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SSERUWU RONALD

Hons BSc(Educ) MUST

DEDICATION

This book is dedicated to my mother Agnes Adenyi.

All suggestions and advice to improve the material is warmly welcome at nkuyegetetyasaabo@gmail.com or 0785043794

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CHAPTER ONE: INTRODUCTION

Ordinary level Biology practical paper consists of three compulsory questions to be done in two hours. These questions require carrying out practical procedures, making and recording observations and then making the correct deductions from the observations. Questions set fall under three main categories;

1. **PHYSIOLOGY**; which involves investigating life processes such as nutrition, transport, respiration, gaseous exchange, excretion, reproduction, growth and development.

2. **ANATOMY AND IDENTIFICATION**; which involves identification, classification, structure and function of body parts or the whole organism.

3. **ECOLOGY AND SOIL SCIENCE**; which involves relating an organism in its environment and investigating different properties of different types of soil.

GUIDELINES TO CARRYING OUT A SUCCESSFUL BIOLOGY PRACTICAL

1. TIME MANAGEMENT

- Success is proportional to the time spent grasping the concept. Always prepare adequately before the examination. Doing as many practicals as possible is always part of preparation for the final examination.
- Budget your time appropriately during the examination. Don't waste time unnecessarily.

2. RECORDING OBSERVATIONS OR RESULTS

- The candidate should be very keen with a lot of precision so as to make the correct observations. Observations may be in terms of colour changes, change of state, heat changes etc.
- Recording may be in form of colour changes, tables, plotting graphs as well as making some biological drawings.
- Record observations immediately

3. RECORDING DEDUCTIONS

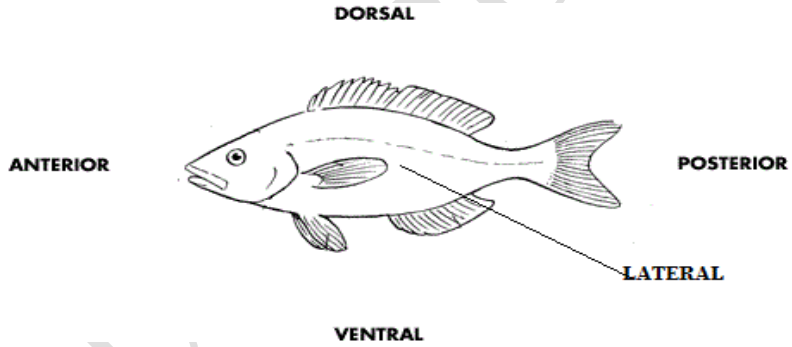
- Should be written basing on the observations
- Should be precise and logical

4. DRAWING

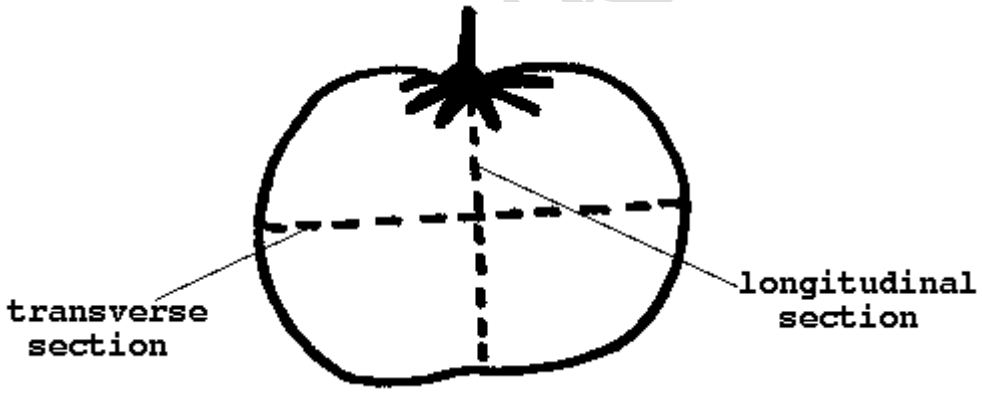
VIEWING THE SPECIMEN

A whole specimen can be viewed from the following

- Anterior; from the front
- Posterior; from the hind
- Dorsal; from the back or top side
- Ventral; from the bottom or under side
- Lateral; from the side view



A learner may be tasked to cut the specimen either longitudinally (along its length/vertical) or cross sectionally (side wise)



➢ **Marks for biology practical drawings are awarded in line with the following**

➲ **Title;**

This is the heading for the drawing which should be stated precisely and clearly. In stating the tittle, labels should be used not the actual name or identity. For example **DRAWING OF A LONGITUDINAL SECTION OF SPECIMEN M** not **DRAWING OF A FLOWER**

If a candidate is tasked to observe the specimen from a particular view, the view should be indicated in the tittle for example**; DRAWING OF SPECIMEN M FROM THE DORSAL VIEW.**

Drawing views.

View	Region / Area.
Dorsal	As observed from the back of the specimen. (Also top view).
Ventral view	As seen from the belly side
Anterior View	View as observed from front the rear or hind part.
Longitudinal section	As cut along length of specimen
Transverse section	As cut across the specimen.
Proximal end	Top part of the drawing /specimen.
Distal end	Lower end of a drawing / specimen.
Cephalic View	Viewed from the head
Caudal View	The tail region.
Lateral View	Side View
Interior part	Inner part
Exterior part	Outer part.
Trunk	Part of the body without limbs, head and tail (animals) or branches and roots (Plants).

➲ **Drawing**

Outlines should be thin, complete and non-overlapping. Drawing marks are only given when the drawn parts are neat with complete, non-overlapping and smooth lines.

➲ **Labelling**

Label lines should touch the structure to be labeled. Label lines should not cross each other and should not have arrows. Names of the parts [labels] should be besides their label lines. The name of the part should be written using the correct spelling and MUST be in singular.

➲ **Neatness**

Dirty untidy work does not score marks. Neatness can be achieved by; Avoiding unnecessary rubbing, using a well sharpened pencil, rubbing using a white rubber and not a coloured one, placing the question paper in a clean place free from water and reagents.

➲ **Accuracy**

Drawings should be representatives of the specimen and proportions should be maintained i.e. a drawing of an Irish potato should be representative of the Irish potato not a carrot.

➲ **Magnification**

All biological drawings MUST have a magnification. It should be;

- Stated in the bottom right hand corner of the drawing
- Magnification is stated starting with a multiplication sign which indicates how many times the drawing is bigger or smaller than the specimen

Graphing In Biology

A. Parts of a Graph

1. Title

- The two variables must appear. Avoid using expressions like versus or against as in physical rather use terms like relationship between….. or graphs showing changes in…. with… e.g.
- The place of study or investigation or any
- Name of organism under study
- Begin the title as "the graph showing: -relation, change, variation.

2. Scale

- Determination of scale.
- Highest figure-lowest figure (range)
- To get the scale divide the range with the space available

3. **Axes**
   - They must be drawn with arrows superimposed on the grid line of the graph paper
   - Label axes
4. **Plots**
   - Use a symbol
   - Join the plots
5. **Key**

- Means of identifying the graph

THE DICHOTOMOUS KEY

Is an identification key constructed using similarities and differences in structures. Enter the characteristics into a table Use the table data to construct a flow chart which places the specimens in their groups

Note:

- If you have **n** specimens, the number of steps on the flow chart should be **n-1.**
- All the above is done as side work not in the space provided for the dichotomous key.
- Use data on the flow chart to construct a dichotomous key using the steps below.

State the tittle of the dichotomous key

Number the pairs of sentences (couples) of the key i.e

1 a)
  b)

2 a)
  b)

- use each characteristic only once.

- indicate the identified specimen and that not identified is refered to the next level e.g

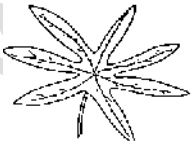
1 a) lamina undivided……p
  b) lamina divided into leaflets……go to 2

CHAPTER TWO: LEAVES

TYPES OF LEAVES AND LEAF LAMINA

Simple leaf – one whose lamina is not completely divided into leaflets

- Simple entire – lamina not divided at all
- Simple lobed – lamina divided into leaf lobes along the axis e.g passion fruit, *Ipomea batatas* (sweet potato)
- Simple palmate/ digitate -; leaf lobes radiate out from the end of the stalk like the fingers of the hand e.g cassava leaf



Cassava

Compound leaf – one whose lamina is completely divided into leaflets

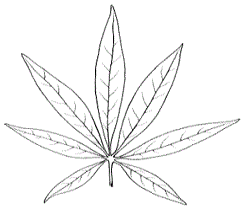
- Pinnate – leaflets arranged in pairs opposite one another along the main stalk e.g. cassia, soya bean.
- Bi pinnate – leaflets arranged in opposite pairs on branches from the midrib e.g. jacaranda and *Acacia*
- Trifoliate – lamina divided into three leaflets e.g. beans and peas.

➲ Compound palmate – lamina divided into many leaflets originating from the central portion of leaf base e.g. silk cotton.

Cassia

Accacia

Trifoliate



Palmate

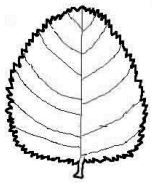
➲ **Leaf lamina**

This is described in the nature of its surface or appearance. It may be described as

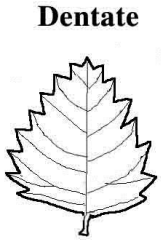
- Fleshy ; thick and succulent such as in *Bryophyllum*
- Smooth, hairy or rough e.g. in pumpkin leaves
- Spiny

Leaf margin

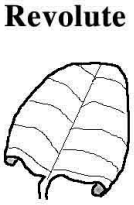
- Entire/ smooth without any indentation
- Indented – margin broken in outline by indentions. Are described as
  - Wavy
  - Serrated



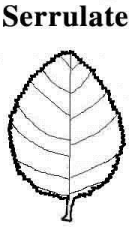
  - Dentate



  - revolute



  - Crenate



  - Lobed

  - Spiny e.g. in pineapple leaves

Leaf Petiole

A **petiole** is present in **dicotyledonous leaves** and may be described as

- Absent/ sessile
- Short or long
- Smooth or hairy
- Hollow or solid

Monocotyledonous leaves have a **leaf sheath** not a petiole. A leaf sheath may be

- Smooth or hairy
- Powdery or membranous

Leaf Venation.

There are two types of leaf venation i.e

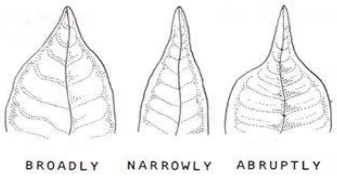
- ***Network leaf venation***; where veins form a network thought the lamina. It's found in leaves of dicotyledonous plants
- ***Parallel leaf venation***; where veins run parallel to one another and the midrib. It's found in leaves of monocotyledonous plants

Leaf Apices [Singular Apex]

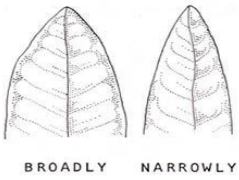
- Pointed

Round

- Acuminate



Cuspidate



Retuse

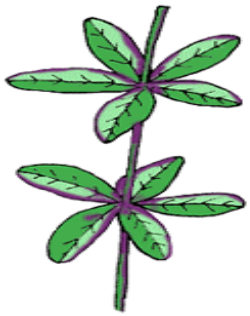
Acute

Leaf Arrangement

Opposite arrangement

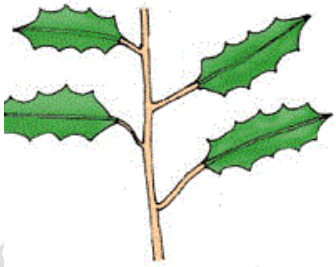
opposite

Whorled arrangement



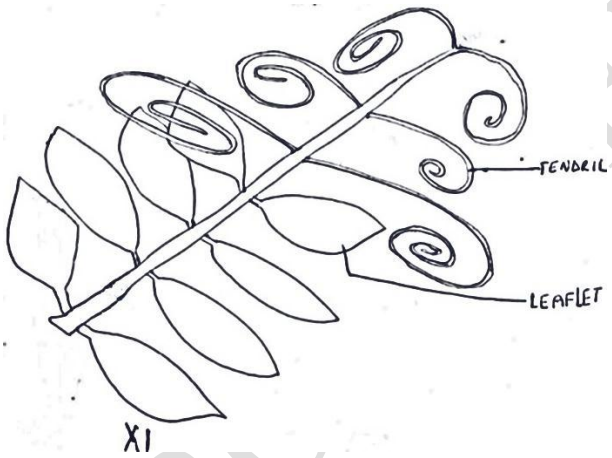
whorled

alternate arrangement



alternate

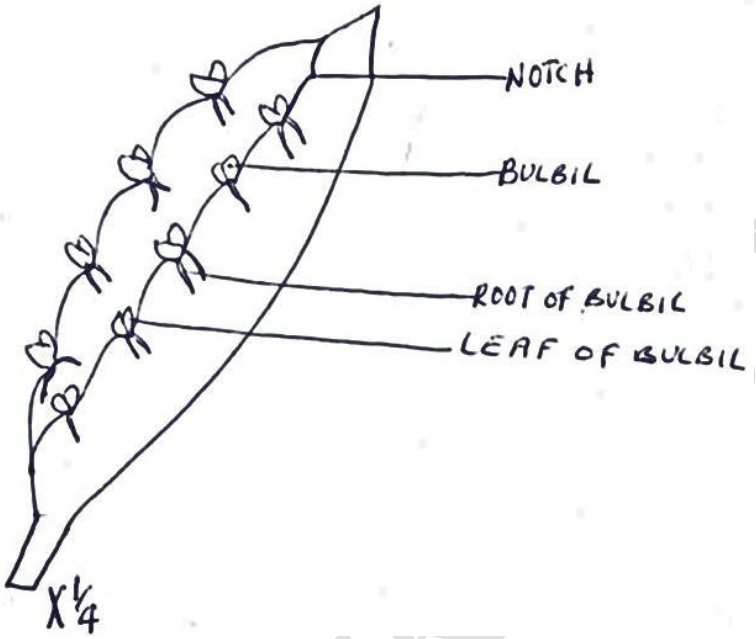
LEAF MODIFICATIONS



Modification	Function	Examples
Tendrils	Provide support for the plant to reach sunlight for photosynthesis	Passion fruit
Thorns	Provide protection from Herbivores	Boungainvillae
With Buds	Vegetative reproduction	Bryophyllum
Fleshy Margin	Stores food and water	Bryophyllum

Hairy Lamina	Minimize water loss by Transpiration	Pumpkin leaf

Bryophyllum leaf



- It is thick/fleshy to store food and water and water to withstand dry long conditions
- Have buds for vegetative propagation for continuity of life, the buds develop into mature plants.
- Have veins to transport/distribute manufactured food, water, mineral salts and other materials to plant parts where they are required
- Have a broad lamina to increase surface area over which light for photosynthesis is trapped
- Some leaves also have a hairy lamina. The hairs trap a layer of moisture and therefore minimize loss of water by Transpiration e.g in most grasses, bean plant, soya bean, pumpkin

Questions

1. You are provided with specimens (leaves) labeled O, P, Q, R and S. Study the specimens carefully and answer the questions that follow
   a) Describe the characteristics of the specimens in the table below.

Specimen	Stalk	Lamina
O		

P		
Q		
R		
S		

b) Using only characteristics of the lamina, construct a dichotomous key to identify specimens O, P, Q , R and S.

c) State the advantages of specimen O over specimen R.

2. You are provided with specimens A, B, C, D and E which are parts of a plant

a) Observe specimens and record their characteristic features in the table below

Specimen	Lamina	Petiole	Margin	Apex
A				
B				
C				
D				
E				

b) Using the observable features, state how specimens A and E are adapted to surviving in their habitats

Adaptations of A

Adaptations of E

c) Using the observable features, construct a dichotomous key to identify the specimens

d) Observe specimen E carefully. Draw and label. Clearly state the magnification

3. You are provided with specimens W, X, Y and Z which are plant parts.
   a) State which plant parts they are.
   b) Using observable features of the specimens complete the table below.

Specimen	Type of margin	Nature of lamina (hairy/hairless)	Type of venation
W			
X			
Y			
Z			

   c) From only the characteristics stated above in the table, construct a dichotomous key to identify the specimens.
   d) In the space below, draw the outline of specimen W to show its shape. Don't label. State your magnification.

You are provided with specimen U, V, W and X, which are plant parts.

(a) Identify the plant parts above.

(b) (i) Give five points of similarity observed on specimen U,V and W.

(ii) Give three points of variation, basing on the flat broad surfaces of specimen U,V and W.

(c)(i) State the key functions of the plant parts in (a) above to the plant.

(ii) From your identification in (a) above, categorize the system exhibited by specimen X and give a reason to support your answer.

System:

Reason:

(d) Using the points of variation in (b) ii above, construct a dichotomous key in the space provided.

(e) Draw and label plant part X. State the magnification.

CHAPTER THREE: STEMS

These are identified by possession of the following;

- Have adventitious roots
- Have buds
- Have leaves or leaf scars
- Have nodes and internodes

a) Modified Stems

Stems are mainly modified for storage of water and food and vegetative propagation. These include;

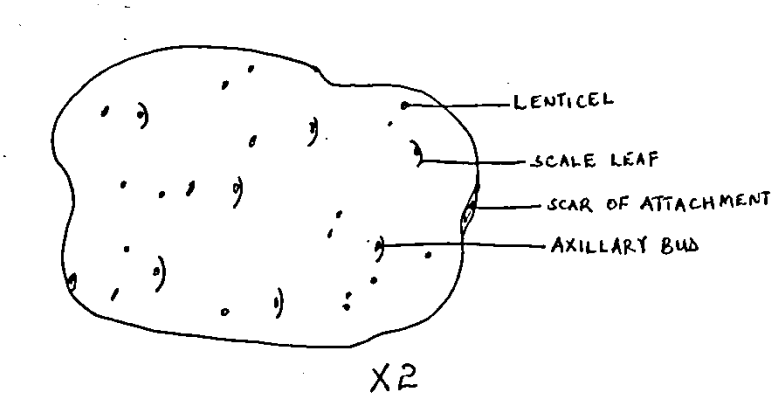
1. STEM TUBER

Characteristics of stem tubers

- Have axillary buds
- Have scale leaves
- Are swollen with food reserves

Examples; Irish potato, yam, sugar cane

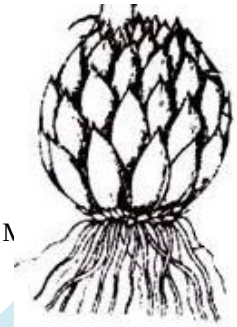
DRAWING SHOWING EXTERNAL FEATURES OF AN IRISH POTATO



2. BULB

Characteristics of bulbs

- Have short conical stem

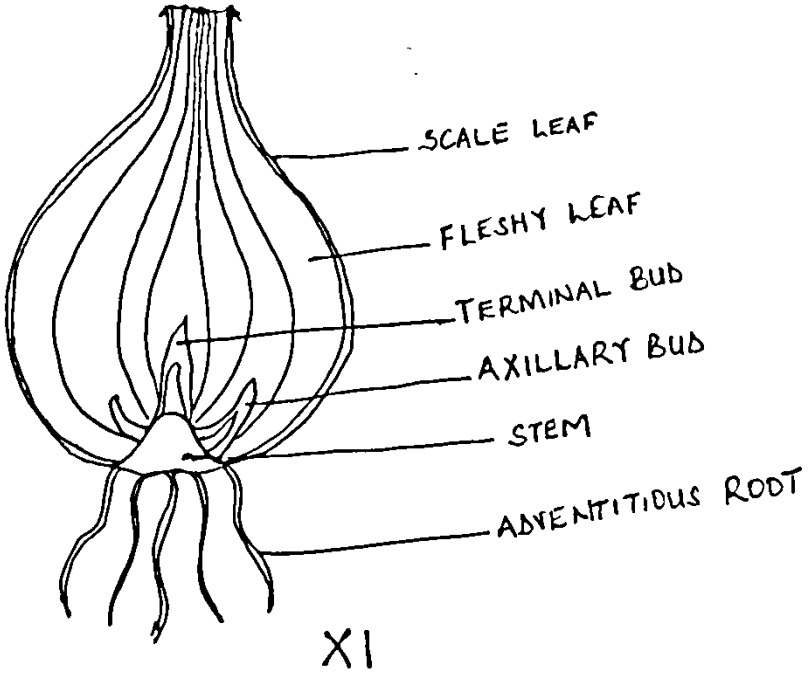


Garlic (*Allium sativum*)

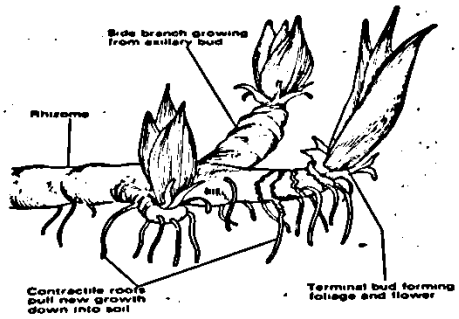
- Have dry scale leaves
- Have fibrous roots
- Have axillary and terminal buds when cut longitudinally.

