



Organisms and the environment





- (a) Describe the non-cyclical nature of energy flow

- (b) Explain how energy losses occur along food chains, and discuss the efficiency of energy transfer between trophic levels



Ecology Environment Ecosystem



Ecology: study of interactions between organisms and environment

Ecosystem: consists of all organisms; biotic factors and abiotic factors

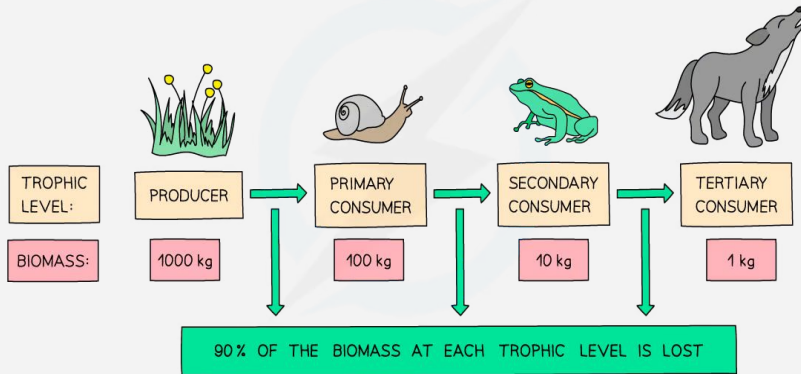
Biotic factors: refers to all living organisms (e.g. plants, bacteria) within an ecosystem and the interactions between them (e.g. predation, competition for resources)

Abiotic factors: non-living, chemical and physical factors in the environment that the community interacts with (e.g. air composition like oxygen content, light intensity, temperature)



Non-cyclic energy flow

ONLY 10% OF THE BIOMASS AT EACH TROPHIC LEVEL IS PASSED ON THE NEXT



Non-cyclic/ linear/ one-directional energy flow:

- In any ecosystem, the ultimate source of energy is the Sun. Light energy from the sun is absorbed by chlorophyll in producers and converted into chemical energy during photosynthesis
- Plants make its own food via photosynthesis and contain carbon in the form glucose, sucrose, starch
- Energy is passed from one trophic level to another when primary consumer feed on the producers and so on

Efficiency of energy transfer:

- Organisms at each trophic level pass on about 10% energy to the next trophic level compared to what they receive
- Hence organisms in the lower trophic level have more energy available to them compared to those in higher trophic levels

Energy losses:

- Energy is lost at every trophic level as heat in respiration, uneaten organism parts and through excreted and egested waste material.
- This lost energy cannot be recycled.
- Faeces, excretory products and dead organisms contain trapped chemical energy. This energy is released through the activity of decomposers. Decomposers use some of this trapped chemical energy for their needs, releasing CO₂. The rest of the energy is lost as heat.

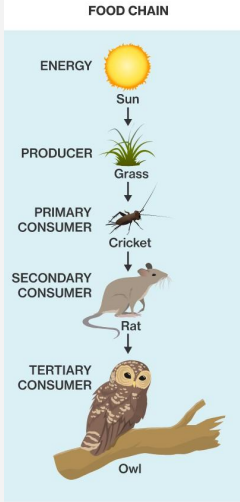


(c) Describe the roles of producers, consumers and decomposers in food chains and food webs

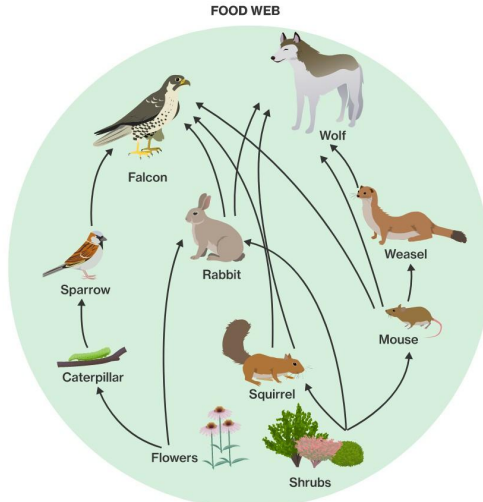


Food chain

Food Chains Within a Food Web



A food chain describes the relationship between different organisms based on what they eat.



A food web has several food chains that occur between different animals.

