NOTES ON SPECIMENS FOR WASSCE 2024 PAPER 3

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SPECIMEN A - C*assava stem (with leaves and roots intact)*

OBSERVABLE FEATURES

- ✓ Presence of ridges nodes
- ✓ Deeply intented leaves
- ✓ Leaf stalk(long)
- ✓ Palamate leaves
- ✓ Leaves with net venation
- ✓ Nodes
- ✓ Internodes
- ✓ Auxillary bud
- ✓ Terminal bud
- ✓ Green stems
- ✓ Lenticels

HABITAT: school farm

BIOLOGICAL CLASSFICATION:

Kingdom: Plantae

Reasons for the kingdom

- Multicellular
- Eukaryotic
- Cell wall made of cellulose
- Cells contain chlorophyll for photosynthesis

Division
Angiospermophyta/Angiospermatophyta/Magnili ophyta

Reasons for classification

- ✓ They produce flowers
- ✓ Seeds are contained in fruits

Class Dicotyledoneae/Magniliopsida

Reason for classification

- ✓ presence of leaf stalk
- ✓ presence of net venation
- ✓ presence of broad leaves

Type of leaves

Simple digitate

Adaptive features

- ✓ leaves for photosynthesis
- ✓ nodes for vegetative propagation
- ✓ axillary buds develop branches
- ✓ terminal bud to increase in length of stem

Name two areas where meristematic tissues are found

- ✓ Axillary buds
- ✓ Terminal buds

Name two areas where active mitosis occurs

- ✓ Axillary buds
- ✓ Terminal buds

Observable characteristics of a dicotyledonous stem

- ✓ Presence of leaf stalk
- ✓ Presence of broad leaves with net venation
- ✓ Presence of nodes and internodes
- ✓ Presence of buds

Economic importance of cassava

- ✓ Source of food and beverages
- ✓ Starch
- ✓ Biofuel
- ✓ Ethanol
- ✓ Source of oxygen through photosynthesis
- ✓ Removes carbon dioxide from the environment through photosynthesis

Position in food chain

Primary producer/first trophic level

Reason for the trophic level

It manufactures food for herbivores

Mode of reproduction/ method of reproduction of specimen A: vegetative propagation by stem cutting

Observable features of the cassava stem:

- ➢ Presence of ridges at node
- ➢ Presence of sprouting buds
- ➢ Presence of dominant axillary buds
- ➢ Woody stem
- ➢ Presence of lenticels
- ➢ Adventitious root
- ➢ Leaf scar presence on the ridge

Cassava stem

Drawing of the sprouted stem of cassava

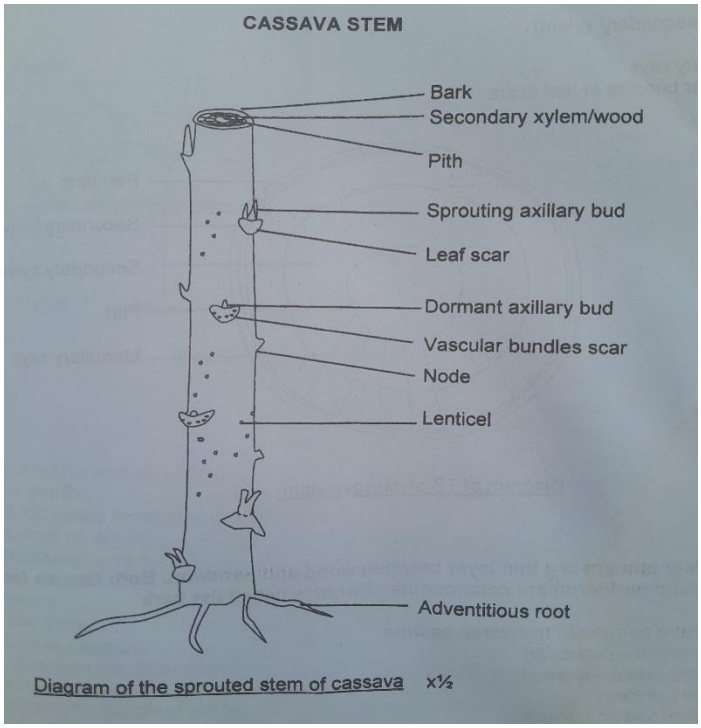


Diagram of the sprouted stem of cassava x½

Plant modification: Root tuber / Cassava tuber

Part of plant modified: Root

Example of plant modification: Cassava

Function of modification:

- ✓ Storage of food
- ✓ Anchorage

Observable features of the cassava stem

External

- ✓ Nodes
- ✓ Internodes
- ✓ Buds
- ✓ Adventitious roots
- ✓ Leaf scar
- ✓ Lenticels
- ✓ Bark/periderm
- ✓ Wood (secondary xylem)
- ✓ Pith
- ✓ Medullary rays
- ✓ Vascular bundles in leaf scars

Internal

- ✓ Wood (secondary xylem)
- ✓ Pith
- ✓ Medullary rays
- ✓ Vascular bundles in leaf scars

Diagram of TS of cassava stem

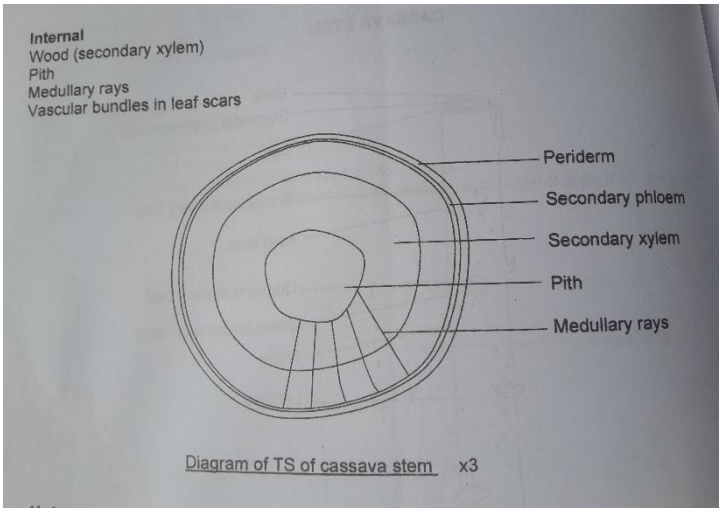


Diagram of TS of cassava stem x3

Observable tissues in transverse section

- ✓ Cork/periderm- protection
- ✓ Secondary xylem- support
- ✓ Secondary phloem
- ✓ Pith stores food and gases

Cassava stem with tubers

Diagram of root tubers in cassava

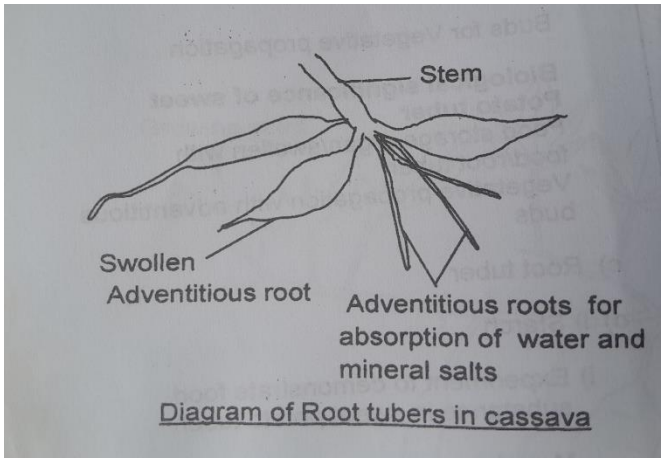


Diagram of Root tubers in cassava

Food nutrients: starch

Biological significance

- ✓ Swollen with food
- ✓ Food storage organ
- ✓ Stem with buds for vegetative propagation

Economic importance

- ✓ **Source of food**
- ✓ **Source of raw material for industries**
- ✓ **Source of income**
- ✓ **Source of employment**

SPECIMEN B (Dry maize grain)

Observable features

- Fruit wall
- Position of embryo
- Remains of style
- Point of attachment to cob
- Position of scutellum

Features of biological importance or significance

- Presence of remnant of style at the broad end
- A ridge in the center making the position of the plumule and the radicle
- Presence of the remains of stalk at the narrow end which marks its attachment to the cob.

Description of the external view / structure of the maize plant

- There are two scars since it is a fruit.
- At the narrow end is the remains of the stalk which marks the attachment to the cob
- At the broad end is the remnant of the style. It is flat with a whitish patch on the flat sides.
- A ridge in the center of the white marks the position of the plumule and the radicle.

Level of organization: *Organ*

Full classification of fruit type in maize

- **True fruit**: developed from the fertilized ovary only
- **Simple fruit**: this formed from a single flower
- **Dry fruit**: fruit is not fleshy at maturity
- **Indehiscent fruit**: The fruit pericarp does not split open
- **Caryopsis**: A one seeded fruit in which the pericarp is dry and fuses with the seed coat.

Type / class of fruit: *Caryopsis*

Type of seed: *Monocotyledonous endospermous seed*

Agricultural classification: *Cereal*

Type of germination: *hypogeal*

Class of food: *carbohydrate, protein*

Food storage tissue in maize grain

- Endosperm stores starch
- Aleurone stores protein

Pest affecting maize grain: Weevil, termites, rats, mouse, birds, grasscutter

Treatment / control / preservation of maize

- Use pesticides
- Use irradiation

Problems of pest on maize

- Food contamination
- Can affect the food chain.

