Association of Biology Educators (ABE)

2023 EDITION 'O' LEVEL NATIONAL SEMINAR-SERIE No: 7 HELD AT SACRED HEART S.S, GULU (U) ON THE SATURDAY 23RD SEPTEMBER, 2023

This write up is a university link, and has been epically designed as part of ABE National seminar series of the 2023. The Association of Biology Educators (ABE) team has curated sample questions to ease your revision, using expert guidance. **Note** *that whereas this work covers all the key concepts and principles, it does not exhaust all the possible questions in each topic. Accordingly, use it alongside your notes, textbooks and any other materials recommended by your teachers.*

Association of Biology Educators (ABE)

2023 EDITION 'O' LEVEL NATIONAL SEMINAR-SERIE No: 7 HELD AT SACRED HEART S.S, GULU (U) ON THE SATURDAY 23RD SEPTEMBER, 2023

FOREWORD

Biology revision can be a daunting task, but it doesn't have to be. The **Association of Biology Educators** (ABE) has simplified Biology revision through seminars, where expert guidance, as well as sample questions and answers are discussed.

Biology Revision Tips

Whether you are a student preparing for exams or an adult looking to brush up on your skills, this work can help you achieve your Biology goal.

- First, set your Biology goal. What distinction or credit do you aim to score in Biology? Do you know the marks needed to score each distinction or credit?
- Next, create a revision plan. During which hours will you be revising Biology per day or in a week? Manage your time effectively - draw a revision time table with Biology placed in favorable hours when your brain is fresh. Strictly follow your Biology reading time table, no matter what!
- Then, collect materials, read them, answer questions and mark yourself using the answers. Balance all topics, from **S.1** to **4**. Sources of questions include textbooks, newspapers and past exam papers.
- Beware that marks from two papers make your final grade. For paper 1 (553/1), spend more time practicing Section **B** and **C** questions. For practical (paper 2/ 3), pay special attention to drawings, food tests and features for classification, including biological keys.
- Lastly, where you find difficulty, discuss with classmates or approach your teachers for further guidance.

How to use this work

You can read this work from cover to cover, or you can dip in and out of the different topics as needed. If you are a student preparing for exams, I recommend that you first read your notes to understand the key concepts. Once you have understood the basics in a given topic, start answering questions. In this work, questions are arranged in a sequence following the Uganda Biology syllabus. Therefore, you can quickly locate the topics where you need to focus your revision.

Note that whereas this work covers all the key concepts and principles, it does not exhaust all the possible questions in each topic. Accordingly, use it alongside your notes, textbooks and any other materials recommended by your teachers.

I hope that you find this work helpful. Good luck with your exams!

Frederick Dongo-Shema. *President, ABE*

ABE CURATORS

DONGO F. SHEMA
+256 782 642 338

LAWRENCE A. BRONSTD
+256 778 749 581

ROBERT BANDIKUBI
+256 772 582 857

RONALD SIKUBWABU
+256 783 686 735

KUGONZA H. ARTHUR
+256 701 366 474

JUSAN
+256 707 167 909

WATSON AIJUKA
+256 702 475 599

KEMIGISHA SHERINA
+256 701 007107

PROPOSED GUIDE TO ABE_DISCUSSION QUESTIONS.

1.1.1

(a)(i) Both have a petiole/ Both have a lamina/ Both have network veins.

(ii)

Specimen D	Specimen E
Undivided lamina	Divided lamina
Serrated margin	Entire margin
Has no leaflets	Has leaflets
Pointed apex	Round apices
Lacks pinnules	Has pinnules

(iii) It is green with chlorophyll to absorb light energy.
It has many leaflets with a large surface area for maximum photosynthesis.
It has a thin lamina to allow light penetration
They have a network of veins for transportation of water for photosynthesis.

(b)

1 (a) Specimen with parallel leaf venation..... F
(b) Specimen with network venation.....go to.....2(A, B, C, D, E)

2 (a) Specimen with undivided lamina.....go to.....3(C and D)
(b) Specimen with divided lamina.....go to.....4(A, B and E)

3 (a) Specimen with entire margin.....C
(b) Specimen with serrated margin.....D

4 (a) Specimen with three leaflets.....A
(b) Specimen with many leaflets.....go to.....5(B and E)

5 (a) Specimen without pinnules .....B
(b) Specimen with pinnules .....E

1.1.2

(a) (i) Phylum Arthropoda: Segmented appendages, exoskeleton, segmented body.
(ii) Class Arachnida:
They have four pairs of legs.
They have simple eyes with no compound eyes.
They lack antennae.
They have two body parts

(b) (i) Protects internal body parts
Attachment of muscles for locomotion
Has a waxy cuticle to prevent desiccation.
(ii) Cockroach, mosquito.
(iii) Spiders are predators that feed on a wide range of insects controlling the populations of these smaller organisms to regulate insect populations, preventing outbreaks that could damage crops and disrupt ecosystems.
Spiders are incredibly diverse, with thousands of species found in various habitats worldwide.

Burrowing spiders enhance soil aeration and drainage through their burrowing activities. This can improve soil health and facilitate the growth of plants.

The presence and abundance of certain spider species can serve as indicators of the health and stability of ecosystems. Changes in spider populations may reflect alterations in food webs, habitat quality, and environmental conditions.

1.1.3

(a)(i) In Animals:

Tissues: Tissues are groups of similar cells that work together to perform a specific function. In animals, there are four primary types of tissues:

Epithelial Tissue: This covers the body's surfaces, lines internal organs, and forms glands. For example, the skin is made up of epithelial tissue.

Connective Tissue: Connective tissues provide support and structure, including bone, cartilage, blood, and adipose (fat) tissue.

Organs: Organs are made up of multiple tissues that work together to perform specific functions. For example:

The heart is an organ composed of cardiac muscle tissue, connective tissues, and nervous tissues, and its function is to pump blood.

The liver is an organ that contains various types of tissues and performs functions like detoxification, nutrient processing, and bile production.

Systems: Organ systems are groups of organs that work together to perform complex functions in the body. Examples include:

The circulatory system, which includes the heart, blood vessels, and blood, is responsible for transporting oxygen, nutrients, and waste products throughout the body.

The respiratory system, consisting of the lungs and associated structures, facilitates the exchange of oxygen and carbon dioxide.

The nervous system, comprised of the brain, spinal cord, and nerves, controls and coordinates bodily functions and responses.

In Plants:

Tissues: Plant tissues are categorized into three main types:

Epidermal Tissue: This covers the plant's surfaces and helps protect it. The epidermis is an example of dermal tissue.

