

**PRACTICAL MANNUAL**

# **Fundamentals of Entomology**

**Course Code: APE 121; Credit Hrs.: 4(3+1), and  
HPP 228; Credit Hrs.: 3(2+1)**

**For B.Sc. (Hons.) Agriculture & B.Sc. (Hons.) Horticulture Students**



**Dr. Usha  
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**2019**

**College of Agriculture  
Department of Entomology  
Rani Lakshmi Bai Central Agricultural University,  
Jhansi-284 003**

**Syllabus:**

**APE 121:** Methods of collection and preservation of insects including immature stages; External features of Grasshopper/Blister beetle; Types of insect antennae, mouthparts and legs; Wing venation, types of wings and wing coupling apparatus. Types of insect larvae and pupae; Dissection of digestive system in insects (Grasshopper); Dissection of male and female reproductive systems in insects (Grasshopper); Study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance. Insecticides and their formulations. Pesticide appliances and their maintenance. Sampling techniques for estimation of insect population and damage.

**HPP 228:** Insect collection and preservation. Identification of important insects. General body organization of insects. Study on morphology of grasshopper or cockroach. Preparation of permanent mounts of mouth parts, antennae, legs and wings. Dissection of grasshopper and caterpillar for study of internal morphology. Observations on metamorphosis of larvae and pupae. Dissection of cockroaches.

**Name of Student** .....

**Roll No.** .....

**Batch** .....

**Session** .....

**Semester** .....

**Course Name :** .....

**Course No. :** .....

**Credit** .....

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**CERTIFICATE**

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Date:

Course Teacher

## CONTENT

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2.	To study external features of Grasshopper	
3.	To study insect antennae and their types	
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6.	To study insect wings and Wing venation	
7.	To study wing coupling apparatus found in insects	
8.	To study types of insect larvae	
9.	To study types of insect pupae	
10.	To study digestive system in Grasshopper	
11.	To study male and female reproductive systems in Grasshopper	
12.	To study characters of orders Orthoptera, Dictyoptera and their families of agricultural importance	
13.	To study characters of orders Odonata, Isoptera and their families of agricultural importance.	
14.	To study characters of orders Thysanoptera, Hemiptera and their families of agricultural importance	
15.	To study characters of orders Lepidoptera, Neuroptera and their families of agricultural importance	
16.	To study characters of orders Coleoptera, Hymenoptera, Diptera and their families of agricultural importance	
17.	To study insecticides and their different formulations.	
18.	To study properties of pesticide appliances and their uses	

**Exercise No. 1**

**Objective: To learn about insect collection equipment**

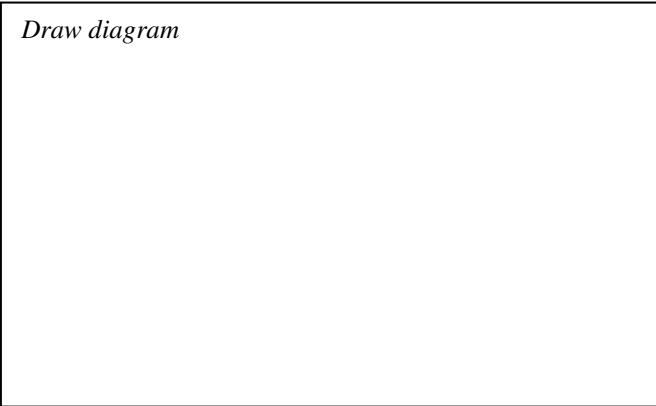
Collecting and identifying insects requires a basic understanding of insect anatomy (morphology), development, and physiology (digestion, reproduction, nervous system, circulation, and respiration), as well as behavior. This exercise deals with the methods of collection of insects, their setting and storage in the insect collection boxes for proper taxonomic studies.

**Materials Required:** .....

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**Insect collection net:** .....

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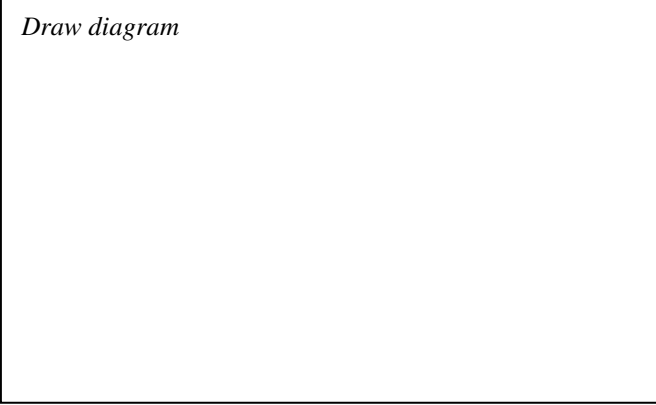
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**Uses:** .....

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**Insect collection box:** .....

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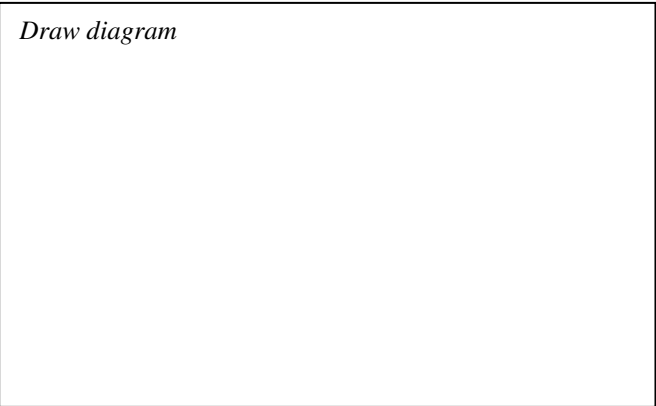


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Uses: .....

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**Aspirator:** .....