Why it is considered as a fruit and not a seed

- Develops from a matured ovary
- Has two scars
- Contains a matured ovule

Economic importance

- Source of food for humans
- Source of animal feed
- Source of oil for cooking and soap making
- For production of cosmetics
- For production of drugs

Biological classification of the plant that produces Specimen B(maize grain)

Kingdom: Plantae
Division /Phylum: Angiospermophyta / Angiospermatophyta /Tracheophyta / Magnoliophyta
Class: Monocotyledoneae / Liliopsida

Reasons for the Kingdom plantae

- Multicellular
- Presence of chlorophyll
- Have definite nucleus
- Cell wall made up of cellulose

Reasons for the Division Angiospermophyta

- Produces flower
- Seeds contained in fruits
- Have true roots, stems and leaves

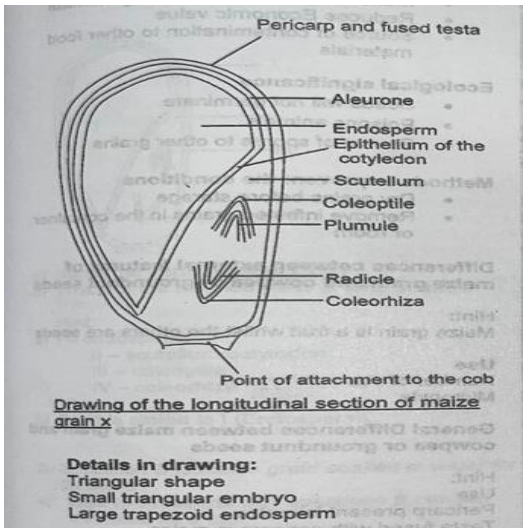
Reasons for the Class Monocotyledoneae

- Fibrous roots
- Leaves with parallel venation
- Presence of Leaf sheath
- narrow leaves
- leaves lack stalk

Classification of specimen B(maize grain) according to origin and structure

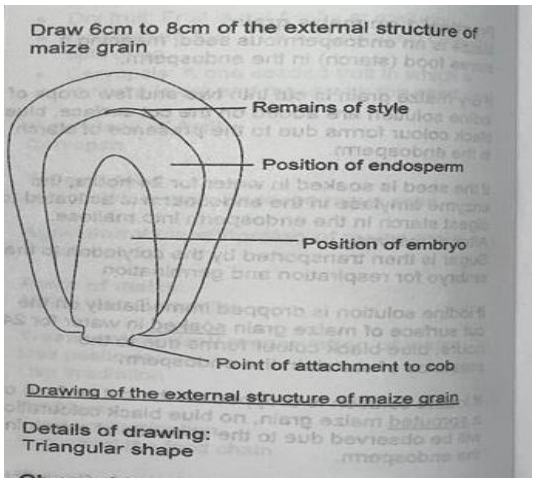
- true
- simple
- dry
- indehiscent
- caryopsis

Biological drawing of maize grain



Drawing of the longitudinal section of maize grain x

Details in drawing:
Triangular shape
Small triangular embryo
Large trapezoid endosperm



Drawing of the external structure of maize grain

Details of drawing:
Triangular shape

SPECIMEN C (stem of mature maize plants with at least **two** leaves and **all** roots intact)
Arrangement of leaves: alternate

Types of leaf: simple

Shape: linear

Margin: smooth

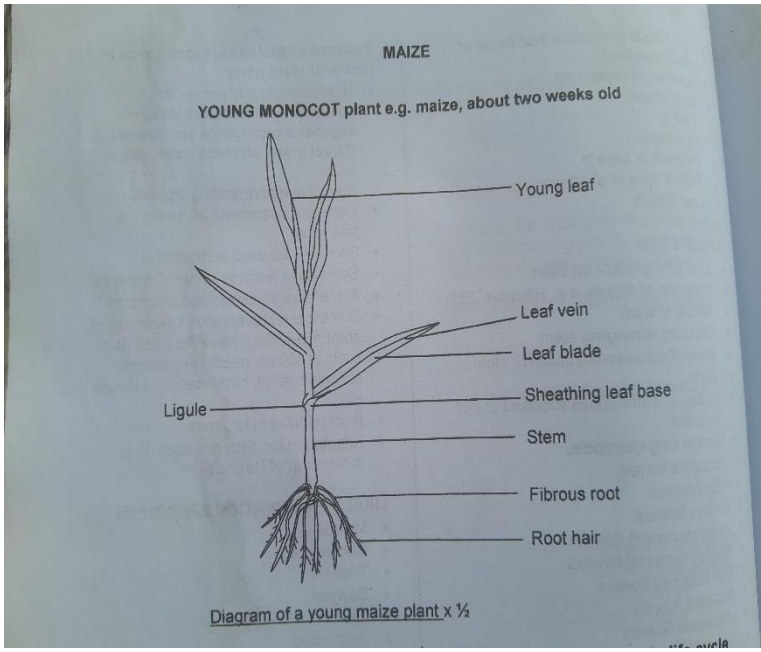
Tip: accumulate

Base: sheathing

Venation: parallel

Examples of plants with linear leaves: guinea grass and elephant grass

Drawing of the leaf of young maize plant



Classification according to the stem structure

Herbaceous plant

Classification according to the life cycle

Annual plant

Agricultural classification

Food crop

Biological classification

Division Angiospermophyta

Reasons

- ✓ Produces leaves
- ✓ Produces fruits containing seeds

Class Monocotyledoneae

Observable reasons

- ✓ Presence of leaves with parallel venation
- ✓ Presence of narrow leaves
- ✓ Leaves ack petiole

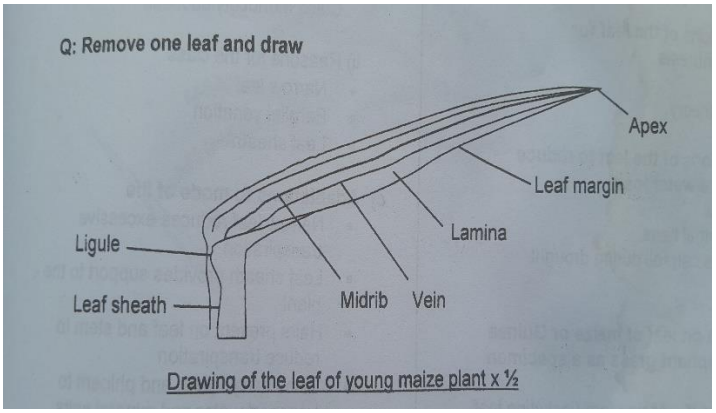
- ✓ Presence of leaf shealth
- ✓ Presence of fibrous roots

Observable characteristics

- ✓ Presence of leaves with parallel venation
- ✓ Presence of arrow leaves
- ✓ Leaves lack petiole
- ✓ Presence of leaf sheath
- ✓ Presence of fibrous roots
- ✓ Hairs

Adaptations of the maize plant to mood of life/features of interest of the maize plant

- ✓ Narrow leaves reduce excessive transpiration
- ✓ Erect leaves to prevent direct effect of sunlight in order to reduce overheating
- ✓ Hairs present on laves and stem to reduce transpiration
- ✓ Leaf sheath provides support to the plant to withstand wind



Functions of the parts of the leaf

Lamina: photosynthesis

Veins: i. for support

ii. for the transport of water, mineral salt and manufactured food.

Leaf sheath:

i. connects the leaf sheath to the leaf base

ii. supports the leaf in position

Functions of the leaf

- ✓ Photosynthesis
- ✓ Excretion
- ✓ Transpiration
- ✓ Gaseous exchange
- ✓ Temperature regulation

Adaptation of the leaf to reduce excess water loss

- ✓ Narrow
- ✓ Epidermal hairs
- ✓ Leaves can roll during drought

Relationship between specimen B and C

- ➢ Specimen B is the fruit or seed of specimen C

Type of plant of specimen C

- ➢ Monoecious plant

Reason for the type of plant

- ➢ It has separate male and female flowers on the same plant(hermaphrodite)

SPECIMEN D (Mango leaf)

Arrangement: Alternate / Spiral

Type / blade: Simple

Shape: Lanceolate / sword-like/ narrow

Margin: Entire / Smooth / Wavy

Tip: Acuminate / elongated

Base: Acute

Venation: Reticulate / net

Features of specimen D(mango leaf) that adapt it to its function

- ➢ Broad and flat blade has a large surface for absorption of light and carbon dioxide for photosynthesis
- ➢ Presence of veins to transport water to every part of leaf
- ➢ Petiole attaches the leaf in a right position to absorb light for photosynthesis
- ➢ Midrib hold lamina together and transports food and water

Observable features of specimen D

- Narrow lamina
- Leaf have elongated apex or accumulate
- Smooth margin
- Net venation
- Green colour

Significance/ importance of the chlorophyll in specimen D

- Absorbs or traps sunlight for photosynthesis

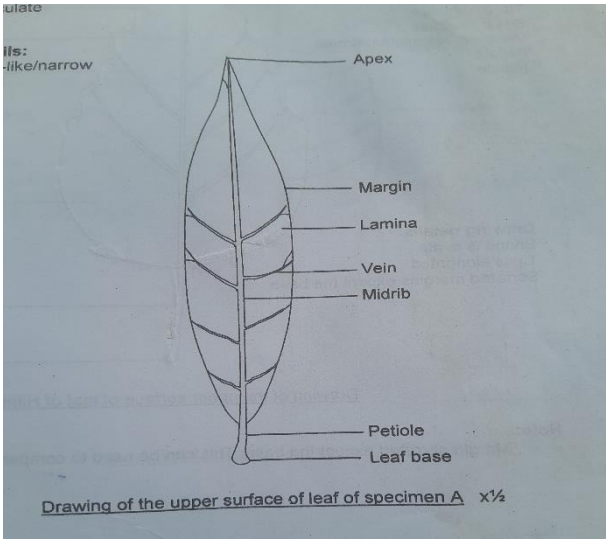
Factors affecting the rate of photosynthesis in leaves

- Light intensity
- Carbon dioxide concentration
- Chlorophyll concentration
- Temperature
- Water
- Leaf surface area
- Product accumulation e.g oxygen concentration, glucose concentration
- Pollutants e.g sulphur oxide, dust, soot
- Inhibitors eg urea
- Light wavelength

Reasons why living things rely solely on photosynthesis

- By photosynthesis; green plants manufacture their own foods
- Animals rely on plants for food
- Release of oxygen to the environment for respiration and combustion
- Removal of carbon(IV) oxide from the environment
- Glucose is formed for synthesizing fats, oil and vitamins
- Maintains carbon, oxygen and water cycles in nature

Drawing of the upper surface of leaf of specimen D



Drawing of the upper surface of leaf of specimen A x½

SPECIMEN E(flower of Hibiscus plant)

Scientific name: Hibiscus sp.