Vascular Tissue: Vascular tissue consists of the xylem and phloem, which transport water, nutrients, and food throughout the plant.

Organs: In plants, organs include roots, stems, leaves, and reproductive structures like flowers and fruits. These organs consist of various tissues that perform specialized functions.

For example, a leaf contains dermal tissue on its surface, ground tissue in its mesophyll for photosynthesis, and vascular tissue (xylem and phloem) for transporting water, nutrients, and food.

Systems: In plants, there are no discrete systems comparable to those in animals. Instead, various organs and tissues work together for overall plant function. For example:

The root system includes roots and associated tissues responsible for anchoring the plant, absorbing water and nutrients, and storing energy.

The shoot system consists of stems, leaves, and reproductive structures involved in photosynthesis, support, and reproduction.

1.3.1

(a) They have wings to fly from one place to another.

They are small and occupy a small space hence many can live in a small area.

They need little food because of their small bodies hence reduced competition for food.

They have an exoskeleton made out of chitin to prevent desiccation.

They have compound eyes for a wide field of view.

They have antennae for sensitivity.

They have a tracheal system for efficient gaseous exchange.

Their colors camouflage with the environment to prevent them from being eaten by predators.

They undergo different stages during their development, which feed on different foods to prevent competition.

(b) Decreased Crop Production: Bees are essential pollinators for numerous fruit, vegetable, nut, and seed crops.

Economic Impact on Agriculture: Agriculture is heavily dependent on pollinators, and the decline of bee populations can have a substantial economic impact on the agricultural sector. Reduced crop yields can lead to financial losses for farmers and can even threaten the viability of some agricultural operations.

Reduced Dietary Diversity: A decline in bee populations can affect the availability of diverse and nutritious foods. Fruits, vegetables, and nuts that rely on bee pollination are important components of a healthy diet.

Increased Costs: Farmers may need to resort to costly alternative pollination methods, such as

renting beehives or using mechanical pollination techniques, to compensate for the lack of natural pollinators.
Loss of Biodiversity: The decline of bee populations may signal broader ecological imbalances, potentially affecting other pollinators and the overall biodiversity of ecosystems.
Impact on Honey Production: A decline in bees can lead to reduced honey production, impacting honey producers and the availability of this natural sweetener.
Bees also pollinate plants used for medicinal purposes. A decrease in bee populations could affect the availability of medicinal herbs and plants, potentially impacting traditional and alternative medicine practices.
Bees are food for other living organisms in the ecosystem. decline in bee populations can disrupt these ecosystems, affecting the plants, animals, and ecological processes that rely on bees.

1.2.1

(a) X: Stigma. Y: Anther head.
(b) It has feathery stigmas to trap pollen grains carried by wind.
It has long stamens and pistils hanging outside the petals to release and receive respectively pollen grains easily.
It has simple and small floral parts to reduce drag and allow efficient dispersal of pollen.

(c)

Insect pollinated flowers	**Wind pollinated flowers**
They have brightly coloured petals to attract insects.	They have dull-colored petals.
They have a scent to attract insects	They have no scent
They have large conspicuous petals, which act as landing sites for insects.	They have small petals.
They have sticky pollen grains, which stick to the insects' bodies.	They have non-sticky pollen grains, which stick to the insects' bodies.
They produce heavy pollen grains.	They produce light pollen grains, which can easily be carried by wind.
They produce nectar from nectarines to attract insects.	They produce no nectar.

1.2.2

(a) They have sticky pollen grains, which stick to the insects' bodies.
They have sticky stigmas, which hold pollen grains.
They produce light pollen grains, which can easily be carried by wind.
They have feathery stigmas to trap pollen grains carried by wind.
They produce a lot of pollen grains to increase the chances of dropping on the stigma of other flowers
Have brightly colored petals to attract pollinators such as bees, butterflies, and hummingbirds.
They produce good scents to target different pollinators.
Flowers produce nectar for different pollinating insects.
The shape and structure of flowers can be specialized to accommodate specific pollinators.
Flowering in some plants coincides with the activity of their target pollinators.
Self-Incompatibility: Some plants have mechanisms of self-incompatibility. This encourages cross-pollination, increasing genetic diversity.

Some plants have feathery stigmas to trap pollen grains carried by wind.

Some plants have long stamens and pistils hanging outside the petals to release and receive pollen grains easily.

(b)

Fertilisation in plants	**Fertilisation in man**
External agents are required for pollination.	External agents are not required.
The seed is formed after fertilisation.	The human baby is formed after fertilisation

1.3.2

(a)

1 (a) Specimen with hairy body surface……go to 3(A, B and E)
(b) Specimen without hairy body surface……. go to 4(C and D)

2 (a) Specimen with three pairs of legs……go to 3 (B and E)
(b) Specimen without three pairs of legs……A

3 (a) Specimen with pollen basket……E
(b) Specimen without pollen basket……....B

4 (a) Specimen with anal circus……..C
(b) Specimen without anal circus……D

(b)(i) It has wings for flight with precision from one place to another.
It has large compound eyes, which provide them with a wide field of view to detect movement and potential threats, as well as locate suitable breeding sites and food sources.
It has a specialized mouthpart called a proboscis used for feeding on liquids such as decaying organic matter.
It has dark coloration with dark stripes on its thorax to blend into various environments, making it easier to evade predators.
It has specialized bristles on the body to clean itself.

(ii) It sas wings for flight with precision to transport germs from one place to another.
It has large compound eyes, which provide them with a wide field of view to see the decaying organic matter.
It has a hairy body surface to pick disease-causing germs from one place to another.
It has sponging mouthparts to feed on a wide range of liquid and semi-liquid substances that have disease-causing germs.

(c)(i)
Both have exoskeletons
Both segmented legs.
Both have segmented bodies.

(ii)

Specimen A	Specimen B
Has four pairs of legs	Has three pairs of legs
Has two main body parts	Has three main body parts

2.1

(a) Organic Matter Addition: Adding organic matter such as compost, manure, or crop residues can significantly improve sandy soils. Organic matter increases water retention, nutrient content, and microbial activity.
Addition of lime: lime improves soil structure and pH balance. This makes the soil retain water.

Crop Rotation: Implementing crop rotation systems that include nitrogen-fixing plants to enrich the soil with essential nutrients. Legumes fix atmospheric nitrogen into the soil.

Cover Cropping: Using cover crops to protect the soil from erosion, increase organic matter content, and prevent weed growth. Cover crops also add nutrients to the soil when they are incorporated.

Mulching: Applying mulch to reduce evaporation, maintain soil moisture, and moderate temperature fluctuations. This can improve conditions for plant growth.

