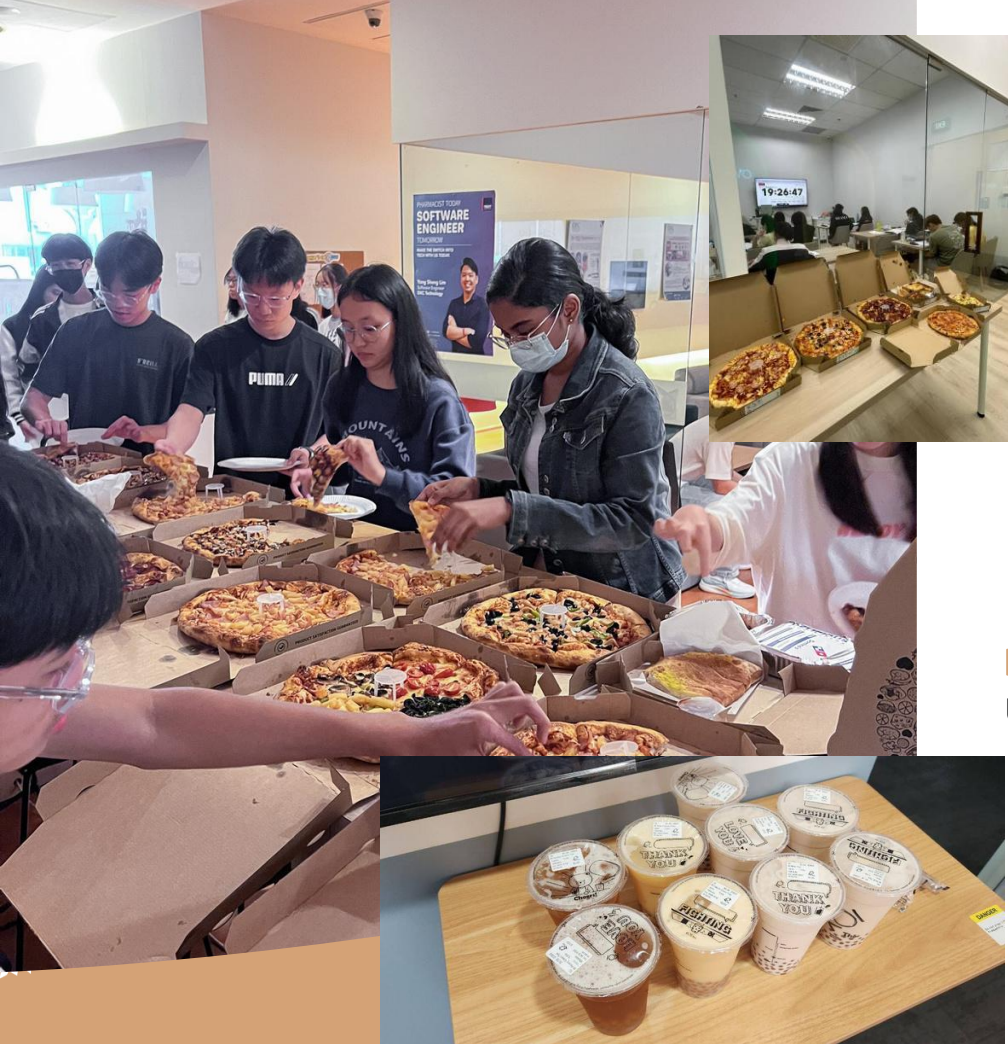
Topic names will be listed above each question for your benefit and reference.

**Upon completion of solutions:**  
Each candidate must identify 2 marks to submit their solution.  
Take a picture or use the digital version of your solution to use (submit) via Telegram channels, WhatsApp or Messenger: @overmugged.  
Ensure that all writings are clear and legible.  
Solutions will be marked based on your presentation, accuracy and completeness of your solution.  
A 'master' report and the full solution will be provided at the end of the month.