Examples; onion, garlic

DRAWING SHOWING LONGITUNAL SECTION OF AN ONION



3. RHIZOME

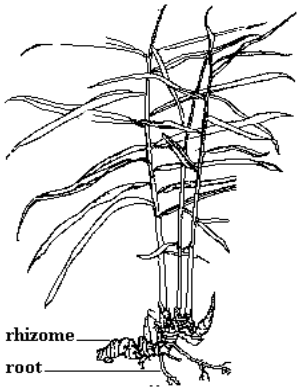


Characteristics of rhizomes

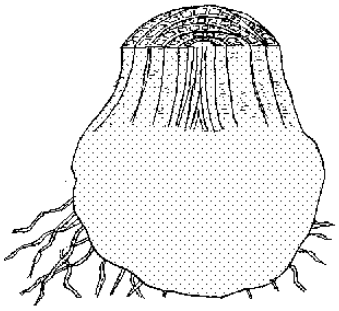
- Has nodes and internodes
- Has scale leaves on the nodes
- Has axillary and terminal buds
- Has adventitious roots

Examples; ginger, cana lily, couch grass

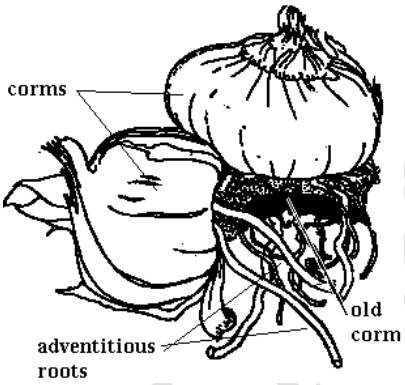
Ginger



1. CORM



vertical section of the corm and leaf bases



2. RUNNER

Characteristics of runners

- Have long internodes
- Have many roots at every node
- Have many axillary buds
- Have many aerial shoots

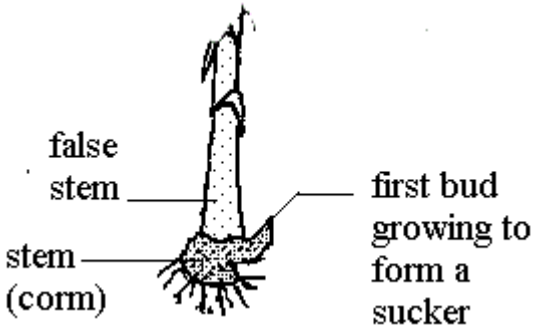
Example; *Pasparum notatum*

3. 5. SUCKER

Characteristics of suckers

- Have adventitious roots at the base
- Have aerial leafy shoot
-
- Have distinct buds
- Have several nodes and internodes

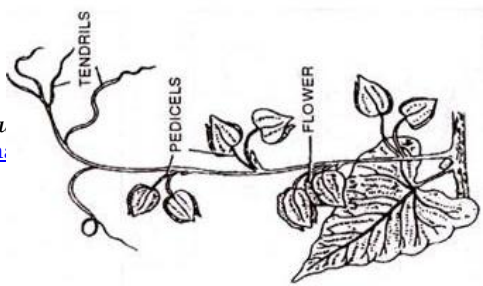
Examples; rose, pineapple, banana, sisal.



4. 6. STEM TENDRILS

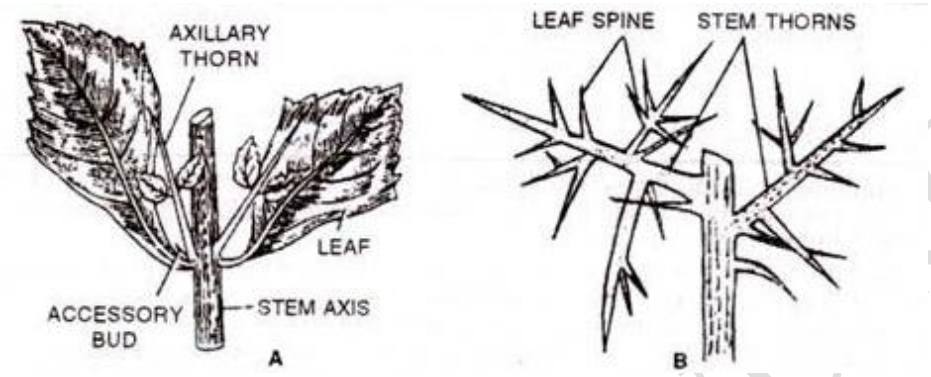
These possess thin, long and spirally coiled structures. They are modified for climbing so as to allow the plant to receive sunlight for photosynthesis

Examples; passion fruit, morning glory



5. 7. STEMS WITH THORNS

Thorns are long tapering sharp structures on stems of some plants. They offer protection to the plant against herbivores such as in lemon, oranges, Bougainvillea and solanum species.



b) Questions

1. Study specimens U and W which are parts of a plant an use them to answer the questions that follow.
   a. I) Identify specimens U and W and give reasons for your answers.
      Specimen U is a
      Reasons
      (i)
      (ii)
      (iii)
      Specimen W is a
      (i)
      (ii)
      (iii)

      b) Outline similarities between the specimens
      i)
      ii)
      iii)
      c) State differences between the specimens U and W
   b. Cut specimen U into similar halves. Draw and label one half

2. You are provided with specimens F, G and H. Observe the specimens and answer the questions that follow.

   a. What part of a plant is specimen G and H. Give reasons for your answer
      (i) G

Reasons

(ii) H

Reasons

b. State three observable similarities between F and G

c. Using a razorblade, cut specimen F and H along its line of best symmetry into two halves with the aid of a hand lens examine carefully the cut surface of one half.

i. State the differences between F and G

F	G

ii. Draw and label the structures seen in one half of H.

d. Dip the other half of specimen H into a Petri dish containing iodine solution. Leave for 3 minutes. Remove and wash off the excess iodine solution with water. Examine the cut surface, record and explain your observation.

e. Suggest any other two food substances that may be stored by specimen H

(i)

(ii)

f. State the role of the food substances stored by specimen H.

3. ***(a) You are provided with specimen R, S and T.***

Giving two observable characteristic features identify the specimen.

(i) R:

Identity:

Features:

(ii) S:

Identity:

Features:

(iii) T:

Identity:

Features:

(b) From your observations of specimen S, state two functions of the specimen in plant life.

(c)(i) With reference to the characteristic features of specimen T, in which category of fruits do you place it?

(ii) State the agent of dispersal and outline the mode of dispersal of specimen T.

Agent:

Mode:

(d) Draw and label specimen R. State the magnification of the drawing.

4. You are provided with specimen O.

Examine it carefully, use a knife to make a longitudinal section through it and use the halves to answer the questions that follow:

(a) (i) With a reason, identify specimen O.

Identity :

Reason:

(ii) State the functions of the following structures as observed on the specimen.

Outer brown leaves:

Inner fleshy leaves

Buds at the base

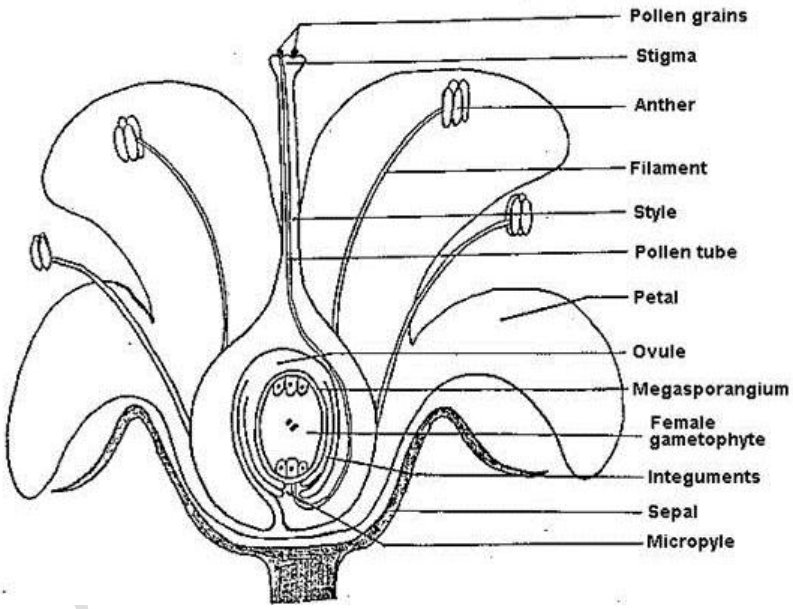
(b) Draw and label one half of specimen O. State the magnification of the drawing.

(c) Using one half of specimen O, cut it into small pieces, crush them in a mortar and add 10cm^3 of distilled water. Stir and decant the mixture to a level of 10cm^3 in a measuring cylinder and call this solution Z. Carry out the following tests on solution Z using the reagents provided.

TEST	OBSERVATION	DEDUCTION
(i) To 1cm^3 of solution Z in a test tube, add 2 drops of Iodine solution		
(ii) To 1cm^3 of solution Z in a test-tube, add 5 drops of Benedict's solution and boil.		
(iii) To 1cm^3 of solution Z in a test tube, add 1cm^3 sodium hydroxide solution, followed by 3 drops of copper sulphate solution		
(iv) Place a drop of solution Z on a piece of paper and allow it to dry near the heat source. After drying hold the paper against light.		

2. CHAPTER FOUR: FLOWERS

A flower is a modified part of a stem in which the primary sex organs are found. A flower has the following parts; peduncle, receptacle, **calyx** (sepal), **corolla** (petals). The male reproductive organ called the **stamen** consists of filament and anthers which form pollen grains. The female reproductive organs called the **pistil** consisting of an ovary, style and stigma. *Hibiscus* flowers are **bisexual** because they have both male and female organs in one flower. Some pawpaw flowers have either female or male flowers and are referred to as unisexual flowers. Plants with both male and female flowers on the same plant are called **monoecious** like maize. Plants with male and female Flowers on separate plants are **deciduous** like a pawpaw plant.-



Description of floral parts which may be described as follows

1. Calyx

- Free of fused
- Hairy or smooth
- Number of calyses
- Nature i.e epicalyx or not

2. Petals

- brightly coloured or dull coloured
- Fused or free
- Shape and number
- Regular or irregular

➲ **Stamens [Androecium]**

- number of stamens
- length of stamens
- hairy or not hairy
- filaments fused with petals or not
- Anthers hang inside or outside of the corolla.

➲ **Pistil [Gynoecium]**

- Number of carpels - monocarpous [one carpel]

  - Apocarpous [more than one separate carpels]

  -Syncarpous [more than one fused carpels]

- Nature of ovary - superior [above the receptacle]

  - Inferior [below the receptacle]

- Stigma -sticky or smooth
  - Single or lobbed

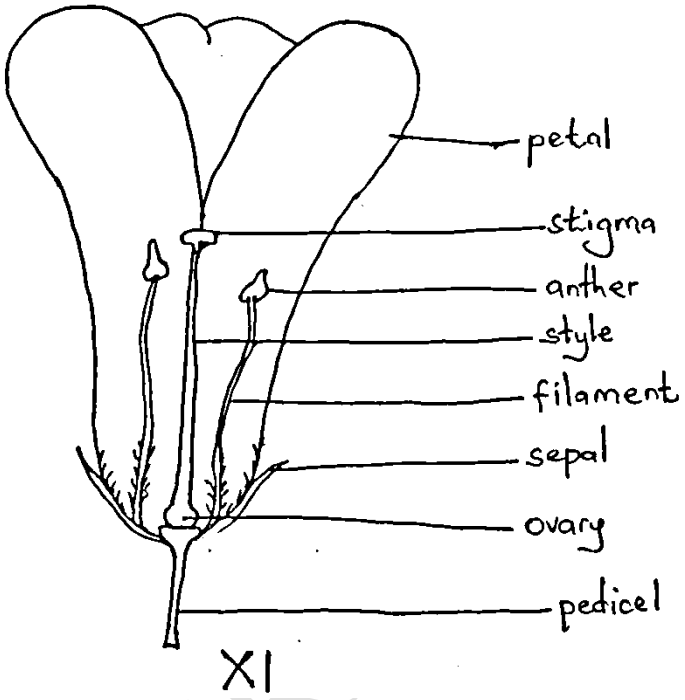
- Style - curved or straight

  - Long or short

b) CHARACTERISTICS OF SOME COMMON FLOWERS

1. Morning Glory

A DRAWING SHOWING A LONGITUDINAL SECTION OF A MORNING GLORY FLOWER



Sepals:

- They are five in number, free and hairy

Petals:

- They are five in number, fused and brightly coloured
- are funnel shaped/tubular with nectar guides

Stamens

- It consists of five separate/free stamens attached to the petals
- They are bilobbed and of different length

Pistil

- have a superior ovary
- The style is threadlike is smooth, threadlike tapering at the end
- The stigma is broad and sticky

2. Hibiscus

Sepals:

- They are five, fused and hairy
- They are tapering at the end

Petals:

- Five free brightly coloured petals, are veined
- are long with nectar guides

Stamens:

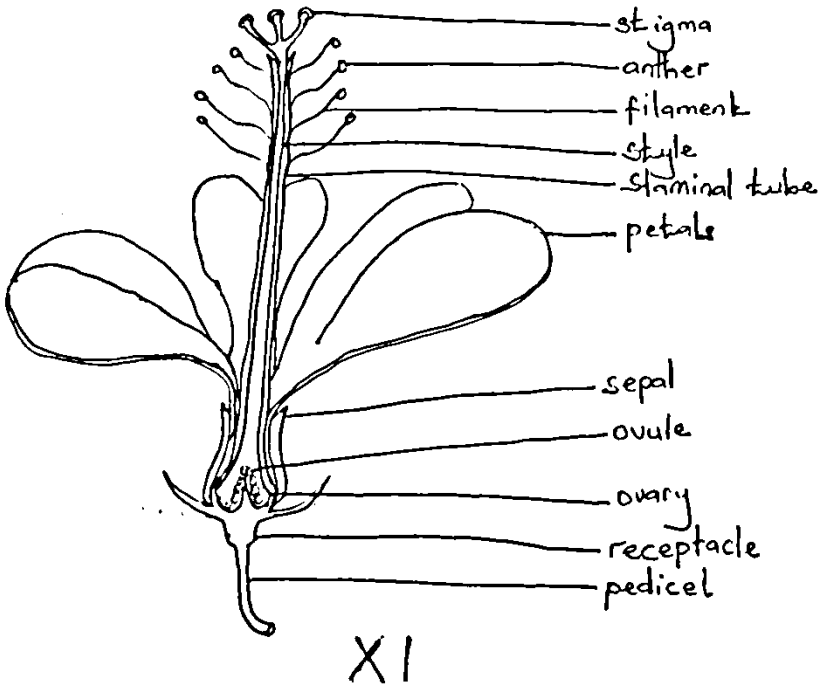
- have many anthers whose filament fuse to form a filament tube called a staminal tube
- Anthers are small and cylindrical/round
- Filaments are short and threadlike

Pistil:

- has a conical shaped superior ovary
- have five long and slender fused styles inside the staminal tube

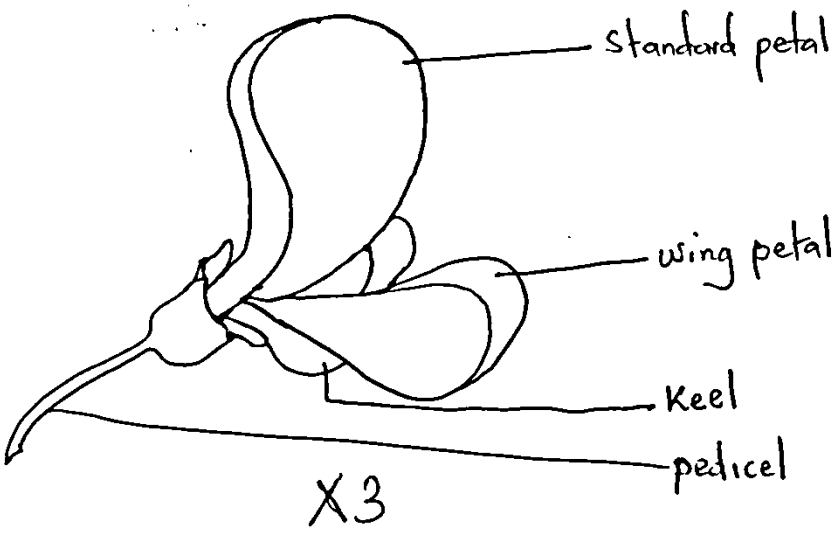
- have five separate stigmas

A DRAWING SHOWING A LONGITUDINAL SECTION OF A FLOWER



3. Crotalaria

A DRAWING SHOWING EXTERNAL FEATURES OF A CROTALARIA FLOWER



Sepals:

- are five in number, fused and veined

Petals:

- Five in number, brightly coloured and veined

- The petals vary in size and shape. The outermost petal is the largest and round. It is called standary

- The two middle petals are partially fused and are called wind petals

- Inner most petals are boot shaped and are called keel petals

Stamens:

- They are ten in number and free

- Five have rounded anthers while other five have elongate anthers. The anthers are bilobbed

- Stamens are of varying length, the filaments are fused to form a staminal tube

Pistil:

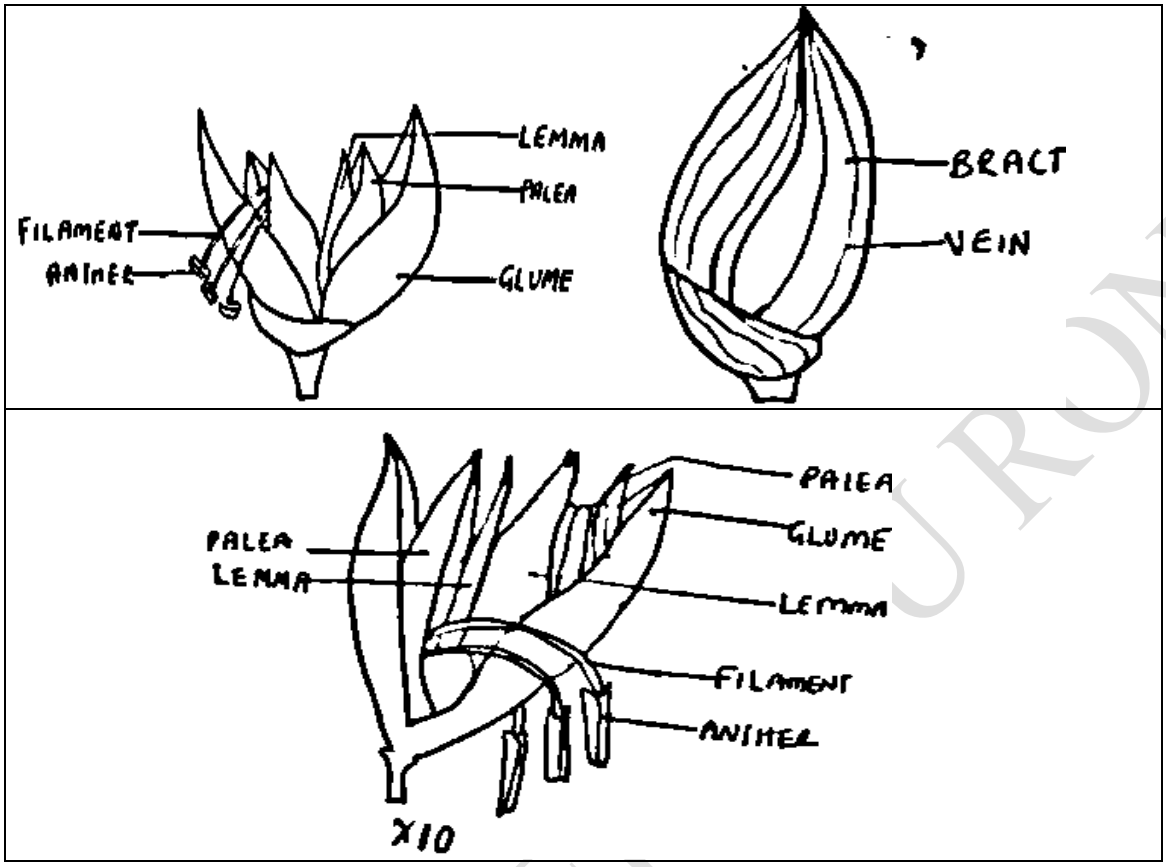
- Has a long, narrow and pod-shaped ovary

- Consists of one carpel with many ovules

- The style has a hairy stigma at the end

The Grasses

Grass and male maize flowers grow in groups along the same axis. The flowers are in pairs and each pair is called a ***spikelet.*** The whole individual flower is called a ***floret.*** These flowers have no petals or sepals instead they have green leaf-like structures called ***bracts.*** The outer and larger bract is called ***lemma*** and the inner smaller one is called ***palea.*** At the base of each spikelet is a pair of modified leaves called ***glumes.***



Pollination

- Agents of pollination based on observable characteristics
- Adaptations for the mode of pollination

You may be required to compare the specimens given e.g. comparing *Hibiscus* and *Crotalaria*; here you are expected to give both the Similarities and differences.