Type of pollination: cross

Pollinating agents: insects

Reasons:

- Large and conspicuous
- Brightly coloured
- Nectary present
- Honey guide present

Two animals that pollinate the flower

- Sunbird
- Honey bee
- Butterfly
- Moth

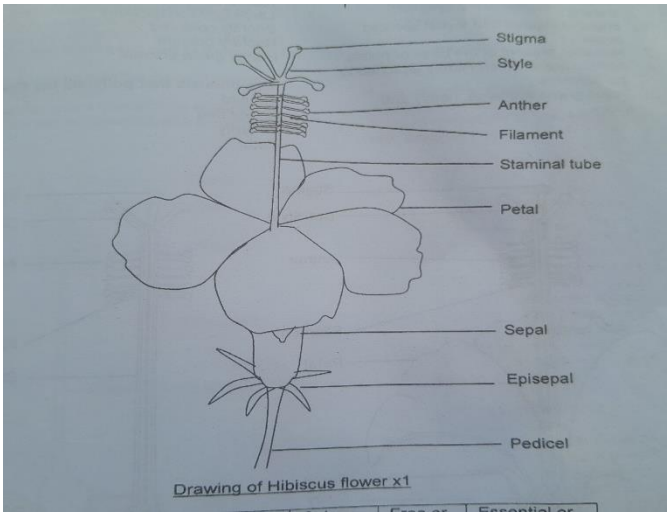
Type of flower; Bisexual

Symmetry: Actinomorphic/ Radial

Classify the flower as far as possible

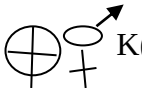
- Complete flower because it has all four floral leaves
- Bisexual because it has both androecium and gynaecium
- Actinomorphic because it is radially symmetrical
- Syncarpous pistil because gynaecium has more than one carpel which are fused

- Hypogynous because it has a superior ovary
- Entomophilous(insect pollinated) flower because of the presence of coloured petals, nectar, sweet scent and is conspicuous



Drawing of Hibiscus flower x1

Floral formula

 K(5)C5A(°°)G(5)

Description/interpretation of the floral formula in words

Actinomorphic

Bisexual

Calyx is made up of a total of similar sepals which are fused

Corolla is made up of a total of 5 similar petals, which are free

Androecium is made up of indefinite number of stamens in which all are fused(the number is more than 10)

Gynaecium has s fused carpels which are similar with a superior ovary

General description of Specimen F(hibiscus flower)

Bisexual actinomorphic flower

Epicalyx is made up of 6 similar episepals which are free

Calyx is made up of a total of 5 similar sepals which are fused

Corolla is made up of a total of 5 similar petals,which are free

Androecium is made up of indefinite number of stamens in which all are fused(the number is more than 10)

Gynaecium has s fused carpels which are similar with a superior ovary

Hibiscus is a flower with an additional floral whorl below the calyx

This is called epicalyx made up of 6 episepals

Features of interest

- Stigma receives pollen grains
- Fused styles support stigmas
- Filament supports anther
- Anther produces pollen grains

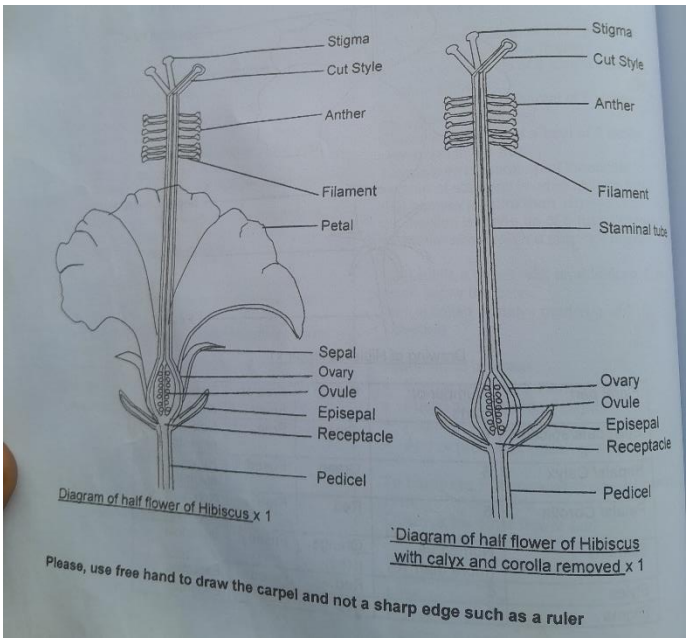
Floral part	Number of parts	colour	Free or fused	Essential or non-essential
Episepals/epicalyx	6	Green	free	Non-essential
Sepals/calyx	5	Green	Fused	Non-essential
Petals/corolla	5	Red	Free	Non-essential
Stamens	Numerous (more than 10)	Orange (red)	Fused	Essential
Styles	5	Red	Fused	Essential
stigma	5	Red	free	Essential

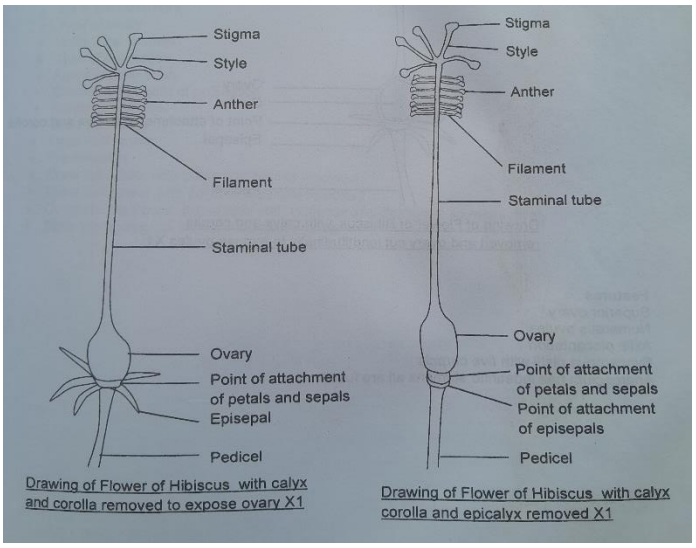
Adaptation for insect pollination

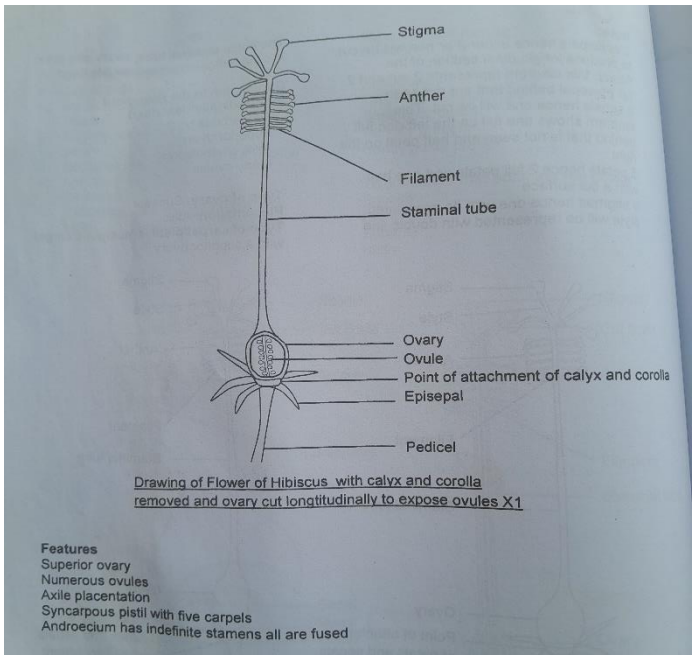
- Large and conspicuous ton attract insects
- Brightly coloured and sweet scented petals
- Nectaries present at the base of flowers
- Anther are smal and firmly attached to the filament
- Pollen grains are large, heavy and sticky

How pollination occurs in hibiscus

- The flower has brightly coloured petals, sweet scented and a nectary which produces nectar
- The insect is attracted by the petals of the flower
- When an insect lands on the flowers to feed on the nectar, the hairy body of the insect touches the anther, dusting it with pollen grains
- When the insect flies to another flower of the same species with a mature stigma to continue feeding, the pollen grains on its body fall onto the stigma brining about pollination







SPECIMEN F(cassava leaves)

Classification of cassava leaves

Arrangement on stem: Alternate

Type: Simple

Leaf blade: Palmate

Margin: deeply indented/ digitate

Petiole: peltate

Note:

Lobes: oblanceolate to narrow elliptic

Differences between Specimen D and F

Specimen D(mango leaf)	**Specimen F(cassava leaf)**
Thick and leathery	Thin and flexible
Longer leaves	Shorter leaves
Entire/smooth/wavy margin	Deeply indented margin

Specimen C(maize leaf)	**Specimen F(cassava leaf)**
Longer leaves	Shorter leaves
Simple leaf	Palmate leaf
Parallel venation	Net venation
Leaf lacks petiole	Leaf has petiole
Presence of sheath	Absent of sheath
Presence of ligule	Absent of ligule

Specimen C(maize leaf)	Specimen D(mango leaf)
Longer leaves	Shorter leaves
Simple leaf	Palmate leaf
Parallel venation	Net venation
Leaf lacks petiole	Leaf has petiole
Presence of sheath	Absent of sheath
Presence of ligule	Absent of ligule

Similarities between specimen D and F

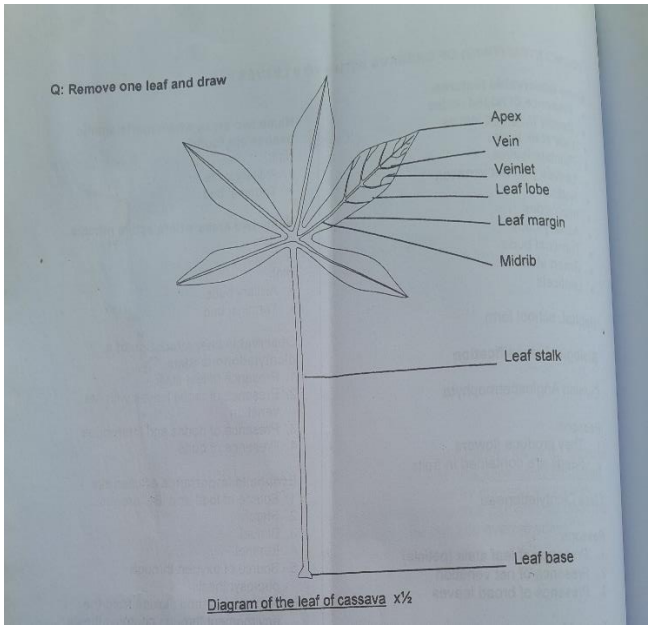
- They are all green leaves
- They all have net venation
- They all have pointed tip
- Both are narrow
- Both have broad lamina

Similarities between leaf of specimen C and F

- Green
- They have pointed tip
- They have midrib
- They all have smooth margin

Class of food in cassava leaf

- Roughage
- Vitamin k



SPECIMEN G(guava fruit/ garden egg fruit)(cross section)

GARDEN EGGS (Solanum melongena)

Observable features

- Oval or round-shaped
- Glossy, smooth skin
- Colors vary from white, green, yellow to purple
- Size: small to medium
- Spongy flesh with small seeds inside

Placentation

- Axile placentation (seeds are attached to the central axis in the ovary)

Reason

Garden eggs show axile placentation where the seeds are attached to ta central axis in the ovary. This is a common feature in many plants of the Solanaceae family

Symmetry

- Radial symmetry(actinomorphic)

Reason

The flower and fruit of garden eggs exhibit radial symmetry, meaning they can be divided into halves through multiple planes. This is typical in many angiosperms (flowering plants)

Class of fruit

- Berry

Reason

Garden eggs are classified as berry fruits because they are fleshy, develop from a single ovary, and contain multiple seeds embedded in the pulp.

Type of fruit

- Fleshy fruit

Reason

As a fleshy fruit, the edible part of the garden egg is soft and pulpy when ripe, as opposed to dry or hard fruits

Agent of dispersal

- Animals(zoochory)

Reasons

Garden eggs are primarily dispersed by animals(zoochory), which consume the fruit and later excrete the seeds, enabling them to spread.