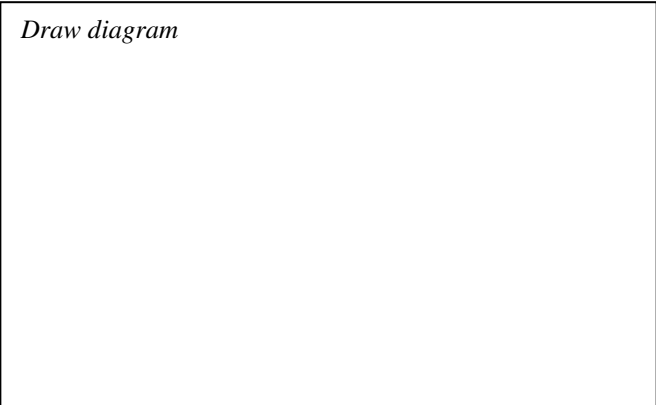
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Uses: .....

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**Light trap:** .....

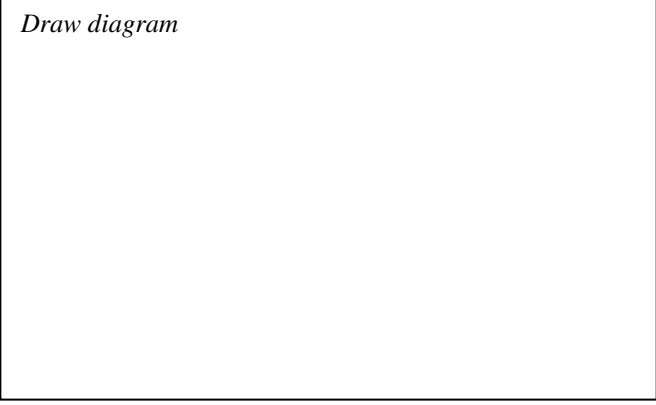
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Uses: .....

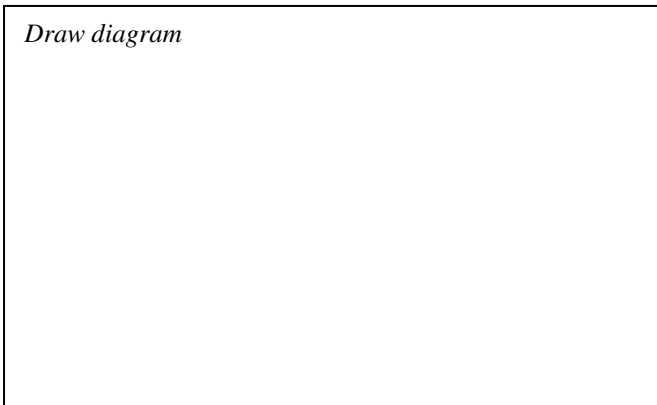
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**Killing bottle:** .....

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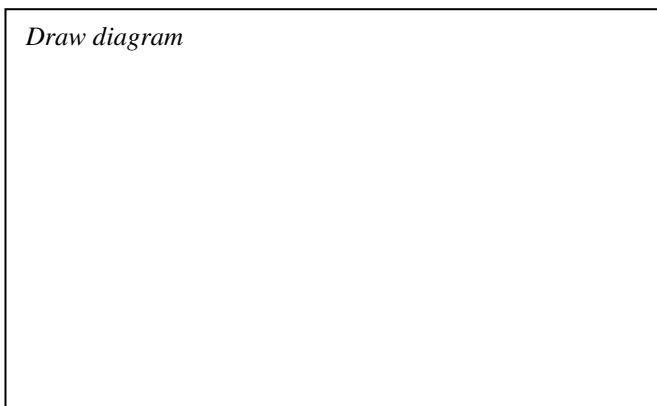
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Uses: .....

**Setting boards:** .....



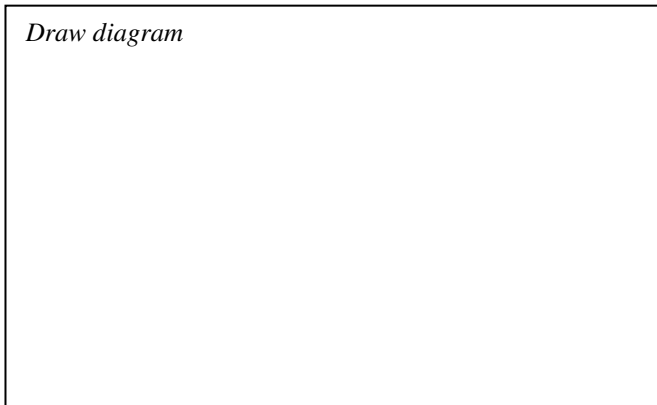
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Uses: .....

**Cabinets:** .....



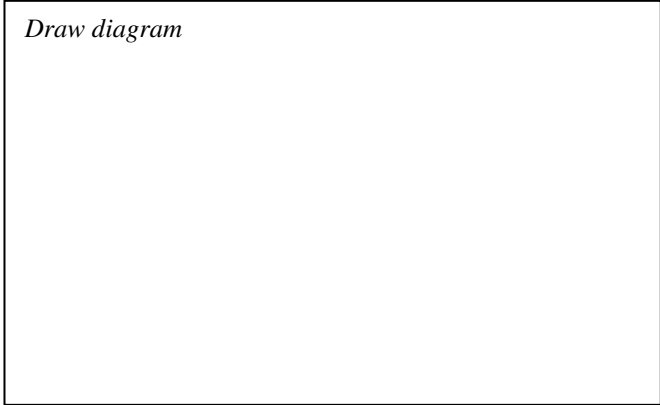
.....  
Uses: .....

**Entomological pins:** .....



.....  
**Uses:** .....

**Pinning block:** .....



.....  
**Uses:** .....

**Double mounting (Write the process):** .....

.....  
**Uses:** .....

**Pinning of insect in collection box (Write the process):** .....

.....  
**Uses:** .....

**Relaxing jar:** .....

.....  
.....  
**Uses:** .....

.....  
**Labels:** A specimen in a collection box is accompanied by label bearing essential information. The following information must be written on a label in black India ink.

