

PLANT ANATOMY

Anatomy is the science that deals with the study of the structures of living organisms.

It involves the detailed study of the external and internal features of organisms and depends on skills of observation, dissection and microscopy;

The study of the general form and shape of organisms is called Morphology.

Note the spellings;

FLORAL STRUCTURE

The flower is the structure in angiosperms (flowering plants) that bear the organs for sexual reproduction.

These organs are from the outermost

- sepals that collectively form the calyx;

- petals that collectively form the corolla;

- stamens that collectively form the Androecium;

- Carpels that collectively form the Gynoecium or pistil.

All these consist of floral leaves arranged in rings called Whorls;

Some flowers have an extra whorl of sepal-like structures external to the calyx; This is known as the epicalyx;

The reproductive parts i.e. stamen and pistil are the essential parts of the flower; All other parts i.e. stalk, calyx and corolla are non essential or accessory structures;

Sometimes flowers are arranged in groups and are known as Inflorescences;

some are so compact that are often mistaken to be a single flower e.g. in sunflower,

Terms used to describe dicotyledonous flowers.

- A flower is complete; if it has the gynoecium, androecium, calyx and corolla; i.e. if it has all these four whorls;

- A flower is incomplete if it lacks any of the above parts (whorls);
- A flower is perfect if it has both male and female reproductive parts;
- A flower is Unisexual if it only has one type of sex, eg pawpaws have male and female flowers on separate plants (they are dioecious); Unisexual flowers are said to be pistillate if they are female and staminate if they are male;

Note:

plants with both types of sexes in different flowers on the same plant are said to be monoecious; eg maize;

- A flower is regular; if it can be divided into two similar parts longitudinally; in more than one way eg Hibiscus; and sweet potato flowers;

Regular flowers are also called Actinomorphic (Radial symmetry); → cut through many planes to give equal parts;

- A flower is irregular; if it cannot be divided longitudinally into two similar parts in more than one way eg Cassia; and bean flowers; (also Crotalaria);

These are also said to be Zygomorphic; (Bilateral symmetry);

- A flower is bisexual; or hermaphroditic; if it has both stamens and carpels; /pistil/;

- An floral whorl external to the calyx is called epicalyx;

- The calyx (pln. calyces) is the outer most whorl or leaf-like segments (called sepals) of a dicotyledonous flower; It is usually green and serves to enclose and protect the flower in bud stages;

The calyx is said to be petaloid; if it resembles the petals;

It is polysepalous if the sepals are free (separate); and gamosepalous if the sepals are fused (joined);

- The corolla consists of petals; it encircles the stamens and carpels;
It is polypetalous; if the petals are free; and gamopetalous; if the petals are fused;
- The gynoecium consists of the pistil also known as the carpel (not carpal); This is the female reproductive organ of a flower; and it consists of (stigma); style; and ovary;
The ovary is a hollow region at the base of the carpel;
It is said to be monocarpous if it consists of one carpel
eg in Crotalaria; polycarpous if it consists of more than one carpel; Apocarpous if it consists of more than one free carpels; and synacarpous if all the carpels are fused together;
In synacarpous ovaries the fusion of the carpels results in internal cavities called locules; which may be separated by septae;
The ovary is superior if it lies above the origin of other floral parts;
- The Androecium consists of stamens; each stamen consists of an anther head; attached to the filament;
Sometimes the stamens are fused to form a staminal tube / filamental tube; eg in Hibiscus; and Bean;
- The ovary is said to be inferior if it lies below the origin of the other floral parts;

Note.

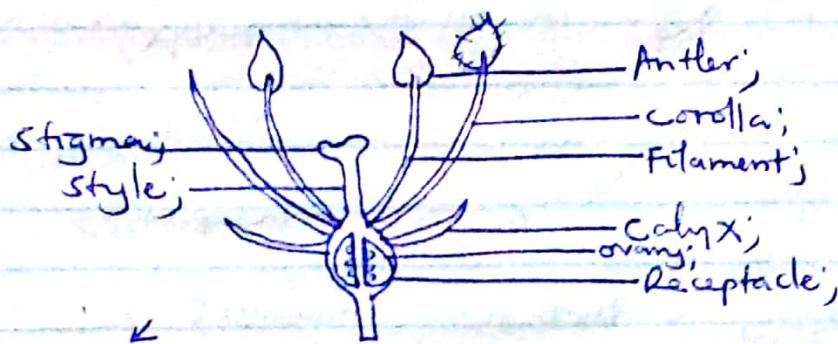
The terms superior; hypogynous; inferior and epigynous are often confused and taken to be the same;
While the term superior and inferior apply to the ovary; the terms hypogynous; epigynous and perigynous apply to the

rest of the flower'; i.e

- ✓ Epigynous: A flower in which the receptacle completely encloses and fuses with an inferior ovary; such that the other floral parts (i.e sepals and petals and stamens are borne at the point above it e.g. in apple, dandelion);

Epigynous flower'

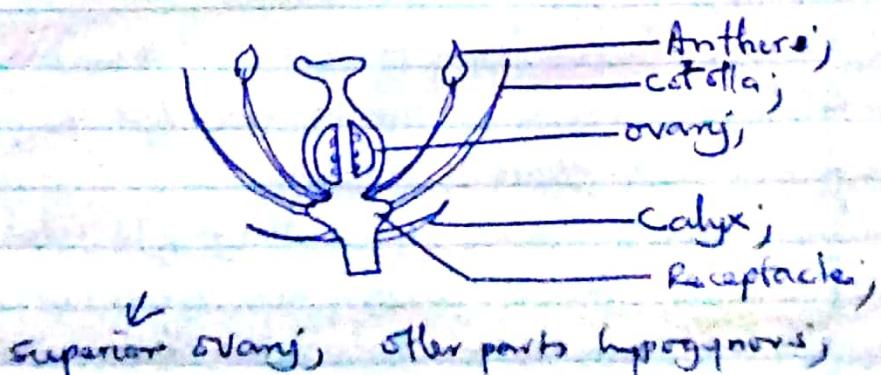
+ drawing showing...