Features of biological interest

- Contains small seeds embedded in the pulp
- Can exhibit various colours and shapes depending on the variety

Reason

Garden eggs exhibit a range of shapes and colors, which are of interest in the study of plant morphology. The spongy texture and small seeds within also make them unique for study in reproductive biology.

Mode of dispersal

- Through consumption by animals, which disperse seeds through excretion

Reason

The seeds of garden eggs are dispersed through endozoochory, where animals ingest the seeds along with the fruit and release them after digestion

Class of food

- Vegetable(through botanically a fruit)

Reasons

Although botanically a fruit, garden eggs are often considered a vegetable in culinary contexts because they are used in savory dishes rather than sweet preparations.

Economic importance

- Used as a vegetable in various cuisines
- Important cash crop for small-scale farmers

Nutritional importance

- Rich in dietary fiber, vitamin C(very high), vitamin A and antioxidants

Agricultural classification

- Horticultural crop(cultivated for human consumption)

Ecological importance

- Provides habitat and food for certain insects
- Contributes to the biodiversity

Process of dispersal

- Endozoochory

Reason

Animals eat the fruit and the seeds pass through their digestive system without being damaged. This process ensures seed dispersal over a wide area

GUAVA (Psidium guajava)

Observable features

- Round or pear-shaped
- Green to yellow outer skin
- White, pink, or red flesh with numerous small hard seeds
- Fragrant aroma when ripe

Reason

Guava have a distinctive feature, such as its round or pear shaped, green to yellow skin when ripe, and white, pink or red flesh. The fruit is also known for its aromatic smell when fully ripe.

Placentation

- Axile placentation

Reason

Guava also exhibits axile placentation, meaning the seeds are attached along a central axis with the ovary, a common feature in many flowering plants.

Symmetry

- Radial symmetry(actinomorphic)

Reasons

Where the fruit can be divided equally along several planes, which is typical for fruits derived from flowers with radial symmetry.

Class of fruit

- Berry

Reasons

It is fleshy, has multiple seeds, and develops from a single ovary

Type of fruit

- Fleshy fruit

Reasons

Guava is a fleshy fruit due to its soft, edible pulp. The seeds are also embedded within the flesh, a characteristic of fleshy fruits.

Agent of dispersal

- Animals (birds, bats and mammals)

Reasons

Guava is dispersed by animals(zoochory), especially birds, bats and mammals, which consume the fruit and disperse the seeds

Features of biological interest

- High seed content
- Sweet and fragrant fruit that attracts various animal species

Reasons

Guava has high seed content, and its attractive scent and taste draw animals. It also contains compounds like antioxidants, which make it of interest to scientists studying nutrition and plant chemistry

Mode of dispersal

- Through consumption by animals, which disperse seeds through excretion

Reason

Guava seeds are dispersed through endozoochory, where animals ingest the seeds and later excrete them, enabling seed dispersal

Process of dispersal

- Endozoochory

Reason

The endozoochory process involves animals eating the guava fruit, digesting the pulp, and dispersing the seeds through feaces over large distances.

Class of food

- Fruit

Reason

Guava is classified as a fruit because it is weet, fleshy and eaten primarily as part of a fruit diet

Economic importance

- Commercial fruit used in food industries making jams, jellies, juices, and sweets
- Popular in local market and international trade

Nutritional importance

- Rich in dietary fiber, vitamin C(very high), vitamin A and antioxidants

Agricultural classification

- Horticultural crop

Ecological importance

- Attract pollinators such as bees
- Provides food for wildlife and contributes to the biodiversity of fruit-bearing trees

SPECIMEN H (transverse section of a citrus fruit)

Identification

Transverse section of Citrus fruit

Type of fruit: *Berry*

Reasons for type of fruit

- Has a thin outer epicarp
- Fleshy mesocarp
- Fleshy inner endocarp

Placentation: Axile

Difference between Axile placentation (citrus fruit) and parietal placentation (pawpaw fruit)

Axile placentation	Parietal placentation
Septa is present	Septa is absent
Multi locular ovary	Unilocular ovary
Ovules are along the central axis formed by the inner angel of the septa	Ovules are attached to the ovary wall

Features of biological significance

- Exocarp and mesocarp are fused

- Presence of multiple locules separated by septa (or walls)
- Endocarp is fibrous and edible
- Rich with Vitamin C

Observable features
- Seeds
- Placentation
- Fleshy endocarp
- Succulent mesocarp
- Bright colour of epicarp
- Several chambers
- Remains of style and point of attachment
- One scar

Food nutrients / classes of food in citrus fruit
- Vitamin C
- Glucose
- Water
- Mineral salts
- Dietary fibre

Function of vitamin C
- Formation of connective tissues
- Healing of wounds
- Production of strong skin
- Prevention of infection
- Collagen fiber synthesis

Deficiency of vitamin C: *Scurvy*

Symptoms of scurvy
- Bleeding gum
- Wound fail to heal
- Anemia
- Swelling joints or gum
- Loosening teeth
- Reduced resistance to infection

Other source of vitamin C

Green vegetables, raw leafy vegetables, potatoes, tomatoes

Function of glucose: *source of energy*

Function of water to animals
- Aids digestion
- Osmotic balance
- Transport excretory products for elimination
- Transport nutrients in the body
- Regulation of temperature
- Lubricates joints

Functions of minerals
- Structure of tissues
- Metabolic activities

Functions of dietary fibre in humans
- Source of vitamin K
- Aids digestion
- Prevent constipation

Classification in term of origin, structure

True fruit: formed from ovary only.
Simple fruit: formed from one flower
Fleshy fruit: pericarp fleshy at maturity
Berry: numerous seeds with fleshy endocarp

Classification in terms of food nutrients:

citrus fruit

Agricultural classification

fruit crop / cash crop / citrus fruit

Agent of dispersal: *Animals*

Reasons;
- brightly coloured epicarp attract animals
- sweet scented
- succulent hairs in mesocarp serves as food for animals

Examples of animals that disperse citrus fruits

Birds, humans, monkeys, bats.

Adaptation to dispersal of citrus fruit
- coloured epicarp attract animals
- sweet scent attracts animals
- succulent mesocarp as food for animals
- seeds with hard testa to resist digestion when swallowed
- sticky seed stick to beaks of large birds

Description of the dispersal of citrus fruit
- it is dispersed by animals and it is a succulent fruit.
- The bright colour of epicarp and succulent mesocarp attract animals.
- The animals may carry the fruit away.
- Some seeds may be swallowed but have hard testa which escapes digestion in the alimentary canal if the animals and come out as faeces.

- Some seeds may fall on the ground while feeding in the fruit
- Some seeds are sticky and adhere to the beak of birds and get dispersed when the birds clean the beak elsewhere, thereby bringing about dispersal.

Classification of the plant that produces Specimen S (citrus fruit)

Kingdom: Plantae
Division / Phylum: Angiospermophyta / Angiospermatophyta /Tracheophyta / Magnoliophyta
Class: Dicotyledoneae

Reasons for the Kingdom plantae

- Multicellular
- Presence of chlorophyll
- Have definite nucleus
- Cell wall made up of cellulose

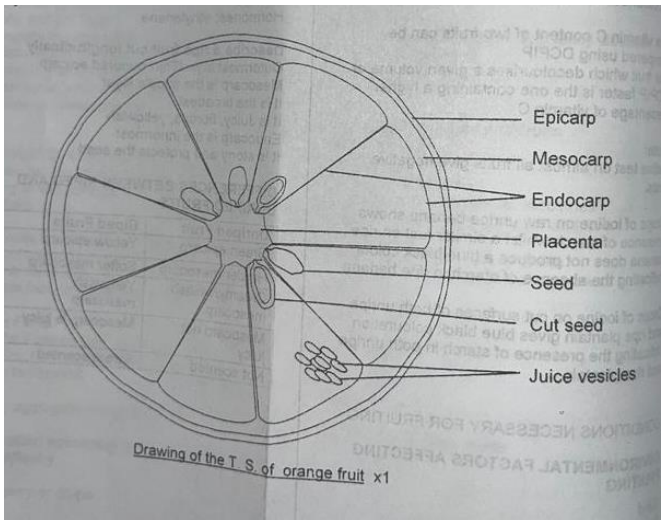
Reasons for the Division Angiospermophyta

- Produces flower
- Seeds contained in fruits
- Have true roots, stems and leaves

Reasons for the Class Dicotyledoneae

- Taproot
- Leaves with net venation
- Presence of Leaf stalk
- Broad leaves
- Petals in five

Biological drawing of Specimen S (citrus fruit)



SPECIMEN J - (Toad / Frog)

Habitat: under stones, logs, under liter, pond, hole and in fresh water.

Reasons for habitat:

Streamlines body shape swimming in water

Webbed digits in hind limbs for paddling in water

Type of reproduction: Sexual reproduction

Mode of reproduction: Oviparity

Type of fertilization: External fertilization

Life cycle: Complete metamorphosis

Biological Classification of specimen J

Kingdom: Animalia

Reasons / Characteristics for the Kingdom

- Most of them move about
- Feed on other animals of plants or both
- Multicellular
- Eukaryotic
- Posses' nervous system for coordination

Phylum: Chordata

Reasons / Characteristics/ features for the Phylum

- Presence of notochord
- Presence of dorsal nerve cord
- Presence of pharyngeal cleft
- Presence of vertebral column that encloses a spinal cord.