Host of the Insect:

Locality of collection:

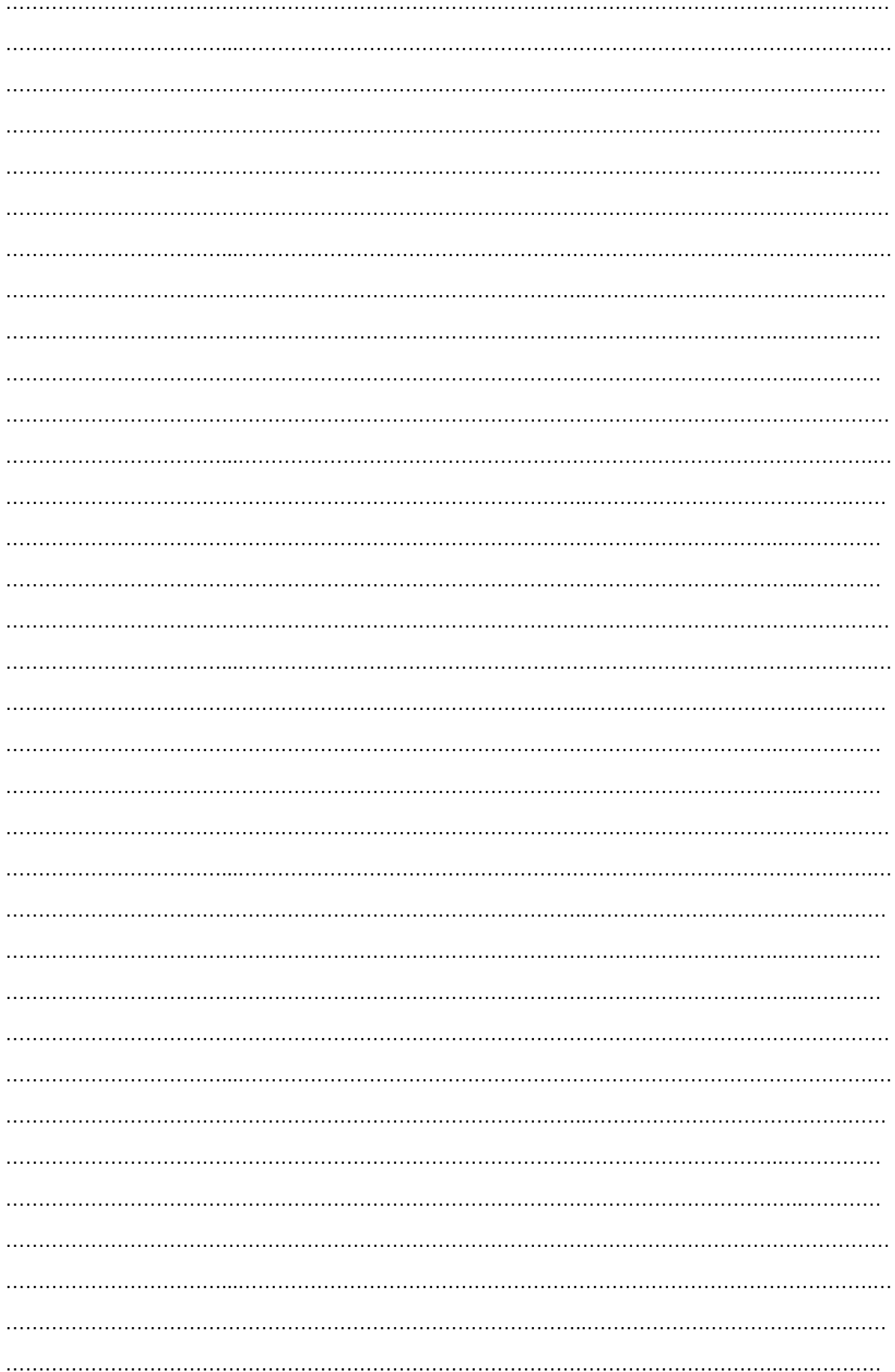
Date of collection:

Name of the insect (with order and family):

Name of the collector:



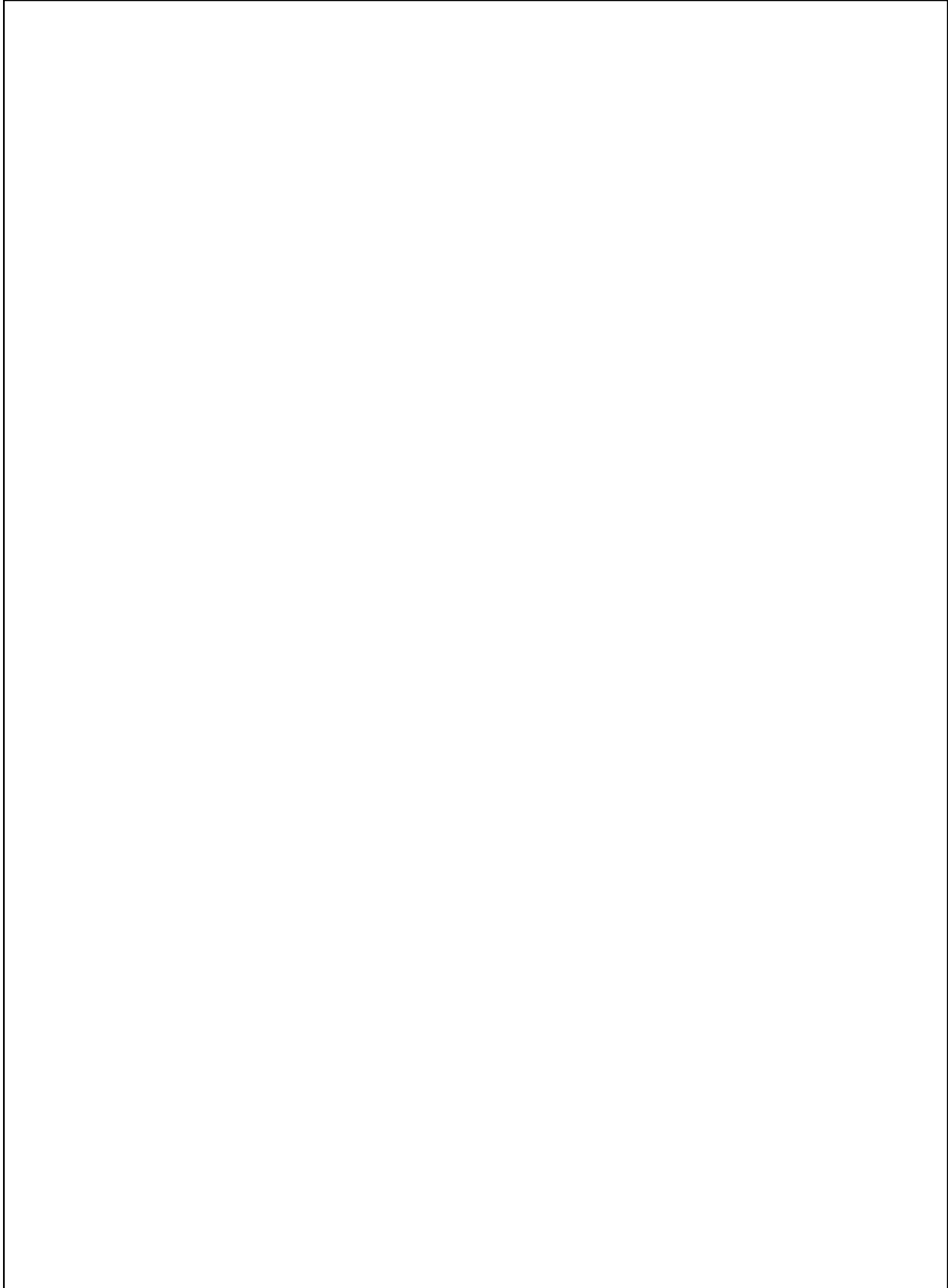




### Exercise No. 3

**Objective: To study insect antennae and their types**

**Problem:** Put the already prepared slides of antennae under the microscope or (binocular) of from the field and draw the well-labelled diagram of antennae and its modifications.





## Exercise No. 4

### Objective: To study insect Mouth parts and their types

#### Method:

- Cut the head from the thorax of a freshly killed grasshopper
  - Hold the head gently between the thumb and index finger facing the mouth parts front side.
  - Remove the labrum from the clypeus with the help of a forceps.
  - Remove the paired maxillae lying behind the mandibles with the help of a needle and forceps carefully because the maxillary palps (5 segmented) may not damaged.
  - Remove the labium (lower lip) gently with the help of a needle and forceps.
  - Mount the mouthparts in glycerine on a slide.
  - Remove the attached tissues and muscles with the help of needle.
  - Examine the various parts type of mouth parts under stereo zoom microscope
- 'OR'**
- Already prepared slides of mouthparts of insects, dissecting binocular/microscope, pencil, rubber and practical record book.

**Observation:** Observe the specimens under the microscope, draw the well labeled diagram of insect mouth parts and describe in detail

**Biting and chewing type**



**Labium:**.....

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**Hypopharynx:** .....

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Draw the diagram of different type of mouth parts of insects and also write their features

Piercing and sucking type

Bug type	Piercing and sucking type	Mosquito type

(a) Bug type: .....

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Example: .....

(b) Mosquito type: .....

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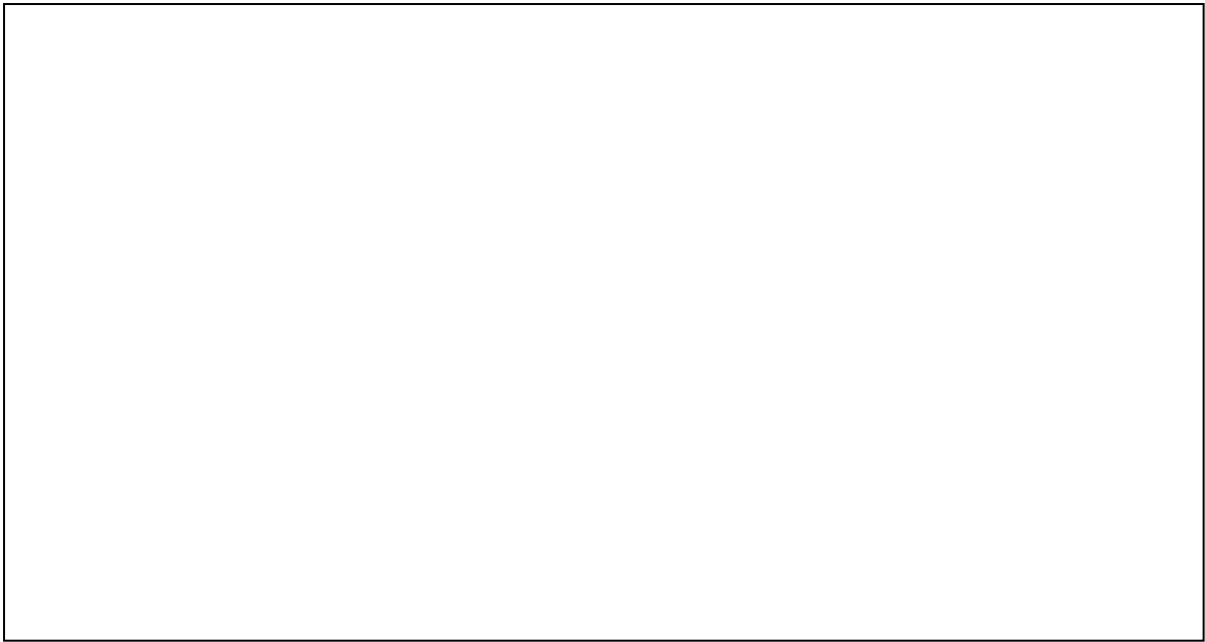
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Example: .....



**2. Sponging type:**



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**Example:**.....