- ✓ Hypogynous: A flower in which the sepals, petals and stamens are borne in the receptacle at a point below the carpels (i.e. a flower with a superior gynoecium); e.g. Tulip, buttercup,

Hypogynous flower'

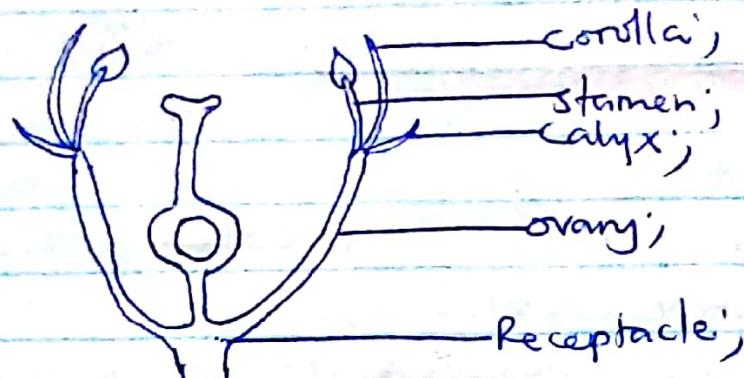
+ drawing showing...



- ✓ The intermediate condition is perigynous, where the sepals, petals, and stamens are borne on the margin of the concave receptacle, with the carpels of superior ovary at the centre of

the receptacle i.e other floral parts are at level around the gynoecium; eg in rose cherry and plum flowers;

Perigynous flower:



ovary superior; other floral parts perigynous;

- Receptacle - is the apex of the flower stalk ; where the four whorls of a flower are attached ;

Note

Pedicel the stalk of an individual flower; Flowers with pedicel are pedicellate; those without are sessile;

Penduncle; the stalk of an inflorescence;

Corolla tube; formed by the union of the petals eg; in morning glory;

Keel - sac-shaped lower petal formed from two united lower petals - found in some insect-pollinated Zygomatic flowers like legume flowers;

Standard; - large brightly coloured upright petal above Keel of a zygomorphic flower;

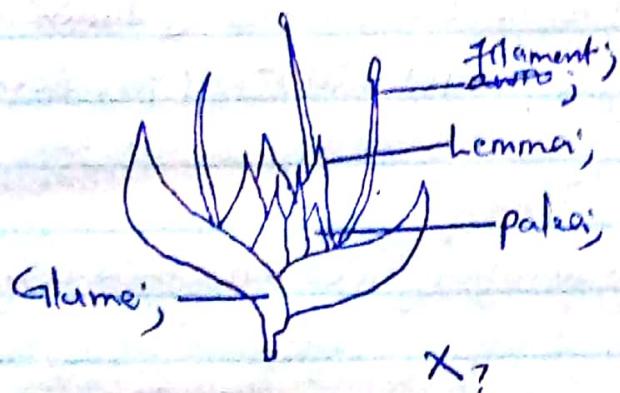
Winged petal; one of two side petals between the Keel and the standard of a Zygomatic flower;

Terms used to describe monocotyledonous flowers (grass flower)

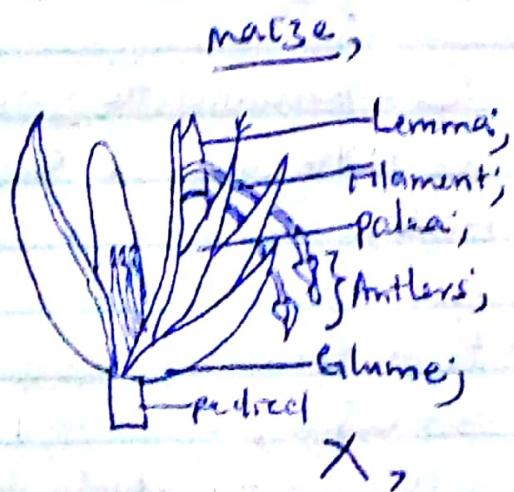
Apart from the terms used to describe the essential parts of the flower, the accessory parts have names that differ much from those used to describe the dicotyledonous flowers;

These are wind pollinated flowers; not brightly coloured; no petals; sepals; and thus are collectively called perianth parts; they are named according to position in the grass spikelet;

Drawing showing the parts of a grass spikelet;



X?



X?

Glume small scale like bracts; A pair of glumes encloses a grass spikelet;

Lemma (lemmæ); small bract in whose axis arises the grass flower;

Palea; (phi paleæ); small bract arising from the axis of the flower stalk just below the flower;

The palea and lemma together enclose the young grass flower just like the sepals in the dicot flower;

Hodicules; Two tiny scale-like structures below the ovary of a grass flower; represent a much reduced perianth;

Awn, this is a slender stiff bristle like process on the apex of a glume found in many grass spikelets e.g. wheat; protects the flower from being destroyed by birds;

FLORAL FORMULAE :

is the method of expressing the number and arrangement of the four whorls of a flower using standard symbols i.e K, C, A and G in dicot flowers; and P, A, G in monocot flowers;

It gives a summary of the structure and components of a flower using symbols and numbers;

- K - represents calyx and the number of sepals is shown after it is K_5 ; if the sepals are fused, then the figure is bracketed e.g $K(s)$; and if they are not i.e free, no brackets;
- C - represents the corolla and the number of petals is shown like in the calyx i.e C_5 (five free petals) and $C(s)$ (five fused petals)
- P - represents perianth; when undifferentiated into calyx and corolla; No brackets; if free;
If there are two whorls, the numbers are shown separately e.g $P(3+3)$
The + indicates that the whorls are undifferentiated; the brackets show the segments are united;

A - Androecium; if the stamens are more than 10, then it is signed infinity '(oo) Hibiscus',

If the stamens are of two types i.e fused and free; they are shown by two separate numbers $A(9)+1$ e.g in Bean flower; 9 fused and 1 free stamen;

- G - Gynoecium; No brackets for apocarpous; bracketed for syncarpous; \underline{G} for superior; \overline{G} for inferior ovary;

If the stamens are fused to the corolla, an arc is used to join C and A e.g $(s) \overbrace{A(s)}$

Eg:

Eg.

$P(3+3) A_3 G(3)$, refers to a flower with a perianth of six segments in two undifferentiated whorls, three free stamens fused to three perianth segments, three carpels; inferior ovary;

$\textcircled{O}^\rightarrow$ — staminate flower; (male)

\textcircled{F} — pistillate flower; (female)

$\textcircled{F}^\rightarrow$ — Bisexual flower;

\oplus — Actinomorphic flower;

\circlearrowleft — Zgomorphic flower;

\nearrow — sepals in calyx;

\searrow — petals in corolla;

∞ — single stamen;

\circ — gynoecium; (one free carpel); \odot — two carpels;

\ominus — Three carpels;

\sim — connects the fused parts; (Bract)

Note

Whenever you are constructing a floral diagram, hold the flower so that the pedicel is furthest from you and the petals are facing you directly; Ensure that your diagram shows the actual appearance of the flower from this view;

Note

Floral diagrams are not labelled;

- shows position of the main axis and usually written at the top of the diagram;

Below are examples of flowers and their descriptions; floral diagram; floral formula; and cross sections where possible;