Food chain

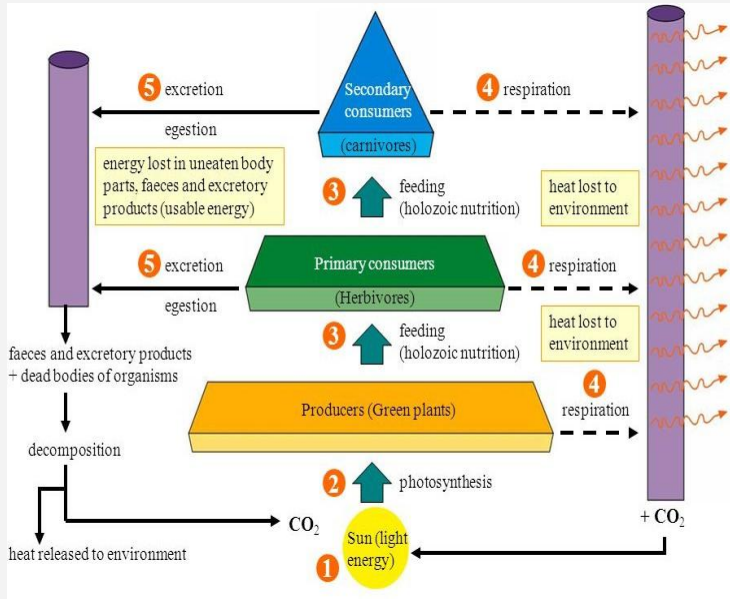
- A linear sequence of energy transferred in the form of food, between organisms in an ecosystem
- Each level of the food chain is known as trophic level
- In an ecosystem, food chain do not exist alone. They are interconnected to form a **food web**

Food web

- Consist of 2 or more food chains linked together
- Shows feeding relationship in an ecosystem



Food chain



Producers (plants)

- First organism in the food chain (**1st trophic level**)
- Organism that contain chlorophyll → photosynthesis → synthesis food through converting light energy from the sun to chemical energy
- Make energy available to other organisms in the food chain / community

Consumers (animals)

- Organisms that are not able to make their own food and obtain energy by feeding on other organisms
- Primary consumers: herbivores, feed on primary producers directly (**2nd trophic level**)
- Secondary consumers: carnivores, feed on primary consumers (**3rd trophic level**)
- Tertiary consumers: carnivores, feed on secondary consumers (**4th trophic level**)

Decomposers (eg. bacteria, fungi)

- Not shown in food chain
- Obtains energy by breaking down dead organic matter ---> recycle nutrients back into the environment, releasing nutrients into soil and making energy available to other organism indirectly



(d) Describe and interpret pyramids of numbers and biomass

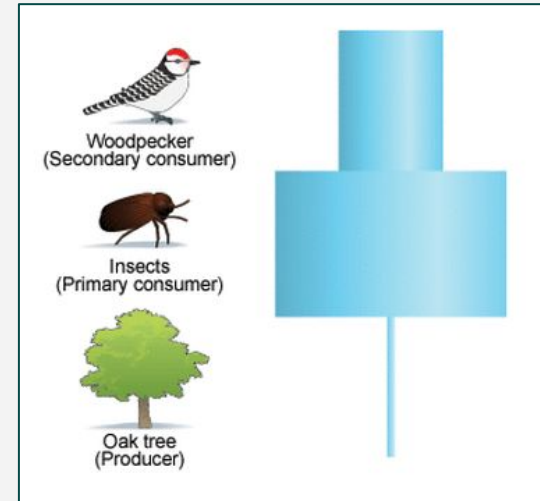
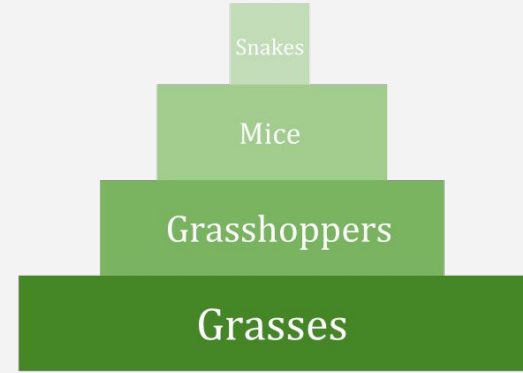


pyramid of food chain

pyramid of numbers

- A pyramid of numbers shows the **relative population size/ number** of each trophic level in a food chain at a particular time
- **Pattern:** Usually, the number of producers at the base is the largest, as they are needed to feed the next level. The number of consumers gradually decreases towards the top

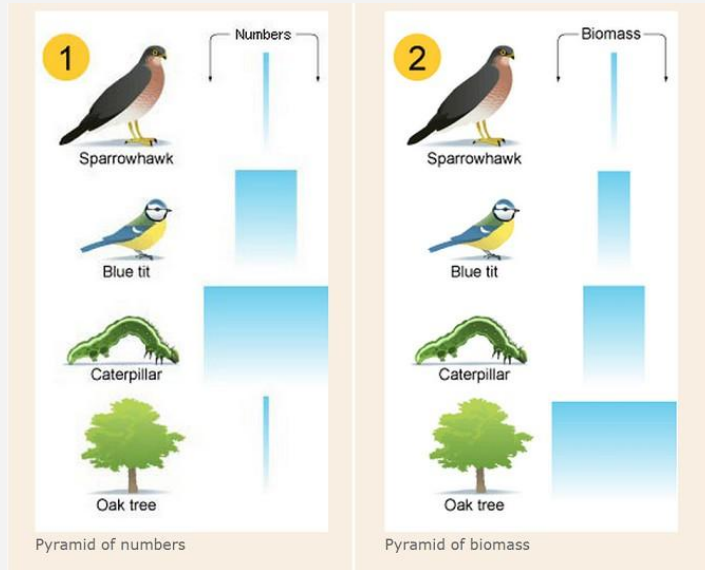
- **Disadvantage:** It is not an accurate estimate of the amount of energy at each trophic level because the population number does not always correspond to the amount of energy it can transfer to the next trophic level, e.g. a single tree can support a large population of caterpillars