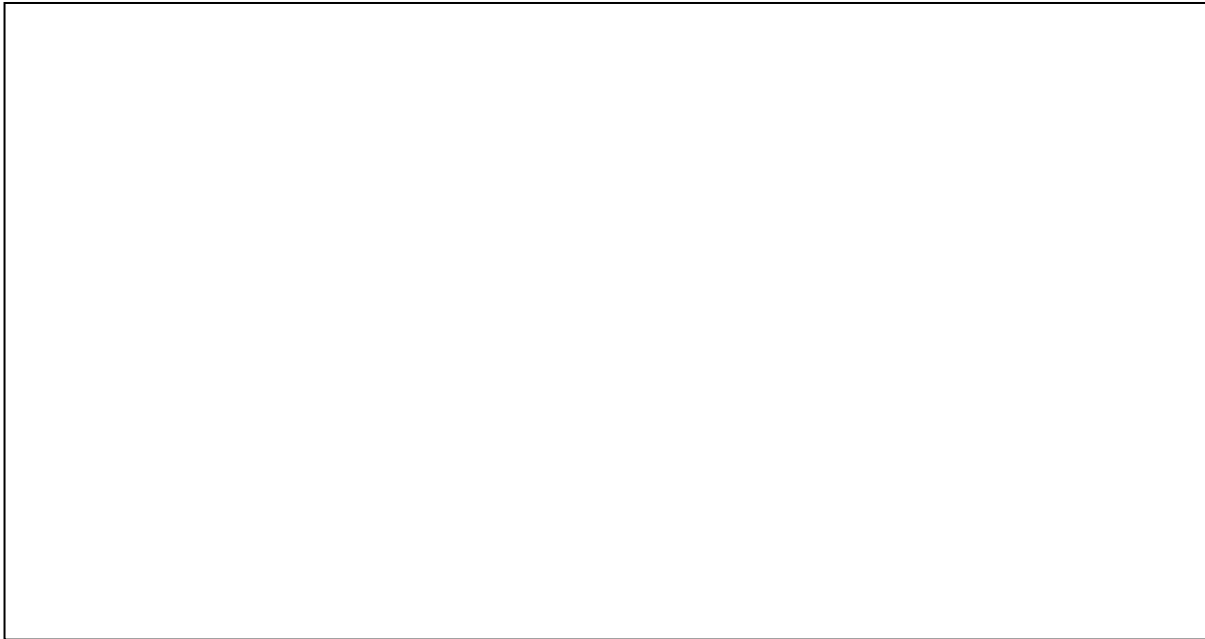
**Siphoning type :**



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**Example:**.....

**Chewing and lapping type:**



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**Example:**.....

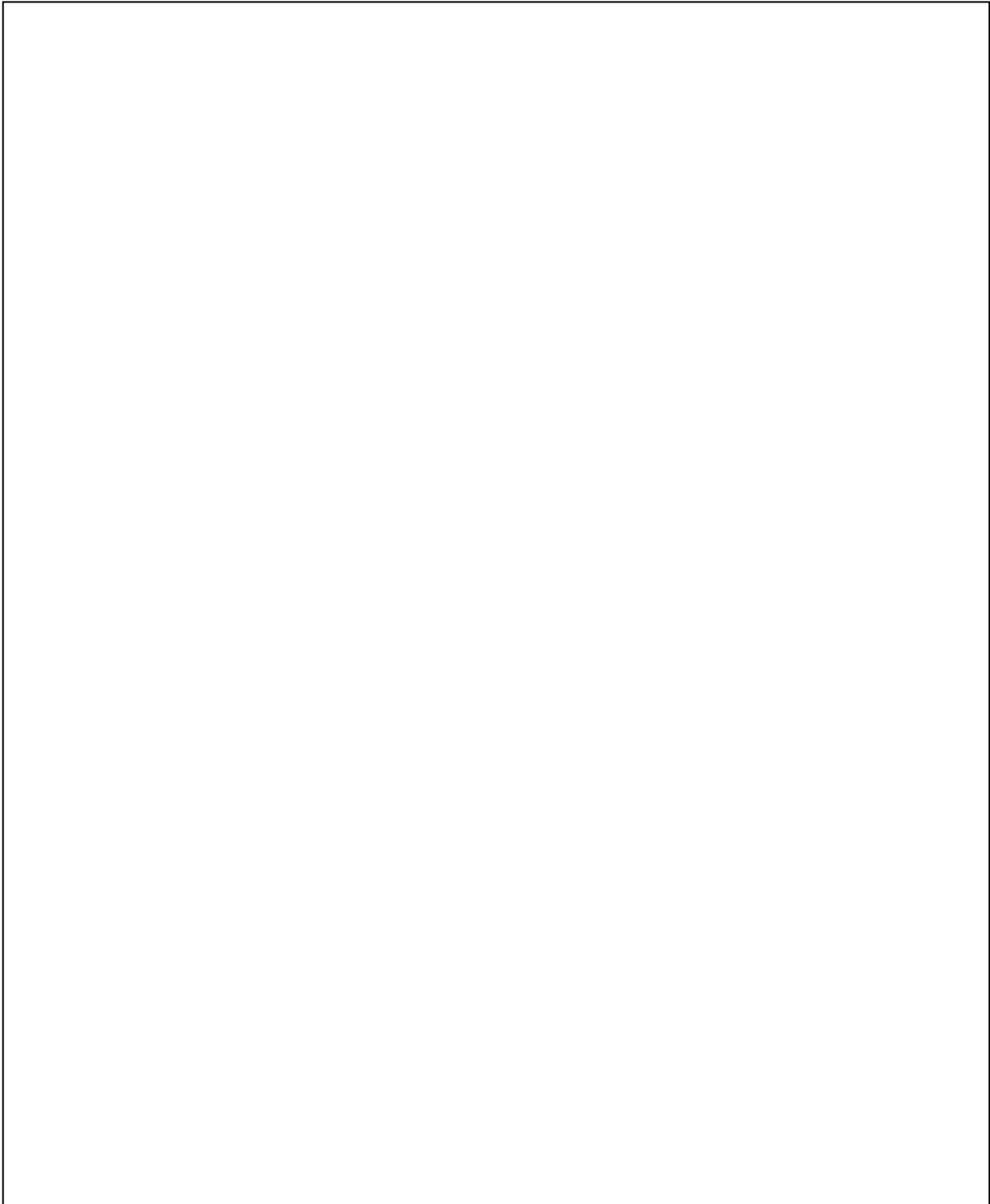
## Exercise No. 5

**Objective:** To study insect's legs and their types

**Materials required:** Already prepared slides, dissecting binocular/microscope, pencil, rubber and practical record book.

**Method:** Put the slides under the microscope/binocular and adjust the slide and eye piece in such a way to get the clear view of the parts of leg on the slide.

**Observations:** Observe the specimen under the microscope. Draw well labeled diagram of insect leg and its modifications.