Note:

Care should be taken when cutting the longitudinal section of flowers to avoid destroying other floral parts

Discussion Questions

1. Is the flower that you examined male or female or bisexual?
2. Mention the reproductive parts of the flower and state their functions.

Questions

1. You are provided with specimen H. Study it carefully and answer the questions that follow.

a) Fully describe the structure of the flower (6 mks)
b) How is the Specimen adapted to pollination? (3 mks)
d) Cut one flower longitudinally to clearly display the internal floral parts. Draw and label (6 mks)

2. You are provided with specimens X and Y. Study them carefully and answer the questions below:
(a) (i) What observable structural features do specimens X and Y have for pollination?
X
Y
(ii) List four observable structural differences between the two specimens

Specimen X	Specimen Y
(i) (ii (iii) (iv)	

(b) Cut specimen X longitudinally into two equal halves. Make a large labelled drawing of one half

3. You are provided with specimen N, O,P,Q
(a) List the specimens which are;
(i) Wind pollinated
(ii) Insect pollinated
(iii) Suggest the mechanism of pollination of specimen Q and give five adaptive features to this mechanism.
Mechanism
Adaptation
(b) Give 3 structural differences between specimen N and P

(c) Make a longitudinal section through specimen N. draw and label

4. You are provided with specimen ***P*** and ***Q*** which are plant parts.

(a) Giving two reasons, name the part of the plant to which specimens ***P*** and ***Q*** belong.

Part of the plant
Reasons

Describe the following structures of specimen P and ***Q***.

Structure	**Specimen P**	**Specimen Q**
Stamens		

Pistil		

(b) (i) State the agent of pollination for specimen ***P***.

(c) (ii) How is specimen ***P*** adapted to being pollinated by the mentioned in c(i) above.

(d) Remove the sepals and stamens from Specimen P. Draw and label the remaining part of the specimen.

CHAPTER FIVE: FRUITS

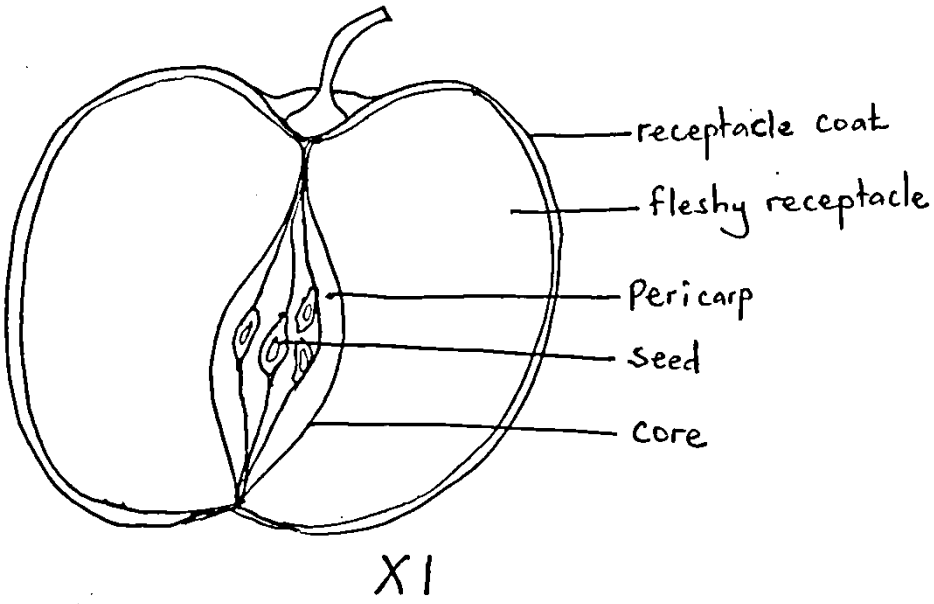
A fruit is a fertilized ovary of a fruit. In general, a fruit is identified by;

- ✓ Having two scars
- ✓ Having a pericarp

Fruits can be grouped into two categories i.e. **true** fruits and **false** fruits eg apples
True fruits are further divided into three categories

- ➢ Simple fruits e.g. mango, orange maize etc.
- ➢ Aggregate e.g. straw berries
- ➢ Multiple e.g. pineapple, jack fruit

A DRAWING SHOWING ATHE LONGITUDINAL SECTION OF AN APPLE FRUIT



Simple fruits

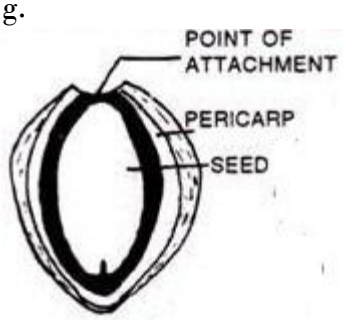
Simple fruits are either **dry**, if they have a dry pericarp or **succulent**, if they have a juicy pericarp

Dry simple fruits

These are divided into dry dehiscent fruits and dry indehiscent fruits

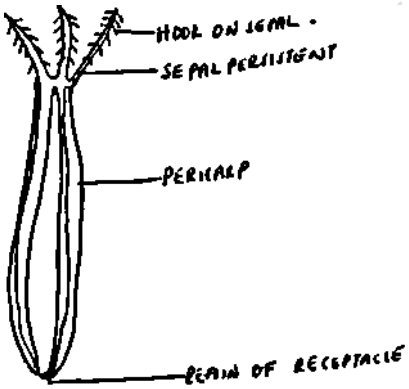
Dry indehiscent fruits include

i. **Achene** e.g.

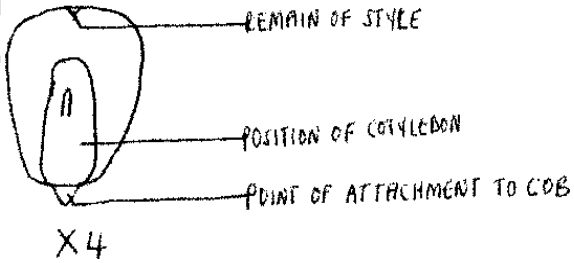


ii.

iii. **Cypsela** e.g. *Bidens pilosa* and *Tridax* features. They have a persistent calyx modified into hooks (for *Bidens)* or paracute of hairs called pappus (for *Tridax*)

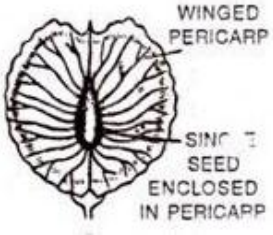


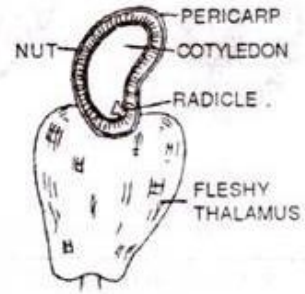
iv. **Caryopsis** e.g. grains of cereals and grasses e.g maize fruit these have a pericarp fused with the testa.



v. **Nuts** e.g. oak, cashew nuts, hazel, sweet chestnuts. These have a very dry, hard and tough pericarp.

vi. **samara**





Dry dehiscent fruits include

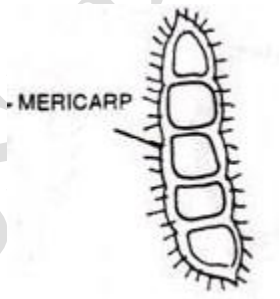
i. **Legume;** Has dry fused pericarp that splits open along two longitudinal sutures

Examples ; pea pods, bean pods, cassia pods, ground nut pods.

ii. **Follicle;** Has a dry pericarp which split open along one suture; e.g. in acacia, Sodom apple etc

iii. **Capsule;** Has a dry pericarp which splits along many longitudinal sutures between seed e.g. cana lily, Dutch man's pipe, cotton, datura, balsam, poppy.

iv. **Schizocarp;** Has a dry pericarp which break up into several parts called mericarps. A mericarp is a compartment containing only one seed e.g. desmodium



Succulent Fruits

These are divided into two; those that have very many seeds inside a fleshy pericarp **(berries)** and those that have only one seed **(drupes)**

i. **Drupe**

- Has only one seed
- Has fleshy pericarp
- Has woody endocarp

Examples; mango, avocado, coconut

ii. **Berry**

- Has many seeds
- Has fleshy and soft pericarp
- Has a fleshy and soft endocarp

Examples; oranges, passion fruit, tomatoes, green pepper, egg plant

PLACENTATION

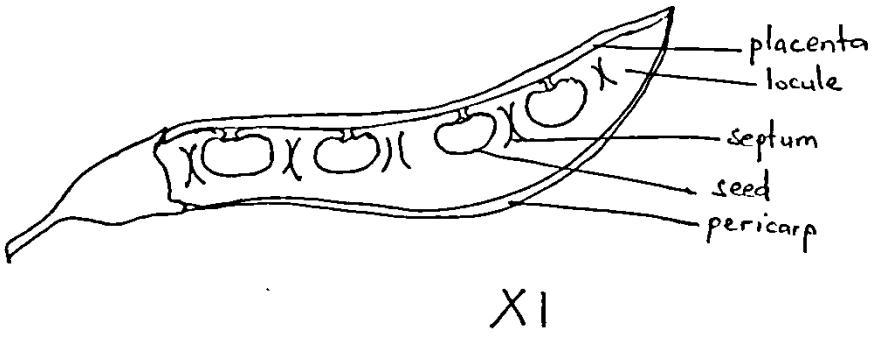
This is the arrangement of seeds on a placenta in the fruit

TYPES OF PLACENTATION

a) **Marginal placentation**

Seeds are attached along a logitudinal margin of the pericarp
e.g. in beans, peas, cassia

A DRAWING OF A BEAN POD SHOWING ARRANGEMENT OF SEEDS AROUND A PLACENTA

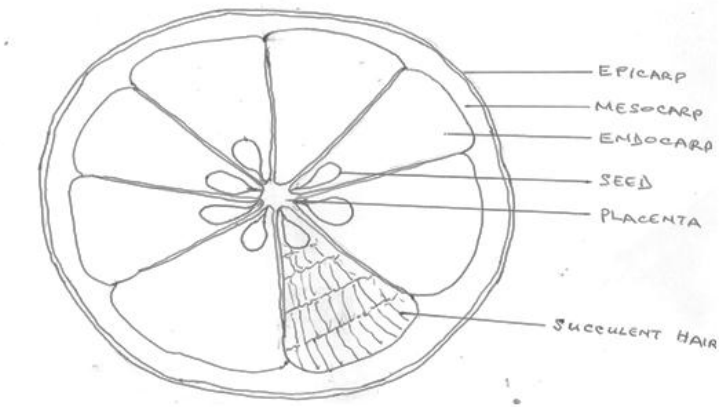


X1

b) **Axile placentation**

Seeds are arranged on the placenta originating from the centre of the fruit in angles formed by meeting septa e.g. oranges, lemon, banana, sweet potato, lily.

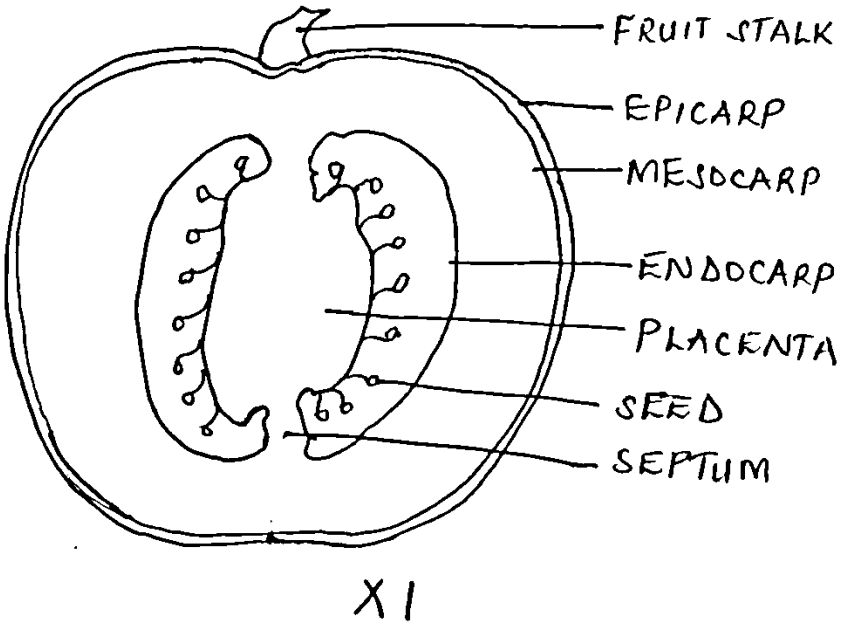
A DRAWING OF CROSS SECTION OF AN ORANGE



c) **Parietal placentation**

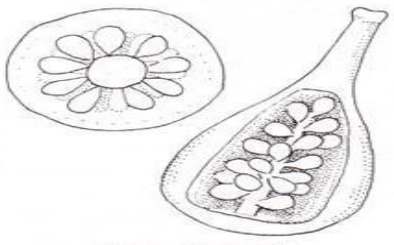
Seeds are arranged on the inner wall of the fruit wall e.g. in passion fruit, paw paw, cocoa, cucumber

DRAWING OF A LONGITUDINAL SECTION OF A TOMATO



d) **Free central placentation**

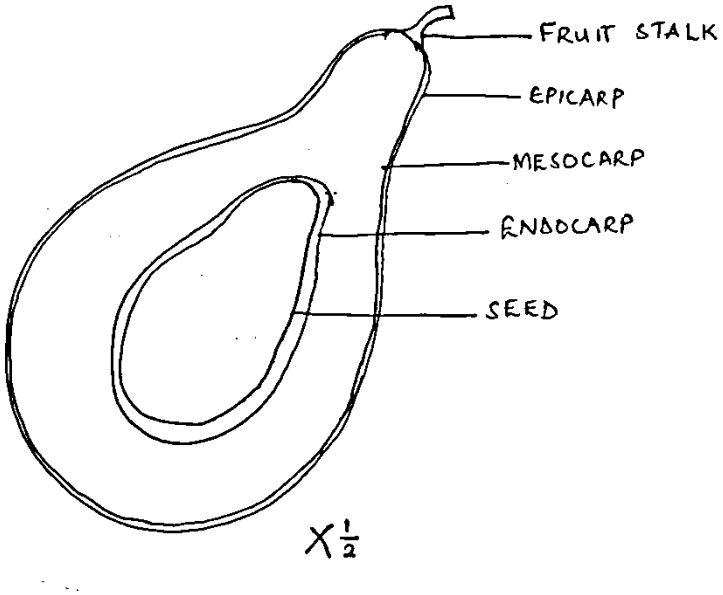
Seeds are arranged on a placenta which arises from the base of the fruit wall e.g. in green pepper.



e) **Basal placentation**

Seeds are attached on a placenta at the base of the fruit e.g. in mango, avocado, sunflower, maize

A DRAWING OF THE LONGITUDINAL SECTION OF AN AVOCADO SHOWING BASAL PLACENTATION



Dispersal

This is the scattering of fruits and seeds away from the parent plant

Agents of Dispersal

- Animals
- Water
- Wind
- Self-explosive mechanism

Description of Mode/ Mechanism of Dispersal

- Mature fruits are blown away by wind
- Ripe fruits are eaten and seeds egested in feaces.
- Mature fruit attaches onto the animal's skin of clothes using hooks or sticky hairs
- When dry, the fruit splits along the sutures and seeds are scattered away
- Mature fruits are carried away by running water

Questions

1. You are provided with specimen A,B,C and D observe the specimen carefully and answer the following questions.

SPECIMEN	MODE OF DISPERSAL	Reasons for the type of dispersal.
A		
B		
C		
D		

b) i-Cut specimen D transversally into two . Draw and label one half (5mks)

(ii) What type of fruit is specimen B (1mks)

(iii) Give two reasons for your answer.

2. You are provided with specimens A, B, C, and D which are plant organs.

(a) i) Identify the specimens A and B, give the reason(s) for your identity. (02marks)

Identity:

Reason(s):

(ii) Describe the mode of dispersal of specimens A, B, and C. (3 marks)

(iii) Identify specimen D, giving reasons for your answer. (2 marks)

Identity:

Reason(s):

(iv) How is specimen B adapted to its mode of dispersal? (3 marks)

(b) (i) Cut specimen C and D to split them open, along their length, into two halves. Draw and label the structures observed in one half of D. (05 marks)

(ii) Examine the pericarp and seeds (if possible) of specimens A, B, C, and D. State at least three observable features on each specimen.

3. You are provided with specimen **E,F,G** and **H** which are fruits .

(a) State;

i) The type of fruit each one is.

E

F

G

H

ii) The mode of dispersal for each specimen giving a reason.

Mode of dispersal	Reason.
E	
F	
G	

(b) Open up specimen **G** longitudinally specimen H transversally . Compare the sections and state three observable differences between the specimens.

Specimen G	Specimen H.

1	
2	
3	

(c) Draw and label the transverse section of specimen H.

4. You are provided with specimens W,X and Y which are fruits cut across section of specimen Y and examine the specimens using a hand lens where necessary.