pyramid of food chain

pyramid of biomass



- A pyramid of biomass shows the dry mass of organisms at each trophic level in a food chain.
- Dry mass: mass of an organism after moisture is removed
- **Pattern:** The biomass of the producer is the largest as it supplies all the energy for the resumeres. Biomass is lost along the food chain due to loss of energy (to respiration, heat, waste etc.)
- **-Disadvantages:** Dry mass cannot be easily obtained from every animal e.g. human beings, large animals like tigers. It is also destructive as it involves drying the organism at 100 °C, which will affect the food chain/ food web.

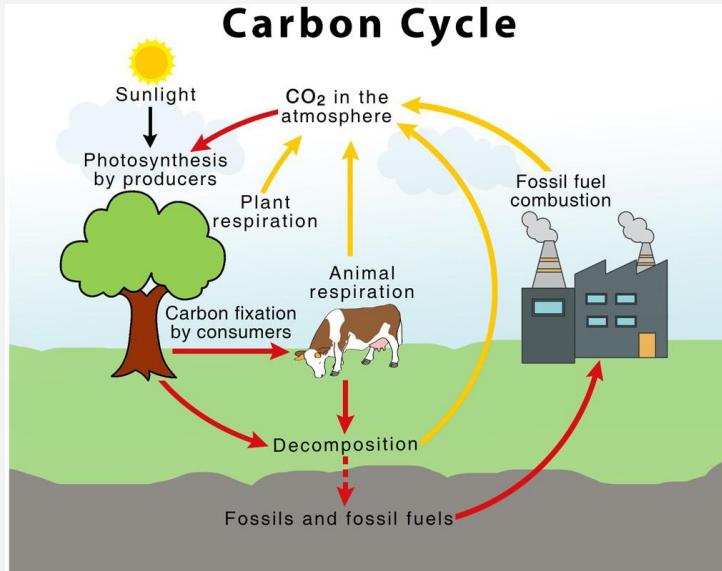
One single tree has larger biomass than a large number of caterpillars.



(e) Describe how carbon is cycled within an ecosystem and outline the role of forests and oceans as carbon sinks



carbon cycle



Removal of carbon dioxide

1. Plants convert atmospheric carbon dioxide into glucose during photosynthesis. Glucose can be converted to other carbohydrates, proteins and fats within the plants

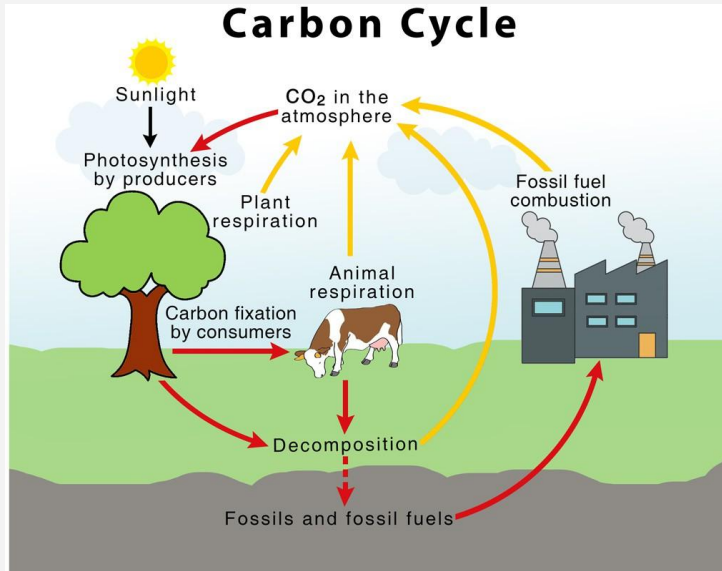


Return/ contributors of carbon dioxide

2. When cellular respiration takes place in living organisms.
3. When the plants and animals die, decomposers such as bacteria and fungi break down the organic matter into carbon dioxide, which is released back to the atmosphere.
4. When fossil fuels and wood (carbon-based compounds) are burnt