(b) Water dissolves the soil nitrates transporting them to deeper layers of the soil where plant roots cannot reach during leaching.
Water lodging causes reduced oxygen concentration in the soil, this activates denitrifying bacteria that break down nitrates to free gaseous nitrogen reducing the concentration of nitrates in the soil.
(c) Aerenchyma Tissues: have specialized tissues called aerenchyma that contain air spaces. These tissues allow for the exchange of gases, enabling the plant to obtain oxygen even when submerged in waterlogged soils.

Floating Leaves and Stems: Some plants have floating leaves and stems that stay on the water's surface. This adaptation allows them to capture sunlight for photosynthesis while keeping the rest of the plant above water.

Shallow Roots: Swamp plants often have shallow roots that spread out horizontally rather than growing deep into the soil. Shallow roots can access oxygen in the upper soil layers more effectively.

Stilt Roots: Plants like cypress trees and red mangroves develop stilt roots that extend above the water's surface, providing support and anchoring the plant in unstable swamp environments.

Insectivorous Adaptations: Some swamp plants, like pitcher plants and sundews, have evolved insect-catching mechanisms to supplement their nutrient uptake in nutrient-poor swamp soils.

Symbiotic Relationships: Mycorrhizal fungi and other beneficial microorganisms allow swamp plants to access nutrients more effectively, particularly in nutrient-poor swamp soils.

Seed Dispersal: Swamp plants often have specialized adaptations for seed dispersal in water, such as buoyant seeds or seeds with appendages that aid in waterborne dispersal.

2.2

(a) W: Nitrification. X: Nitrogen fixation. Y: Absorption. W2: Denitrification.
(b) (i) Nitrites
(c)(i) Nitrifying bacteria like Nitrobacter, nitrogen-fixing bacteria like Rhizobium
(ii) Roots
(iii) Mutualism. The bacteria obtain shelter, food, and oxygen from the plant. The plant obtains nitrates.
(d) Nitrogen Fixation: Humans have greatly increased nitrogen fixation through industrial processes, such as the production of synthetic fertilizers and the cultivation of nitrogen-fixing crops like legumes.

Fertilizer Application: The use of synthetic nitrogen fertilizers in agriculture has increased crop yields.
Livestock Farming: livestock releases ammonia into the atmosphere, which can contribute to air pollution and acid rain.
Burning Fossil Fuels: The combustion of fossil fuels releases nitrogen oxides into the atmosphere, which can eventually be deposited onto land and water bodies.
Industrial Processes: such as the production of nitric acid and the burning of fossil fuels, release nitrogen compounds into the atmosphere, which can be deposited in different forms and affect ecosystems.

Wastewater and Sewage: Discharge of nitrogen-rich wastewater from sewage treatment plants can contribute to nitrogen pollution in water bodies.

3.1

(a)(i) To cut off light penetration

(ii) Pond water is non-chlorinated with the necessary conditions for the survival of the aquatic organisms

(iii) It can survive and carry out gas exchange when in water.

(iv) It can carry out photosynthesis while fully immersed in water.

(b)(i) Test tubes A and B: No bubbles of a colourless gas, the snail dies.

(ii) The black box cuts off light, the pond weed fails to photosynthesize, no oxygen release and the aquatic snail suffocates and dies.

(c)(i) Test tube C: Bubbles of a colourless gas, the pond snail remains alive.

Test tube D: No bubbles of a colourless gas, the pond snail dies.

(ii) Test tube C: The pond weed carries out photosynthesis to release bubbles of oxygen used for respiration by the pond snail.

Test tube D: No pond weed, no oxygen, the pond snail suffocates and dies.

(d)(i) Photosynthesis

(ii) The survival of some aquatic organisms depends on light energy.

3.2

(a) Y: Gall bladder. Z: Duodenum. L: Pancreatic duct.

(b)(i) It secretes pancreatic juice with a variety of digestive enzymes that are poured into the duodenum via the pancreatic duct.

Amylase to catalyse the conversion of starch to maltose.

Lipase to catalyse the conversion of lipids (fats and oils) to fatty acids and glycerol;

Trypsinogen which, when converted to trypsin by enterokinase from the microvilli, catalyses the conversion of proteins into smaller polypeptides.

(ii) When glucose levels exceed the normal after a meal, It secretes insulin that travels to the liver and muscles, the liver burns the glucose, some is converted to glycogen and the remaining to fats. In muscles, glucose uptake is increased.

When glucose levels get below normal levels, it secretes glucagon, which travels through the blood to the liver, the liver reduces respiration to reduce glucose breakdown, the conversion of glycogen back to glucose.

(c) The liver produces bile salts. These contain alkaline substances that neutralize acid food from the stomach for optimum conditions for enzyme activity in the duodenum. Bile salts also emulsify fats, this increases the surface area for action of lipase.

3.3

(a)(i) It secretes pancreatic juice with a variety of digestive enzymes that are poured into the duodenum via the pancreatic duct.

Amylase catalyzes the conversion of starch to maltose.

Lipase to catalyse the conversion of lipids (fats and oils) to fatty acids and glycerol;

Trypsinogen which, when converted to trypsin by enterokinase from the microvilli, catalyses the conversion of proteins into smaller polypeptides.

(ii) These contain alkaline substances that nuetralise acid food from the stomach for optimum conditions for enzyme activity in the duodenum. Bile salts also emulsify fats, this increases the surface area for action of lipase.

(iii) They break down food into small particles. This increases the surface area for the action of digestive enzymes.

(b) Increased body temperature above the normal stops the normal activity of digestive enzymes, this affects food digestion and reduces the amount absorbed food substances.

4.1

(a) From 0.0 moldm^{-3} to 0.4 moldm^{-3} increases in sucrose concentration cause a decrease in the mass of the potato cylinders back to the original mass where a change in mass is zero.

From 0.4 moldm^{-3} to 1.0 moldm^{-3} increase in sucrose concentration causes a decrease in the mass of the potato cylinders from the original mass.

(b) (i) There is a decrease in the mass to the original mass. The increase in sucrose concentration causes water to move out by osmosis from the potato cylinder.
(ii) There is a decrease in the mass. The increase in the sucrose solution causes water to move out of the potato cylinders by osmosis, reducing turgor pressure and a decrease in the mass from the original mass of the cylinders.
(c)(i) The mass remains constant. The potato tissues are fully plasmolysed, no more water loss.
(ii) At 0.4 $moldm^{-3}$. This is the sucrose concentration without a change in mass.