Class: Amphibia

Reasons / Characteristics features for the Class

- Presence of moist skin
- Presence of poison gland
- **Presence** of one pair of webbed hind limbs
- Presence of a pair of bulging eyes
- Watty skin
- Two body division; head and trunk

Observable features of Specimen J

- Two pairs of limbs
- Nictating membrane
- Tympanic membrane

- Brown / dark dorsal surface
- Wide mouth
- Loose moist warty skin
- Glands in skin
- A pair of long muscular hind limbs
- A pair of large eyes

6. Glands in the skin
7. Wide mouth
8. Sticky tongue
9. A pair of large eyes
10. A pair of long muscular hind limbs
11. Loose moist warty scales skin

Adaptive features
1. Absence of tail enables hopping / leaping
2. Position of eye and nostril is useful when floating in water
3. Absence of neck (streamlined shape) for movement in water
4. Tympanic membrane detects vibration
5. Prominent eyes for vision
6. Skin – sensitive to chemicals
7. Poisonous glands in skin for defence against predation
8. Skin for camouflage against predation
9. Moist vascularised skin for respirations in water
10. Vascularised buccal cavity for respiration
11. Hind Limbs, muscular and webbed to enable jumping on land and propulsion in water
12. Fore limbs short and stout for landing when leaping on land and also for steering in water
13. Lower eyelid has nictitating membrane to clean and moisten the eye

Description of the skin
Moist
Loose
Warty
Scaless

Types of movement
1) Swimming in water
2) Hopping/leaping on land
3) Crawling on land

Functions of the skin
1) Respiration/gaseous exchange
2) Protection against mechanical injury
3) Poisonous glands for defence
4) Camouflage for defence

Functions of forelimbs
1. Landing when leaping
2. Steering in water
3. Crawling

Functions of hind limbs
1) Lifting when jumping
2) Propulsion/swimming (Paddle) in water
3) Crawling

Q.
Differentiate between fore and hind limbs

Fore limb	Hind limb
Four digits	Five digits
Short	Long
Not webbed	Webbed digits
Less muscular	More muscular

Sense organs
1. Skin : Sensitive to chemicals
2. Eyes for light
3. Nose detects smell
4. Tympanum detects vibration

Excretory organs
Skin
Lungs
Kidneys

Gaseous exchange structures
Skin
Lungs
Buccal cavity

Describe the features for movement

Movement in Water:
Streamlined shape provides reduced resistance for swimming in water
Webbed digits in hind limbs for swimming

Movement on Land
Large muscular and powerful ... for lifting the body/hopping/jumping
Short and stout forelimbs for landing during hopping

Adaptation to life in water
1. Streamlined shape/absence of neck

2. Position of nostril and eye (protruding eyes and nostrils to allow vision and smell when partially submerged
3. Webbed hind limbs for propulsion
4. Dark dorsal surface and light ventral surface reduces detection when swimming
5. Vascularised skin for gaseous exchange.
6. Nictitating membrane protects the eye in water

Adaptation to life on land
1. Moist skin to prevent desiccation
2. Webbed hind limbs for hopping/leaping
3. Absence of tail for hopping
4. Camouflaged skin to prevent predation
5. Lungs for respiration etc.

Mode of nutrition: Holozoic

Method of feeding: Carnivorous

Diet: Insects

Trophic level/position in food chain:
Third trophic level/secondary consumer

Adaptation to feeding
1. Wide mouth to capture insects
2. Long sticky tongue for capturing insects
3. Large eyes when pulled inward help in swallowing food
4. Nostril: for smelling/detecting food

Relation with other specimens in a food chain
Feeds on insects
Fed on by snakes

General Adaptations to escape predation
1. Poisonous and mucous glands in skin prevents being preyed upon
2. Prominent eyes to see
3. Olfactory organs in nose to detect smell
4. Tympanum/Ear to detect vibrations
5. Dark dorsal surface and light ventral surface (countershading) reduces detection when in water.
6. Can change colour on land to blend with environment
7. Large hind limbs to hop (escape)

Economic importance of frog
1. Tadpole decreases the population of algae
2. Tadpole is food for fish
3. Both tadpole and its adult feed on mosquito larvae
4. Frog is a food
5. Toad is carnivore that reduces (serves the purpose of biological control of) pests of man and crops such as insects

Similarities between toad/frog and lizard
- Wide mouth
- Nostril above mouth
- Protruding eyes
- Tympanum present
- Two pairs of limbs

Differences between toad and lizard

Toad	Lizard
Webbed digits	Web absent
Digits not clawed	Clawed digits
Scaless skin	Scaled skin
No tail	Tail present
Nuchal crest and gular fold absent	Nuchal crest and gular fold present

Similarities between the skin of toad and lung of goat
- Highly Vascularized (rich supply of capillary network)
- Wet
- Large surface area

Significance of the similarities
- Highly Vascularized for efficient transport of gases
- Wet for efficient diffusion of gases in solution
- Large surface area provides maximum contact with its external environment

Similarities between toad and fowl
- Cloacal opening
- Nictitating membrane
- Two pairs of limbs

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head	
Eyes on top and protruding	Eyes on ... not protruding
No wattle and comb	Presence of wattle and comb
No oil gland/tail	Oil gland/tail

Similarities between toad and Tilapia/bony fish
Presence of prominent eyes
Presence of mouth
Presence of cloacal opening
Presence of darker dorsal surface and light ventral surface to escape predation

Differences between toad and Tilapia

Toad	Tilapia/bony fish
Absence of scales	Presence of scales
Eyes on top and protruding	Eyes on the side and not protruding
Presence of legs	Presence of fins
Absence of tail	Presence of tail
Absence of operculum	Presence of lateral line
Absence of lateral line	Presence of operculum
Presence of lungs	Presence of gills
Dorsoventrally compressed	Laterally flattened
Presence of poison gland	Absence of poison gland

Similarities between toad and Guinea pig/rabbit/rat/mouse
- Presence of two pairs of limbs with digits

Similarities between Toad and Insect
Presence of Prominent eyes
Presence of legs with claws
Presence of mouth

Differences between toad and an insect
Hint:
Use the following points to draw a table
Number of legs
Wings or no wings
Antennae
Segmentation
Compound or no compound eyes
Type of skeleton
Claws and spine
Spiracles
External nares
Jointed legs
etc

STUDY QUESTIONS ON TOAD

1. Specimens provided:
   L Toad
   M Cockroach
   a. Name the habitat of each
   b. State the adaptive features of each
   c. Tabulate five differences between specimens L and M
   d. Make a drawing 8-10cm long of specimen L

Hint:

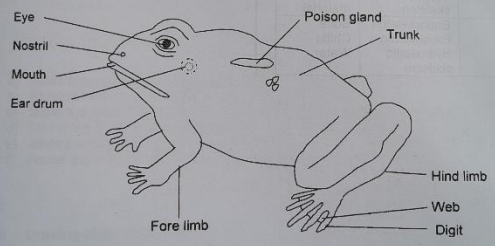
a) Habitat:
Specimen L –
Under stones
Under logs
Under litter
Pond
Hole

Specimen M-
Dark cupboards
Toilet/
Stores
Kitchen
Wall cracks/crevices

b) Refer to notes

c) Differences between specimens L and M

Specimen L TOAD	Specimen M COCKROACH
Presence of Two pairs of legs	Presence of three pairs of legs
Presence of Simple eyes	Presence of Compound eyes
Absence of wings	Presence of wings
Absence of feathers	Presence of feathers
Unsegmented body	Segmented body
Absence of exoskeleton	Presence of Chitinous endoskeleton
Presence of Mouthparts	Absence of mouth parts
Absence of antennae	Presence of antennae
Presence of external nares	Presence of spiracles



Drawing of the lateral view of specimen L X1

Steps in drawing to score full marks

- Details
  - Eyes positioned above ear drum and nostril
  - Nostril positioned above the ear drum
  - Webbed digits in hind limb
  - Streamlined shape
  - Wide mouth
- Title:
  Must begin with: drawing of or diagram of and must include lateral view

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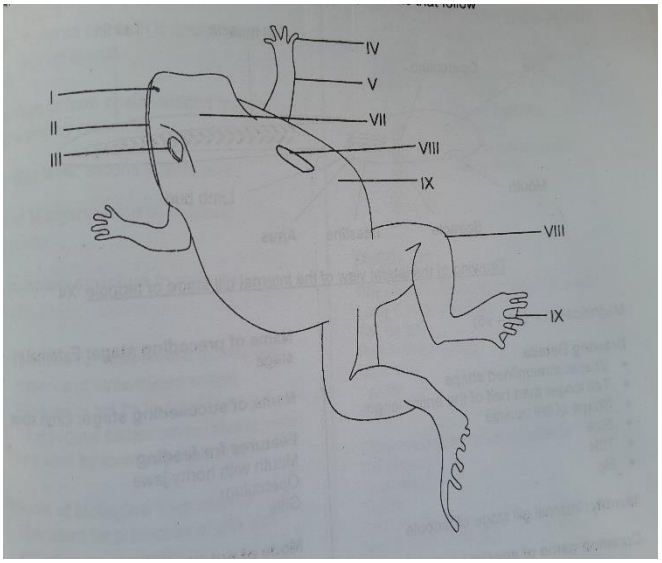

Mg x1/3

0.3 or 0.4

Hint:

Normal male length is between 30-35cm

Normal female length is between 25-28cm

Details in drawing

- Tail must be longer than half of the entire length
- Not less than 5 scales
- Scales must overlap
- Tail pointed at the tip
- 5 digits with claws

Other points

- Title
- Magnification

HABITAT

Gardens/trees/under stones/walls/ceiling

Reasons:

Horny scales to reduce desiccation on land

Two pairs of limbs to support the body and for movement on land

Clawed digits to hold on support or for climbing

Mode of reproduction: Sexual with internal fertilisation, oviparity with cleidoic eggs. Parental care

Mode of nutrition: Holozoic

Feeding habit: Carnivorous (but not carnivore)

Diet: Insects

Position in the food chain:

Third trophic level / Secondary consumer

Reasons:

Feeds on flesh of animals

State the sex

Hint:

a) Male

Reasons:

1. Pre-anal pad present around cloaca
2. Relatively Bigger in size
3. Brightly coloured
4. Bright orange head
5. More prominent nuchal crest
6. More prominent gular fold
7. Tail is blue at the base, orange or black in the middle and black at the tip

b) Female

Reasons:

Dull colour

Absence of prominent gular fold and nuchal crest

Classification

Phylum Chordata

Class Reptilia

- Skin is covered with dry, horny epidermal scales
- Have two pairs of limbs with clawed digits
- Have homodont dentition
- Absence of external ear

Observable characteristics in Agama lizard

1. Skin is covered with dry, horny epidermal scales
2. Have two pairs of limbs with claws
3. Have homodont dentition

Adaptive features of lizard in its habitat

1. Clawed digits for holding onto ground and for climbing
2. Scales for protection against desiccation and mechanical injury
3. Long hind Legs for fast movement on land
4. Long tail for balancing when moving

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SPECIMEN K (lizard/ agama lizard)

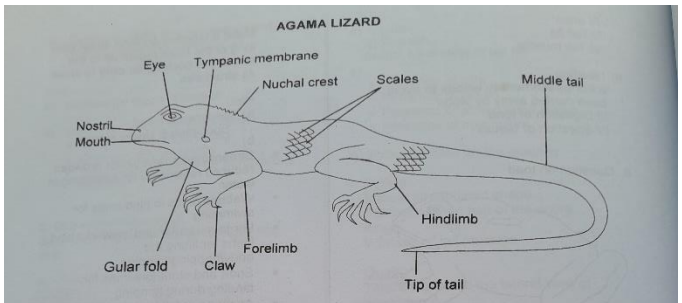

Diagram of the lateral view of male agama lizard x ½

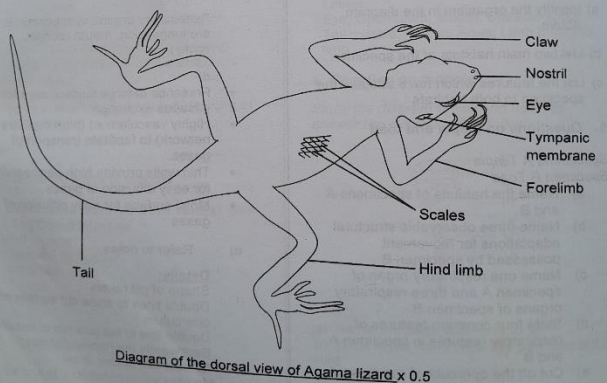

Diagram of the dorsal view of Agama lizard x 0.5

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Observable features that help in sexual behaviour

1. Nuchal crest raised during courtship
2. Gular fold is lowered during courtship
3. Brightly coloured to attract females
4. Pre-anal pad to provide attachment during mating

Note:

Adaptive features to live in its habitat may also be used to answer question relating reasons why a student states the organism lives in that habitat.