Senior Ding Kai Sun  
The question paper consists of 6 printed pages including the cover page.

it reached in a time $t$ or $v_y = 0$	$v_y^2 = (u \sin \theta)^2 - 2gh$ $\therefore H = \frac{u^2 \sin^2 \theta}{2g}$	<b>With air resistance,</b> <ul style="list-style-type: none"> <li>Drag force acts in the same direction as the weight of object.</li> <li>Net acceleration <math>&gt;&gt; g</math></li> <li>Maximum height reached lower.</li> </ul>
or $v_y = 0$	$v_y = u \sin \theta - gt$ $\therefore t_{up} = \frac{u \sin \theta}{g}$	<b>With air resistance,</b> <ul style="list-style-type: none"> <li>Drag force acts in the same direction as the weight of object.</li> <li>Net acceleration <math>&gt;&gt; g</math></li> <li>Final vertical speed smaller than vertical speed.</li> <li>Average speed upwards <math>&gt;</math></li> </ul>

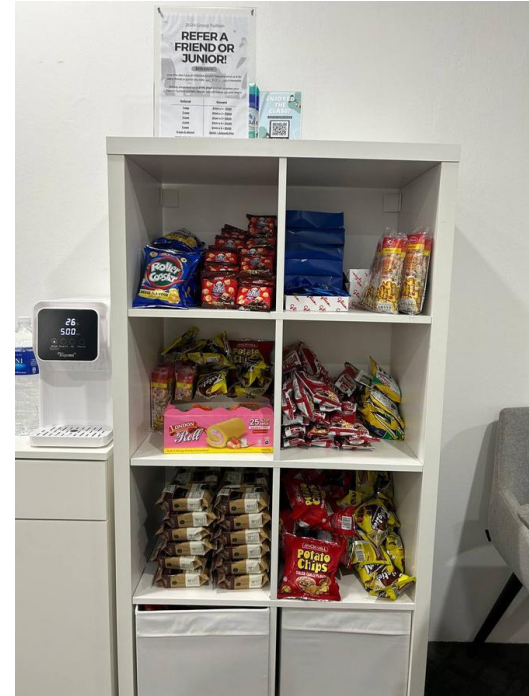




# WELFARE, ALL DAY EVERYDAY



**NEED FOOD TO THINK**  
Unlimited snack shelf





### Our Policy

- No deposit fee.
- No extra material fee.
- Unlimited access to study lounge.
- Unlimited snacks.
- Free consultations.
- Special discounts for holiday program.

# TUITION RATES

## 'O' LEVELS

\$80/lesson

\$85/lesson (weekend)

## INTEGRATED PROGRAM

\$90/lesson

\$95/lesson (weekend)

## 'A' LEVELS

\$100/lesson

\$105/lesson (weekend)

*10% if signing up for 2 'A' Levels subject & above*

**Fees are collected at the start of the term  
(every 3 months).**



# ACADEMIC YEAR

## TERM 1: NOV – JAN

### Topical Recaps

Key highlight: Christmas Party

## TERM 2: FEB – APR

### Topical Mastery

Key highlight: March Holiday Cohesion Program

## TERM 3: MAY – JUL

### Prelim/EOY Preparation

Key highlight: Mock Prelim/EOY

## TERM 4: AUG – OCT

### 'O' Levels / 'A' Levels Preparation

Key highlight: Mock Exams, Science Practical Assessment





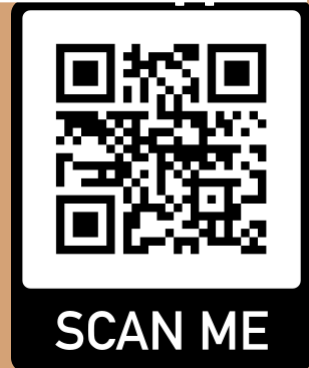
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Class Schedule:

SCAN ME



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