4.2

(a)(i) Blood (ii) Tissue fluid
(ii) By ultrafiltration. The high blood pressure in the arteriole causes plasma to move out of the blood via the permeable capillaries along small substances like glucose, amino acids, minerals, hormones, and oxygen to form the tissue fluid that bathes the body cells.
(iii) It is a medium of exchange between blood and the body cells. It transports important substances from the blood to the cells to be used, it then transports the waste products back into the blood at the venous end.
(b) Lymph fluid
(c) It transports fatty acids and glycerol from the ileum to the heart where they join the blood system.
It carries excretory substances from tissues to the bloodstream.
It produces white blood cells, which assist in the defense of the body.
It filters out bacteria before they reach the bloodstream.
(d)

Blood system	Lymphatic system
Has a heart that acts as a pump	Has no pump
Blood flow is two-way, i.e. from heart to body and back to the heart.	Lymph flow is one way, i.e. from body tissues to the heart.
Blood travels at high speed.	Lymph travels at a very slow speed
Valves are only found in veins	Have valves in all its vessels
Contains blood cells and proteins	Only white blood cells are present. Proteins are lacking
Does not contain emulsified fats	Contains and transports fatty acids and glycerol.

4.3

(a)(i) Active transport
(ii) An increase in oxygen concentration causes an increase in respiration to produce energy used for the active uptake of potassium ions.
(iii) The rate would decrease and stop. Cyanide is a metabolic poison that inhibits respiration, this reduces energy production to stop ion uptake.
(b) (i) Similarities
In both, there is an increase in the uptake of ions
Difference
The uptake in the presence of oxygen is higher than the uptake in the absence of oxygen.
(ii) Uptake without oxygen occurs by diffusion which does not use energy and when equilibrium is attained the uptake stops. With oxygen, respiration occurs to produce energy which is used for the active uptake of ions against a concentration gradient to achieve a higher uptake.
(iii) Flooding causes reduced oxygen in the soils, which reduces respiration, causing a reduced uptake of ions by the roots, this affects the growth of the plants. At the same time with few ions in the root hair cells, this reduces water absorption from the soil by osmosis which may lead to wilting affecting plant growth.

4.4

(a)(i) Innate immunity constitutes defense mechanisms the individual possesses at birth. Innate defense mechanisms include the following. Keratinized skin surface does not allow entry of germs. Saliva contains substances that kill germs. Etc.

(ii) Adaptive immunity. This is a specific type of immunity acquired after the body has been exposed to the external environment and disease-causing germs.

(b)

	Innate	Acquired
Mechanism	Innate immunity is the first line of defense against pathogens and is present from birth. It includes physical and chemical barriers, such as the skin, mucous membranes, and stomach acid, as well as various cells and proteins that are always ready to combat invaders.	Adaptive immunity is a more specialized and acquired defense mechanism. It involves the recognition of specific pathogens and the development of immune responses tailored to combat them.
Specificity	nonspecific	Highly specific, targeting particular pathogens.
Response time	acts quickly	slower initially but provides long-lasting protection
Components	relies on physical barriers, phagocytes	involves T cells, B cells, and antibodies
Memory	No memory	Memory

5.1

(a)(i) The muscles relax, and they form a dome shape that pushes and squeezes the lungs, this creates an increase in pressure above atmospheric pressure and a reduction in volume to push out the air.

(ii) The external intercostal muscles relax. This relaxation allows the ribcage to return to its resting position, decreasing the volume of the chest cavity. As a result, the air pressure in the lungs increases volume reduces, and air is forced out.

Internal intercostal muscles work during forced exhalation (forced expiration), these muscles contract vigorously. Their contraction pulls the ribcage downward and inward, reducing the volume of the chest cavity even more. This action increases the air pressure in the lungs, facilitating the expulsion of air.

(b)(i) Bronchus

(ii) The mucus membrane has a rich blood supply which warms and moistens the incoming air for easy diffusion in the lungs.

The epiglottis and other structures on the top of the trachea prevent food, drinks, and other solid particles from going into the trachea during swallowing.

It is highly supplied with blood capillaries that transport oxygen and carbon dioxide to and from the body tissues respectively.

The whole lungs are covered with the pleural membrane which is gas-tight thus changes in the pressure within the lungs can occur without external interference.

The walls of the trachea and bronchi are lined by rings of cartilage which prevent them from collapsing and keep them open for air passage.

Lungs are composed of numerous alveoli; providing a large surface area over which respiratory gasses oxygen and CO_2 diffuse and become exchanged at a high rate.

5.2

(a)(i) At 2 minutes: At 2 minutes, there is an increase in the breathing rate per minute.

(ii) From 2 min to 6 minutes, the breathing rate increases rapidly to allow faster exchange of gases, oxygen for respiration to provide energy for the split, and release of carbon dioxide.

From 6 minutes to 10 minutes, the breathing rate decreases rapidly, after splinting, the need for oxygen reduces to reduce oxygen consumption and carbon dioxide release.

From 10 minutes to 16 minutes, the breathing rate remains constant because the student is at rest with little use of oxygen and release of carbon dioxide.
(b)(i) Student A
(ii) The breathing rate per minute for student A is higher than for student B. This is caused by the large lung capacity of athletes which is developed during continuous exercise.
(c)Student B. The breathing rate is low, with reduced exchange of gases, and reduced transport of oxygen to the respiring muscles. This causes anaerobic respiration to release lactic acid which causes muscle cramps.

5.3

(a)

Insects	Fish
Use tracheole	Uses gill filaments
The medium of exchange is air	The medium of exchange is water
No circulatory system for oxygen transport	Transport system to transport oxygen

(b) (i) Inhalation: The abdomen relaxes which causes the spiracles to open wider. The volume of the abdominal cavity increases and pressure reduces below that of the atmosphere. Air enters through the spiracles into the trachea. It dissolves in the moisture within the trachea. This facilitates the diffusion of oxygen from the tracheoles into the surrounding body tissues. Oxygen is used by the tissues and the Carbon dioxide produced is eliminated during exhalation.
(ii) Exhalation: The abdomen contracts; this reduces the volume in the abdominal cavity and raises the pressure above that in the atmosphere. This causes air to move from the tracheal tubes through the spiracles to the atmosphere. After exhalation inhalation follows and the cycle repeats.
(c)
Spiracles are guarded with valves that allow respiratory gases in and out of the tracheal system.
Tracheoles are kept moist to facilitate easy diffusion of respiratory gases.
The tracheal system terminates into tracheoles which are in direct contact with body cells for direct delivery of respiratory gases to metabolically active cells, reducing greatly the distance of diffusion.
Tracheoles are permeable to respiratory gases.
The tracheal system is highly branched to increase the surface area to volume ratio for efficient gaseous exchange.
The trachea is made up of chitin which keeps them open to the tracheal system and maintains a diffusion gradient.
Movement of the abdomen and thorax due to contraction and relaxation of abdominal and thoracic muscles enhances the ventilation of the tracheal system and maintains a diffusion gradient.