carbon cycle

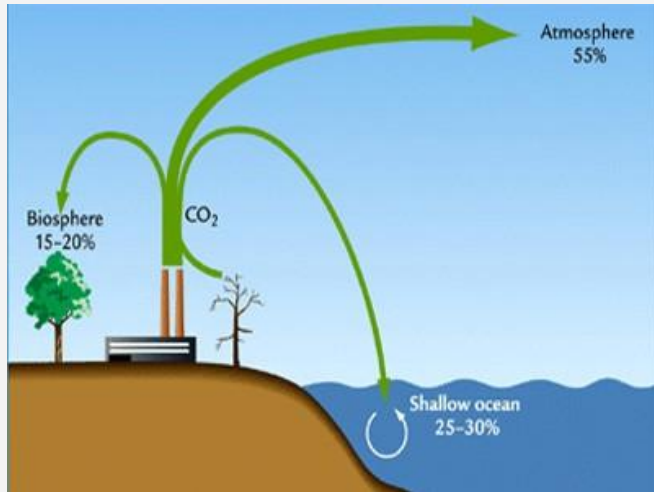


Importance of carbon cycle

- Ensures there is a continuous supply of carbon dioxide for plants to carry out photosynthesis.
- Allows photosynthesis to convert light energy from the Sun into chemical energy in food, which non-photosynthetic organisms can feed on to stay alive.
- Enables energy to flow through the ecosystem. Carbon compounds carry the stored energy from organism to organism in the food chains of an ecosystem.
- Maintains the correct concentration of carbon dioxide in the atmosphere.



Role of oceans and forests as carbon sinks 🌟👍



Carbon sinks

An area that absorbs **more** carbon than it releases as carbon dioxide

Oceans

- Atmospheric carbon dioxide is absorbed by the ocean as carbon dioxide dissolves in the ocean's water
- Dissolved CO₂ is used by phytoplankton and algae in photosynthesis.
- Iron compounds increases the photosynthetic activity of phytoplankton.
- The organisms in the oceans store carbon compound. When they die, they may sink and be buried deep in the seabed and may form fossil fuels.

Forests

- The plants in forests absorb atmospheric carbon dioxide for photosynthesis
- A large amount of carbon compound is stored in trees. When trees die, they are buried deep in the ground and form coal, a kind of fossil fuels.



(f) Describe how human activities, such as deforestation and use of fossil fuels, cause an increase in atmospheric carbon dioxide concentration, leading to global warming



Human activities as carbon sources, leading to global warming

Fossil fuels are burnt to release energy so as to generate electricity for human uses.

Combustion of fossil fuels release large amount of carbon dioxide, increasing level of atmospheric carbon dioxide



Deforestation, purposeful clearance of forest, is done for reasons such as urbanisation or agriculture.

When trees are “slash and burnt” / cut down, they release stored carbon as atmospheric carbon dioxide and there are lesser trees to photosynthesis, increasing level of atmospheric carbon dioxide



Carbon dioxide causes more heat to be absorbed and reflected back to earth, increasing greenhouse effect, leading to **global warming-- the rise in earth's temperature**