(i) Specimen W
Reason.
(ii) Specimen X
Reason.

(i) Specimen
Reason.

(b) Using observable features, describe how each specimen is dispersed. (09mks).
(i) Specimen W
(ii) Specimen X
(iii) Specimen Y

(c) Make a well labeled drawing of one half of specimen Y in the space provided below State your magnification (05mks).

5. (a) You have been provided with specimen J,K and L. Giving a reason in each case, identify them

(i) J
Identity:
Reason:
(ii) K
Identity:
Reason:
(iii) L
Identity:
Reason:

(b) Make longitudinal sections through J and K and answer the following:
(i) List three points of similarity between specimen J and K.
(ii) Without using size and color, give three points of difference between specimen J and K.

J	K

(c)(i) State the agents of dispersal of specimen J, K and L

J

K

L

(ii) Outline the mode of dispersal of specimen L.

(iii) In the space provided below, draw and label the lateral view of specimen L

CHAPTER SIX: PHYSIOLOGY

FOOD TESTS

These are carried out to investigate the presence or absence of specific food substances in a given food sample.

The major food substances tested are;

1. Starch
2. Proteins
3. Reducing sugars
4. Non reducing sugars
5. Lipids
6. Vitamin C (Ascorbic acid)

The following should be carefully considered

- Colour and nature of test reagents and food sample
- Test procedures
- Observations i.e appropriate changes in colour and state
- Conclusions/deductions made from the observations

When recording observations;

- Record the initial colour and nature of substance and its final colour and nature eg for a positive benedict's test on a colourless solution would be; the colourless solution turns to blue solution then green solution then yellow precipitate and finally to orange precipitate.
- Record using present and past tenses only. E.g a turbid solution turned to brown solution

TABLE SHOWING FOOD TYPE, TEST REAGENT AND THE COLOUR OF THE REAGENTS

FOOD TYPE	TEST REAGENT	COLOUR OF REAGENT
Starch	Iodine solution	Brown
Reducing sugars	Benedict's/Fehling's solution	Blue
Non reducing sugars	Benedict's/Fehling's solution	Blue
	Sodium hydroxide	Colourless
	Hydrochloric acid	Colourless
Proteins	Copper(II)sulphate	Blue
	Sodium hydroxide	Colourless
Lipids	Water	Colourless
	Ethanol	Colourless
Vitamin C	Dichlorophenolindophenol(DCPIP)	

FOOD TYPE, TEST PROCEDURES, OBSERVATIONS AND DEDUCTIONS

FOOD TYPE	TEST PROCEDURE	OBSERVATION	DEDUCTION
STARCH	To 1 cm3 of solution in the test tube, add 2 drops of iodine solution	A colourless/turbid solution, turned to black/blue solution.	Starch present
		A colourless/turbid solution, turned to brown/yellow solution.	Starch absent
PROTEINS a. Biuret's test	To 1 cm^3 of solution in the test tube, add 1 cm^3 of sodium hydroxide followed by 3 drops of copper(II)sulphate solution	A colourless/turbid solution, turned turns to purple solution	Proteins present
		A colourless/turbid solution, turned to blue solution	Proteins absent
REDUCING SUGARS	To 1 cm^3 of solution in the test tube, add 1 cm^3 of benedicts solution and boil	A colourless/turbid solution turned to blue solution which persisted on boiling	Reducing sugars absent
		A colourless/turbid solution, turned to blue solution, then to green solution, to yellow precipitate, to orange/brown precipitate.	Reducing sugars present
NON REDUCING SUGARS	To 1 cm^3 of solution in the test tube, add 1 cm^3 of dilute hydrochloric acid and boil for 1 minute. Cool in cold water and add 1 cm^3 of sodium hydroxide solution followed by 1 cm^3 of benedicts solution and boil	A colourless/turbid solution turned to blue solution which persisted on boiling	Non Reducing sugars absent
		A colourless/turbid solution, turned to blue solution, then to green solution, to yellow precipitate, to orange/brown precipitate.	Non Reducing sugars present
LIPIDS a. Ethanol emulsion test	To 1 cm^3 of solution in the test tube, add 1 cm^3 of ethanol, shake vigorously and add equal volume of water	A colourless/turbid solution turned to a white emulsion	Lipids present
		The solution remains colourless	Lipids absent
b. Translucent	Rub a solid food sample on a clean piece of	White paper remains clear after drying	Lipids absent

mark test	paper. Dry the paper in the sunshine	Permanent translucent mark is formed on the white paper	Lipids present
VITAMIN C	To 1 cm^3 of DCPIP, add the solution drop by drop till in excess	Deep blue solution turns into colourless solution	Vitamin C present
		The solution remains deep blue	Vitamin C absent

NOTE:

- *The non-reducing sugars' test will also test positive for all reducing sugars. Therefore it is important to perform the test for reducing sugars before considering this test. If the test for reducing sugars is positive, there is no reason to perform the test for non-reducing sugars - the conclusion will be invalid.*
- *The purpose of the sodium hydroxide is to neutralize the hydrochloric acid added for hydrolysis. If the hydrochloric acid is not hydrolysed, it will react with the sodium carbonate in Benedict's solution, possibly making the solution ineffective.*
- *Some textbooks may recommend using Millon's reagent to test for protein. This reagent contains mercury, which is extremely poisonous and should never be handled by students.*

ENZYME PHYSIOLOGY

Enzyme activity

Enzymes are organic catalysts protein in nature and made in living cells, that speed up the rates of chemical reactions. Without enzymes, metabolic activities would proceed at rather very low rates which would make processes like growth and response very slow.

Enzymes and digestion; Digestion is the breakdown of large complex and insoluble food molecules into small simple and absorbable food molecules. The process of digestion is called hydrolysis since large molecules are broken down to smaller molecules when water molecules are added to them. So we can say that enzymes catalyse hydrolysis or break down of particular foods.

ENZYME	SOURCE	OPTIMUM PH	SUBSTRATE	END PRODUCT
	Synthetic	Weakly Alkaline		(reducing sugar)

Catalase	Animal Tissues	Neutral or weakly alkaline	Hydrogen peroxide	Water and Oxygen
Lipase	Duodenum Extract	Alkaline	Lipids	Fatty acids and Glycerol
Pepsin	Stomach extract Synthetic	Acidic	Proteins	Polypeptides
Trypsin	Duodenum Extract	Neutral or weakly alkaline	Proteins	Amino acids
Sucrase	Yeast	Neutral/ weakly alkaline	Sucrose (non- reducing sugars)	Glucose and fructose (reducing sugars)

Enzymes hydrolyse substrates to products under suitable conditions of temperature and PH

Starch $\xrightarrow{\text{amylase}}$ maltose

Sucrose $\xrightarrow{\text{sucrase}}$ glucose and fructose

<u>When dealing with enzyme physiology note the following</u>

- Addition of sodium hydroxide makes pH alkaline
- Addition of an acid makes the pH acidic
- Addition of distilled water creates a neutral pH

  - When starch is broken down to maltose by amylase(in saliva), reducing sugars are present when a benedict's test is carried out on the resultant solution.

a) Amount of reducing sugars is indicated by the intensity of colours observed from the benedict's test which indicates rate of enzyme activity

Observation	Deduction
Blue solution	Reducing sugars absent
Green solution	Traces of reducing sugars present
Yellow precipitate	Moderate reducing sugars present
Orange/brown precipitate	Much/Very much reducing sugars present

b) When proteins are broken down by pepsin, the resultant solution is less turbid (not thick) and tests negative (blue precipitate) with a biuret test.

Observation	Deduction
Purple precipitate	Proteins present (not broken down to polypeptides)
Blue precipitate	Proteins absent (broken down to polypeptides)
Very turbid solution	Proteins present in high concentrations
Less turbid solution	Proteins present in low concentrations
Clear solution	Proteins absent (broken down to polypeptides)

Action of catalase on hydrogen peroxide

Catalase is secreted in living cells to break down toxic hydrogen peroxide to less harmful water and oxygen. These can be used in other important body functions

Hydrogen peroxide $\xrightarrow{\text{catalase}}$ water + oxygen

Examples of tissues with catalase include

- Liver tissue
- banana tissue
- Potato tissue
- raw pawpaw tissue
- Meat/muscles

Action of catalase is observed in formation of bubbles. Rate of reaction is observed in rate of formation of bubbles (effervescence).

Boiling the tissue destroys (denatures) the enzyme and thus no bubbles are evolved/ no effevescence

Observation	Conclusion/Deduction
Fast bubbles/evolution of gas/fast effervescence occurs/many babbles produced	Fast break down/decomposition of hydrogen peroxide.
Few bubbles of gas given off/slow effervescence/slow evolution of gas.	Slow/less breakdown/decomposition of hydrogen peroxide.
Moderate bubbles of gas given off/moderate evolution/moderate effervescence.	Moderate breakdown/decomposition of hydrogen peroxide.
Least/fewest bubbles/slowest evolution/effervescence occurs	Less/least/little breakdown of hydrogen peroxide.
Very fast/rapid/vigorous evolution of a gas given off/very many bubbles of a gas/very fast effervescence.	Very fast/rapid breakdown of hydrogen peroxide

Factors that can be investigated include

- Surface area where the tissue can be chopped into pieces to increase the total surface area
- PH where a dilute acid/dilute base can be added to a solution containing catalase and the rate of bubbling monitored. LIKE any other enzyme, catalase is affected by these changes in PH. Less bubbling will be observed with acidic solution. This is because catalase works best in neutral/slightly alkaline PH
- Temperature

Questions

1. You are provided with solutions X, Y and Z.
(a) Carry out the following tests to identify the food substances present in solutions X and Y and identify the nature of solution Z.
Record you observations and deductions in the table provided.

	TESTS	OBSERVATIONS	DEDUCTIONS.
i)	T 1 cm^3 of solution X in a test tube add 3 drops of Iodine.		

ii)	Repeat test (i) using solution Y		
iii)	To 1 cm^3 of solution x in a test tube, add 1 cm^3 of Benedicts solution & boil		
iv)	Repeat test (iii) using solution Y		
v)	To 1 cm^3 of solution X in a test tube add 1 cm^3 of diluted sodium hydroxide followed by 4 drops of copper (II) sulphate solution		
vi)	Repeat test (v) using solution Y.		
vii)	To 1 cm^3 of solution Y , add 10 cm^3 of solution Z Boil the mixture for two minutes & cool. Then add 1 cm^3 of diluted sodium hydroxide solution followed by 1 cm of Benedict's solution and boil.		

(b) Explain the results in test (vii)

(c) From the results, suggest what solution Z could be.

2. You are provided with solution T and P.

(a) Carry out the following tests to identify the food substances in solution T Identify the nature of solution P Record your observation and deductions in the table below.

TESTS	OBSERVATIONS	DEDUCTIONS.
i) to 1 cm^3 of solution T in a test tube, add 3 drops of Iodine solution.		
ii) To 1 cm^3 of solution T in a test tube add 1 cm^3 of benedicts solution and boil		
iii) To 1 cm^3 of solution T in a test tube add 1 cm^3 of dilute sodium hydroxide solution followed by two drops of copper II sulphate solution.		
iv) to 1 cm^3 of solution t		

in a test tube add 1 cm^3 of ethanol & shake thoroughly leave it to settle then add 1 cm^3 of distilled water.		
v) To 1 cm^3 of DCPIP in a test tube, add solution t drop by drop up to 10 drops.		

a) From your results in the table above suggest the food substances Resent in solution F

(b)i- Put 5 $cm^2$of T in a test tube and add an equal amount of solution P Incubate the mixture in a water bath maintained at 35^0- 40^0C for 20 minutes (;;You may continue with other numbers in the meantime) After the 20 minutes divide the solution into three portions carry out the following tests and record your observations and deductions in the table below.

Test	Observations	Deductions.
i) to 1 cm^3 of the first portion , add 3 drops of Iodine solution.		
ii) To 1 cm^3 of the second portion add 1 cm^3 of dilute sodium hydroxide followed by 3 drops of copper (ii) sulphate		
(iii) To the third portion add 1 cm^3 of Benedicts solution and boil.		

(b) From your results in the table above suggest with a reason the identity of solution P

(iii) State with a reason one property of solution P

3. (a) You are provided with solution A, B and C. Use the reagents provided to determine the chemical nature of the substances present in the two solutions. Fill in your observations and deductions in the table below.

TEST		OBSERVATIONS	DEDUCTIONS
(i)	To 1cm^3 of solution A add 2 drops of iodine solution		
(ii)	Repeat the test in (i) above with 1cm^3 of solution B		
(iii)	To 1cm3 of A add 1 cm3 of Benedict's solution and boil for 3 minutes		

(iv)	Repeat the test in (iii) above with 1cm^3 of solution B		
(v)	To 1cm^3 of A add 5 drops of dilute hydrochloric acid and boil for 1 minute. Cool in cold water and add 1cm^3 of dilute sodium hydroxide. Add 1cm^3 of Benedict's solution and boil for 3 minutes.		
(vi)	Repeat the test in (v) with 1cm^3 of B.		

(b) What is the nature of A and B?

A

B

(c) What was the purpose of adding;

(i) Dilute hydrochloric acid?

(ii) Dilute sodium hydroxide in experiments (v) and (vi)?

(d) Using the reagents provided carry out tests for protein and vitamin C on substance C. Record your tests, observations and conclusions in the table below.

	Test	Observation	Deduction
Protein			
Vitamin C			

4. You are provided with suspension ***A*** and solution ***B***.

(a) Carry out the following tests to identify the food substances in solution ***A*** and the effect of solution ***B*** on ***A***.

Table 1

TESTS	OBSERVATION	DEDUCTION
(i) To $1cm^3$ of ***A*** in a test tube add 2 drops of iodine solution.		
(ii) To $1cm^3$ of ***A*** in a test tube add $1cm^3$ of Benedict's solution and boil.		
(iii) To $1cm^3$ of ***A*** in a test tube add $1cm^3$ of dilute		

sodium hydroxide solution followed by 2 drops of copper sulphate solution.		
(iv) To $1cm^3$ of ***A*** in a test tube add $1cm^3$of ethanol and shake thoroughly. Leave to settle then pour off $1cm^3$ of the mixture into a test tube containing $1cm^3$of distilled water.		
(v) To $1cm^3$ of DCPIP in a test tube add a drop by drop up to 10 drops of solution ***A***		

(b) To $4cm^3$ of suspension ***A*** add $2cm^3$ of solution **B**. Incubate the test tube in a water bath maintained between $35^oC - 40^oC$ for 30 minutes. (you may continue with other work meantime) after 30 minutes carry out the tests in table 2 and record your observations and deductions in the table below.

Table 2

TEST	OBSERVATION	DEDUCTION
To $1cm^3$ of the mixture add 2 drops of iodine solution.		
To $1cm^3$ of the mixture add $1cm^3$ of dilute sodium solution followed by 2 drops of copper sulphate solution.		

(c) Explain the effects of solution ***B*** on solution ***A***.

(d) Suggest with a reason the identity of the active substance in solution **B**.

Identity:

Reasons:

(e) State with a reason, one property of the active substance in solution ***B*** shown in this experiment.

Property:

Reasons:

(f) Explain why the test tube in (b) was incubated in a water bath maintained between $35^oC - 40^oC$ for 30 minutes.

5. You are provided with specimen A.

(a) Make a drawing of specimen A. Do not label, state the magnification.

(b) Crush specimen A in a mortar, add 10cm^3 of water and decant into a test tube. Call this solution B. Carry out tests on solution B as indicated in the table below, to identify the food nutrients contained in A. Write down your tests, observations and deductions in Table 1 below.

Table 1

TEST	OBSERVATIONS	DEDUCTION
Buiret test		
Benedict's test		
Non reducing sugar test		

(c) Where do the stored foods come from if any and of what significance are they?

(d) You are provided with solution C. Carry out the following tests as indicated in Table 2 to find out the nature of C.

Table 2

TEST	OBSERVATIONS	DEDUCTION
(i) Put 1cm^3 of solution C in a test tube, add 2 drops of Iodine solution		
(ii) Put 2cm^3 of solution C in a test tube, add 2cm^3 of Benedict's solution and boil.		
(iii) To 1cm^3 of DCPIP in a test tube, add solution C drop by drop until no further change		

(e) From your results above, name the food substances in solution C.

OSMOSIS AND DIFFUSION

Osmosis is the movement of solvent molecules from the region of lower concentration (dilute) to a region of higher concentration through a semi permeable membrane. The solvent molecules are usually water molecules

- When a plant tissue is put in a solution of a different concentration to that of its cell sap, it may gain water by osmosis if the solution is hypotonic to (more dilute than) the plant sap or it may lose water by osmosis if the solution is more concentrated than (hypertonic to) the sap. This causes a change in ;
    - ⇨ Length of the tissues
    - ⇨ Volume of solution
    - ⇨ Texture of the tissues

Change in Length, Mechanical state and Texture.

In dilute (hypotonic) solution plant cells take in water by osmosis and;

- Become hard and rigid
- Increase in Length

In concentrated (hypertonic) solutions, plant cells lose water by osmosis and;

- Decrease in length
- Become soft and flexible

In solutions isotonic (have the same concentration) with the cell sap, there is no net movement of water by osmosis between the cells and the solution hence show no change in length, texture and rigidity.

Change in Curvature (Curling Of Strips)

- In dilute (hypotonic) solutions, strips absorb water into the fleshy inner cells and the strip curls with the outer layer (epidermis) on the inside of the curve.
- In concentrated (hypertonic) solutions, strips lose water by osmosis from its fleshy inner cells and the strip curves inwards with the outer layer (epidermis) on the outside.
- Strips in isotonic solutions do not curl because they have no net loss or gain of water by osmosis.

Change in Density/ Volume (Using coloured solution)

- Two sets of solutions one which is coloured and another which is clear are used.
- Strips are immersed into the coloured solutions and left for some time.

- A little coloured solution is sucked and a drop introduced just below the meniscus of the corresponding clear solution.
- If the coloured solution is hypotonic to the cell sap, the coloured solution loses water to the plant tissue. As a result, the density of the coloured solution increases. This is observed by sinking of the drop in the clear solution.
- If the coloured solution is hypertonic to the cell sap, the tissue loses water by osmosis to the coloured solution. As a result, the solution becomes less dense hence the drop becomes less dense and rises.
- If the solution and the cell sap are isotonic, the coloured solution neither loses nor gains water by osmosis. As a result, its density does not change hence the drop neither sinks nor rises but rather spreads

EXPERIMENTS INVOLVING VISKING TUBING

Proof that Visking Tubing is Semi Permeable

- One end of the visking tubing is tied
- Through the open end, pour some starch and glucose solution into the visking tubing
- Wash the visking tubing under a running tap to avoid contamination
- Immerse the visking tubing and its contents into a beaker containing distilled water.
- Leave the experiment to stand for 30 minutes.
- After 30 minutes test the solution in the beaker for starch and reducing sugars.
- Reducing sugars are found present while starch is found to be absent
- Small glucose molecules diffuse across the semipermeable membrane of visking tubing.
- Large molecules of starch do not diffuse across the visking tubing.
- Due to osmosis, water molecules diffuse from the beaker into the visking tubing causing the visking tubing to expand

Questions

1. You are provided with the following specimen T, Solution A solution B, Solution C; using a cork borer produce 4 cylinders of tissues from specimen T, cut the cylinders to a uniform length of 4cm each
   (ii) Place one cylinder of tissue in each solution A, B, and C and leave one exposed to air leave the set up for 1 hour.

(iii) Remove the tissue cylinders and dry them gently using a filter paper to remove excess solution
- measure them
- record them
- feel each cylinder and record their texture in the table below
- Calculate the percentage change in length for each cylinder and record in the table below.