6.1

(a) (i) Ultrafiltration: Blood is filtered at high pressure. The afferent arteriole is larger than the efferent arteriole, more blood goes into the glomerulus and little is drained, the excess blood causes a high blood pressure that causes ultrafiltration of blood. This pressure forces small molecules to filter out of the blood capillaries into the glomerulus to form the glomerular filtrate. This filtrate contains glucose, urea, water, salts, and vitamins. Proteins and blood cells do not filter out because they have bigger molecules, which cannot pass through the walls of the glomerulus.
(ii) Selective reabsorption. All the glucose, amino acids, and vitamins are reabsorbed back into the blood. The process may occur through facilitated diffusion and active transport. A lot of water is also selectively reabsorbed along the tubules back into the blood. The remaining fluid that contains urea, some minerals, and water continues to the loop of Henle.
(iii) Water reabsorption by osmosis, the collecting ducts pass through the medulla with high solute concentration that causes osmotic outflow of blood from the filtrate into the blood.
(b)(i) High intake of salts, reduced intake of water, after a vigorous activity.
(ii) The water is used to move the medicine very fast to pass parts of the body for faster healing, water is used to dilute the metabolic wastes from medicine, and water is used to remove the waste products of medicine during urine formation.

6.2

(a) Glucose: Still needed by the body and it is not excess in the blood.

(b) %age Na reabsorbed = $\frac{Na\ filtred\ reabsorbed}{Na\ filtered} X\ 100$

%age Na reabsorbed = $\frac{480}{500} X\ 100$

%age Na reabsorbed =96%

(c)(i) %water reabsorbed = $\frac{water\ filtered - watere\ excreted}{water\ filtered} X\ 100$

%water reabsorbed = $\frac{160-1.6}{160} X\ 100$

%water reabsorbed =99%

(ii) Antidiuretic hormone

(d)(i) Glucose

(ii) Urea

6.3

(a)(i) During hot conditions, peripheral blood vessels on the skin surface dilute to increase blood flow to the skin allowing heat loss by radiation, in cold conditions blood vessels constrict to reduce blood flow to the skin reducing heat loss by radiation

(ii) Hairs: In hot conditions, the pili erector muscles relax and the hairs lie flat on the skin surface to reduce insulation. In cold conditions, the pili erector muscles contract to make the hairs stand, these trap thin air to insulate the body against heat loss.

(iii) Sweat gland, in hot conditions, sweat is secreted, on the skin surface, it then evaporates to allow heat loss. In cold conditions, no secretion of sweat to reduce heat loss.

(iv) They form a layer beneath the skin that insulates the body against heat loss in cold conditions.

(b)(i) Thick fat subcutaneous layer, the thick layer of gut

(ii) They expose a small surface area compared to the total volume for heat loss, they maintain a lot of heat inside their bodies, no need to hibernate.

7.1

(a) (i) A: Dendrites. B: Axon. D: Cell body

(ii) Secrets myelin sheath.

(b)(i) Transports impulses from the central nervous system to the effectors.

(ii) The arrow should move from A towards B

Motor neuron	Relay neuron
Long axon	Short axon
One axon	May have numerous axons

7.2

(a) (i) Light from a dog enters the eye. It is refracted by the cornea into the aqueous humour. The aqueous humour then refracts it to the lens. The lens refracts it to the vitreous humour. The vitreous humour finally refracts light and focuses it to the retina making an image of the dog on the retina.

(ii) The photoreceptors in the retina change the light stimulus into a nervous impulse. The impulse travels along the optic nerve to the brain where interpretation of the image is made. The information is then taken to the cerebrum for further interpretation and processing, the decision is made, the impulse is sent to skeletal muscles for contraction and relaxation to cause movement, and then the boy decides to run away from the dog.

(b)(i) Adrenaline

(ii) It increases the rate of heartbeat.

It increases the breathing rate.

It widens the pupils of the eyes.

It brings about the conversion of glycogen to glucose in the liver.

It brings about the growth of goose pimples on the body.

It increases the rate of respiration to ensure an adequate supply of energy to body muscles.

7.3

(a)

Nastic response	Tropism
Does not depend on the direction of the stimulus.	It depends on the direction of the stimulus
It occurs in any part of the plant.	It occurs in the growing tips of plants
It does not involve auxins	It involves auxins
Are usually faster	Are usually slower
It involves growth and turgor changes	It involves growth only.

(b) In shoots: Stimulus-like light from one direction of the shoot causes auxins on that side to escape to the opposite side without light. The side without the stimulus like light receives more auxins than one receiving lighter. A high concentration of auxins on the side with little or no light causes cell elongation on that side. This causes the shoot to bend towards the direction of the stimulus.

In roots: On the side with few or no auxins, Cell elongation takes place more on the lower side than the side with more auxins. This makes the shoot to bend upwards away from the gravitational pull (

The higher concentration of auxins on the lower side reduces elongation in the root. The upper side grows faster than the lower side causing the root to bend in the direction of the stimulus like gravitational force.

(c)

Auxins	Gibberellins
It promotes the growth	It promotes the growth of
Auxin brings about	Gibberellin has no role in
No effect on seed	Cause seed germination
The normal concentration of auxin	Gibberellin has no such effect.

8.1

(a)(i) Thoracic vertebra

(ii) It has a Centrum to provide the main support of the backbone and allows articulation with another vertebra.

It had transverse processes to provide a surface for the attachment of muscles. For articulation with ribs in the thoracic vertebra.

It has a neural arch. It forms a bonny tube that protects the spinal cord.

It has a neural spine for attachment points for various muscles and ligaments.

It has a neural canal. To provide passage for the spinal cord.

(b)(i) A: Neural spine. B: tubercular facet. C: Shaft. D: costal cartilage

(ii) The contraction of the external intercostal muscles causes the rib to move outwards and upwards, this causes an increase in the volume of the thoracic cavity and a reduction in the pressure below the atmospheric pressure to cause inhalation.

8.2

(a)(i) Femur

(ii)A: Tendon. B: Articular cartilage. C: Synovial membrane

(b)(i) Joint pain.

Joint stiffness

Joint Tenderness.

Loss of flexibility.

Joint Swelling.

(ii) Secrets synovial fluid

(c) (i) Hinge joint.

(ii) Wearing of synovial membrane, reduced synovial fluid, wearing of articular cartilage, joint pain.

9.1

(a) (i) It has an exoskeleton made of chitin.

It has jointed legs.