**Q. 1 Describe the different parts of insect legs**

**Coxa (first segment):** .....

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**Trochanter (second segment):** .....

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**Femur (third segment):** .....

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**Tibia (fourth segment):** .....

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**Tarsus (fifth segment):** .....

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**Pretarsus (last segment having claw like structure):** .....

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**Describe different type of legs present in insects and also write their functions and features**

**Ambulatorial:**.....

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**Cursorial:** .....

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**Scansorial:** .....

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**Saltatorial:** .....

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**Stridulatory:** .....

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**Fossorial** .....

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**Natatorial:** .....

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**Foragial:** .....

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**Raptorial:** .....

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**Climbing:** .....

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**Clasping** .....

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**Suctorial:** .....

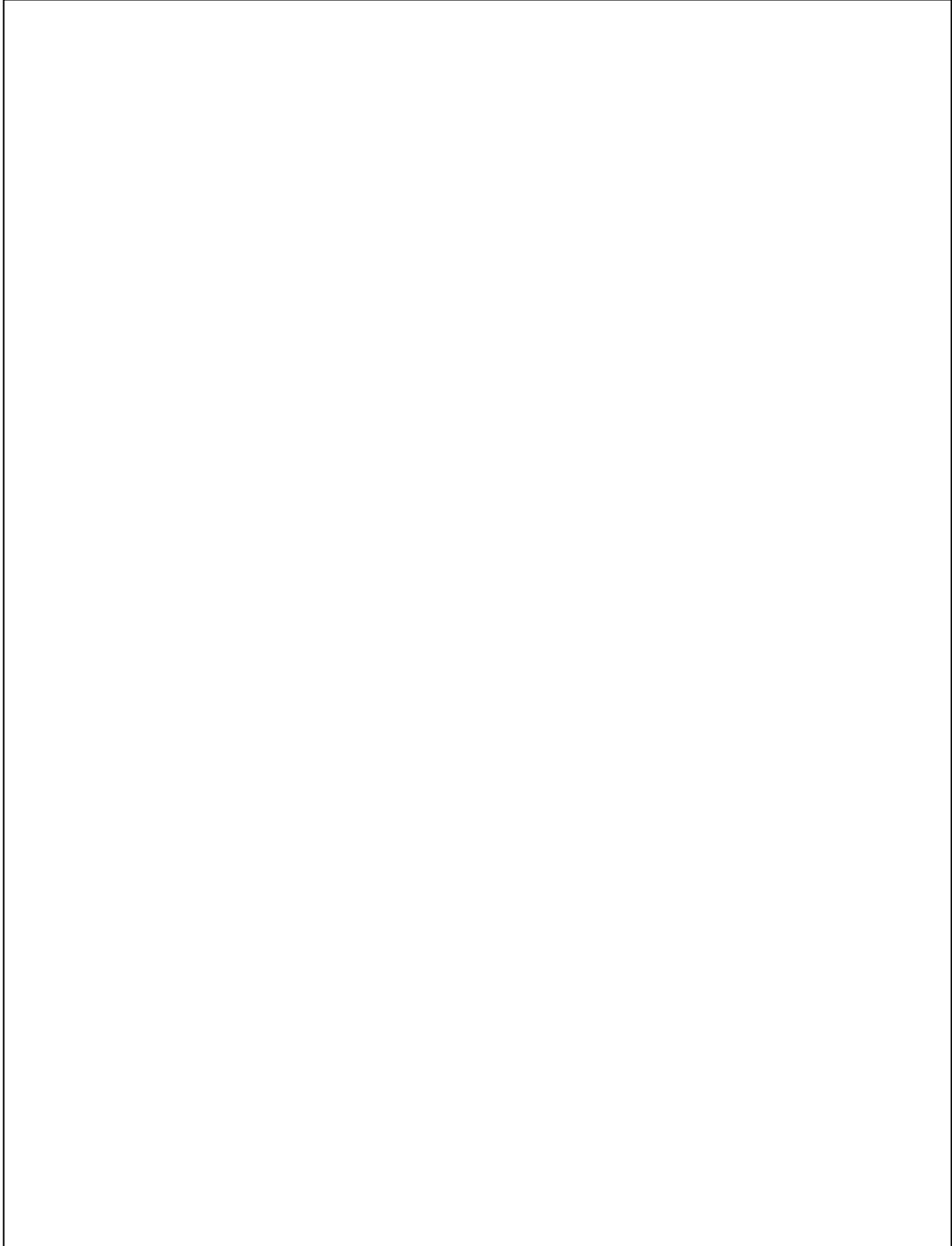
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## Exercise No. 6

**Objective: To study insect's wings and wing venation**

**Requirement:** Permanent mounted slides of wings, binocular hand lens etc.

**Problem:** Observe Insect wings under the microscope. Draw the well-labeled diagram of insect's wing with wing venation and its modifications.





**Describe longitudinal veins present in insect wing:** .....

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**Describe the about the Cross veins present in insect wing:** .....

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**Write about the features of different modification present in insect wings.**

**Tegmina:** .....

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**Example:** .....

**Elytra:** .....

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**Example:**.....

**Hemelytra:** .....

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**Example:**.....

**Halters:** .....

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Example:.....

**Fringed Wings:** .....

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Example:.....

**Scaly Wings:** .....

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Example:.....

**Membranous Wings:** .....

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Example:.....

**Describe wing:** .....

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**Write the role of wings in insects:** .....