Adaptations for movement in agama lizard

1. Two pairs of legs lift the body off ground while moving
2. Clawed digits for holding onto ground and for climbing
3. Long hind Legs for fast movement on land
4. Long tail for balancing when moving

Adaptations to escape danger

- Detachable tail
- Colour can blend with the environment
- Long hind legs for fast movement

Adaptations to regulate temperature

- Scales to reduce excessive evaporation of water in dry season
- Basks in the sun in the morning
- Hides under stone in hot afternoon(weather)
- Remains inactive during cold weather (night)

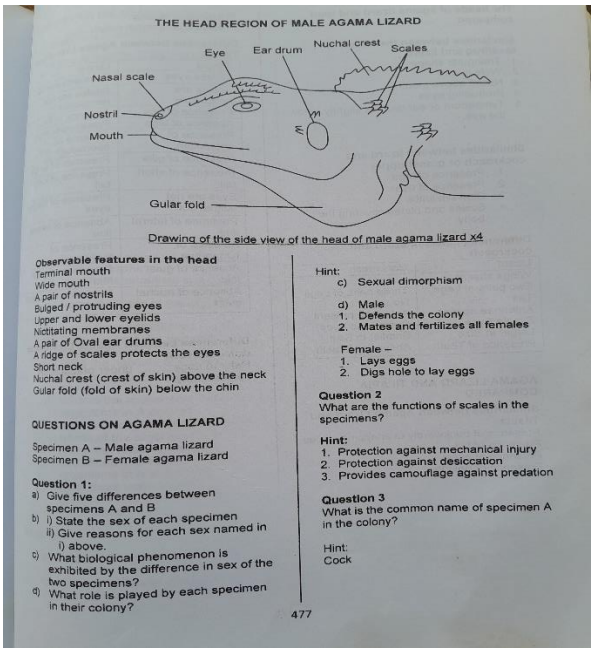
Observable features in ventral view of the male

- Gular fold
- Cloacal opening
- The male has a hemi-penis at each end of the cloaca
- The male's pre-anal pads provide firm contact.

TAIL OF AGAMA LIZARD

Functions of tail of agama lizard:

1. Balancing during movement
2. Defence: Detachable tail to escape predation



THE HEAD REGION OF MALE AGAMA LIZARD

Eye Ear drum Nuchal crest Scales
Nasal scale
Nostril
Mouth
Gular fold

Drawing of the side view of the head of male agama lizard x4

Observable features in the head
Terminal mouth
Wide mouth
A pair of nostrils
Bulged / protruding eyes
Upper and lower eyelids
Nictitating membranes
A pair of Oval ear drums
A ridge of scales protects the eyes
Short neck
Nuchal crest (crest of skin) above the neck
Gular fold (fold of skin) below the chin

QUESTIONS ON AGAMA LIZARD

Specimen A – Male agama lizard
Specimen B – Female agama lizard

Question 1:
a) Give five differences between specimens A and B
b) i) State the sex of each specimen
ii) Give reasons for each sex named in i) above.
c) What biological phenomenon is exhibited by the difference in sex of the two specimens?
d) What role is played by each specimen in their colony?

Hint:
c) Sexual dimorphism

d) Male
1. Defends the colony
2. Mates and fertilizes all females

Female –
1. Lays eggs
2. Digs hole to lay eggs

Question 2
What are the functions of scales in the specimens?

Hint:
1. Protection against mechanical injury
2. Protection against desiccation
3. Provides camouflage against predation

Question 3
What is the common name of specimen A in the colony?

Hint:
Cock

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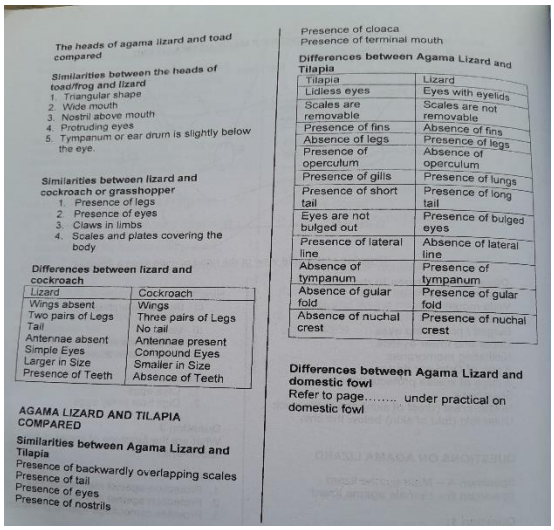


The heads of agama lizard and toad compared

Similarities between the heads of toad/frog and lizard
1. Triangular shape
2. Wide mouth
3. Nostril above mouth
4. Protruding eyes
5. Tympanum or ear drum is slightly below the eye.

Similarities between lizard and cockroach or grasshopper
1. Presence of legs
2. Presence of eyes
3. Claws in limbs
4. Scales and plates covering the body

Differences between lizard and cockroach

Lizard	Cockroach
Wings absent	Wings
Two pairs of Legs	Three pairs of Legs
Tail	No tail
Antennae absent	Antennae present
Simple Eyes	Compound Eyes
Larger in Size	Smaller in Size
Presence of Teeth	Absence of Teeth

AGAMA LIZARD AND TILAPIA COMPARED

Similarities between Agama Lizard and Tilapia
Presence of backwardly overlapping scales
Presence of tail
Presence of eyes
Presence of nostrils
Presence of cloaca
Presence of terminal mouth

Differences between Agama Lizard and Tilapia

Tilapia	Lizard
Lidless eyes	Eyes with eyelids
Scales are removable	Scales are not removable
Presence of fins	Absence of fins
Absence of legs	Presence of legs
Presence of operculum	Absence of operculum
Presence of gills	Presence of lungs
Presence of short tail	Presence of long tail
Eyes are not bulged out	Presence of bulged eyes
Presence of lateral line	Absence of lateral line
Absence of tympanum	Presence of tympanum
Absence of gular fold	Presence of gular fold
Absence of nuchal crest	Presence of nuchal crest

Differences between Agama Lizard and domestic fowl
Refer to page…… under practical on domestic fowl

Specimen L (Cockroach)

Classification

Kingdom Animalia
Phylum Arthropoda
Class Insecta
Order Dictyoptera
Habitat: Dark cupboards, toilet pits, stores, kitchen, crevices, cabinets, wall cracks

Reasons for Kingdom of specimen L

- It is eukaryotic
- It is multicellular
- It possesses a nervous system
- It lacks chlorophyll (it is heterotrophic)
- If has no cell wall

Reasons for Phylum Arthropoda of specimen L

- It has chitinous exoskeleton
- It has jointed appendages
- It is bilaterally symmetrical
- It is metamerically segmented

Reasons for Class Insecta of specimen L

- Presence of three body divisions
- Presence of a pair of antennae
- Presence of a pair of compound eyes
- Presence of three pairs of legs

Reasons / Characteristics of Order Dictyoptera

- Presence of leathery forewings and membranous hind wings
- Presence of almost equally developed legs
- Presence of chewing and biting mouth part

Features of interest

- A pair of antennae
- Leathery forewings and membranous hind wings
- Legs almost equally developed
- Chewing and biting mouth part

Observable features of specimen L (cockroach) for movement

- Three pairs of legs for walking and running
- A pair of membranous hind wings for flying short distance
- Arolium for attachment to substratum

Adaptation of Cockroach to escape danger

- Wings for flying
- Dark brown colour for camouflage
- Dorso – ventrally flattened for easy movement in crevices
- A pair of long antennae to detect food, vibration and touch.
- A pair of compound eyes for vision
- Walking legs for running

Adaptive features / adaptation / features of biological interest or significance or importance

- Presence of antennae for sensing touch, smell and vibrations
- Presence of anal cerci to detect vibrations
- Presence of spiracles for gaseous exchange
- Presence of leathery forewings to protect the membranous hind wings
- Presence of jointed legs for locomotion

- Compound eyes for vision
- Wings for flying
- Biting and chewing mouth part for feeding
- Chitinous exoskeleton for protection against mechanical injury and desiccation
- Clawed legs with sticky arolium for climbing

Type of nutrition: *Heterotrophic nutrition*
Mode of nutrition: *Holozoic*
Feeding habit / feeding method: *Omnivorous*
Adaptation to feeding habit: *It has chewing mouth part.*

Food items fed on by cockroach
Sugar, cereals, fruits, flesh, plants

Observable features of cockroach for feeding
Chewing and biting mouth parts

- ➢ Maxillary and labial palps help to choose suitable food
- ➢ Maxillae directs food to the mandibles
- ➢ Mandibles cut food into pieces / mastication
- ➢ Labrum holds food
- ➢ Labium prevents food from leaving the mandibles when being chewed

Position of cockroach in a food chain: *Secondary consumer / 3rd trophic level*

Organisms that feed on cockroach in a food chain: *lizards(reptiles), fowl(birds), humans*

Feeding and digestion in cockroach

- ✓ Maxillary and labial palps help to choose suitable food
- ✓ Maxillae directs food to the mandibles
- ✓ Mandibles cut food into pieces / mastication
- ✓ Labrum holds food
- ✓ Labium prevents food from leaving the mandibles when being chewed
- ✓ A pair of salivary glands in the mouth secretes digestive enzymes
- ✓ Crop digest food by enzymes that ascends from the mid gut.
- ✓ Gizzard or the proventiculus crushes food and strain food in order to allow only fine particles / well – grounded food to enter the mid – gut
- ✓ Hepatic caeca or enteric caeca secretes digestive enzymes and also absorb food.
- ✓ Mid gut secretes digestive enzymes, complete digestion of food and absorbs most of digested food.
- ✓ Hind gut absorbs water and salt.

Type of reproduction: *Sexual reproduction*
Mode of reproduction: *internal fertilization with oviparity.*

Life cycle: *Incomplete metamorphosis*

Incomplete metamorphosis in cockroach

- ✓ The eggs of the cockroach hatch into nymphs usually called instar.
- ✓ The nymphs mature by moulting at least 13 times to become adults (moulting is the periodic shedding of the exoskeleton to permit growth to occur)
- ✓ Nymphs are wingless, pale in colour and have short antennae and less prominent cerci.