Cylinder of potato	Initial length	Final length	Percentage change in length	Texture
Solution A				
Solution B				
Solution C				
Air				

(a) Name the process responsible for your results above
(b) Explain what happens in the cylinder placed in each solution
i) Solution A

ii) Solution B

iii) Solution C

iv) Air

Arrange solution A, B and C in order of increasing osmotic potential

(c) What is the significance of your observations about the role of water in plant tissues

2. You are provided with a piece of Liver and solution **X**. You are requested to carry out tests on the Liver using solution **X**

(a) cut six (6) pieces of liver each measuring 1 cm X 1 cm Z 1 cm. Take one piece and boil it in 3 cm^3 of water for 10 minutes and leave it to cool.

Take four pieces four pieces one at a time and divide each into four smaller pieces but keep the smaller of each piece together.

Label 6 (six) test tubes 1,2,3,4, 5 and 6, Add contents to each of the test tubes as shown in the table 1 below.

Test tube	**Contents.**
1	**2 cm^3 of X**
2	**2 $m,^3$ of X**
3	**2cm^3 of X + 3 drops of dilute Hcl**
4	**2 cm^3 of X + 3 drops of dilute NaoH**
5	**2cm^3 of water.**

6	**2 cm^3 of X**

Now add the pieces of liver to the test tubes as shown in Table 2 and record your observation.

TEST TUBE	PIECE OF LIVER	OBSERVATION
1	Un boiled whole piece of 1 cm^3 X 1 cm^3 X 1cm^3	
2	4 smaller pieces.	
3-	4 smaller pieces.	
4	4 smaller pieces.	
5	4 smaller pieces	
6	Boiled whole pieces of 1 cm^3 X 1 cm^3 X 1cm^3	

(b) Using your results write the numbers of test tubes indicating the order of reactivity, starting with the most reactive. (02mks)

(c) Explain the difference in reaction between the contents in.

(i) Test tube 1 and test tube 2 (2 ½ mks)

ii) Test tube 3 and test tube 4 (2 ½ mks)

(d) Explain your results in.

i) Test tube 5 (2mks)

ii) Test tube 6 (2mks)

3. You are provided with solutions A and B

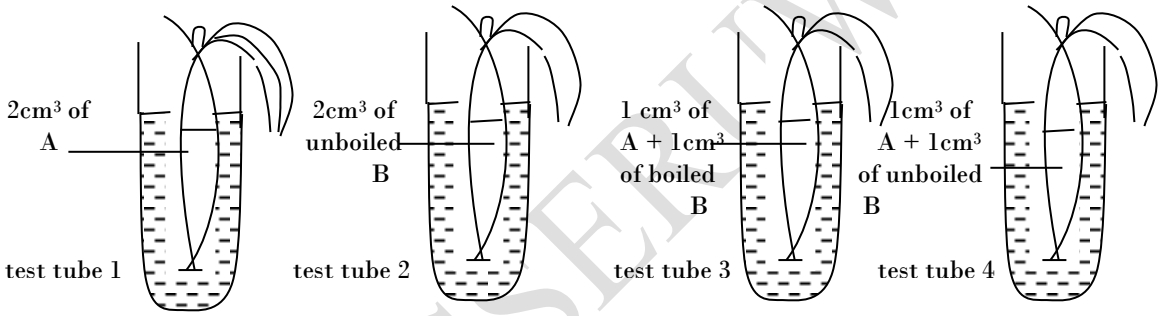
(a) Carry out the following tests to identify the food substance in solution A and record your observation and deductions in the table (6 marks)

TEST	OBSERVATION	DEDUCTION
(i) To 1cm^3 of solution A add 2 drops of iodine solution.		
(ii) To 1cm^3 of solution A add 1cm^3 of Benedict's solution and		

	boil.		
(iii)	To 1cm^3 of solution A add 1cm^3 of NaOH followed by 2 drops of copper sulphate solution.		

(b) Label four, test tubes 1,2,3 and 4 and fill each tube with distilled water.

- Tie one end of each of the four visking tubes provided using a thread. Add different contents to each visking tube and tie the second end of each visking tube as shown in figure 1
- Wash the outside of the visking tubes and place them into the test tubes half filled with water as shown in the set up in Figure 1. Leave the set up for 25 minutes. (You may proceed with other work in the meantime)



After 25 minutes, remove the visking tubes and carry out test for reducing sugars on the distilled water in each test tube by using only 1cm^3 of distilled water. Record your observations and deductions in the table. (4 marks)

TEST TUBE	OBSERVATION	DEDUCTION
1		
2		
3		
4		

(c) Explain your results in

(i) Test Tube 1

(ii) Test tube 3

(iii) Test tube 4

(d) (i) State the process that leads to the presence of reducing sugars in distilled water of test tube(s) in which it is present.

(ii) What is the importance of this process in the human body and plants?

Human body
Plants

4. You are provided with solutions A, B and C and a piece of a plant stem; T. you are to carryout tests on T, using the solutions, by following the instructions below.

Label three petri dishes, A, B and C and fill each of them with the corresponding solution. Measure and cut off a piece 4cm long from T using a razor blade, evenly peel off 3 strips, each about 2mm thick, along the whole length of the cut piece (see figure 1) . Ensure that each strip has the epidermis.

Put one strip in each of the solutions in the petri dishes and leave for 20 minutes.

(a) After 20 minutes, remove the strips from the solutions and,

(i) Measure the distance between the ends of each strip and record your results in the space provided in the table. Label the Epidermis.

	Strips after 20 minutes in solutions		
	A	**B**	**C**
Distance between ends (cm)			
Drawing			

(b) Explain the effect of solutions A, B and C on the strips in:

(i) Solutions A.

(ii) Solution B.

(iii) Solution C

(c) (i) Which one of the solutions A, B and C has a concentration which is almost the same as that of the cell sap of the plant strip?

(ii) Explain your answer.

(d) (i) Name the process demonstrated in the experiment.

(ii) Outline the importance of the process to flowering plants

5. You are provided with specimen A and sucrose solutions of different concentrations as shown in table 1.

i) Cut six long strips out of A using a cork borer of 0.5 cm in diameter. All the strips must be cut along the same axis.

ii) From the long strips, cut out six strips each measuring 3 cm in length.

iii) Place one strip in each of the sucrose solutions ensuring that the strip is immersed.

iv) Leavethe strip for one hour (be doing other work)

v) After one hour, remove one strip at a time and measure its final length.

a) Record the measurements appropriately in table 1. Complete the table.

Molarity of sucrose solutions	Initial length(cm)	Final length(cm)	Initial length: final length ratio
0.00M			
0.10M			
0.25M			
0.50M			
0.75M			
1.00M			

b) in the space provided plot a graph of the initial: final length ratio against molarity of the sucrose solution

c) i) explain the shape of the graph.

ii) determine the molarity of the sucrose solution that is isotonic to the cell sap of A.

i) compare the physical condition of the cylinder from a 0.00M solution and that from 1.00M solution.

Physical condition of cylinder from 0.00M	Physical condition of cylinder from 1.00M

ii) explain the significance(s) of the physical condition of the cylinder from 0.01M solution to plants.

CHAPTER SEVEN: ARTHROPODS

Phylum Arthropoda

Characteristics (observable features) of phylum arthropoda

- Have segmented body
- Have an exo skeleton made of chitin
- Have jointed legs.

Phylum arthropoda has five classes namely; insect, arachnida, crustacea, chilopoda and diplopoda.

Classes of phylum arthropoda

CLASS	EXAMPLES	OBSERVABLE FEATURES
Insecta	Cockroach, house fly, bee, grass hopper, beetles	- Have body divided into 3 parts - Have 3 pairs of legs - Have a pair of compound eyes - Some have wings - Some have antennae
Crustacea	Crabs, prawns, robsters	-have two pairs of antennae -have bi-forked appendages
Arachinida	Spider, ticks, Scorpions	- Have two body divisions(have a cephalothorax ie head fused with thorax) - Have four pairs of legs - No antennae - Have more than two simple eyes
Chilopoda	Centipedes,	- Have elongated bodies with several segments - Have one pair of antennae - Have several legs - Have simple eyes
Diplopoda	Millipedes	

The most examinable class of arthropods is class Insecta

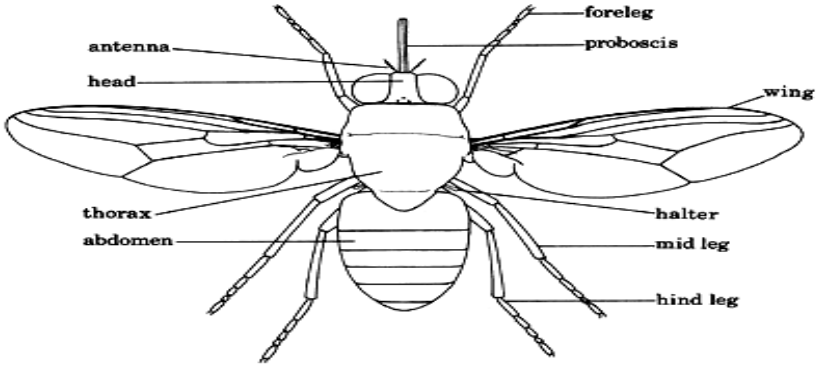
CLASS INSECTA

Characteristics (observable features) of class insecta

- Possession of three main body divisions
- Possession of three pairs of legs
- Possession of three thoracic segments i.e. prothorax, mesothorax and metathorax.

Other characteristics include;

- Have a pair of compound eyes except for the soldier termite
- Have a pair of antennae
- Have wings except in very few species like termites
- Have three simple eyes called ocelli



Orders of some common insects

ORDER	EXAMPLES
Dictyoptera	Cockroach
Hymenoptera	Ants, bees, wasps,
Isoptera	Termites
Lepidoptera	Butterflies, moths
Diptera	Houseflies, mosquitoes
Orthoptera	Locusts, grass hoppers
Coleopteran	Beetles, weevils

Candidate may be required to;

- Identify the specimen i.e. stating the phylum and class with reasons.
- Describe observable features on the head, thorax, abdomen and legs.
- Use the observed features of the parts to construct a dichotomous key
- State structural differences between different specimens
- Give adaptations of specimens to their habitats and mode of life.

Cockroach (*Periplaneta americana*)

The common species of cockroach in the tropics is Periplaneta americana. This is most active at night, during day it hides in dark places and crevices of walls.

Kingdom: **Animalia;**

- eyes for sight
- mouth parts for feeding
- legs for locomotion

Phylum: **arthropoda;**

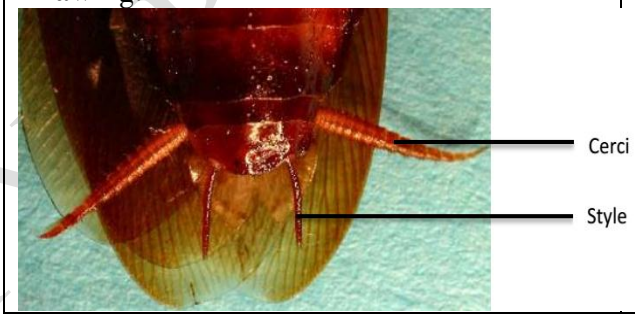
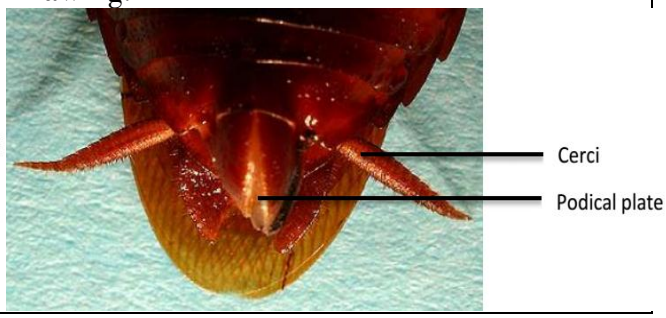
- body segmented
- legs jointed
- exoskeleton

Class: **insecta;**

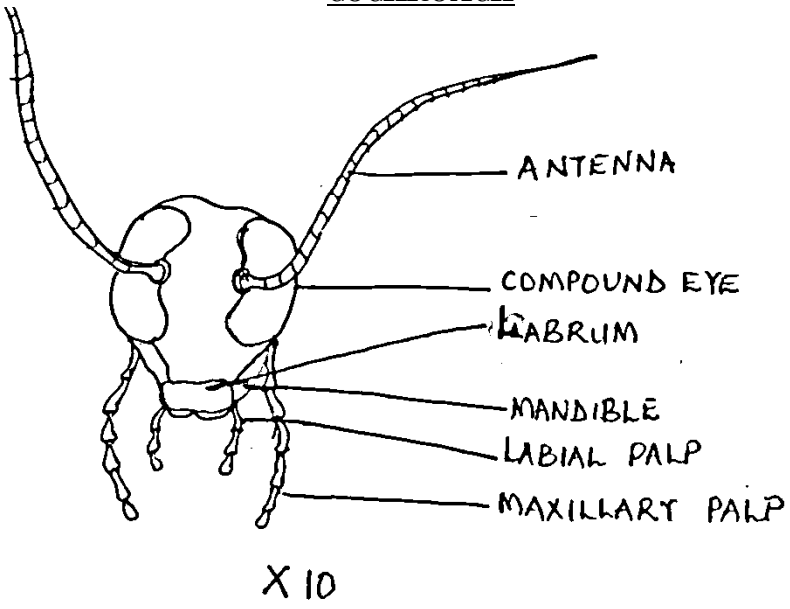
- three main body divisions
- three pairs of legs
- Three thoracic segments, a pair of antennae.

Order: **Dictyoptera**
Genus: *Periplaneta*
Species: *Periplaneta americana*

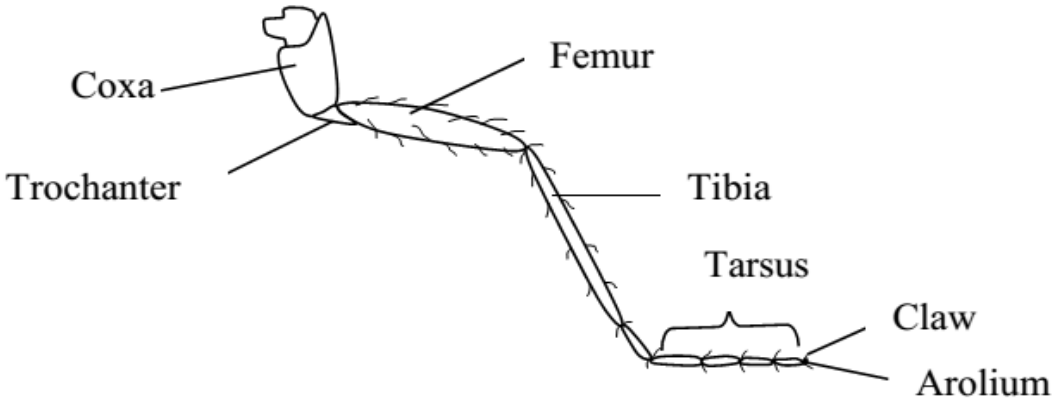
Identification of sex

Male	**Female**
1. Has a narrow abdomen	Has a broader abdomen
2. Lack oothecal	Has ootheca which develops after fertilization.
3. Has rod-shaped structures called styles on the 9th abdominal segments.	No styles on the 9th abdominal segment.
4. No podical plates.	Has podical plate for carrying eggs.
Drawing: 	Drawing: 

A DRAWING SHOWING EXTERNAL FEATURES OF THE HEAD OFA COCKROACH



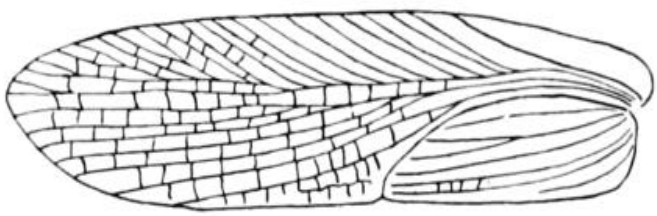
THE HIND LEG OF A COCKROACH



Adaptation of the wings

The outer wing

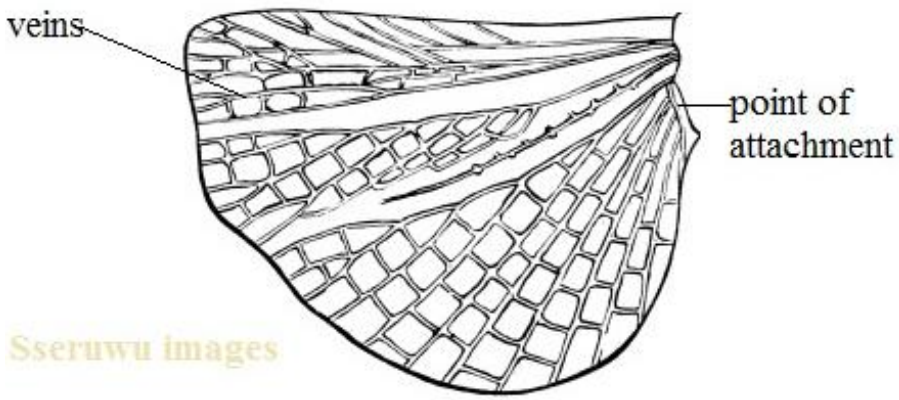
- Are hard; hence they are for protection.



- They are dull – coloured for camouflage(hide from its enemies)

The inner wing

- Are veined and membranous; for flight also allows air circulation in the wing.
- They are wide spread(broad when unfolded) to increase the surface area during flight.



Adaptations to its mode of life

- ➲ Dorsal-ventrally flattened body that enables it to fit in cracks and crevices to avoid predators
- ➲ Its streamlined body shape reduces air resistance during movement
- ➲ Dark in colour for camouflage in the habitat
- ➲ Has a glossy body surface to escape from the grip of the predators
- ➲ Body is covered with waxy cuticle to reduce evaporation of water/desiccation
- ➲ Have sharp serrated mandibles for cutting food
- ➲ Jointed maxillae and labium for flexibility when pushing food
- ➲ Have hairy maxillary palps for increased sensitivity
- ➲ Have long tapering antennae to sense at a distance. The antennae are segmented for flexibility to move in all directions
- ➲ Possession of hard outer wings to protect the inner membranous wings from physical damage
- ➲ Inner wings are broad for generating a big lift force during flight. They have veins for support in flight
- ➲ Have jointed limbs for flexibility during movement. Each limb bears a pair of claws with Arolium pad between them; adhesive for gripping on a slippery surface
- ➲ Hind legs are long and strong to offer a propulsive force to push the insect forward; they bear spines to prick and scare away predators (offers protection)

OBSERVABLE FEATURES OF WINGS OF SOME COMMON INSECTS

COCKROACH	WORKER BEE	HOUSEFLY
- Inner wings are thin, transparent, and membranous. - Outer wings are opaque, thick, stiff and narrow shaped	- Two pairs of transparent and membranous wings.	- Pair of membranous transparent wings - Pair of halters.

A Table summarizing the observable features of the four major insects

Specimen	Mouth parts	Wings	Legs
COACKROACH	- A pair of maxillary palp which are joined and hairy. - A pair of sharp mandibles. - Jointed labium that hairy with palps.	- 2 pairs of wing - Outer wings are thick, striff and narrow shaped. - Inner wing are membranous and broad shaped.	- 3 pairs of jointed legs. - Legs have spines and claws
WORKER BEE	- Has a pointed proboscis - Jointed pulps sharp mandibles	- Two pairs of membranous wing.	- 3 pairs of legs jointed and hairy. - Hind legs have a pollen basket on stiff hair/pollen brush. - Middle legs have prongs.
HOUSEFLY	- Has grooved/funnel shaped/expanded proboscis. - A pair of hairy pulps.	- A pair of membranous wings.	- 3 pairs of hairy and jointed legs. - Legs have claws.