⑥ 'Bean flower' (B) / *Crotalaria* flower;

- Flower has a short pedicel; cylindrical; solid;

* Bisexual; and ^{sym} zygomorphic;

Calyx of five fused sepals; are hairy; dull colored;

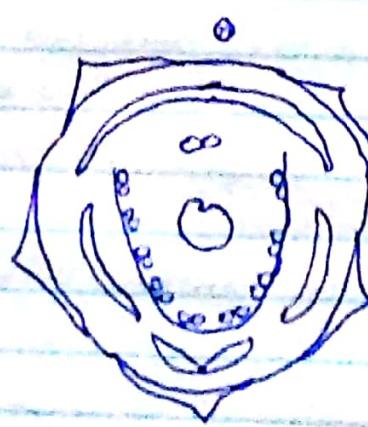
Corolla of five petals of different sizes; i.e. a large veined petal (standard petal); two fused petals enclosing the essential parts; (Keel petals); and two free petals in the outside of the Keels (wing petals);

The androecium consists of ten stamens of which; 9 fused to form a terminal tube around the gynoecium; and one free stamen;

The gynoecium ^(carpel) has a ^{elongated} bean shaped ovary; superior with a short style of the end; ^{or} which is a flat stigma; expanded;

The floral diagram of specimen B;

The description
should match
the diagram;



ASD
2017

3 mm

The full floral formula of specimen B.

% ♀ → K₍₅₎ C₍₂₎ + 3 A₍₁₎ + 1 G,

Note

pollen for bean (insect pollinated);
flower;



3 mm

oval/round; rough
surface; large in
size;

Hibiscus flower P

sex - Bisexual;

symmetry - Actinomorphic;

Calyx - hairy calyx of 5 fused sepals; (brightly coloured; veined);
Has epicalyx of 6 free parts;

Corolla; petals are free at top; fused at bottom; brightly
coloured; overlap at bottom;

Androecium; Numerous free stamens; short fused filaments; to
form staminal tube; which is attached to the petals;

Gynoecium; of a superior ovary; made of 5 carpels; free
stigmas; that are hairy; styles fused;

N.B.

Pollination agent; Insect; Reasons; - petals brightly colored to
attract insects; - pollen grains are sticky for adhering onto
insect body;

Main group ^{of plant} to which the flower belongs; - Dicotyledoneae

Reason; Flower parts are in pairs i.e. 5 petals and 5 sepals;

Type of pollination; Cross pollination; - Anthers lower than stigma;
Hence pollen from other flowers ^{on a visiting insect} is most
likely to pollinate; Q3

Adaptation for reproduction;

Brightly colored petals for attracting pollinator;

Numerous stamens; to increase the production of pollen grains;

Has both stamens and pistil thus increasing chances of
pollination;

Hairy stigmas for trapping pollen grains;

The floral diagram of specimen P.

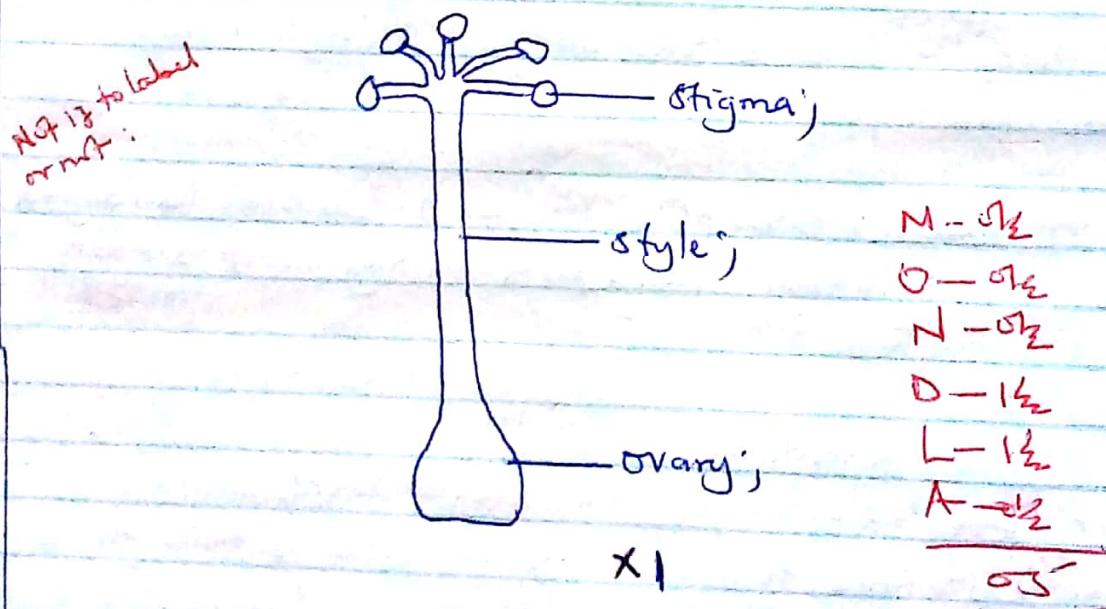


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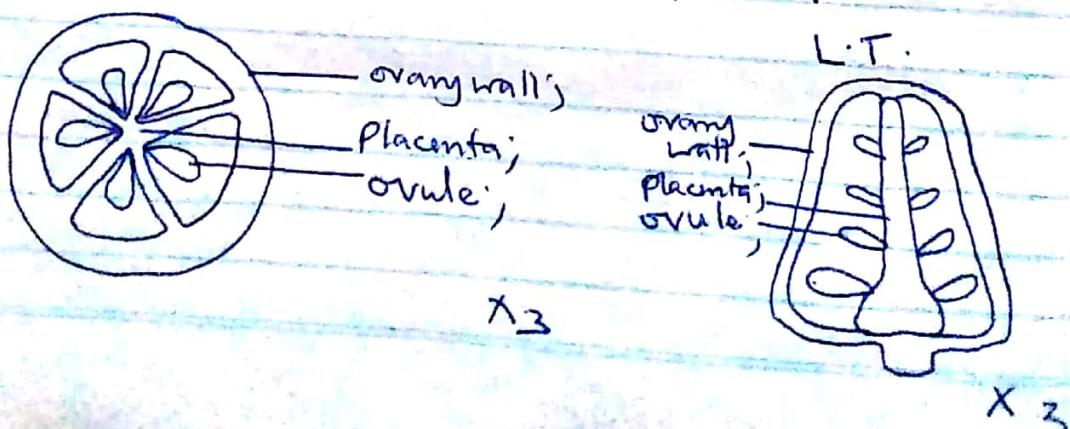
The floral formula of specimen P.