Cockroach exhibits sexual dimorphism: *males and females have distinguishable features.*

Body of cockroach is covered with:
a) Dorsal plates called *terga* (sing. tergum)
b) Ventral plates called *sterna* (sing. sternum)
c) Lateral plates called *Pleura* (sing. pleurum)

Respiratory structure in cockroach: *Spiracles / trachea*

Excretion in cockroach
Excretory products in cockroach: *carbon dioxide and nitrogenous product (uric acid)*

- ➢ Carbon dioxide diffuses through the body surface and tracheal system
- ➢ Nitrogenous products are eliminated by Malpighian tubules.

Excretory structures in cockroach: *Trachea and Malpighian tubule*

Sense organs in cockroach

- Compound eyes for vision
- Antennae for touch, smell and vibration
- Cerci for detection of vibration

Description of the wings of cockroach

- ✓ ***Fore wings*** are attached to the mesothorax. They are stiff, brown and leathery and covers the hind wings. The fore wings are narrow and longer than the hind wings.

- ✓ ***Hind wings*** are attached to the metathorax and are covered by the forewings which protect them. They are transparent and membranous, broad and shorter than the forewings.

Functions of the wings of cockroach

- Forewings for protection of hind wings
- Hind wings for flight

Differences between the fore and hind wings of cockroach

Forewings	Hindwings
Leathery	Membranous
Stiffer	Softer
Narrow	Broad
Borne on the mesothorax	Borne on the metathorax

Economic importance of cockroach

- They destroy valuable household items like books, clothes, furniture. / They are household pests
- They stain and contaminate valuable items and stored food with their feaces.
- They transmit diseases such as cholera, typhoid fever, dysentery, leprosy.
- They produce a repulsive or offensive smell

Diseases spread by the cockroach

- Cholera
- Dysentery
- Tuberculosis
- Typhoid

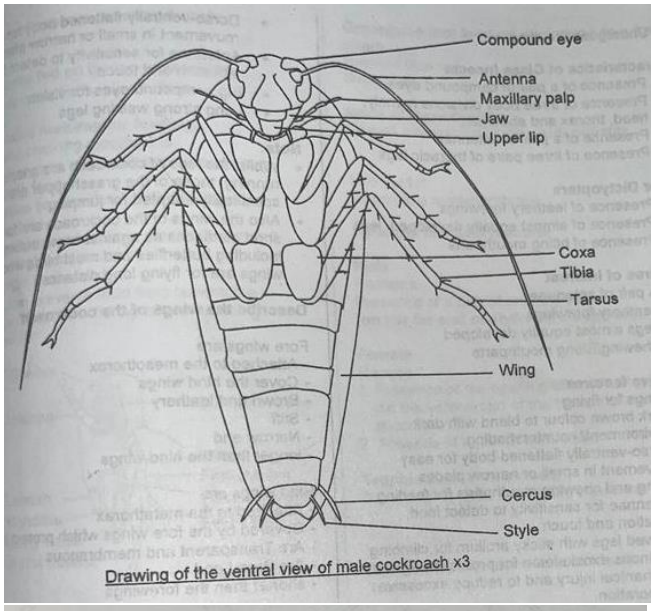
Features that make the cockroach a vector of diseases

- Hairy feet carry germs as it walks which are transferred to food thereby contaminating the food.

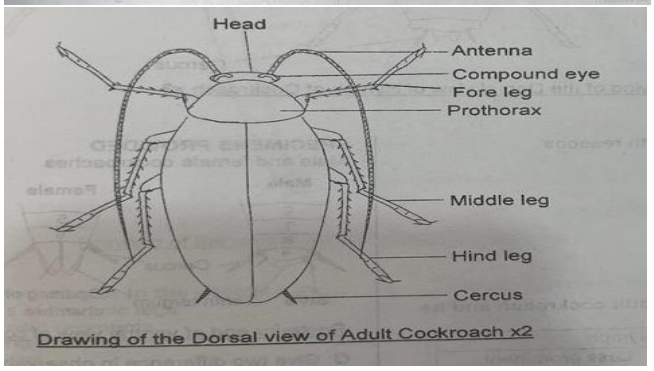
Control of diseases transmitted by cockroach

- Use of insecticides to kill it.
- Keeping kitchen clean and airy with enough light.
- Cover food

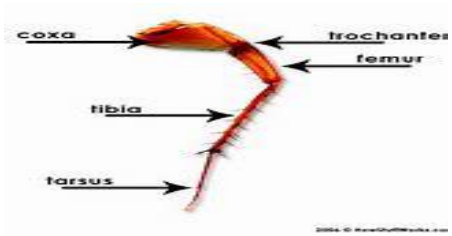
Biological drawings of Specimen L (cockroach)

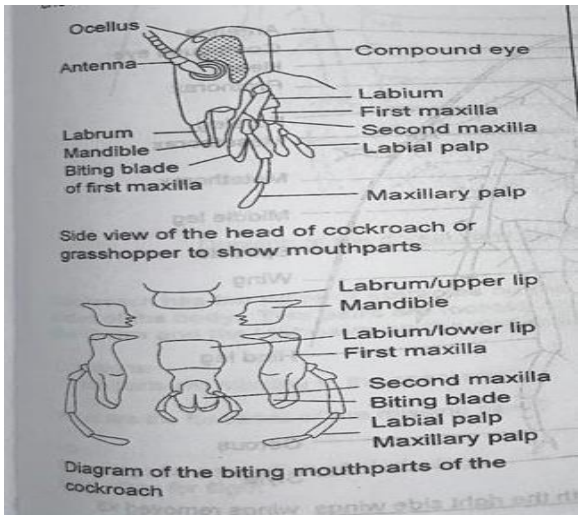


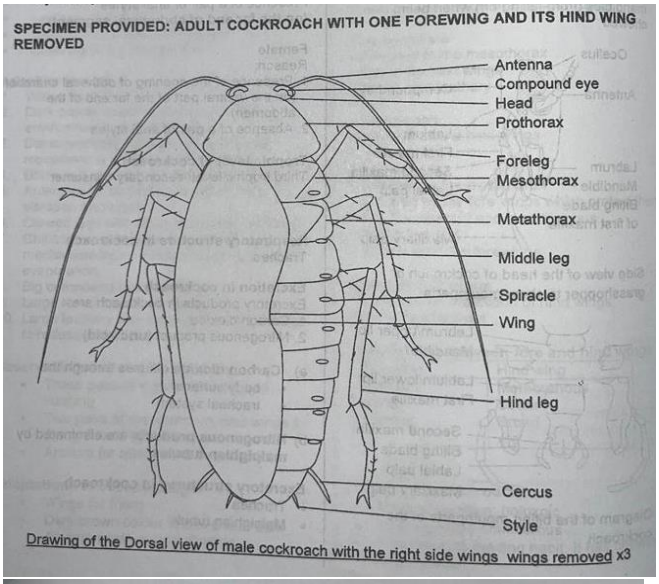
Drawing of the ventral view of male cockroach x3



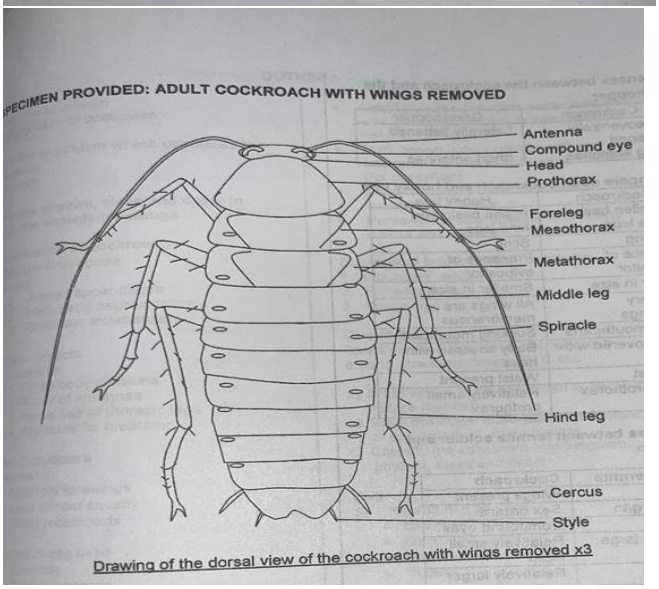
Drawing of the Dorsal view of Adult Cockroach x2







Drawing of the Dorsal view of male cockroach with the right side wings wings removed x3

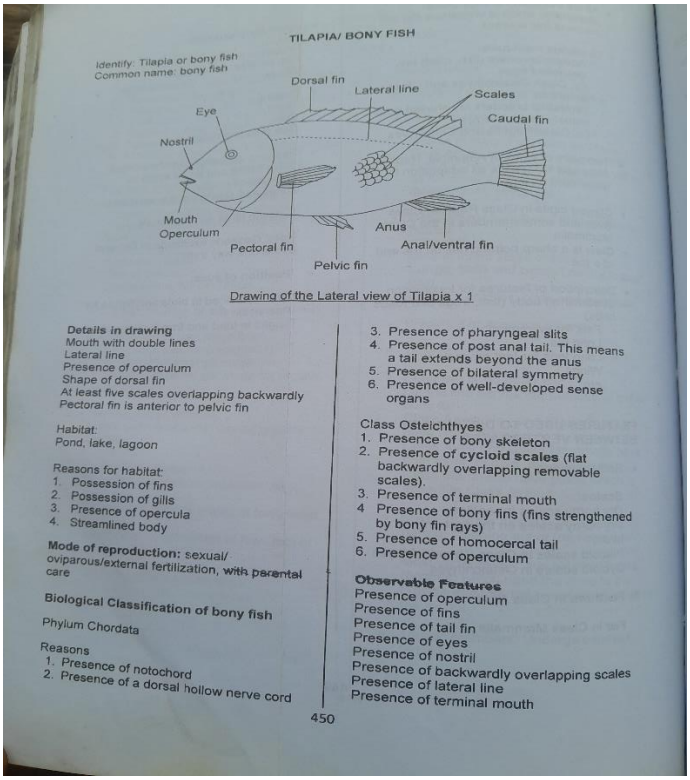


Drawing of the dorsal view of the cockroach with wings removed x3

Lateral view of cockroach



SPECIMEN M (TILAPIA)


TILAPIA/ BONY FISH

Identify: Tilapia or bony fish
Common name: bony fish

Drawing of the Lateral view of Tilapia x 1

Details in drawing
Mouth with double lines
Lateral line
Presence of operculum
Shape of dorsal fin
At least five scales overlapping backwardly
Pectoral fin is anterior to pelvic fin

Habitat:
Pond, lake, lagoon

Reasons for habitat:
1. Possession of fins
2. Possession of gills
3. Presence of opercula
4. Streamlined body

Mode of reproduction: sexual/ oviparous/external fertilization, with parental care