		- A pair of hatres	
TERMITE	- Very sharp and strong curved mandibles. - A pair of jointed pulps.	- No wings	- 3 pairs of jointed legs with claws.

House fly

Kingdom: **Animalia;**
- eyes for sight
- mouth parts for feeding
- legs for locomotion

Phylum: **arthropoda;**
- body segmented
- legs jointed
- exoskeleton

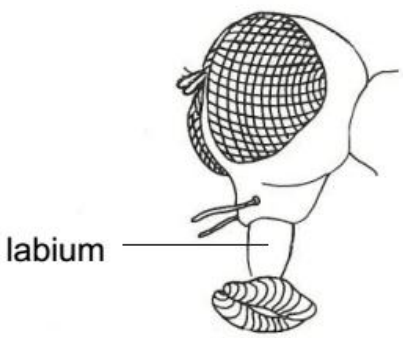
Class: **insecta;**
- three main body divisions
- three pairs of legs
- three thoracic segments, a pair of antennae.

Order: diptera; (two wings)
Genus: *Musca*
Species: *Musca domestica*

Characteristics of housefly:

i. Body is hairy.
ii. A pair of short hairy antennae, each with three segments.
iii. A pair of large bulging compound eyes.
iv. Three ocelli.
v. Sucking proboscis wide at the end.
vi. A pair of thin transparent wings with network veins, and the second pair of wings reduced to haltares.
vii. Three pairs of legs.
viii. Abdomen is short, broad, segmented, with four easily seem segments.

A drawing of a lateral view of the head of a housefly.



Honey Bee

Kingdom: **Animalia**;
- eyes for sight
- mouth parts for feeding
- legs for locomotion)

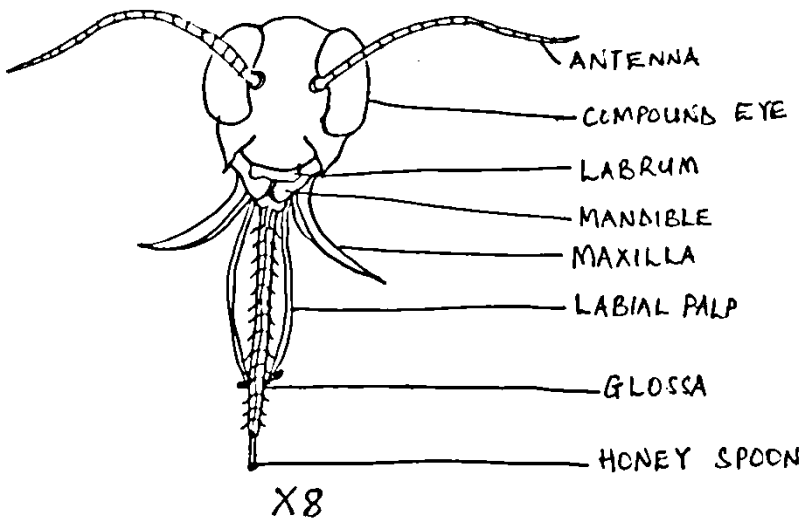
Phylum: **arthropoda**;
- body segmented
- legs jointed
- exoskeleton

Class: **insecta**;
- three main body divisions
- three pairs of legs
- three thoracic segments, a pair of antennae.

Order: **hymenoptera**; (stinging ovipositor, four wings)
Genus: *Apis*
Species: *Apis melifera*
Characteristics of bee:

i. Body is hairy. The head is not fixed on the thorax and therefore it is free to move (mobile)
ii. A pair of short hairy and segmented antennae, each with three segments.
iii. A pair of large bulging compound eyes.
iv. Three ocelli.
v. Sucking proboscis is pointed and curved, mandibles with broad round ends and curved. It is used for lapping during feeding and also used for construction, the glossa also modified for sucking.
vi. Two pair of thin wings with network veins.
vii. Three pairs of hairy legs.
viii. Abdomen is short, broad, segmented, with easily seem segments.

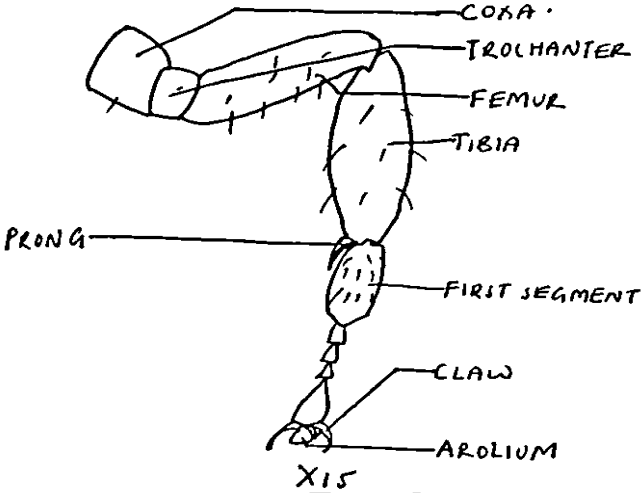
DRAWING OF MOUTH PARTS OF A WORKER BEE



➲ The features on the thorax include pairs of legs which differ in various aspects as shown below.

The fore leg

The fore leg has a pollen comb located at the end of the tibia. This is used for cleaning pollen off the head.

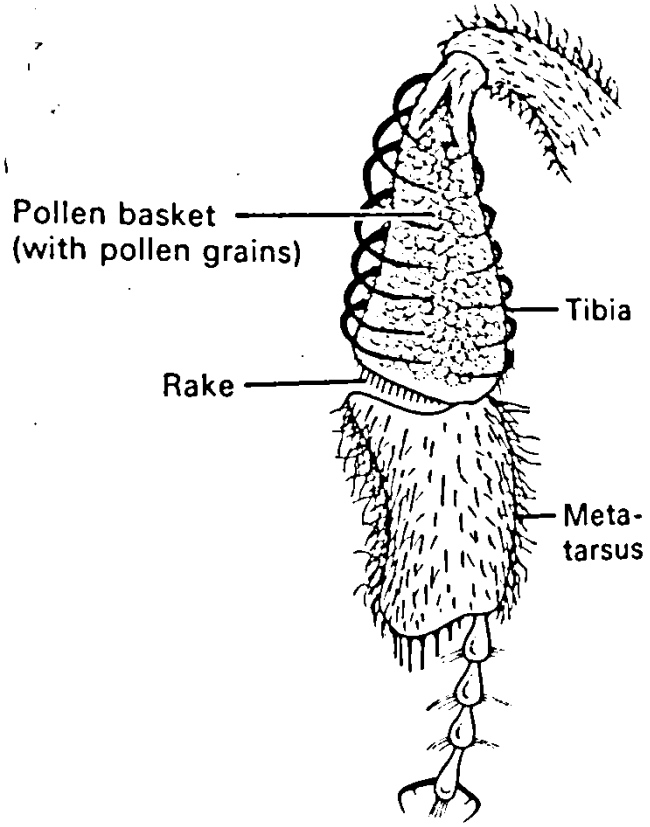


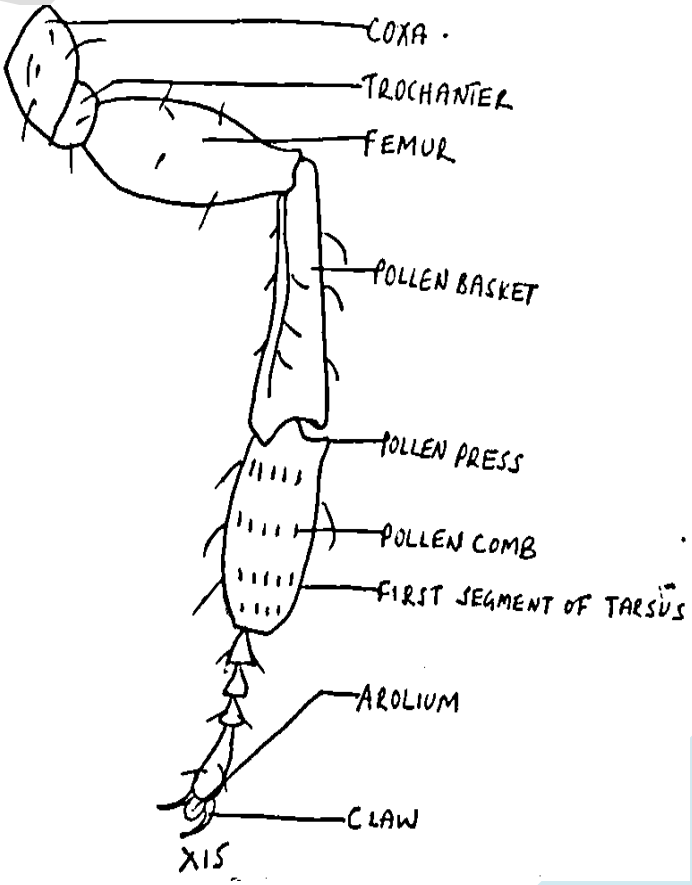
The middle leg

These legs possess a hair like structure, prong at the distal end of the tibia. The prong is used for scooping pollen grains out of the pollen basket on the hind leg

The Hind leg

The leg is hairy with pollen baskets, which are responsible for carrying pollen grains





Termite

Kingdom: **Animalia**;
- mouth parts for feeding
- legs for locomotion)

Phylum: **arthropoda**;
- body segmented
- legs jointed
- exoskeleton

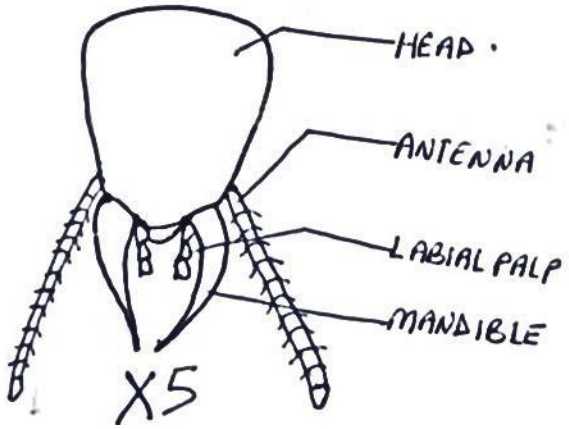
Class: **insecta;**
- Three main body divisions,
- three pairs of legs,
- three thoracic segments, a pair of antennae.

Order: isoptera;
Characteristics of Soldier termite

i. Large head
ii. A pair of short antennae.
iii. A pair of large sharp curved mandibles
iv. Three pairs of legs.

Abdomen is short, narrow, segmented

Drawing of a head of a termite



Sugar ant

Kingdom: Animalia; (eyes for sight, mouth parts for feeding, legs for locomotion)
Phylum: arthropoda; (body segmented, legs jointed, exoskeleton)
Class: insect; (three main body divisions, three pairs of legs, three thoracic segments, a pair of antennae.
Order: diptera; (stinging ovipositor)
Characteristics of Sugar ant

i. A pair of short jointed antennae.
ii. A pair of small bulging compound eyes.
iii. A pair of sharp mandible
iv. Three pairs of legs.
v. Abdomen is pointed at the end and contains a sting.

General adaptations of insects to their mode of life

- A pair of long antennae for sensitivity
- Has hard exoskeleton that prevents dissertation/excessive loss of water
- Have Wings which;
  (i) Provide support for the bird in air.
  (ii) Propel the bird forward during flight.
  (iii) The wings have strong veins to support/strengthen the wings during flight.

- Compound eyes for seeing
- Long and muscular limbs that gives the insect propulsive forward force as it leaves the ground
- Short fore limbs that absorb shock on landing.
- Arolium pad

Class: Arachnida

Arachnida are terrestrial arthropods. Members of this class all have 8 legs. Examples of arachnids include spiders, ticks, scorpions and mites

Characteristics

- Possession of two main body divisions
- Have four pairs of legs
- Lack antenna
- Have no wings
- Have simple eyes.

Class: Chilopoda

Chilopoda is made up of centipedes. These have a pair of antennae, simple and compound eyes, although **some lack compound eyes**, a pair of legs on each segment and poison claws. The centipedes are mainly found on land.

Class: Diplopoda

Class Diplopoda is made up of millipedes. These have one pair of antenna, mandibles, simple and compound eyes and two pairs of legs in each segment. Millipedes are common on damp places.

Questions

1. You have been provided with specimen K study it carefully and answer the questions that follow.

a) Classify the specimen as follows:
Kingdom
Phylum
Class

b) Outline any four structural adaptations of specimen K for surviving in its habitat

c) Cut off one hind leg of specimen K and draw it. Label your drawing and state the magnification

2. You are provided with specimen K.

(a)Observe specimen K & state the phylum class & the specimen belong to. – giving two reasons

(i) Phylum

Reasons.

(iii) Class

Reasons.

(b) Examine the mouth parts of specimen K using a hand lens and suggest the type of food he specimen feds on giving reasons

ii) Describe how the mouth parts are suited for the type of food eaten the specimen

(c)i- Examine the wings of the specimen and describe their structure.

Inner wings

Outer wings.

ii) State the function of the wings of specimen K basing on their structure.

Inner wings.

Outer wings.

d) Observe the fore and hind limbs of specimen K and describe them fore limbs

Fore Limbs.

Hind limbs .

ii) How is the structure of the limbs related to their function

(c) Cut off the hind limb of specimen K and draw It. Do not label but state of t he magnification of your drawing.

3. You are provided with specimens Q,R,S, T and U. Examine the external features of each of the specimens carefully using a hand lens and answer the following questions.

(a) List three observable similarities between all the five specimens.

(b) To what phylum do all the specimens belong?

Phylum

(c) State with reason in each case, the class to which specimen Q and R belong

Q: class

Reason

R: Class

Reason

(d) State one observable difference between specimens S and T

Specimen S	Specimen T

(2 marks)

(e) State two observable features of specimen U which distinguish it from the rest of the specimens

(f) Construct a dichotomous key which would enable you identify the five specimens.

4. You are provided with specimens K and L.

a. Using a hand lens, examine the specimens and state their phylum and class giving reasons.
   a. Phylum
      Reason
   b. Class
      Reason

b. State three structural differences of the head between specimen K and L in the table. (3 marks)

Specimen K	Specimen L

c. Suggest two survival adaptations of each specimen to its habitat.
   i) K
   ii) L

d. Suggest two structural adaptations of specimen K as a vector.

e. Place specimen K dorsal side uppermost and draw its thorax and the first segment of the abdomen. Label your drawing and state its magnification.

5. You are provided with specimens L, M, N and O. Study them

(a)(i) Using a hand lens, observe the head regions of M and N. State five differences in their structures.

M	N

(b)(i) Cut out and examine the wings of O. State three differences between the outer and inner wings.

Outer wing	Inner wing

(ii) How is the hind limb of O adapted for locomotion

(d) With aid of a hand lens, observe the mouth parts of specimens and construct a dichotomous key for their identification.

6. You are provided with specimens **K** and **L**.

(a) Basing on external observable features, state one common group to which both specimens belong. Give two reasons for your answer.

(i) Common group.

(ii) Reasons:

(b) State the class to which each specimen belongs. Give one reason in each case.

Specimen Class Reason

K

L

(c) State four structural differences between specimens **K** and **L**.

	K	**L**
1.		
2.		
3.		
4.		

(d) State one advantage of specimen **K** over **L.**

(e) How is specimen **L** adapted to living in its habitat?

(f) Draw and label the hind limb of specimen **K**.

7. You are provided with specimens P and Q which are animals.

a) Giving 2 reasons, state the class to which the specimens belong.
   Class
   Reasons

b) Observe the head region of both the specimens. State two observable differences between them.

c) Observe features attached to the thorax of specimen P. describe them.

(d) State 2 adaptations of specimen Q that enables it to survive in its habitat.

CHAPTER EIGHT: SOIL

Practical experiments on soil usually aim at investigating soil properties which include

- Proportion of different soil particles
- Water retention capacity of different soils provided
- Drainage rates
- Capillarity of different soil samples
- Percentage of air in the soil sample provided
- Percentage of soil water
- Presence of living organisms in the soil
- Soil PH

A TABLE SUMMARISING PROPERTIES OF DIFFERENT TYPES OF SOIL

Clay Soil	**Loam soil**	**Sandy soil**
Very small particles	Moderate	Large particles
Great water retention capacity	Good water retention capacity	Poor water retention capacity
Compactly packed particles	Moderately packed	Loosely packed particles
Has very small air spaces hence poor aeration	Moderate/average air spaces	Has large air spaces and therefore good aeration
Very smooth and soapy when wet	Moderate texture	Rough texture
Grey in colour	Dark coloured	Light coloured
Poorly drained	moderate	Well drained
Almost have no living organisms	Have few living organisms	Have many living organisms
Warms up slowly(takes time to warm up)	moderate	Heats up/warms up very fast/quickly
Hard/heavy to cultivate	Easy to cultivate	Easy to cultivate
Rich in mineral salts	Rich in humus, good mineral content	Poor mineral content

INVESTIGATING PROPERTIES OF SOIL

Water retention capacity and drainage

- Drainage refers to amount of water that passes through the soil sample.
- Water retention is the water holding capacity.

Consider the following results

Volume of water added to soil = y cm3

Volume of water collected in cylinder = x cm3

Time taken for water to stop draining through = t seconds

Volume of water retained = (y-x) cm3

Rate of drainage = (y-x)/t cm3/second

Texture

Presence of soil organisms

- Two soil samples may be used.one with fresh soil and another with baked soil.
- The two soil samples are tied in muslin bag separately
- Muslin bags are lowered into a boiling tube containing an indicator and corked tightly
- The indicators used are

  Bi carbonate indicator

  Lime water
- Living organisms give out Carbondioxide from respiration
- Carbondioxide turns lime water milky and bi carbonate indicator
- Carbondioxide turns bicarbonate indicator from red to yellow as the solution becomes acidic.

Permeability (capillarity)

❖ capillarity is a measure of how water rises in a soil

To demonstrate capillarity,

- A tube is closed at one end with cotton wool and filled with the soil sample.
- The calibrated glass tube is then made to stand in a trough containing water clamped firmly.
- The rise in water after every 10 minutes is recorded for 1hour.

Percentage of air

A known volume of soil is added to a known volume of water.

- The volume of the mixture before and after stirring are noted.

Volume of water = x cm3

Volume of soil = y cm3

Volume of mixture before stirring = (x+y) cm3

Volume of mixture after stirring = z cm3

Percentage of air $= \frac{(x+y) - z}{y} \times 100\%$

- During stirring, air escapes and is seen as bubbles which reduces the volume of the mixture.

Percentage of water

- A known mass of fresh soil is heated to a temperature of about 105oC for water to evaporate.
- The new mass of the dry soil is noted

Mass of fresh soil = X g

Mass of dry soil heated to 105oC = Y g

The percentage of soil water $= \frac{(X-Y)}{(X)} \times 100\%$

Humus content

To determine the percentage of humus, fresh soil is first heated gently for water to evaporate and then the dry soil is heated strongly to red hotness.

Mass of fresh soil = X g

Mass of dry soil =Y g

Mass of red hot soil =Zg

The percentage of humus in the dry soil sample = $\frac{(Y-Z)}{X} \times 100\%$

Soil pH

Soil pH is measured using the BDH soil indicator which changes colour according to pH.