$$\oplus \text{♀} \rightarrow K_5 C_5 A_2 G_{(s)} \quad \underline{\text{OB}} \text{ max}$$

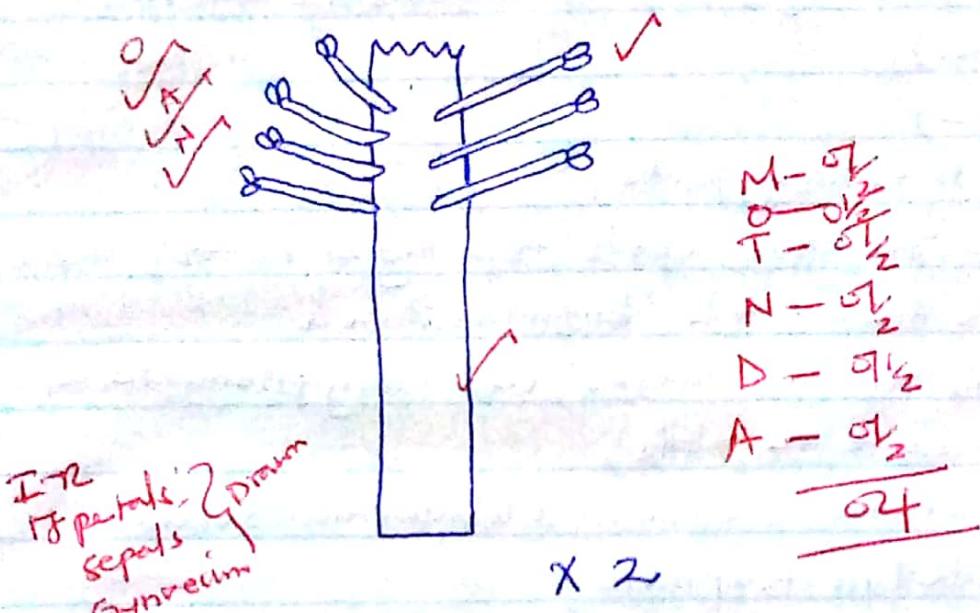
A drawing showing the gynoecium of specimen P.



Transverse section through Ovary of specimen P.

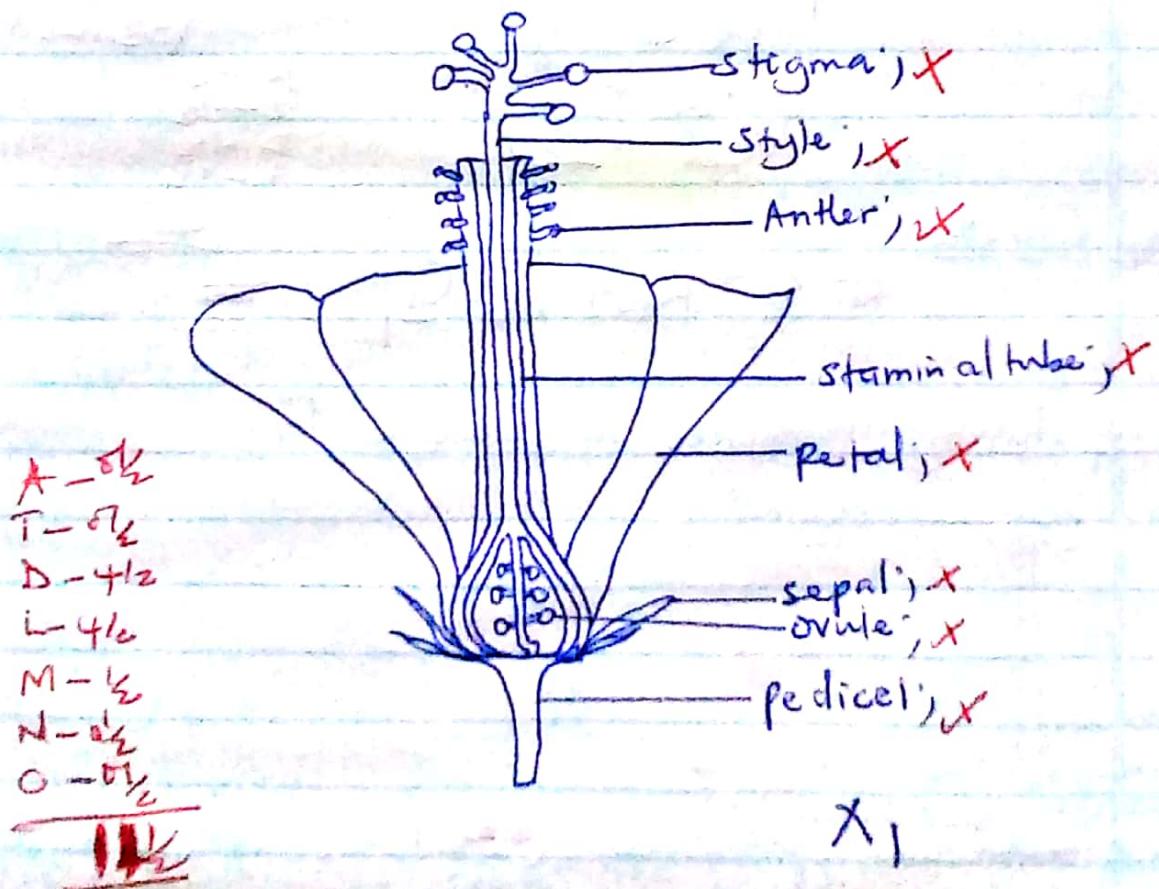


Drawing showing the androecium of specimen P



NO label
here
was asked.