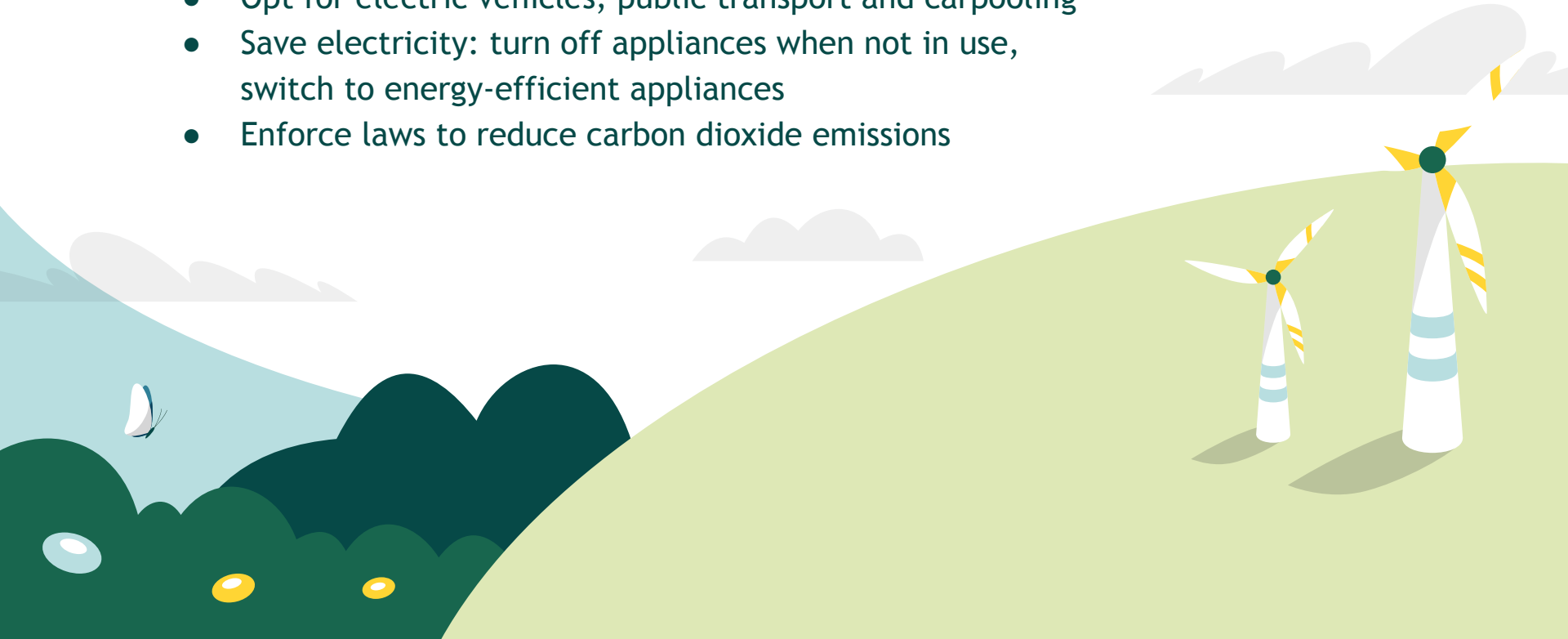


(g) Discuss how human actions can reduce the effects of global warming



Ways to reduce global warming:

- Utilise renewable energy sources like solar or wind energy
- Opt for electric vehicles, public transport and carpooling
- Save electricity: turn off appliances when not in use, switch to energy-efficient appliances
- Enforce laws to reduce carbon dioxide emissions





Address deforestation:

- Regulate rate of logging
- Selective logging: do not cut down young trees
- Designating land as forest reserves
- Reforestation



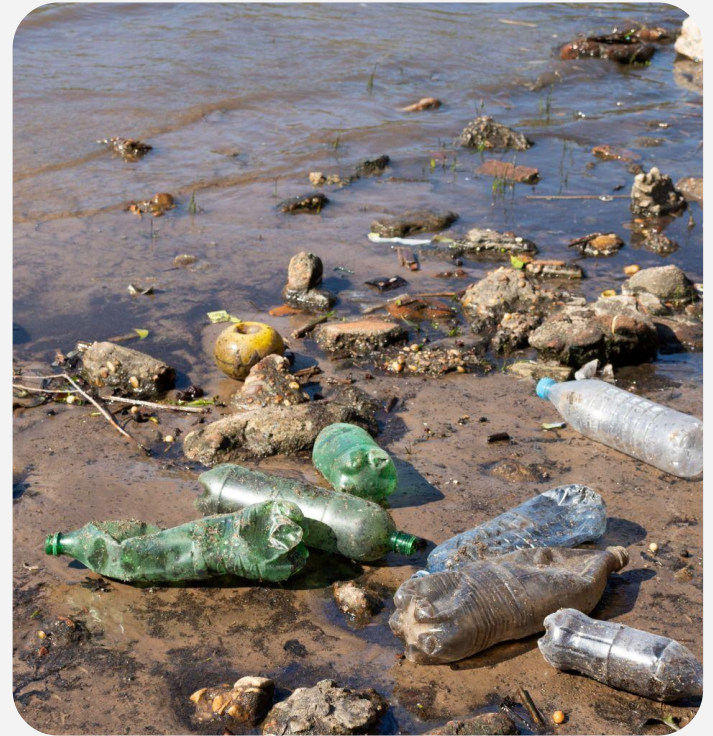


- (h) Describe the effects of pollution caused by:
- sewage in water
 - plastic wastes in the marine environment
 - insecticides and their biomagnification up food chains, impacting on top carnivores



Effects of pollution caused by sewage in water

- Untreated sewage contains high concentrations of nitrates and phosphates
- If released into water, this results in **eutrophication: entry of nitrates and phosphates in into waters**
- Minerals would cause population explosion of native bacterial and algal species, leading to **algal bloom: excessive algae growth, forming thick opaque layer on water surface**
- Algal bloom would block entry of sunlight into the waters
- Submerged plants, or aquatic plants living beneath the water surface cannot photosynthesize and will die
- Decomposers will consume oxygen to break down dead algae and aquatic plants
- This deprives fishes and other aquatic organism of oxygen to respire, who will subsequently die.
- Loss of marine life overall leads to loss in biodiversity and habitat