Examples

1. You are provided with a soil sample T(mixture of many soil samples obtained from the garden).
   - Measure 100cm3 of T using a beaker and transfer it to a 1000ml measuring cylinder and add 500cm3 of distilled water
   - Using a black polythene bag and a rubber bang, tightly close the mouth of the cylinder containing the mixture
   - Gently shake the mixture until its mixed thoroughly well
   - Leave the contents to settle for 10 minutes

a) State your observation after 10 minutes

Layers form in the mixture

Note: *this is due to different sizes and densities of the particles*

b) Using a ruler, measure the vertical length of each layer. Also determine the total vertical distance of all observed layers (h)

Table of results

Vertical distance of each layer	**Percentage depth ($^{1}/_{h} \times$ 100)**	**Identity of the layer**

i) Suggest the aim of the experiment

To compare the proportion of different soil particles in soil sample

ii) Explain your results in the table

Parent rock/coarse particles settle at the bottom since they have big and denser particles than the rest. Fine lightest particles settle at the top due to their low densities

c) using a hand lens, examine the presence of any living organism and name them. Suggest an ecological significance of each organism

Living organism	Ecological significance
Nematodes	Contribute to food web
Earth worms	Food for bigger animals, improve on aeration and drainage
Termites	Breakdown organic matter, improve soil aeration

NOTE; bacteria and fungi are too small to be seen using a hand lens

Questions

You are provided with soil samples X, Y and Z

i) Measure 50cm3 of X into a measuring cylinder

ii) Add 100cm3 of water to the cylinder containing X

iii) Stir the mixture with a glass rod and leave the mixture to settle. Record the volume of the resultant mixture in the table.

iv) Repeat steps (i), (ii) and (iii) with soil samples Y and Z

Volume (cm3)	Soil sample		
	X	Y	Z
Volume of soil			
Volume of water			
Volume of mixture after stirring			

b) From the table, calculate,

i) The volume of air in

Sample X

Sample Y

ii) The percentage of air in;

Sample X

Sample Y

Sample Z

c) From the results in (b), comment about the aeration of the three soil samples

CHAPTER NINE: FEATHERS

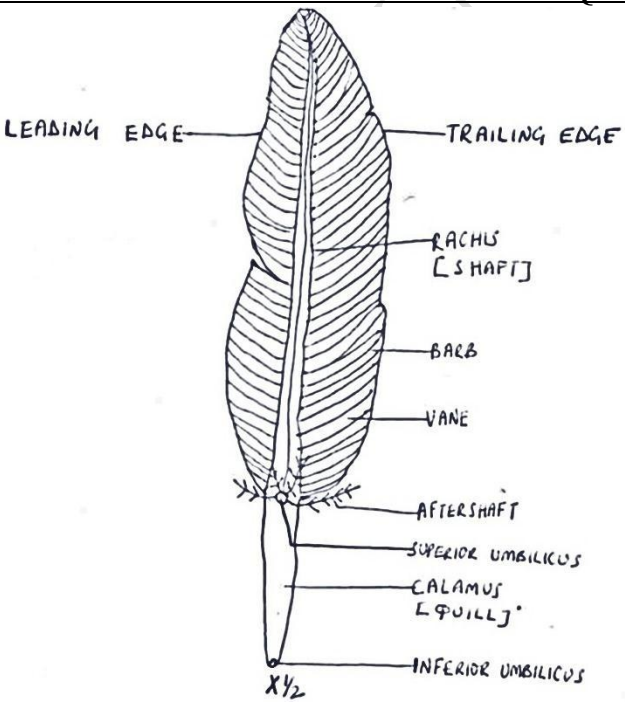
Quill feather (found at the wing and tail)

This consists of a central rod called the shaft which bears a flat expanded part called the vane. The lower part of the shaft is hollow and forms the quill with the hole at the base called at the inferior umbilicus. The vane is made up of processes called barbs arranged obliquely on either sides of the shaft

Characteristic features of the quill

- A broad flat vane spreading from the central axis
- Have vane with interlocking barbs
- Have a small after shaft
- Has two holes i.e Inferior and superior umbilicus
- Long stiff and hollow lower region, the quill
- Have a strong solid rachis/shaft

DRAWING SHOWING EXTERNAL FEATURES OF A QUILL FEATHER



Functions:

- they provide the lift force necessary for flight and balance during flight
- offer protection to the body/skin
- insulates the body against heat loss
- being water proof, they prevent the bird from getting wet

Adaptations of the quill feather

- The quill is hollow to reduce weight during flight.

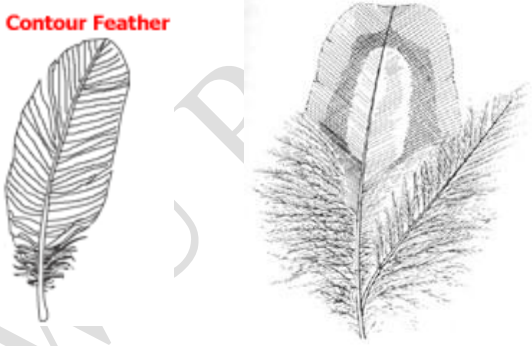
- ➲ The quill is also long for attachment of the feather into the skin.
- ➲ The vane is large to provide a large surface area for resisting the air during flight.

Contour feather(covert)

This is found around the neck and the back. It's similar to the quill in structure though smaller however it has a short shaft and a large aftershaft, almost covering half of the feather. Water proofing the bird is their main function

Characteristic features:

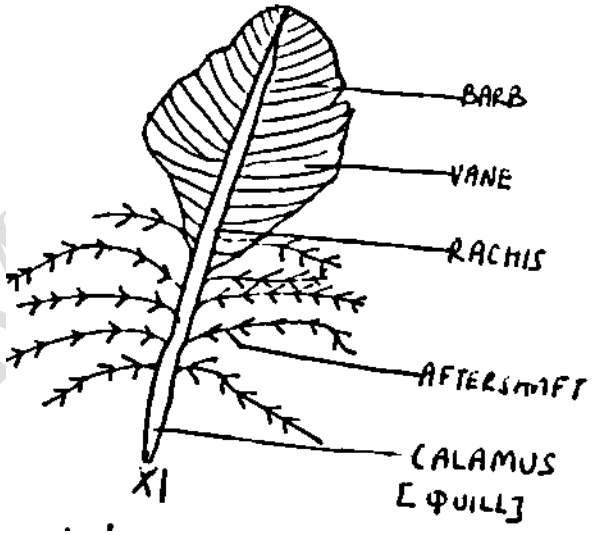
- Has large after shaft
- Has a short quill
- Has short vane



Functions:

- ↳ Prevents the bird from getting wet
- ↳ Protection from injury
- ↳ Insulation against heat loss

DRAWING SHOWING EXTERNAL FEATURES OF A CONTOUR FEATHER

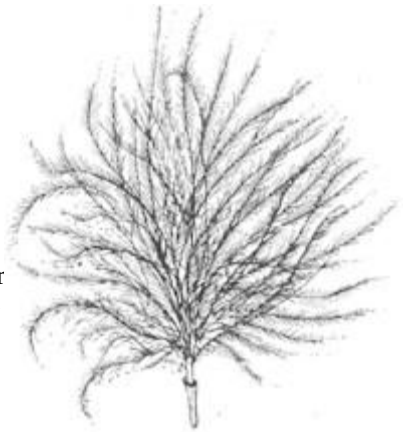


Adaptation of the contour feather

- ➲ They are arranged in such a way as to water proof the bird (like tiles on a roof)
- ➲ the vane is fluffy and has free barbs to insulate the bird's body

Down feathers

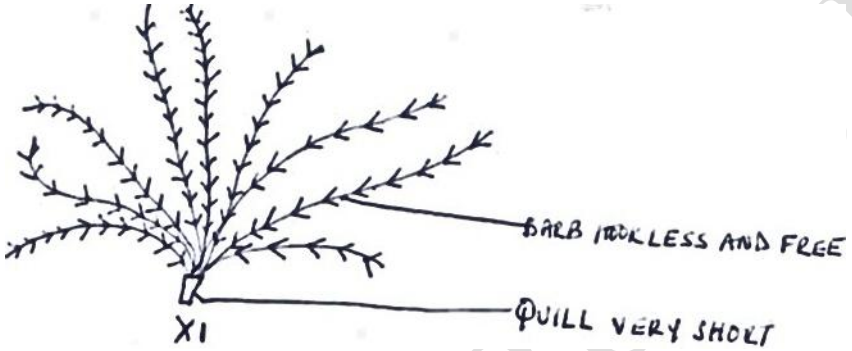
These are found on the lower part of the body and also form the plumage of new hatched birds. They are fluffy and so trap a layer of air close to the body, which prevents heat loss from the bird. These feathers are very small and soft



Characteristic features of the down feather

- They lack the central rachis
- Have a vane that consists of many free barbs
- Have a short and small quill
- They are soft and fluffy
-

DRAWING SHOWING EXTERNAL FEATURES OF A DOWN FEATHER



Filoplumes

These are found all over the body of the bird. They are slender hair like feathers with tuffs on

the end

Functions:

- they provide the bird with a sense of touch to determine the location of flight feathers during flight
- aid the bird in judging air speed during flight

Questions

1. You are provided with specimens P,Q,R and S

a) Identify each specimen

P
Q
R
S

b) State the location and functions of P and Q

LOCATION	FUNCTION
P	
Q	

c) Draw and label specimen P

d) State the location of R and S on the body of the animal

R
S

2. You are provided with specimens W, X, Y, and Z.

a) Observe them and give the identity with three diagnostic features of each specimen in the table below. (7½ mark)

Specimen	Identity	Diagnostic Feature
W		1
		2
		3
X		1
		2
		3
Z		1
		2
		3

a ii) What is the general function of specimen W, X and Y (1 mk)

b i) With a reason in each case, give the functions of specimen Z (4 marks)

ii) Make a well – labelled drawing of the margin of specimen Z (4 marks)

c. Construct a dichotomous key to identify specimen W, X, Y, and Z (3 marks)

3. Specimens P, Q, R and S were obtained from the same animal. Examine the specimens and answer the questions that follow;

a) For each specimen, give one characteristic feature used to identify it. (4 mks)

P

Q

R

S

State the body part from which the specimens were removed. (2 mks)

b) Give two structural differences between specimens. (4 mks)

(i)

P	Q
1.	
2.	

(ii)

R	S
1.	
2.	

d) (i) Hold specimen R in upright position. Using your fingers, stroke along one edge of the vane down wards and then upwards. Record your observations when stroked.

Down wards

Up wards

(ii) Which one of the recorded observations in 1 and 2 above is of great significance to the animal from which the specimen was removed? Give a reason for your answer.

e) (i) Draw specimen P, label the parts used for articulation with other bones. State the magnification for your drawing

4. You are provided with specimen F and G.

(a) (i) Observe them using a hand lens and identify them.

Identity of F:

Identity of G:

(ii) State three structural differences between specimen F and G

F	G

(iii) Make an elaborate drawing of specimen F. State the magnification of the drawing.

(b) Take specimen F between your fingers.

(i) Brush the fingers towards the base of the specimen.
State your observation.

(ii) Brush the fingers towards the tip of the specimen.
State your observation.

(c) Explain your responses in bi and bii above basing on your observation of the vane through the hand lens.

(d) Give two possible functions of the broad flat part of the specimen.

(e) Outline the function of the loose parts near the base of the specimen.

CHAPTER TEN: SKELETON (BONES AND TEETH)

General characteristics of vertebrae

All have a neural spine

All have transverse processes

All have a centrum

All have a neural canal

All have a neural arc.

The Vertebrae

1. THORACIC VERTEBRA (FOUND IN THE NECK REGION)

Observable features for identity

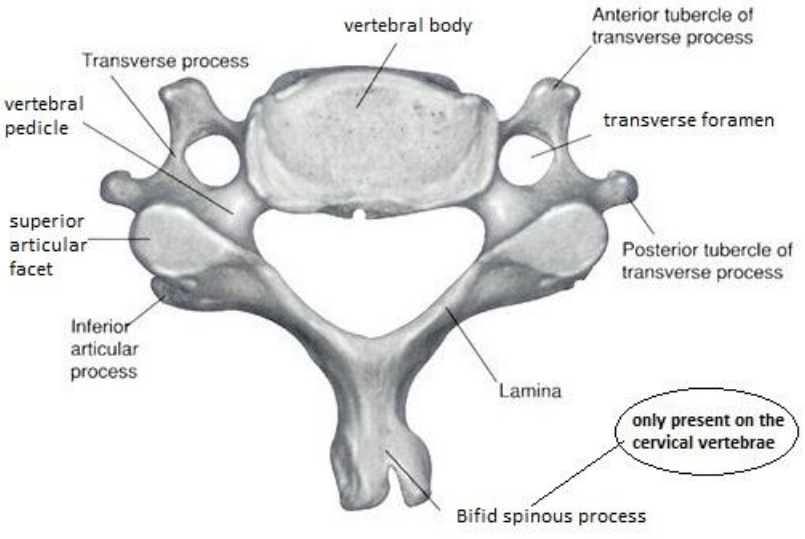
- Long neural spine
- Pair of articular facets
- Pair of short transverse processes
- Pair of notches
- Tubular facets on transverse processes
- Large centrum with a pair of capitular demi facets
- Neural canal

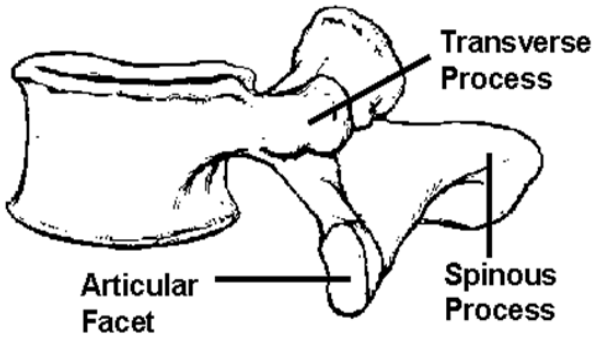
Function: attachment of ribs

Adaptations

- Has a pair of articular facets for attachment of ribs
- Has a pair of capitular demi facets for attachment of ribs
- Has a pair of notches for passage of spinal nerve

2. CERVICAL VERTEBRAE (FOUND IN THE NECK)





Observable features

- Shot neural spine
- Flat and small centrum

- Large neural canal
- Vertebraterial canals
- Divided transverse processes called cervical ribs
- Two pairs of facets on cervical ribs

LUMBER VERTEBRAE (FOUND IN THE BACK REGION)

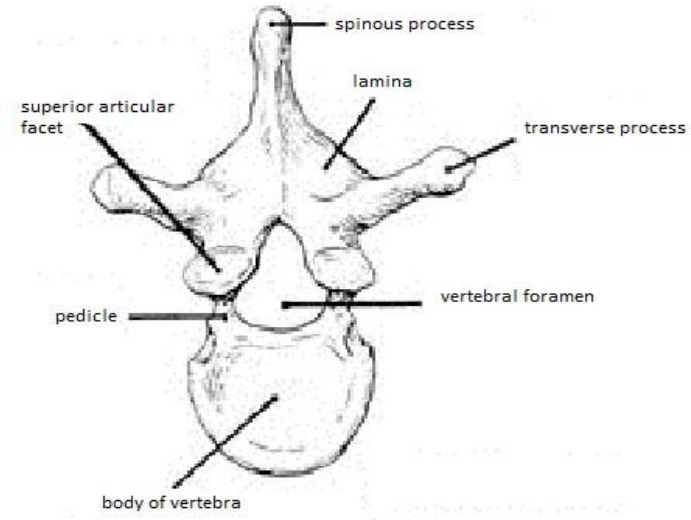
Observable features

- Long transverse processes facing forwards
- Large centrum
- Extra processes called metapophyses
- Narrow neural canal
- Short and broad narrow spines

Function: Attachment of abdominal muscles

Adaptations

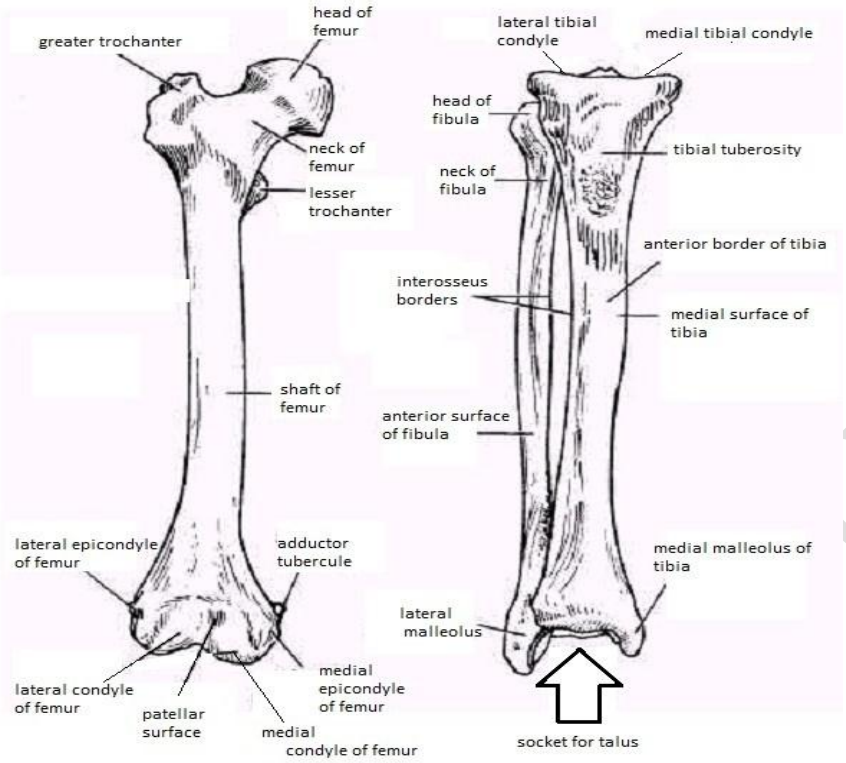
- ➲ Extra processes for attachment of abdominal muscles
- ➲ Large transverse processes for attachment of abdominal muscles



Examinable areas on vertebrae;

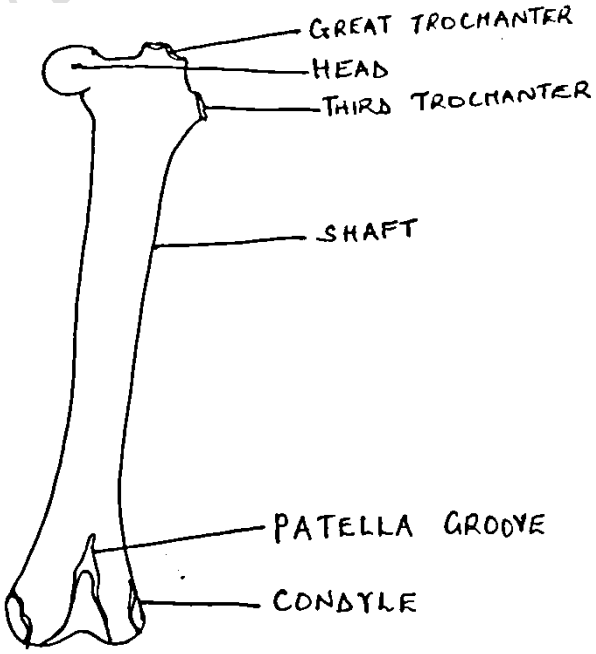
- ⇨ Identity
- ⇨ Location
- ⇨ Observable features
- ⇨ Drawings of the anterior, posterior and side views
- ⇨ functions of the bones
- ⇨ adaptations for their functions

THE FEMOUR



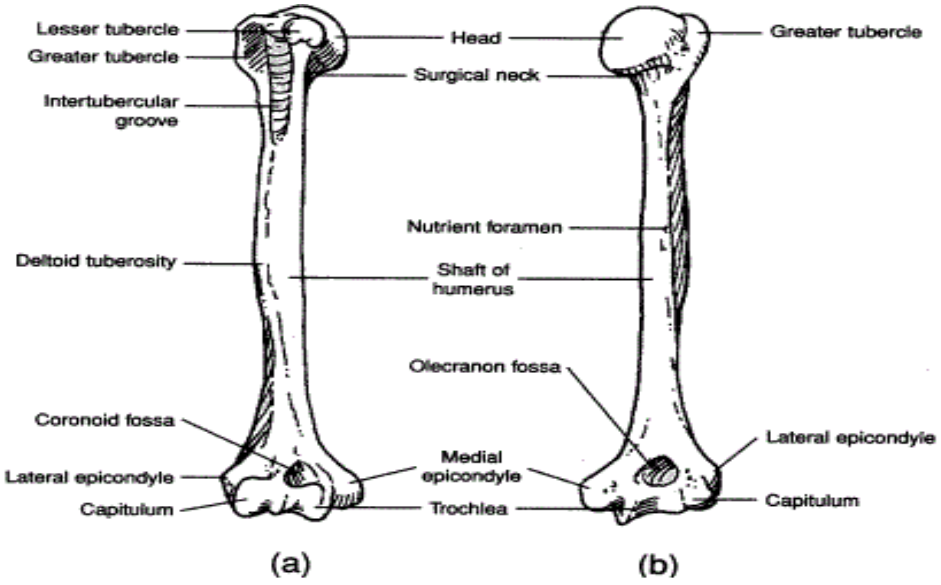
- Has round head that fit in the acetabulum of pelvic girdle to form a ball and socket joint (in the hip)
- Its lower end has two round knobs; condyles separated by the groove which articulate with the tibia
- Three rough projection near the rounded head; the trochanters which are points of attachment of leg muscles

DRAWING OF A FEMUR SHOWING EXTERNAL FEATURES



X ½

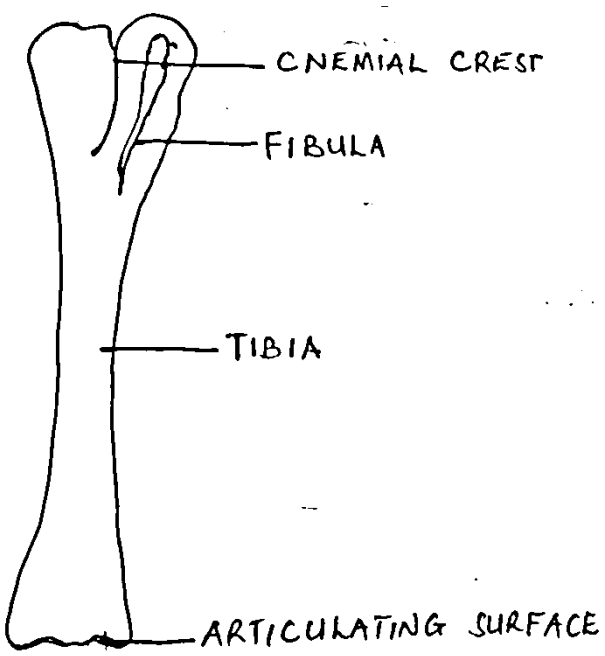
THE HUMERUS



The right humerus (a) anterior view and (b) posterior view.