Biological Classification of bony fish

Phylum Chordata

Reasons
1. Presence of notochord
2. Presence of a dorsal hollow nerve cord
3. Presence of pharyngeal slits
4. Presence of post anal tail. This means a tail extends beyond the anus
5. Presence of bilateral symmetry
6. Presence of well-developed sense organs

Class Osteichthyes
1. Presence of bony skeleton
2. Presence of **cycloid scales** (flat backwardly overlapping removable scales).
3. Presence of terminal mouth
4. Presence of bony fins (fins strengthened by bony fin rays)
5. Presence of homocercal tail
6. Presence of operculum

Observable Features
Presence of operculum
Presence of fins
Presence of tail fin
Presence of eyes
Presence of nostril
Presence of backwardly overlapping scales
Presence of lateral line
Presence of terminal mouth

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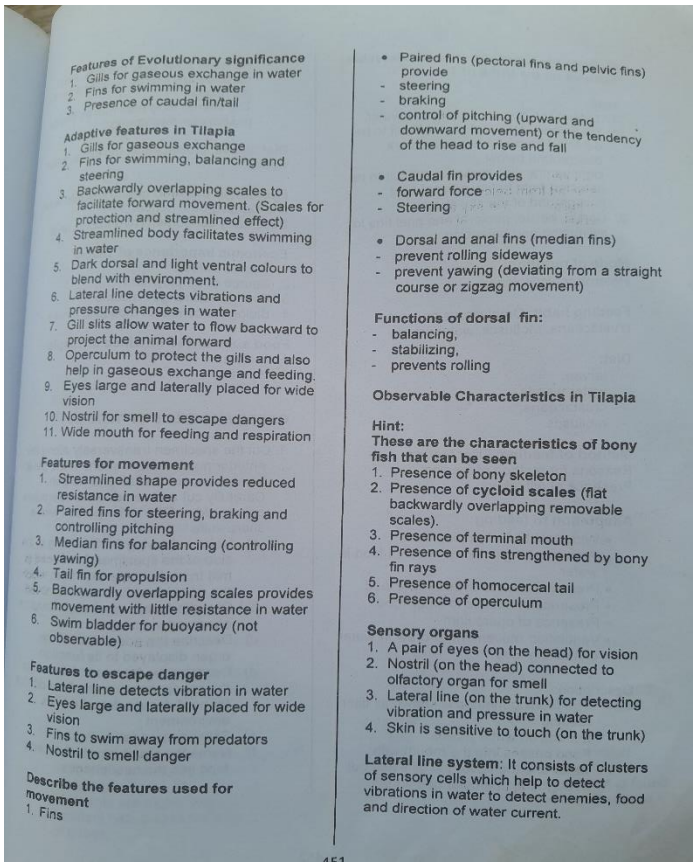
Features of Evolutionary significance
1. Gills for gaseous exchange in water
2. Fins for swimming in water
3. Presence of caudal fin/tail

Adaptive features in Tilapia
1. Gills for gaseous exchange
2. Fins for swimming, balancing and steering
3. Backwardly overlapping scales to facilitate forward movement. (Scales for protection and streamlined effect)
4. Streamlined body facilitates swimming in water
5. Dark dorsal and light ventral colours to blend with environment.
6. Lateral line detects vibrations and pressure changes in water
7. Gill slits allow water to flow backward to project the animal forward
8. Operculum to protect the gills and also help in gaseous exchange and feeding.
9. Eyes large and laterally placed for wide vision
10. Nostril for smell to escape dangers
11. Wide mouth for feeding and respiration

Features for movement
1. Streamlined shape provides reduced resistance in water
2. Paired fins for steering, braking and controlling pitching
3. Median fins for balancing (controlling yawing)
4. Tail fin for propulsion
5. Backwardly overlapping scales provides movement with little resistance in water
6. Swim bladder for buoyancy (not observable)

Features to escape danger
1. Lateral line detects vibration in water
2. Eyes large and laterally placed for wide vision
3. Fins to swim away from predators
4. Nostril to smell danger

Describe the features used for movement
1. Fins
- Paired fins (pectoral fins and pelvic fins) provide
  - steering
  - braking
  - control of pitching (upward and downward movement) or the tendency of the head to rise and fall
- Caudal fin provides
  - forward force
  - Steering
- Dorsal and anal fins (median fins)
  - prevent rolling sideways
  - prevent yawing (deviating from a straight course or zigzag movement)

Functions of dorsal fin:
- balancing,
- stabilizing,
- prevents rolling

Observable Characteristics in Tilapia

Hint:
These are the characteristics of bony fish that can be seen
1. Presence of bony skeleton
2. Presence of **cycloid scales** (flat backwardly overlapping removable scales).
3. Presence of terminal mouth
4. Presence of fins strengthened by bony fin rays
5. Presence of homocercal tail
6. Presence of operculum

Sensory organs
1. A pair of eyes (on the head) for vision
2. Nostril (on the head) connected to olfactory organ for smell
3. Lateral line (on the trunk) for detecting vibration and pressure in water
4. Skin is sensitive to touch (on the trunk)

Lateral line system: It consists of clusters of sensory cells which help to detect vibrations in water to detect enemies, food and direction of water current.

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Q: State the functions of two observable features on the trunk of Tilapia

Hint:
1. Lateral line detects vibration in water
2. Dark dorsal side makes it difficult to be detected from above against dark background below
   Light ventral side makes it difficult to be detected from below against light background of the sky above
3. Dorsal, pelvic, pectoral and anal fins for swimming and balancing

Mode of nutrition:
Heterotrophic/Holozoic

Feeding habit: Omnivorous on larvae, crustaceans, molluscs, water weeds

Diet:
- larvae,
- water weeds,
- crustaceans,
- molluscs

Method of feeding: Filter feeding
Reasons for method of feeding:
Presence of gill rakers

Adaptation to feeding:
- Wide mouth for trapping food
- Presence of gill rakers to strain food in water
- Presence of wide eyes to spot food
- Presence of nostrils to smell food
- Presence of operculum
- Ventilation movement to draw in water containing food

Description:
- The feeding method is known as filter feeding.
- It feeds on water weeds.
- Food passes into the mouth with water and then over the gills and out through the opercular opening.
- As water flows over the gills, food particles are filtered or strained in the gill rakers.
- The filtered food then moves into the pharynx for swallowing.

Diet: larvae, crustaceans, molluscs, water weeds

Position in the food chain/Trophic level:
It is Omnivorous, hence:
Secondary consumer/Third trophic level

Economic importance of Tilapia
1. Source of food
2. Source of employment
3. Foreign exchange / income
4. Biological control of mosquito larvae

Food substances obtained in Tilapia
1. Protein
2. Vitamin

OBSERVING GILLS OF TILAPIA

1. Cut the specimen transversely along the anterior point of attachment of the pelvic fin and discard the tail end portion. Carefully cut and remove the operculum on one side of the other portion with a sharp knife
   a) Make a drawing 8-10cm long of the side of the specimen from head to mid trunk from the side from which the operculum has been removed
   b) Give the functions of each structure observed in the specimen.
   c) Describe the adaptation of the organ displayed to its function.
   d) Describe the features observed in the specimen which make it difficult for predators to detect it in its environment
   e) Sensory organs:
   f) Name the structure which directs food into the oesophagus

Hint:
a) Gill of bony fish/ gill of Tilapia
   Reasons:
   - Presence of reddish gill filaments.
   - Presence of gill rakers

b) Habitat of organism: pond

c) **Adaptive features of gills**
1. Presence of filaments which provides large surface area for gaseous exchange
2. Filaments are highly vascularised (high capillary network) to facilitate transport of gases.
3. Thin walls of filament provide high permeability for easy diffusion of gases.
4. Interlocking gill rakers to strain food in water.

d) **Adaptations for gaseous exchange**
1. Presence of filaments which provide large surface area for gaseous exchange
2. Filaments are highly vascularised (high capillary network) to facilitate transport of gases.
3. Thin walls of filament provide high permeability for easy diffusion of gases.

e) Adaptation to feeding
Interlocking gill rakers to strain food in water

f) i) Two functions of specimen
- Gaseous exchange,
- Feeding,
- Osmoregulation

ii) Reasons

Gaseous exchange
Presence of gill filaments for gaseous exchange

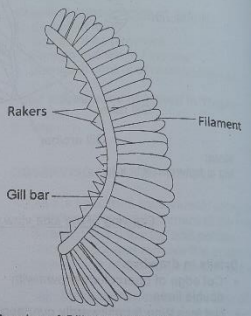
Feeding
Presence of gill rakers for straining food in water

Osmoregulation
Presence of gill filaments to excrete excess salts

g) Level of organisation of specimen:
Organ

h) System in which the specimen is found:
- Respiratory system
- Digestive system

i) Draw the gill of bony fish

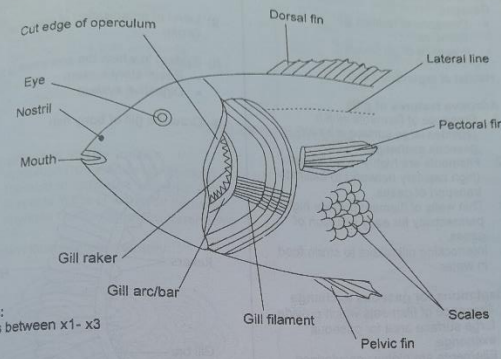


Drawing of Gill of Tilapia x 3

3. Question on gill of Tilapia and Toad
Specimen A is gill of bony fish
Specimen B is toad

a) Identify specimens A and B
b) Name the group of class of organisms from which each of specimens A and B belongs
c) State the location of specimen A in the organism
d) Give any two functions of specimen A to the organism
e) Give one reason each for the functions named

Hint:
a)



Note:
Mg is between x1- x3

Drawing of the side view of the head region of Tilapia to show gills. X 1

Details in drawing:
- Cut edge of operculum shown with double lines
- Not less than 5 backwardly overlapping scales
- Shape of Gill rakers
- Mouth with double lines

a) Gill bar/arc: support the filament and rakers
Gill filaments: gaseous exchange
Gill rakers: strain food and direct it into the oesophagus

b) **Adaptive features of gills**
1. Presence of filaments which provides large surface area for gaseous exchange
2. Filaments are highly vascularised (high capillary network) to facilitate transport of gases.
3. Thin walls of filament provide high permeability for easy diffusion of gases.
4. Interlocking gill rakers to strain food in water.

Question 2
Specimen: Gill of bony fish in a petri dish

a) Identify the specimen with reasons
b) Habitat of organism from which specimen is obtained
c) Adaptive features of specimen
d) Adaptation for gaseous exchange
e) Adaptation to feeding
f) i) Two functions of specimen
   ii) Give reasons for each function
g) Level of organisation of specimen
h) System in which the specimen is found
i) Draw 8 – 10cm long of the specimen