Effects of pollution caused by Plastic wastes in the marine environment

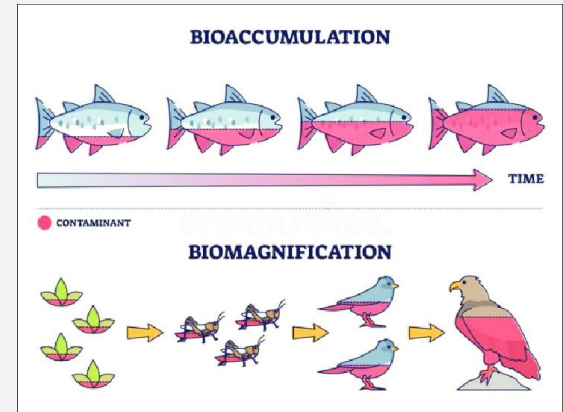
- Most plastics are non-biodegradable. They will remain in the environment for a prolonged period, posing risks to marine life when discarded into waters.
- **Ingestion:** Pieces of plastic may be mistakenly eaten by marine organisms, which can cause internal injuries and kill them.
- **Entanglement:** Marine animals become tangled in plastic debris and live fishing lines. This may cause injuries and even suffocation.
- **Habitat degradation:** Plastic can damage certain ecosystems' habitats such as coral reefs





Effects of pollution caused by insecticides

- Environmental contamination: Insecticides may accumulate in soil, waters and vegetation, contaminating the environment and aquatic ecosystems
- Unintended harm: Insecticides may destroy non-target organism as well, killing other insects, birds and animals. This disrupts ecosystems and reduces biodiversity
- **Bioaccumulation and biomagnification**
- Insecticides contain inorganic and non-biodegradable chemicals that are toxic at high concentrations
- When organisms consume producers laced with insecticides, toxic insecticides is transferred to the organism
- Organisms are unable to digest these insecticides
- Instead, insecticides are stored in the tissues of organisms
- This results in **bioaccumulation: a buildup of inorganic compounds in organism body overtime**
- Organisms at higher trophic levels would need to consume multiple organisms at lower trophic levels due to inefficient energy transfer
- This results in **biomagnification: an increase in concentration of inorganic compounds in organism at higher trophic level as larger amounts of insecticides are being transferred to organisms at higher trophic level**





(I) Discuss how the conservation of species and sustainable use of natural resources contribute to the maintenance of biodiversity and a balanced ecosystem (e.g. coral reef, tropical rainforest, mangrove)



Conservation

Conservation is the protection and perseverance of species, their habitats and entire ecosystems from extinction.

Conservation is important

1. Maintenance of biodiversity
 - Maintaining a large gene pool is important as many wild plants and animals possess favourable genes.
 - By cross-breeding the different varieties of wild plants and animals, we can improve agricultural produce such as improving yield and quality of organisms
2. Scientific research
 - Many tropical plants are of great importance as they are sources of medicinal drugs.
3. Conservation preserves the existence of rich variety of species for us and future generations to appreciate and enjoy
4. Economical value
 - Tropical rainforests provide raw materials such as timber, cotton and rubber for industries
 - Ecotourism is a source of income for several countries such as Costa Rica, Madagascar, and Kenya.
 - Marine life, tropical rainforests provide food sources such as seafood and maize
5. Stable and balances ecosystem
 - This prevents disruption of natural cycles such as carbon cycles
 - Prevents global warming









Conservation

Conservation is the protection and perseveration of species, their habitats and entire ecosystems from extinction.

Importance of conservation:

<p>Maintenance of biodiversity</p> 	<ul style="list-style-type: none">● Maintaining a large gene pool is important as many wild plants and animals possess favourable genes.● By cross-breeding the different varieties of wild plants and animals, we can improve agricultural produce such as improving yield and quality of organisms● Preserves the existence of rich variety of species for us and future generations to appreciate and enjoy
<p>Scientific research</p> 	<ul style="list-style-type: none">● Many tropical plants are of great importance as they are sources of medicinal drugs.
<p>Economical value</p> 	<ul style="list-style-type: none">● Tropical rainforests provide raw materials such as timber, cotton and rubber for industries● Ecotourism is a source of income for several countries such as Costa Rica, Madagascar, and Kenya.● Marine life, tropical rainforests provide food sources such as seafood and maize
<p>Stable and balances ecosystem</p> 	<ul style="list-style-type: none">● This prevents disruption of natural cycles such as carbon cycles● Prevents global warming



Importance of conserving tropical rainforests, coral reefs and mangroves in maintenance of biodiversity and a balanced ecosystem:

Tropical Rainforests

- Host a diversity of plant and animals
- “Lungs of the earth” that maintain balance of atmospheric carbon dioxide and oxygen
- Regulate rainfall patterns and prevent soil erosions
- Sources of ecotourism, medicinal drugs, sustainable resources



Coral Reefs

- “Rainforest of the sea”: an important habitat and breeding grounds for a multitude of marine species

Mangroves

- Serve as important habitats, breeding grounds for a wide variety of plants and animal species (eg. fish, crustaceans, birds)
- Their dense roots serve as natural buffers against coastal erosions
- Effective carbon sinks

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07

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SOME STATS

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OVERMUGGED, 'O' Levels Channel
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OVERMUGGED, 'A' Levels Channel
2,778 subscribers

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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 comes 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 with environment and I cannot concentrate."