- The humerus has a rounded head that articulate with the glenoid cavity of the scapula, to form ball and socket joint (in the shoulder)
- Has a grooved lower end and a hole at the lower end that articulates with the ulna and the the radius. This hole distinguishes it from the femur

DRAWING OF TIBIA AND FIBULA SHOWING EXTERNAL FEATURES



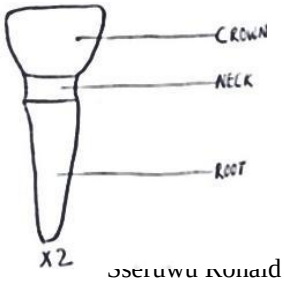
THE TEETH

A table showing types of teeth, their location, description and roles.

Type of tooth	Location	Description	Role
Incisor	In front	The crown is, thin, chisel shaped with sharp surface. Single root or two roots in some.	For cutting food
Canine	Between incisor and premolar	The crown elongated, pointed, curved. Single root.	For tearing food
Premolar	Behind canine	Crown wide and thick; surfaces are flat with cusps and ridges. Two roots.	Grinding or crushing food.
Molar	Behind premolar	Crown wide and thick; surfaces are flat with cusps and ridges. Three or more roots.	Grinding or crushing food.

a. Incisors (for cutting)

- ⇨ Have Chisel shaped crown
- ⇨ Have a single root
- ⇨ Have a narrow and flat crown



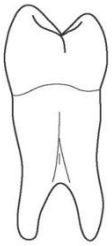
- They are for cutting food

b. Canine (for tearing)

⇨ Have a Pointed crown

⇨ Have a single root

- They are for tearing food and killing the prey



c. Pre Molar(for grinding or chewing)

⇨ Wide crown with ridges and cusps

⇨ Two roots

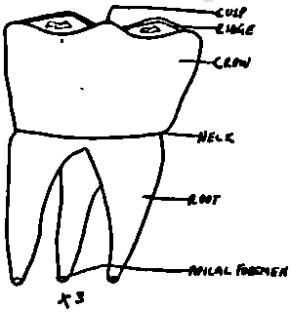
- For grinding and chewing

d. Molar (for grinding or chewing)

⇨ Wide crown with ridges and cusps

⇨ Three or more roots

- For grinding and chewing



Questions

1. You are provided with specimens P and Q.

a) With reasons identify the specimens (4 marks)

Specimen P

Reason

Specimen Q

Reason

b) State the function of each specimen and how the specimen is adapted to that (4 marks)

Function of P

Adaptation

Function of Q

Adaptation

c. Describe the structure of specimen P (2 marks)

d. State 2 similarities and 3 differences between specimen P and Q

Similarities (2 marks)

Differences (3 marks)

Specimen P	Specimen Q

e. Make a well labelled drawing of the upper surface of specimen Q (4 marks)

2. You are provided with specimens R, S and T which are animal structures

a) State the phylum of the animal from which they were got. Give a reason for your answer

Phylum

Reason

ii) Give the part of the body from which the specimens were got.

iii) With reasons, state the identities of the specimens and their location in the body.

Identity of R

Reasons

Location of R

Identity of S

Reasons

Location of S

Identity of T

Reasons

Location of T

b) (i) Give the functions of the specimens in the body of the animal from which they were got

Function of R

Function of S

Function of T

ii) How are the specimens adapted for their functions mentioned in b(i) above

Adaptations of R

Adaptations of S

Adaptations of T

c) (i) Give any four structural similarities between the specimens

iii) Give any five structural differences between specimens

Specimen R Specimen T

c) (i) Examine specimen R from the anterior. Draw and label

ii) Examine specimen T from the lateral side. Draw and label.

3. You are provided with specimen **K, L** and ***M*** which are from the same animal.

(a) From which part of the animal was each specimen taken?

K:

L:

M:

(b) Give three functions common to specimen ***K*, L** and **M** and the feature that enable the specimens to perform their functions.

Function	Feature

(c) State three observable differences between specimens **L** and ***M***.

Specimen L	Specimen M

(d) State the names of the bone(s) with which specimen ***K*** articulates at both ends (upper and lower ends) and using observable features, suggest the type of joint formed at each end.

Bone(s) at upper (anterior) end.

Joint upper end

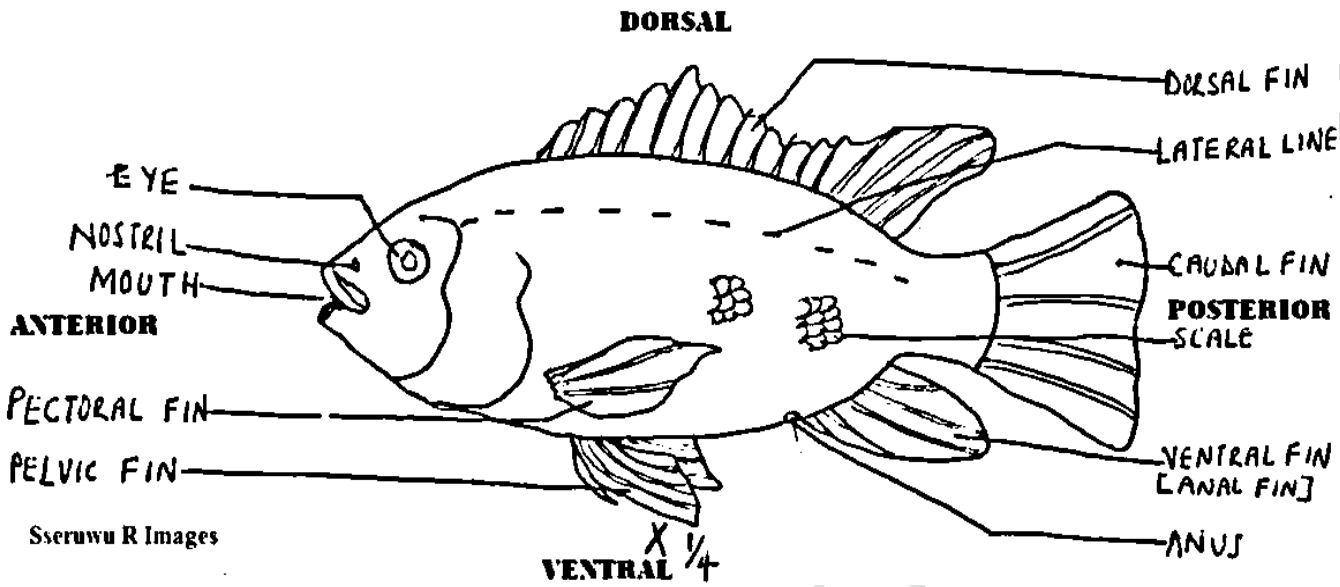
Bone(s) at lower (posterior) end

Joint lower end

(e) Draw and label specimen ***M***.

CHAPTER ELEVEN: FISH

DRAWING OF FISH



Classification

Kingdom: **Animalia**
Reasons:

- ⇨ Possession of mouth for holozoic nutrition
- ⇨ Possession of fins for locomotion
- ⇨ Have many organs e.g eyes hence multicellular
- ⇨ Egg which are evidence of sexual reproduction

Phylum: **Chordata**
Reasons:

- ⇨ Have gill slits
- ⇨ Have a muscular tail
- ⇨ Have a vertebral column which develops from a notochord
- ⇨ Possession of spinal cord which develops from a dorso nerve chord (**not observable**)

Class: **Pisces**
Reasons:

- ⇨ Possession of scales on their bodies
- ⇨ Possession of gills used for gaseous exchange
- ⇨ They lay eggs
- ⇨ They live in water (**not observable**)
- ⇨ They are cold blooded (**not observable**)

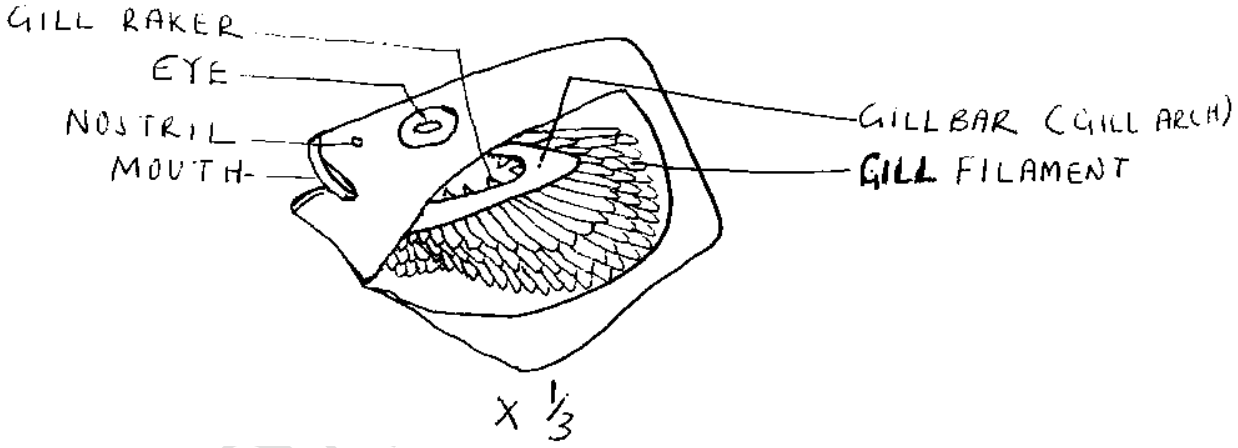
HABITAT

Fish are aquatic organisms i.e they live in water.

Adaptations to aquatic life:

- Possession of lateral line which is a system of sensory cells that help the fish detect changes in water
- All fish have a streamlined body which reduces water resistance as the fish moves.
- They possess gills which enable them carry out gaseous exchange.
- Their body surfaces are smooth, covered with slime, which enables the fish to escape from the enemy in the water easily.
- Most fish have scales which protect the fish from external abrasion e.g moving sticks in the water. The scales point backwards so as to reduce water resistance to a minimum. Those without scales have tough leathery skins for the purpose of protection.
- Fish possess fins which are for balancing and motion in the water.
- Many fish possess a swim bladder, which is a gas filled structure that enables them to alter their densities according to the depth of the water where they are. Hence, the swim bladder enables the fish to gain buoyancy at any depth.

DRAWING OF THE HEAD OF FISH SHOWING THE GILLS



The gills

Gills are structures for gaseous exchange in fish.

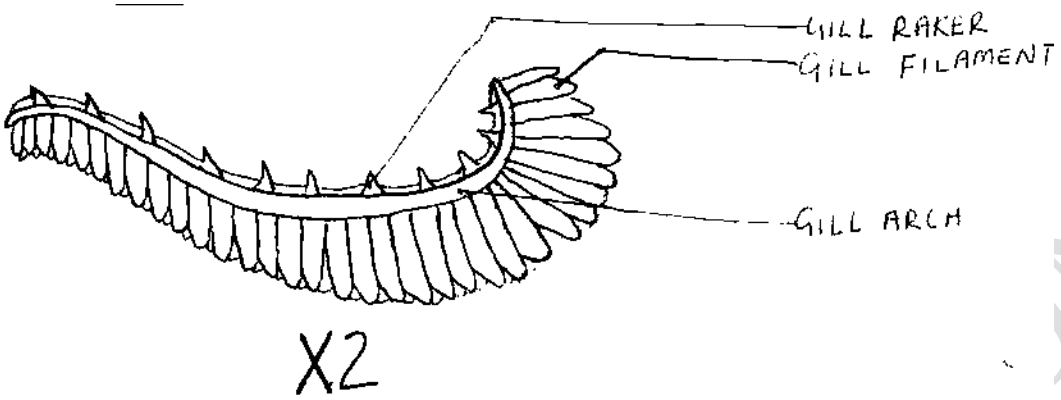
PARTS OF THE GILLS

Gill filaments: these are sites of gaseous exchange

Gill bar: provide an attachment for and support of the filaments

Gill raker: filter large particles in water before they reach and damage the gill filaments

DRAWING OF A GILL



Adaptations of gills to gaseous exchange

- The gill filaments have thin walls , reducing the diffusion distance of gases
- The gill bar is strong to provide support to the gill filaments and rakers
- Filaments are well supplied with blood capillaries to ensure transportation of gases
- Possession of gill rakers for removing solid particles, protecting the gills
- Have numerous lamellae, increasing surface area for diffusion.

Questions

1. You are provided with specimen F. Study it and answer the questions that follow

(a) (i) To what phylum and class does specimen F belong

Phylum

Class

ii) Identify three structural features which are used to place specimen F in the class you have given

b) (i) Suggest the habitat of specimen F

(ii) Give six adaptations of specimen F to its habitat

c) Cut and remove the operculum from one side

(ii) Draw and label the features observed from the cut side.

(iii) Carefully cut out and remove the gill. Draw and label one gill removed.

In what ways is the gill labelled above adapted for its function

2. You are provided with specimen K which is an animal.

a) With reason(s) state the phylum and class to which the specimen belongs i)

Phylum

Reasons

ii) Class

Reasons

b) (i) Name the habitat where specimen K survives

iii) Using observable features only, give three ways in which the specimen is suited to surviving in its habitat

c) (i) Identify the structures that cover the body surface

ii) Carefully remove one of these structures, examine it under a hand lens. Draw but do not label

iii) How is the structure in (c) above suited to its functions

c) Remove the operculum on the left side. Draw the head region showing the structures exposed.

CHAPTER TWELVE: SPECIMEN GUIDE FOR QUESTIONS

Chapter 2

Qn.1 O-Bryophyllum leaf **P-**Pumpkin leaf **Q-**Bean leaf **R-**Passion fruit leaf **S-***Cassia* leaf

Qn. 2 A-Wandering jew leaf **B-**Pineapple leaf **C-***Cassia* leaf **D-**Maize leaf **E-**Bean leaf

Qn. 3 A mango leaf, **U** A bean leaf / any trifoliate leaf **V** A cassia leaf, **W**
A guinea grass root, **X**

Chapter 3

Qn.1 U-Onion/bulb **W-**Irish Potato **Qn.2 F-**Cassava tuber **G-**Ginger **H-**Onion/bulb

Qn.3 A mature couch grass plant (orumbugu, Digitaria scalarum) **R**. A sprouting Irish potato tuber, S A mature Desmoduim fruit, **T**
Qn. 4 onion

Chapter 4

Qn.1 H-Hibiscus; **Qn.2 X-**Morning glory **Y-**Maize;

Qn.3 N-Crotalia **O-**Bougainivalla **P-**Tridax **Q-**maize

Chapter 3 Q devil's horse whip, P Crotalaria

Chapter 5

Qn.1 A-Tomato **B-**Bean **C-**Black jack **D-***Tridax***; Qn.2 A-**Orange **B-**Mango **C-**B.jack **D-**Bean**;**

Qn.3 E-*Tridax* **F-**Bean **G-**Avocado **H-**Green pepper**; Qn.4 W-** B.jack **X-**Guava **Y-**Tomato

Qn5 A bean seed, **J** Socked maize grain, **K** A mature fruit of Bidens pilosa, **L**

Chapter 6(a)

Qn.1 X-5% glucose solution **Y-**10% sucrose solution **Z-**dilute HCl

Qn.2 T-Starch solution **P-**Amylase/Saliva

Qn.3 A-Starch solution **B-**Sugar cane extracts **C-**Albumen solution

Qn.4 A 5% starch solution **B** amylase solution

Qn.5 *An underground stem of spear grass* ***(Imperata cylindrical), A***

Chapter 6(b)

Qn.1 T-Irish potato **A-**Distilled water **B-**8% sucrose solution **C-**super saturated solution**;**

Qn.2 H_2O_2**; Qn.3 A** 15% glucose solution B 15% sucrose solution

Qn.4 T 3 internodes of Commelina stem **A 1.0M** sucrose solution **B** distilled water

Qn.5 A Irish potato

Chapter 7

Qn.1 Housefly**;**

Qn.2 Cockroach**;**

Qn.3 Q-Housefly **R-**Cockroach **S-**Worker bee **T-**Termite **U-**Tick**;**

Qn.4 K-Housefly **L-**Grasshopper

Qn.5 L housefly **M** termite **N** worker bee **O** cockroach

Qn.6 L tick **K** worker bee

Qn.7 Grasshopper, **P** Sugar ant, **Q**

Chapter 8

X-Clay **Y-**Loam **Z-**Sand

Chapter 9

Qn.1 P-Quill **Q-**Covert **R-**Down **S-**Filoplume**;**

Qn.2 W-Filoplume **X-**Covert **Y-** Down **Z-**Quill**;**

Qn.3 P-Covert **Q-**Down **R-**Quill **S-**Filoplume

Qn.4 Quill feather, **F** Down feather, **G**

Chapter 10

Qn.1 P-Canine **Q-**Molar**;**

Qn.2 R-Cervical vertebrae **S-**Lumbar **T-**Thoracic vertebrae

Qn.3 K humerus **L** femur **M** tibia and fibula