It has a segmented body.

(ii) Molting

(iii) Ecdysone

(b)(i) From 0 week to 1 week, the dry mass increase gradually,

From 1 week to 4 weeks, the dry mass increases rapidly,

From 4 weeks to 5 weeks, the dry mass increases gradually,

From 5 weeks to 6 weeks, the dry mass remains constant,

From 6 weeks to 7 weeks, the dry mass decreases rapidly.

(ii) From 0 weeks to 1 week, after germination few leaves and shallow root system, slow productivity.
From 1 week to 4 weeks, extensive root system for water absorption, numerous leaves for maximum harvest maximum light, and fast productivity.
From 4 weeks to 5 weeks, maturation, flowering, reduced produced
From 5 weeks to 6 weeks, maximum size attained, rate of cell death equals to rate of cell death, constant productivity.
From 6 weeks to 7 weeks, aging, fruit fall, leave fall, reduced productivity, reduced dry mass.
(iii) To provide light for photosynthesis, to make food for further growth and development.

9.2

(a)(i) Water is used to hydrolyze food reserves, activate enzymes, act as a medium in which all enzymes act, and a medium for transport of dissolved food substances.
(ii) Hard Seed Coat: impermeable seed coats that act as a barrier to water and gases. This prevents water uptake and inhibits germination.
The presence of germinating inhibitors like abscisic acid (ABA), plays a crucial role in regulating dormancy. High levels of ABA inhibit germination by preventing the embryo from growing and initiating metabolic processes required for germination.
Absence of light in some seeds.
Lack of a period of cold.

(iii) Immersion of seed in water for a long time, cuts off the oxygen supply, reduces respiration, stops energy production, seed dies and rots.

9.3

(a)(i) A: Root hair. B: Root cap.
(ii) It is slender and flexible to grow between soil particles to access water.
It has a cell sap with a higher osmotic potential than the soil to absorb water by osmosis.
It is elongated to increase the surface area for absorption of water and mineral salts.
They are very thin with a semi-permeable cell membrane, to reduce distance for movement.
It lacks a cuticle to allow entry of water and mineral salts.
(b)(i) Region X: Cells absorb water by osmosis, the increased turgor pressure causes the cells to elongate leading to elongation of this region. The small vacuoles fuse to form one large vacuole.
Region Y: Cells divide by mitosis to form two daughter cells, one remains meristematic, and another is sent to the region of cell elongation.
(c)(i)
This is caused by apical meristems found at the tips of the root and the root, leading to an increase in the length or linear dimension of the plant. Cells divide by mitosis to form cells that are pushed into the region of cell elongation, in this region, cells absorb water by osmosis, the increased turgor pressure causes them to elongate, and the numerous vacuoles fuse to form on central vacuole. When they reach the Region of cell differentiation, Cells mature to form specialized tissues that perform different functions.
(ii)

Primary growth	**Secondary growth**
Cell division occurs at the apical meristem.	Cell division takes place in the lateral meristem.
Growth causes the plant's stem and root to grow in height.	Radial growth of the stem and root is the result of secondary growth.
This occurs in all the plants.	It occurs in angiosperms and gymnosperms.
The main growth results in the formation of the primary xylem.	The secondary growth of the vascular cambium produces secondary xylem.

10.1

(a) (i) Oestrogen: Stimulates the repair of the uterine membrane after menstruation. Responsible for the development of sexual secondary characteristics in females: Causes the secretion of LH by the pituitary gland; inhibits the secretion of FSH by the pituitary gland.
Progesterone: Development of the uterine membrane in preparation for implantation. Inhibits the secretion of LH by the pituitary gland.
(ii) It is a passage for menstrual flow, it is a birth canal, it is where the male inserts his erect penis during sexual intercourse.

(iii) It is well supplied with blood vessels to supply blood to the placenta in case of successful fertilisation, it has a large surface area to provide enough space for implantation, and it can stretch during gestation to accommodate the developing fetus.

(b)(i) X: Testis: Secrets testosterone; formation of sperms:

Y: Sperm duct (vas deferens): Transports sperms from the epididymis to the ejaculatory duct.

M: Epididymis; for sperm maturation and temporary storage of sperm.

(ii) Seminal fluid: It had sugars used in respiration to provide energy for sperm motility, it has alkaline substances to neutralize the acidic vagina, and it had ions and mucus to favor the survival of sperms in the female reproductive system.

(iii) Testosterone: Male sexual secondary characteristics like sperm formation, deepening of the voice, pubic hair formation, and muscularity.

(c) Female: Tubal ligation. The fallopian tubes are cut to prevent the meeting of sperm and ova.

Male: Vasectomy. The sperm ducts are cut to prevent the movement of sperm from the epididymis to the ejaculatory duct.

10.2

(a) Ovary

(b) (i) Observation: Oestrogen decreases, and progesterone on increases. Ovulation takes place, the release of ova, the Graafian follicle stops working reducing the secretion of oestrogen, and the Graafian follicle changes into the corpus luteum to secret progesterone.

(ii) Observation: Decrease in both progesterone and oestrogen: The degeneration of the corpus luteum stops the secretion of both oestrogen and progesterone.

(c) Oestrogen, which repairs the uterine membrane after menstruation, causes the release of LH that causes ovulation.

Progesterone: This causes the development and maintenance of the uterine membrane for implantation and a successful gestation period.

(d) Both hormones are used in contraceptive pills. Oestrogen inhibits the secretion of FSH and the development of eggs. Progesterone: It inhibits the secretion of LH, with no ovulation.

10.3

(a)Condoms (Female and male condoms). Condoms provide a barrier that prevents sperm from reaching the ovum. They are most effective if used correctly.

Contraceptive pill. These contain progesterone and oestrogen hormones. They prevent ovulation and the development of the Graafian follicles. There are two different types of pills I.e., the 21-day pill. These are taken for 21 consecutive days of the cycle. They are not so effective due to changes in the menstrual cycles.

The morning-after pill (emergency pill). This is taken after the act of sexual intercourse to prevent the development of any zygote that may have been formed. It is not so effective due to changes in the menstrual cycles and the timing of fertilization.

Intra-uterine devices: these include coils and loops. They prevent implantation from occurring. They are put in the uterus. They are effective for up to 3 years.

Vasectomy: This is the surgical cutting and tying of sperm ducts in males to prevent sperm from leaving the testes. Most effective methods.

Tubal ligation. This is the surgical cutting and tying of the oviducts (fallopian tubes) in females to prevent ova from moving from the ovary. Most effective method but permanent.

Use of spermicides. These are chemicals inserted in the vagina to kill sperms that may be released during sexual intercourse. They may not be effective if not used well.