TODAYONLINE.COM
Hundreds sign up for tuition centre mock exams costing up scrapping of all mid-year school exams

👍👍👍 53

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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

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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

Students are flocking to tuition centres for mock exams to build experience ahead of national exams after the scrapping of mid-year school exams. 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 with environment and I cannot concentrate."

Overmugged, a tuition subscription service for 'O' Levels subjects, has achieved a six-figure revenue in its first year. The service is designed to be more affordable and accessible than traditional tuition.

Associate Professor Alan Tan, who is also the director of the Centre for Educational Research and Innovation, said that the scrapping of mid-year exams has created a gap in students' learning experience. He noted that students need to have a more continuous learning process to build confidence and familiarity with the exam environment.

Overmugged's service provides a structured learning path with regular assessments and mock exams. The company's founder, a 28-year-old, said that the service is designed to be more affordable and accessible than traditional tuition. The service is designed to be more affordable and accessible than traditional tuition.

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



He has continued to provide support and resources for students who are struggling with their studies. He has also been instrumental in the development of the service, ensuring that it meets the needs of students and parents. He has been a vocal advocate for educational reform and has worked closely with the Ministry of Education to address the challenges faced by students and parents. He has also been a key figure in the development of the service, ensuring that it meets the needs of students and parents. He has been a vocal advocate for educational reform and has worked closely with the Ministry of Education to address the challenges faced by students and parents.

OUR LOCATIONS



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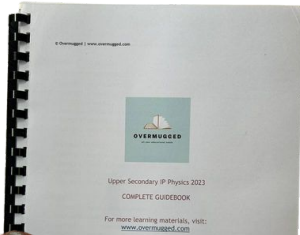
WEEKLY WORKSHEETS

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

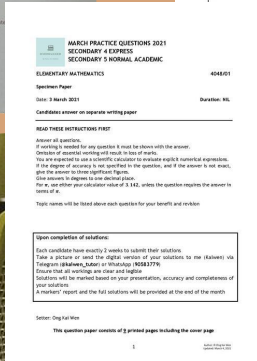


EXCLUSIVE CHEATSHEETS

Revision booklets, extra cheatsheets, Practical Assessment booklet



TOPIC: KINEMATICS			
type	Definition	Formulae	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"> Motion can be represented! (upwards or right) or -ve (down or left) sign Equations can only be used when acceleration is constant
Motion	Object that is moving in a plane 2-D motion Acceleration is experienced in both axes Vertical and horizontal motion are independent of each other	Horizontal motion (acceleration = 0) $v_x = u_x$ $s_x = u_x t$	<ul style="list-style-type: none"> Acceleration always act down Projectile will fall and parabolic if resistance is negligible
		Vertical motion (uniform vertical acceleration = g) $v_y = u_y + at$ $s_y = u_y t + \frac{1}{2}at^2$ $v_y^2 = u_y^2 + 2as$	
Vectors	Analyse the horizontal and vertical motion separately	For a vector V pointing at an angle θ from the horizontal: $v_x = v \cos(\theta)$ $v_y = v \sin(\theta)$ $v = \sqrt{v_x^2 + v_y^2}$ $\tan \theta = \frac{v_y}{v_x} \Rightarrow \theta = \tan^{-1}\left(\frac{v_y}{v_x}\right)$	<ul style="list-style-type: none"> With air resistance, <ul style="list-style-type: none"> Drag force acts in the same as the weight of object. Net acceleration $> > g$ Maximum height reached lower. With air resistance, <ul style="list-style-type: none"> Drag force acts in the same as the weight of object. Net acceleration $> > g$ Final vertical speed smaller than vertical speed. Average speed upwards $> >$