Drawing showing the longitudinal section through specimen P



Morning glory (specimen Q) / sweet potato
short hairy pericarp; few seeds in transverse section;

Bizexal (sex);

Actinomorphic;

Epicalyx of three hairy parts;

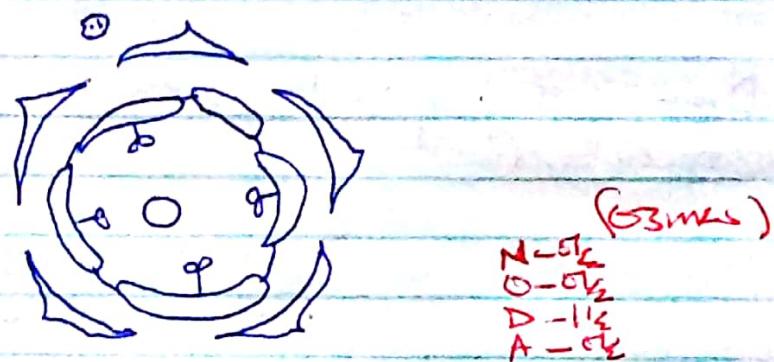
Calyx of five; free; hairy; sepals; tapering at the top;

Cotolla of five fused petals; brightly coloured;

Androecium of five free stamens; with hairy filaments at the base; attached to the petals;

Gynoecium with bi-labiate stigma; globular and superior ovary embedded in receptacle;

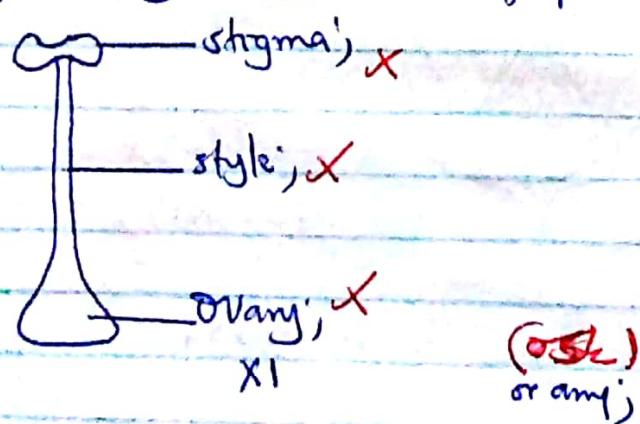
Floral diagram
of specimen Q



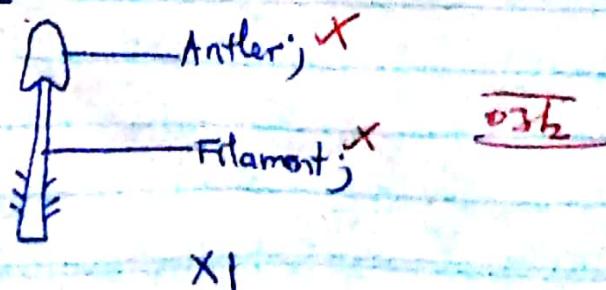
Floral formula:

$$\oplus \text{♀} \rightarrow K(5) A_5 G_1 \quad \underline{\underline{5}} \text{ max}$$

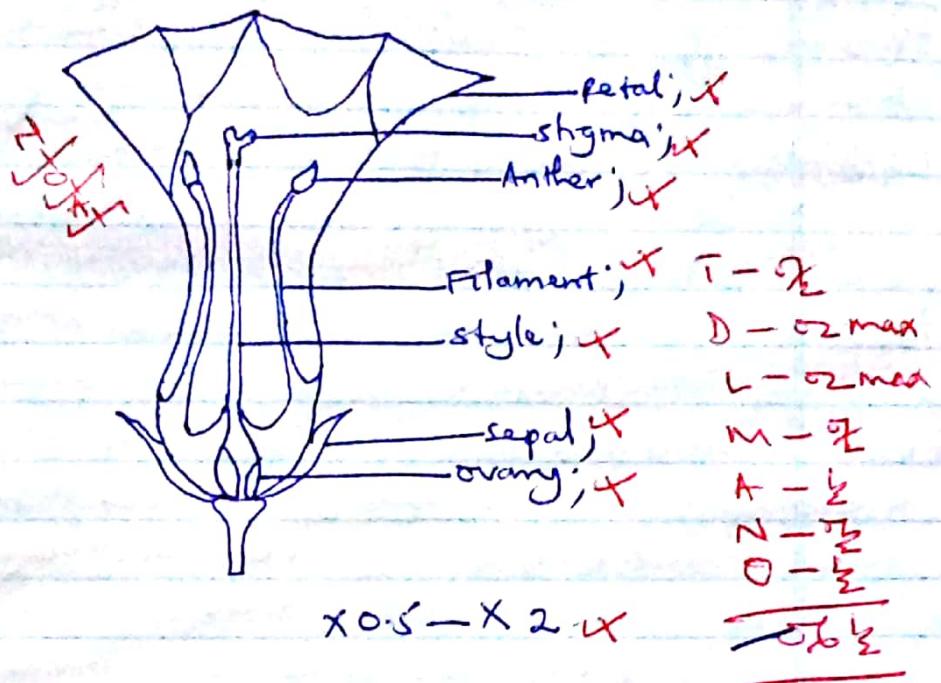
Drawing showing the gynoecium of specimen Q.



Androecium:

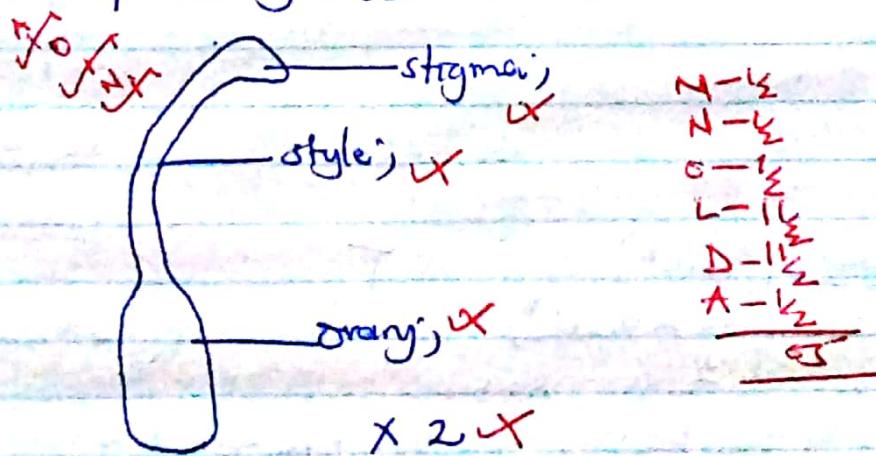


Drawing showing longitudinal section through specimen X.



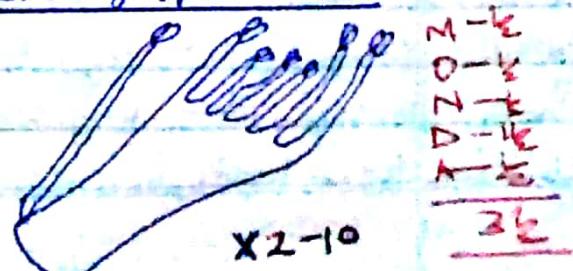
Crotalaria flower: (specimen X) / Beanflower.

Drawing showing the gynoecium of specimen X



Anthers of specimen X

VNEB
2013
Not to label →
2C)



Canna lily flower, specimen Z.

• Banana flower; (Floret) specimen T.