Cervical plug. This is a rubber plug placed at the end of the vagina to prevent sperm from crossing the cervix to reach the uterus. If not properly inserted some sperms may escape into the uterus.

Rhythm method. This is abstinence from sex during the fertile days of the cycle. It Is affected by hormonal imbalance and changes in the menstrual cycle.

Coitus interruptus/withdraw. This is the removal of the penis from the vagina shortly before ejaculation such that sperms are shed. It is not safe. It requires a lot of experience to be effective, so sperm may remain in the urethra.

(b) Condoms: Loss of sexual intimacy and bond between couples.

Birth Control Pills: Nausea, breast tenderness, mood changes, irregular bleeding, and spotting. Blood clots, high blood pressure, weight gain, and decreased libido.
Implant: Skin irritation at the patch site, nausea, breast tenderness, mood changes, and irregular bleeding.
Diaphragm: Vaginal discharge, irritation, nausea, breast tenderness, and mood changes.
Intrauterine Devices (IUDs): Cramping and irregular bleeding, especially during the first few months, Lighter periods, irregular bleeding (especially in the first few months), and less cramping.
Emergency Contraception (Morning-After Pill): Nausea, vomiting, and menstrual irregularities.
Tubal Ligation (Female Sterilization): Surgical risks, such as infection and bleeding. Irreversible.
Vasectomy (Male Sterilization): Surgical risks, such as infection and bleeding. Irreversible.
Withdrawal Method (Pulling Out): High risk of unintended pregnancy due to difficulty in timing withdrawal accurately.
Breastfeeding as Birth Control (Lactational Amenorrhea Method): Only effective if exclusive breastfeeding and may not be reliable once menstruation resumes.

11.1

(a) Testis and ovary
(b)

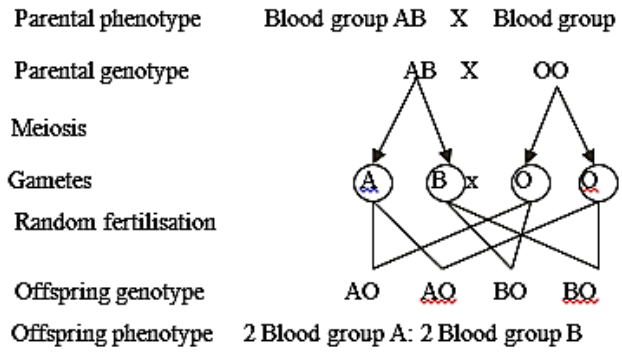
Mitosis	**Meiosis**
Occurs in somatic cells.	Occurs in reproductive cells.
Involves a single division of chromosomes and cytoplasm	Involves two divisions of chromosomes and cytoplasm.
Does not involve the process of synapsis	It involves synapsis
Crossing over does not occur	It involves crossing over between homologous chromatids.
Formation of bivalents does not occur.	There is a formation of bivalents.
Two daughter cells are produced.	Four daughter cells are formed.
Daughter cells formed have the same number of chromosomes as the parent cell	Daughter cells formed have half the number of chromosomes compared to the parent cell
Does not involve the formation of Chiasmata.	It involves the formation of chiasmata

(c) Meiosis generates genetic diversity among offspring. During meiosis, homologous chromosomes pair up and exchange genetic material through a process called recombination or crossing-over. This shuffling of genetic information results in unique combinations of alleles (gene variants) in the gametes (sperm and egg cells). However, in mitosis, there is no genetic diversity, the genetic material is maintained constant.

Variability for Natural Selection: The genetic variability produced by meiosis is the raw material upon which natural selection acts. It allows populations to adapt to changing environmental conditions over generations. In mitosis, no genetic variability leads to the formation of identical organisms more susceptible to extinction.

11.2

(a)
Let A represent the allele for blood group A
Let B represent the allele for blood group B
Let O represent the allele for blood group O



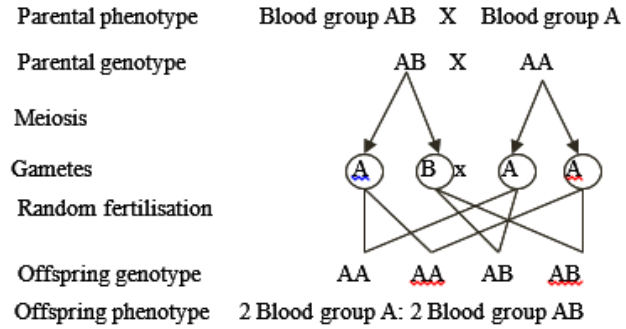
Marlin is the adopted child

(b) Let A represent allele for blood group A

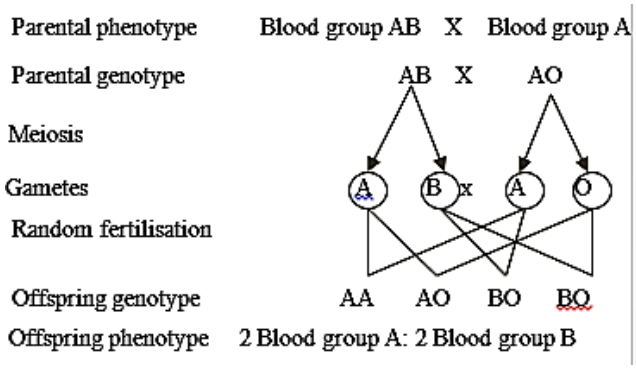
Let B represent the allele for blood group B

Let O represent the allele for blood group O

Case 1



Case 2



From case 1: Offspring are of blood group A and Blood group AB

From case 2: Offspring are of blood groups A and B

(i) It is possible if the woman is of heterozygous blood group A

(ii) The mother's genotype must be AO.

(iii) The results do not provide conclusive evidence. This is because the mother can have both genotypes AO and AA. The exact genotype of the mother is not known. Therefore, the use of a deoxyribonucleic acid sequence can provide conclusive information.