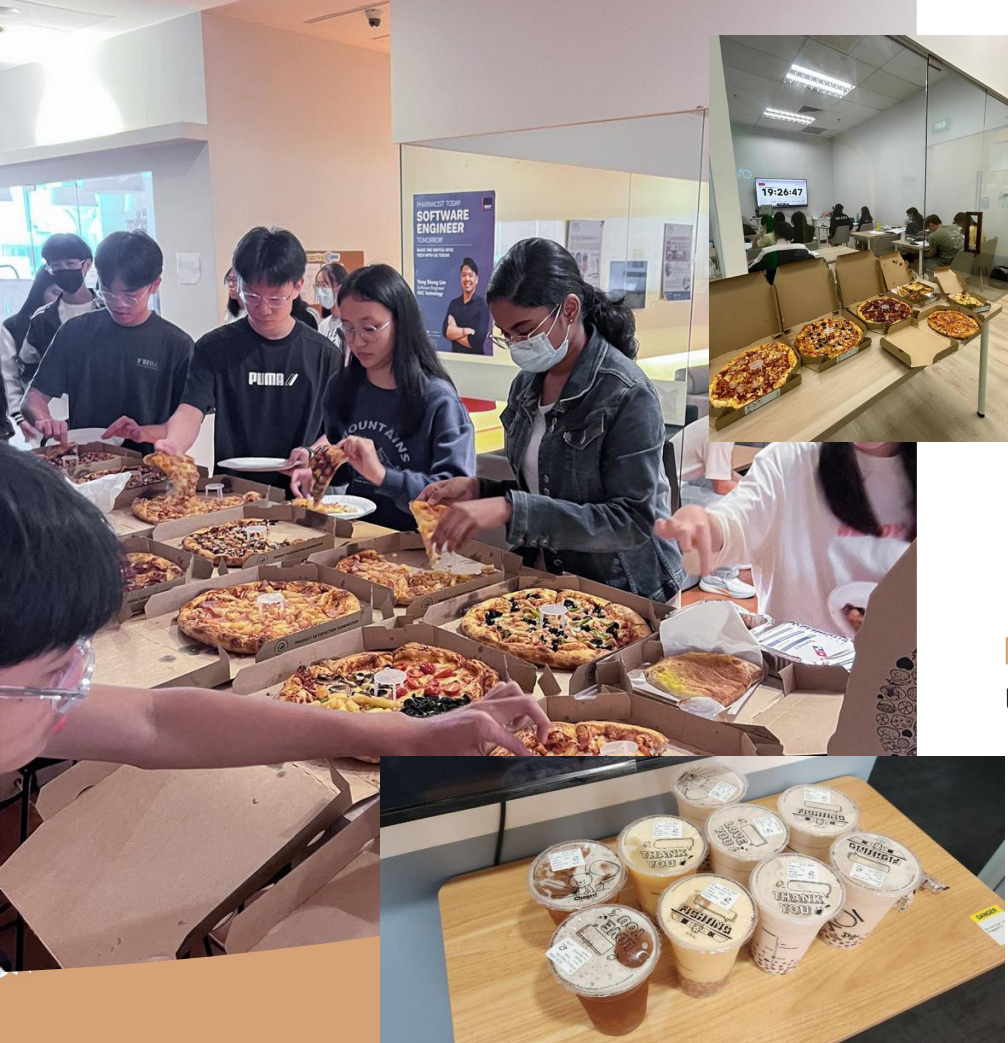
MARCH PRACTICE QUESTIONS 2023 SECONDARY 4 EXPRESS SECONDARY 3 NORMAL ACADEMIC			
Elementary Mathematics	404801		
Specimen Paper Date: 8 March 2021 Candidates answer on separate writing paper	Duration: 90 min	It reached in a second $u^2 = (a \sin \theta)^2 = 2gH$ $\therefore H = \frac{u^2 \sin^2 \theta}{2g}$	With air resistance, <ul style="list-style-type: none"> Drag force acts in the same as the weight of object. Net acceleration $> > g$ Maximum height reached lower.
READ THESE INSTRUCTIONS FIRST		$v_y = u \sin \theta - gt$ $\therefore t_{up} = \frac{u \sin \theta}{g}$	With air resistance, <ul style="list-style-type: none"> Drag force acts in the same as the weight of object. Net acceleration $> > g$ Final vertical speed smaller than vertical speed. Average speed upwards $> >$



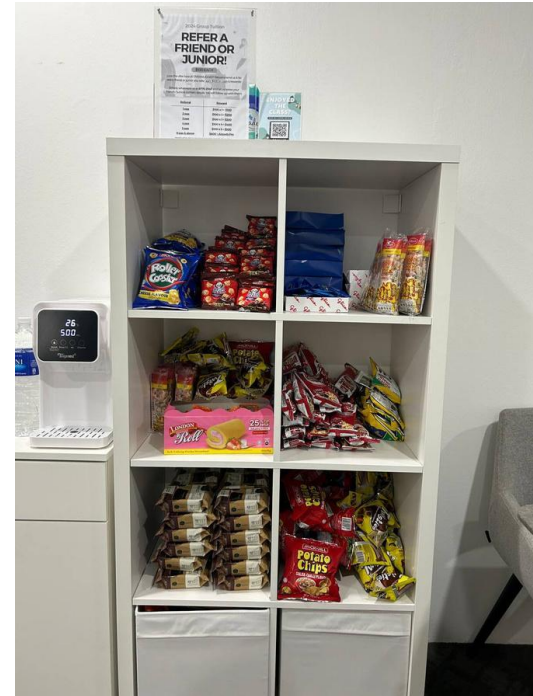
Upon completion of solutions:
Each candidate must identify 3 marks to submit their solutions.
Take a picture or scan the digital version of your solution to email (skibet) via Telegram channels, Wechat or WhatsApp: @MSB275.
Ensure that all writings are clear and legible.
Solutions will be marked based on your presentation, accuracy and completeness of your solution.
A 'major' report and the full solutions will be provided at the end of the month.

Setion: Ong Kai Hin
The question paper consists of 8 printed pages including the cover page.

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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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