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**Exercise No. 7**

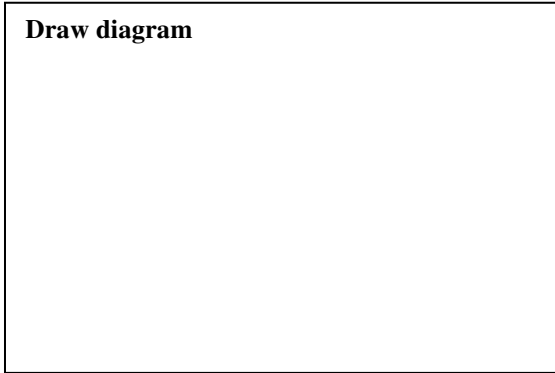
**Objective: Wing coupling apparatus found in insects**

**Requirement:** Permanent mounted slides of wings, binocular hand lens etc.

**Problem:** Observe insect wings under the microscope. Draw the well labeled diagram of insect's wing coupling apparatus

**Jugate type or jugum type:** .....

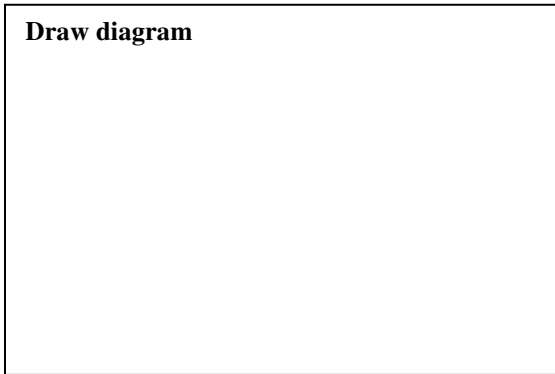
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Example:.....

**Frenulum and retinaculum type:** .....

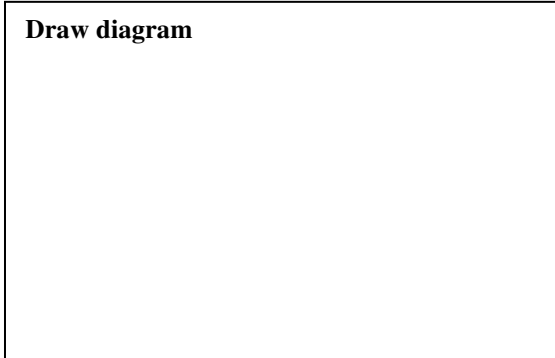
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Example:.....

**Amplexiform:** .....

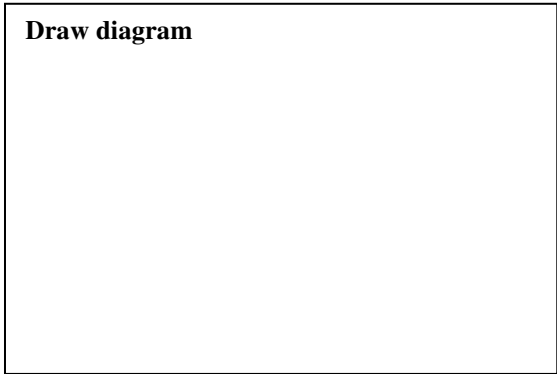
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Example:.....

Hamuli: .....

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Example: .....

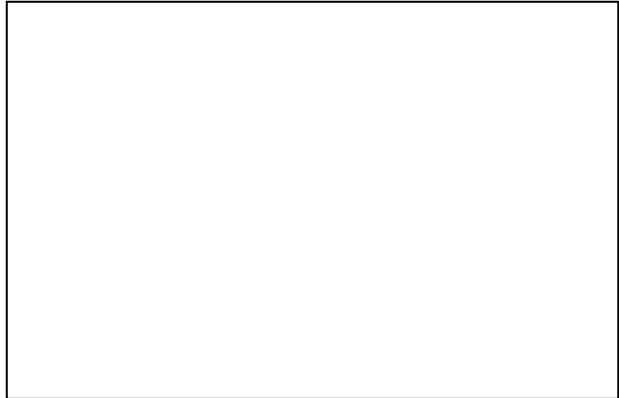
**Exercise No. 8**

**Objective: To study different types of insect larvae**

**Problem: Draw the diagram of different type of insect larvae and also write their features**

**1. Protopod larva:**

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**Example:**.....

**2. Oligopod larva:**

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**Example:**.....

**3. Polyopod larva (Eruciform larva):**

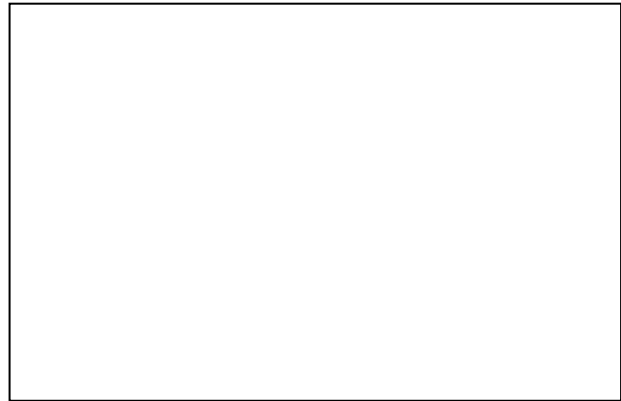
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**Example:**.....

**3. Polypod larva (Eruciform larva):**

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**Example:**.....

**Difference between:**

**Campodeiform**

**Scarabaeiform**

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.....  
.....  
.....  
.....  
.....

**In a phytophagous larva, how many abdominal legs are present**

.....  
.....

**Write the features and one example**

**Hairy caterpillar:** .....

Eg: .....

**Sphingid caterpillar / larva:** .....

Eg: .....

**Looper:** .....

Eg: .....

**Semilooper:** .....

Eg: .....

**Apodous larva:** .....

Eg: .....

**Describe in short:**

**Eucephalous:** .....

Eg: .....

**Hemicephalous.** .....

Eg: .....