Flower is sessile (No pedicel);

It is bisexual; and zygomorphic;

Has a perianth of four bracts; i.e. one free and short, small; boat shaped; and three fused (large); boat-shaped and attached firmly to the ovary;

The androecium consists of six stamens; each with long, spear shaped anther heads;

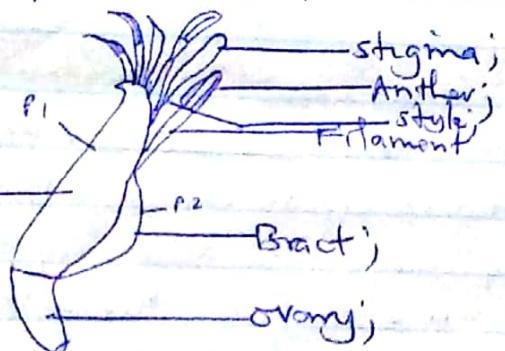
The gynoecium consists of an inferior ovary; a long style (syncarpous)
extending beyond the anthers; and bracts ending in a
trilobed stigma;

Note

The flowers of banana are borne in inflorescences (inflor.) called spadix;
Reactions ↓
Three peduncle;
Leathery three bracts;
Fleshy called spathe

Drawing showing a flower of specimen T.

(depends on what was asked)

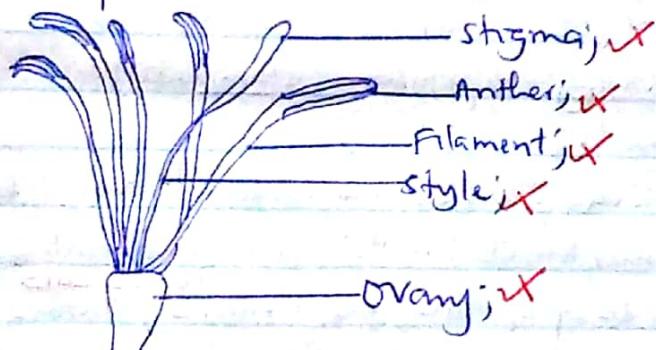


P₁ & P₂
Indicate
the perianth(2)

X 0.5 - X 3

If the essential parts only;

Drawing showing essential parts of specimen T.



T - $\frac{1}{2}$	
L - $\frac{1}{2}$	
D - $\frac{1}{2}$	
M - $\frac{1}{2}$	
O - $\frac{1}{2}$	
<hr/>	
$+ \frac{1}{2}$ max	

X 0.5 - X 3

Floral formula

$\% Q \rightarrow P(3) + 1 A_5 G(3) \swarrow \text{WOB}$

Floral diagram:



INFLORESCENCE

Refers to a flowering shoot consisting of a group of flowers on a single main stalk called peduncle; and also to the arrangement of a flower on an axis;

There are two types / basic arrangements i.e.

- i) Lanceolate (indefinite) inflorescence; Bidens, Dandelion, Crocosmia, maize, Banana, Cassia etc.
- ii) Cymose (definite) e.g. Bougainvillea,

Maize Flower; (~~male maize~~) (male maize) specimen L'

Inflorescence; Has main axis (peduncle); with lateral branches (spikes); each bearing many paired alternately attached spikelets; one spikelet from a pair is stalked; the other is sessile (lacks stalk) one spikelet; Each is enclosed by two hardened; rough; boat-shaped; pointed bracts, one placed a little above the other; inside a spikelet are 4 inner bracts; 2 from each of the two florets;

symmetry - Bilateral; / Zygomorphic;

sex; Unisexual; having only stamens (staminate);

No sepals; No petals;

One floret; Each has 3 bracts; 1 is hardened; rough; boat-shaped and pointed; 2 inner bracts are thin and translucent;

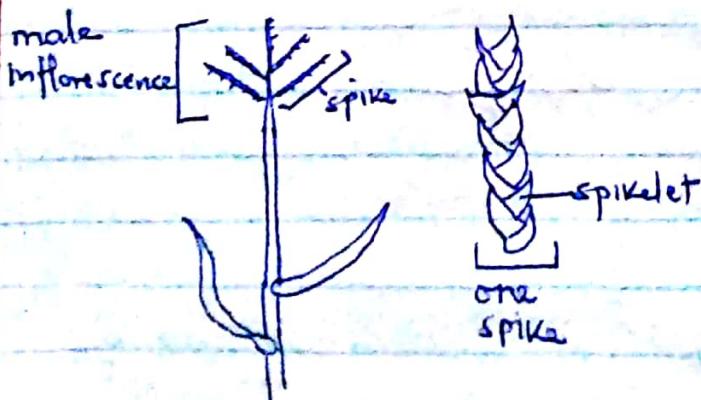
Androecium; Made up of three; free stamens; Anthers are bi-lobed;

broad; elongated; and supported on thin; flexible; long filaments;

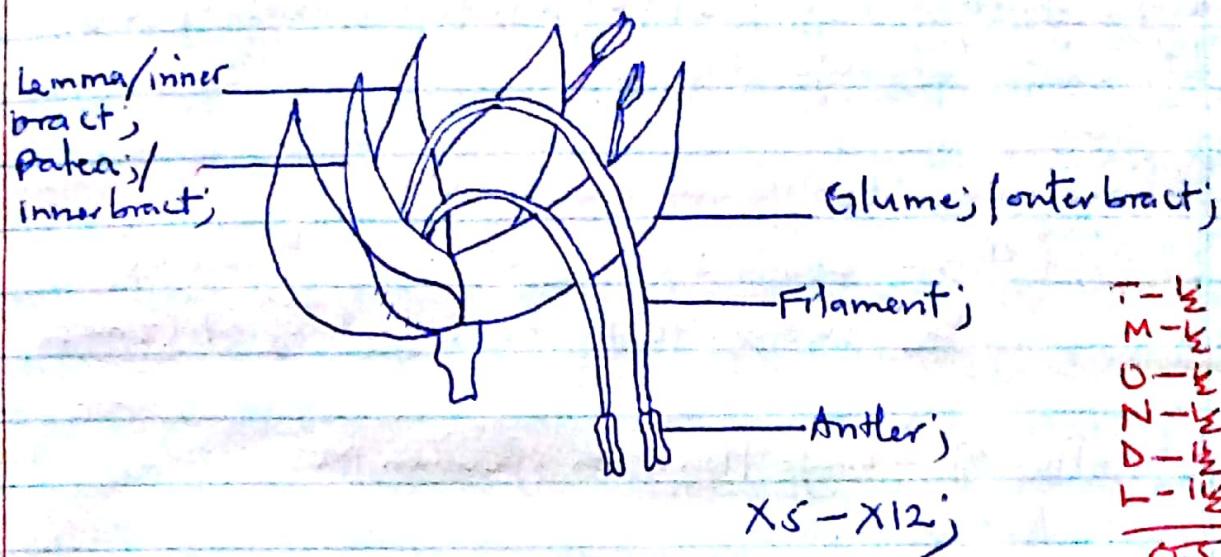
Gynoecium; No gynoecium; pistil / carpel;

Assn 2013
No 3

VNED 2013



Drawing showing the flower of specimen L



Explain how pollination is facilitated by the androecium of specimen L - ?