11.3

(a)

Autosomes	Sex Chromosomes
Chromosomes that do not determine sex	Chromosomes that determine sex
Chromosome number =2n-1	Chromosome number =2
Determine similar morphology in male and female	Determine different morphology in male and female
Do not exhibit sex linkage	Exhibit sex linkage

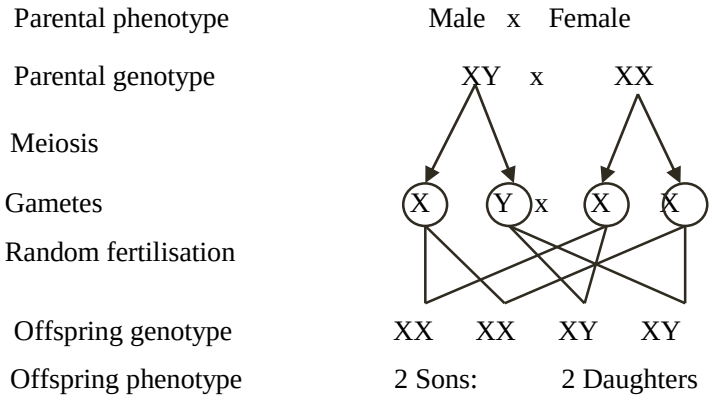
(b)(i) Mammals: In testis and ovary

Plants: In anther heads and ovary

(ii) In a human, there are 23 pairs of chromosomes, one pair determines sex. Females are homogametic with XX whereas Males are heterogametic with XY. The X chromosome carries most of the genes

Let XX represent female chromosomes

Ley XY represents male chromosomes



50%:50% Chance of giving birth to either a boy or a girl.

(c)(i) Refers to the condition where individuals experience significant hair thinning or hair loss at a younger age than is typically expected.

(ii) Let XX represent female chromosomes

Ley XY represents male chromosomes

Let b represent premature baldness

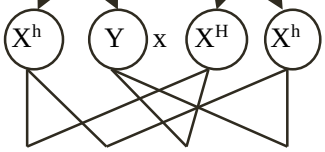
Let B represent the normal

Parental phenotype Bald Male x Normal Female

Parental genotype X^hY x X^HX^h

Meiosis

Gametes



Random fertilisation

Offspring genotype X^hX^H X^hX^h X^HY X^hY

Offspring phenotype 1 normal Girl. 1 premature girl

1 Normal boy. 1 premature bald boy

12.1

(a)(i) From 0km to 100km, the prevalence decreases gradually

From 1000km to 1500km, the prevalence decreases rapidly

From 1500km to 2000km, the prevalence decreases gradually.

(ii) As the distance from the city center increases from 0km to 2000km, lung complications decrease. At 0km, lung complications are high caused by polluted air which is inhaled and affects the structure of the lungs and their functions, as distance increases from the city center, inhaled air gets less polluted.

(b)(i) Motor vehicles, industries and factories, smoking, combustion of fuels.

(ii) It causes inflammation of the walls of the alveolus, which affects its ability to allow faster movement of gases, the toxic gases in the polluted air also affect the surfactant which leads to the collapse of the alveoli.

(iii) Establishing and enforcing air quality regulations and emission standards for industries, vehicles, and other pollution sources.

Implementing strict vehicle emissions standards and encouraging the use of cleaner transportation technologies, such as electric vehicles and hybrid vehicles, can help reduce air pollution from the transportation sector.

Industries can be required to install pollution control technologies, such as scrubbers, filters, and catalytic converters, to reduce emissions of harmful pollutants. Regular inspections and monitoring of industrial facilities can ensure compliance.

Informing the public about the health risks of air pollution and the steps individuals can take to reduce their contribution.

12.1

(a) Loss of Biodiversity: This occurs when habitats are destroyed or altered, leading to the extinction or endangerment of plant and animal species.

Habitat Destruction: The destruction of natural resources often involves the clearing of forests, wetlands, and other ecosystems for agriculture, urban development, or resource extraction.

Climate Change: The burning of fossil fuels and deforestation contribute to greenhouse gas emissions, leading to climate change. Climate change can result in rising temperatures, altered weather patterns, sea level rise, and increased frequency and intensity of extreme weather events.

Water Scarcity: Over-exploitation and contamination of freshwater resources can lead to water scarcity, affecting drinking water supplies, agriculture, and industrial processes.

Soil Degradation: Unsustainable agricultural practices and deforestation can lead to soil erosion and degradation. Loss of fertile topsoil reduces agricultural productivity and can lead to desertification in some areas.

Air and Water Pollution: Resource extraction and industrial processes often release pollutants into the air and water, leading to pollution. This pollution can harm human health, damage ecosystems, and disrupt aquatic life.

Food Insecurity: Destruction of natural resources can reduce agricultural productivity and disrupt food chains. This can lead to food shortages and increased food prices, contributing to food insecurity for vulnerable populations.

Human Health Impacts: Pollution and environmental degradation can lead to a range of health issues, including respiratory diseases, waterborne illnesses, and exposure to toxins and pollutants.
(b) Reduce, Reuse, recycle: Reduce consumption: Use resources more efficiently and avoid overconsumption. Reuse items: Extend the lifespan of products by reusing or repurposing them. Recycle materials: Separate and recycle paper, glass, plastic, and metal to reduce the demand for new resources.
Transition to renewable energy: Invest in solar, wind, hydroelectric, and other renewable energy sources to reduce reliance on fossil fuels.
Forestry Management: Sustainable logging: Implement selective logging and reforestation practices.
Wildlife Conservation: Habitat protection: Create and maintain protected areas for wildlife. Combat poaching and illegal trade: Enforce laws against wildlife trafficking.
Promote conservation education: Raise awareness about the importance of wildlife protection.
Biodiversity Conservation: Protected areas: Establish and maintain national parks, reserves, and wildlife sanctuaries.
Ecosystem restoration: Restore damaged ecosystems to support biodiversity. Invasive species management: Control invasive species that threaten native ecosystems.
Reduce Pollution: Air pollution control: Implement regulations to reduce industrial emissions and promote clean energy.
Land Use Planning: Sustainable urban planning.
Environmental Education: Raise awareness: Educate communities and individuals about the importance of resource conservation.
Legislation and Regulation: Enforce environmental laws: Ensure that laws protecting natural resources are enforced.

12.3

(a)(i) In this method, animals in an environment are captured and counted (N). They are then marked and released back into the environment. The traps are then laid after a given time. The organisms captured are counted (M). The organisms that were marked and recaptured are also counted (R). The population is then calculated.

Population = $\frac{N\ x\ m}{R}$

(ii) A quadrat is a square metal or wooden flame with 1-meter-long sides. It therefore encloses an area of $1m^2$. The quadrat is thrown at random in the study area and the individuals covered are counted. Several quadrats are thrown at random and the average number of organisms is taken. The average number is then multiplied by the total area of the study to get the estimated population.

(b) This is a unit of the environment consisting of both living (biotic) and nonliving (abiotic) components interacting to form a self-sustaining unit.
In the pond, phytoplankton photosynthesize to make food and oxygen. The phytoplankton can be eaten by small fish, and the small fish are then eaten by the big fish. When the small fish die, they decompose to form nutrients that are reused for the growth of aquatic plants that make food and oxygen.