- long filaments for exposing anthers heads with pollen to wind; ✓
 - Large/broad anther heads to produce very many pollen to enhance survival; / increase chances of pollination; X
 - Anthers loosely attached to filaments, thus easily shaken to scatter pollen; ✓
 - Flexible; filaments that easily swing allows to disperse pollen; ✓
- or full mark.
- 02

Disadvantage of maize flower; → Being staminate; has to depend on cross pollination for reproduction;

Floral formula;

$$\% \rightarrow P_0 A_3 G_0$$

Bougainvillea flower (specimen M)

- Flower has short pedicel; i.e; the flower forms at the apex of the peduncle to terminate growth; it is bisexual;
- Each floret attached on its own bract; ✓
- Three, stalked florets; attached on the midrib/main vein of a large bract; Q. Describe the floret arrangement of M (3 mes) OB

Characteristics of a single flower of specimen M

Bisexual; Actinomorphic;

Androecium of 8 stamens; at different heights;

Anther heads are bi-lobed; corolla of five fused petals;

Gynoecium of a club-shaped stigma; elongated; hairy; thin style; superior ovary;

No sepals;

Drawing showing half-flower/longitudinal section of specimen M showing only the essential parts;

Note
The shapes
of parts in ()
while marking

MA -
of calyx, receptacle
of bract is drawn and
labelled;

T - l

M - l

O - l

N - l

D - l max

L - l max

0.5

X/3
wt



X Anther; (Rounded)

X Filament; (double line)

X stigma; (spear shaped)

X style; (shorter than filaments)

X ovary;

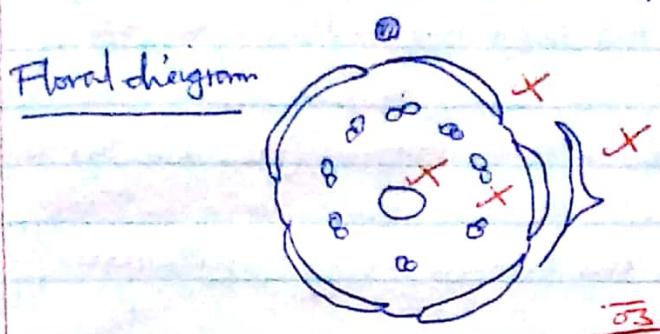
X3-X6 X

Note

Sometimes one is required to cut the specimen longitudinal and draw and label one half; or label only the reproductive organs; or do not label or only draw essential parts;

Floral formula;

$$\oplus \text{♀} \rightarrow K_0, C_5 A_3 G_1 \quad \underline{\underline{3}}$$



Guinea grass; specimen F.

Examine the specimen where necessary use a hand lens;

Description of whole guinea grass inflorescence;

There is a main axis with lateral branches of variable lengths, reducing towards the apex; some attached whorly; some alternately; others oppositely on the main axis;

On each lateral branch of the axes are numerous spikes bearing several spikelets attached alternately;

Both main and lateral axes terminate into individual or double spikelets;

Description of single flower of Guinea grass:

Spikelet; stalked/pedicellate; each enclosed by three hardened, smooth, parallel veined, curved, and anteriorly tapering bracts (glumes); one placed a little below the two,

Inside the spikelet are two florets; arising from short stem axes;

Corolla; no petals;

Calyx; no sepals;

Bracts; outer bracts (glumes) are three; hardened; smooth; parallel veined; curved; and anteriorly tapering; one placed a little below the two; dull coloured;

Inner bracts are paired; thin (membranous) dull coloured; translucent;

stamens

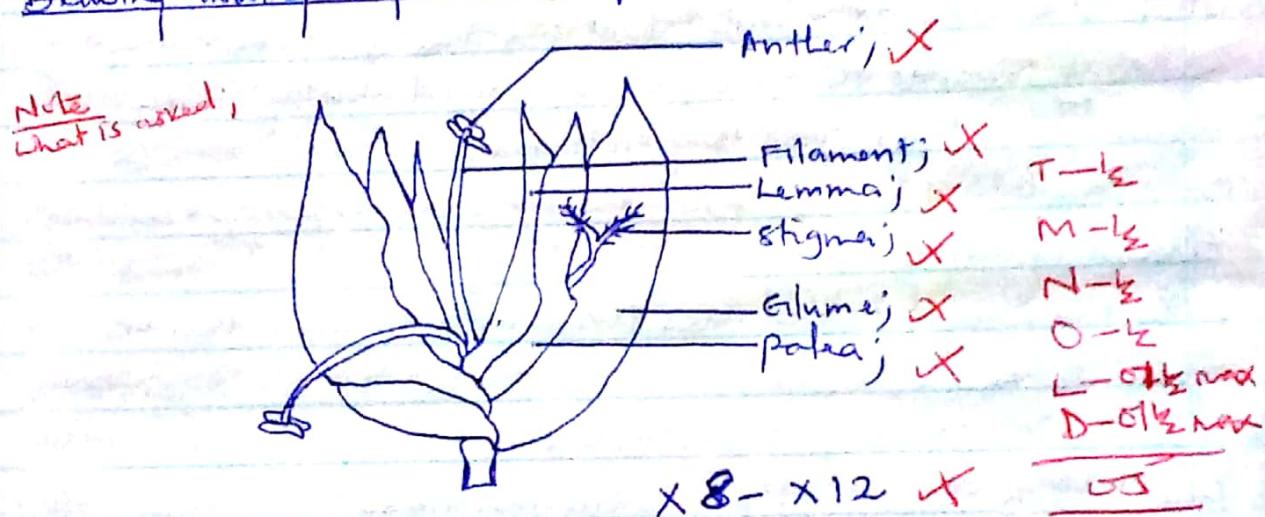
The lower floret is unisexual, bearing only three stamens; which are yellow; free; pendulous (flexible); dull coloured; with bi-lobed anthers; that are supported on thin, flexible; long filament)

Upper floret is bisexual; bearing three stamens (thers similar to) lower floret;

Carpels Upper floret bears one superior ovary; with two feathery; red-purple stigmas;

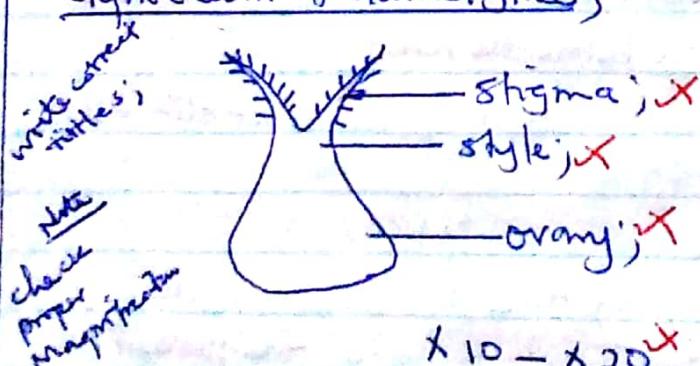
Symmetry Upper floret actinomorphic;
Lower floret zygomorphic;

Drawing showing a spikelet of specimen F (Guinea grass)



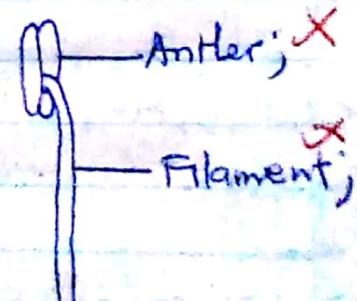
tf;

Gynoecium of Guinea grass;



M - 1/2
N - 1/2
T - 1/2
O - 1/2
L - 1/2
OS

stamen of guinea grass



T - 1/2
N - 1/2
M - 1/2
D - 1/2
L - 1/2
O - 1/2
OS

Adaptations of specimen F for reproduction (pollination)

Broad anthers are for producing much pollen grains to increase chances of pollination; (wind) ✓

↳ crowded florets result in production of much pollen grains to increase chances of wind pollination ✓

Flexible filaments for swinging to disperse pollen in different directions; OB

Note
pollen loosely attached;
for easy dispersal;

Note

Mount pollen grains of specimen F and Hibiscus at different parts of same slide; cover with cover slip; and observe under medium power of a microscope. Describe the appearance of pollen grains from both specimens; give the significance; if you can.

Drawing showing pollen grain of specimen F seen under medium power of microscope;

All wind pollinated grass/flowers;
NB



X100-300

Description

one; oval-shaped; smaller sized; even surface; dull coloured;

Many occur singly;

for Hibiscus



X100

X100-300
one round-shaped; spherical; larger sized; spiny surface; brightly coloured;
many; are clumped together;

Note clearly what the question asks;
state the significance of each structure;

Note

Qn Describe how *Bougainvillea* (specimen M) is adapted for pollination; (4mcs)

Bidens pilosa (Black jack) specimen K

Examine the specimen;

Describe the structure of inflorescence of specimen K. (3½)

Numerous; crowded; sessile florets / flowers; attached onto the apex / tip ~~end~~ of a flattened / cup-shaped / expanded / slightly curved ~~X~~; main axis / peduncle ~~X~~; with a radial / ring / circular pattern of floret arrangement ~~X~~; tubular / disc florets of the centre ~~X~~; surrounded by ray / ligulate florets on the outermost edge; curved by / surrounded by (involucel of) bracts; ~~X~~

3½ max

Note The question may be; Describe the floret arrangement in specimen K? 3½ mcs

Other characteristics of *Bidens*

Hermaphroditic (5 fused androecia and 2 fused gynoecia);

Regular; and Actinomorphic;

Floral parts are cylindrically arranged;

Inferior ovary;

Corolla made of five fused petals; united to form a tube;

Calyx, when present at all, is represented by hairs; scales or tooth-like to form a pappus;

Qn: Extract one disc floret and one ray floret from specimen K. Observe with a hand lens;

i) Describe the structure of a disc floret; (4marks)

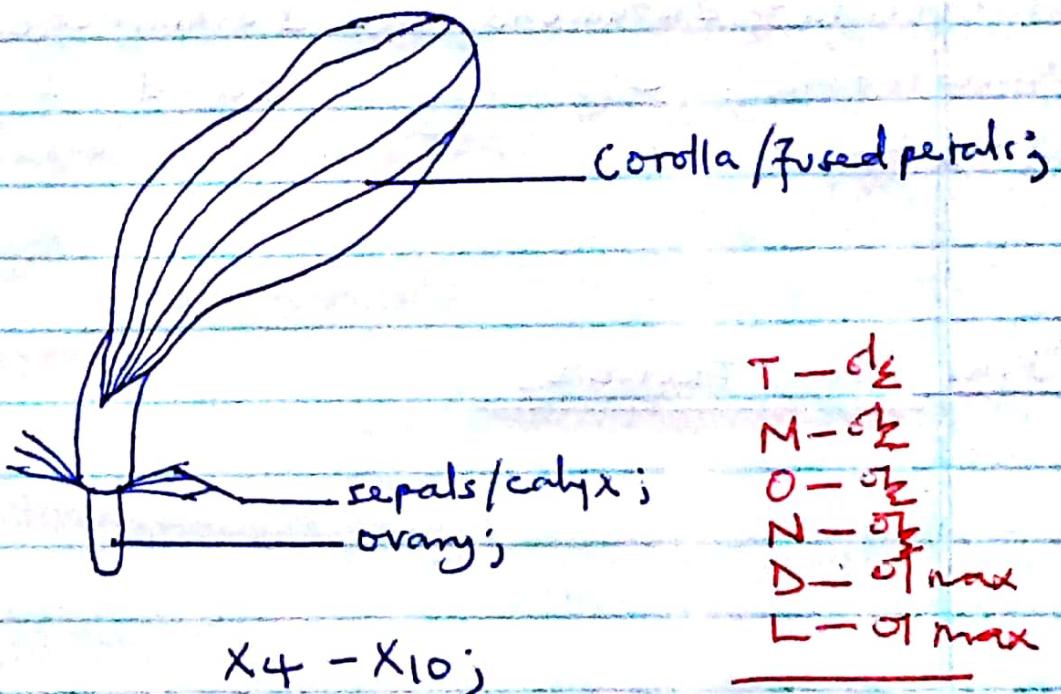
Sessile floret; with fused petals/corolla; with tubular corolla; free; spring sepal/calyx; it is bisexual; pistil with long/elongated inferior ovary; and forked stigma; The stamen with fused; bilobed; elongated anthers; with short filaments;

Actinomorphic/regular/radial symmetry;

04 max

ii) Draw and label a ray floret. (4marks)

Drawing showing a ray floret of specimen K.



Exams