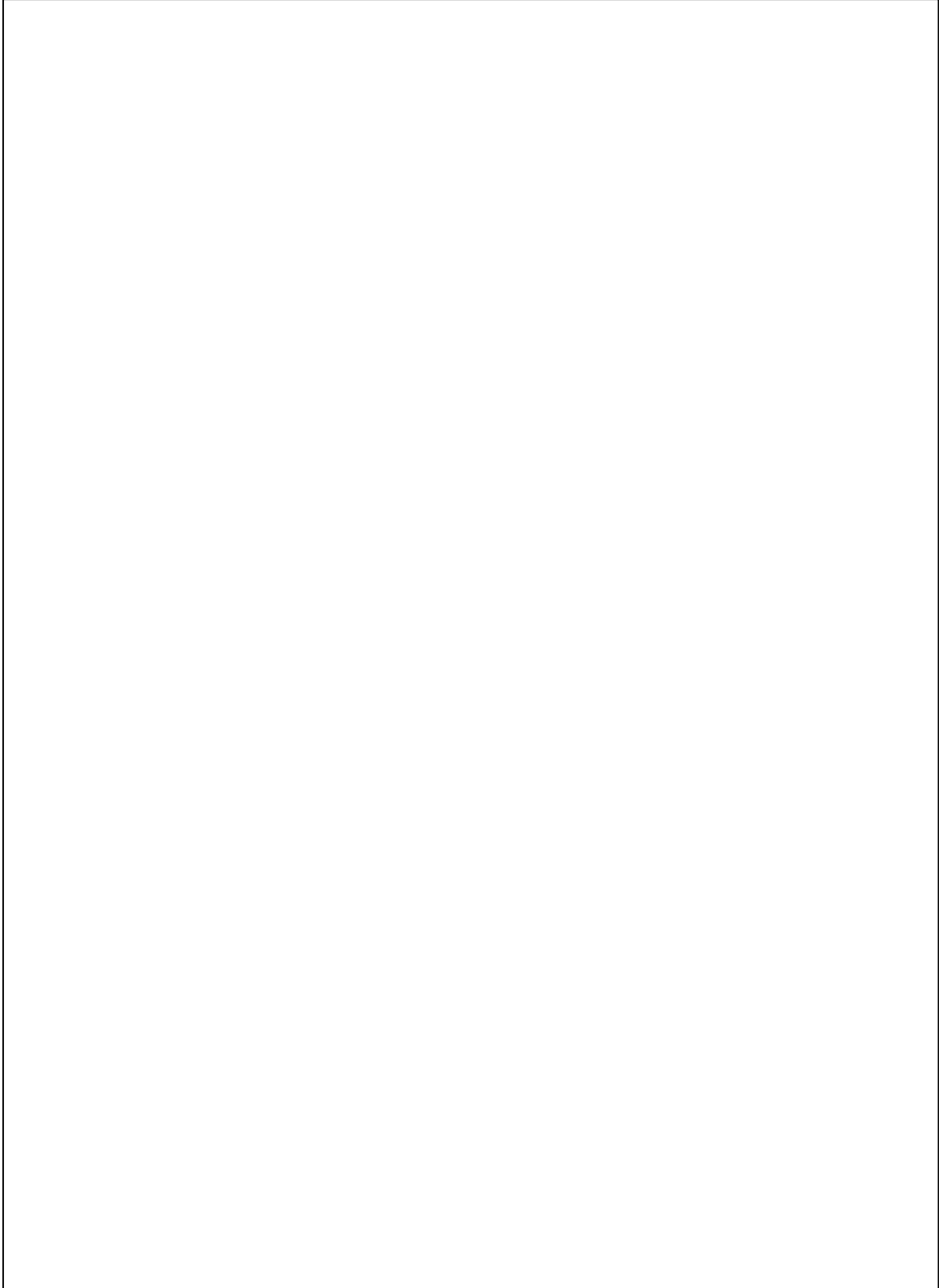
**Acephalous** .....

Eg: .....

## Exercise No. 9

**Objective: To study different types of insect pupae**

**Problem: Draw the diagram of different type of insect pupae and also write their features**





**Write about the general feature of insect pupa**

.....  
.....  
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.....

**Write about the division of insect pupae on the basis of presence and absence of powerful mandibles**

.....  
.....  
.....  
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.....

**Write about the division of insect pupae on the basis of attachment on the appendages (or) shape of the pupae**

.....  
.....  
.....  
.....  
.....  
.....

**Write one example of each**

1. Exarate pupa: .....

2. Obtect pupa: .....

3. Coarctate: .....

4. Chrysalis: .....

**Collect the different type of pupae from the nearby field and identify them**

.....  
.....  
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**Exercise No. 12**

**Objective: To study characters of orders Orthoptera, Dictyoptera and their families of agricultural importance**

**Write the Characters of Order Orthoptera:**

- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....

**Family (with one Example):**

- .....
- .....
- .....
- .....

**Draw diagram**

**Write the Characters of Order Dictyoptera:**

- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....

**Family (with one Example):**

- .....
- .....
- .....
- .....

**Draw diagram**

**Exercise No. 13**

**Objective: To study characters of orders Odonata, Isoptera and their families of agricultural importance.**

**Write the Characters of Order Odonata:**

- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....

**Family (with one Example):**

- .....
- .....
- .....
- .....

**Draw diagram**



**Write the Characters of Order Isoptera:**

- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....

**Family (with one Example):**

- .....
- .....
- .....
- .....

**Draw diagram**





**Exercise No. 14**

**Objective: To study characters of orders Thysanoptera, Hemiptera and their families of agricultural importance.**

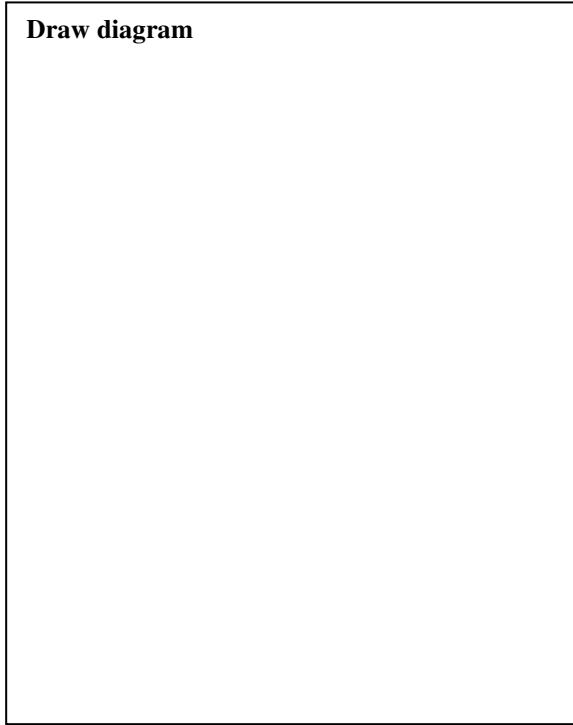
**Write the Characters of Order Thysanoptera:**

- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....

**Family (with one Example):**

- .....
- .....
- .....
- .....

**Draw diagram**



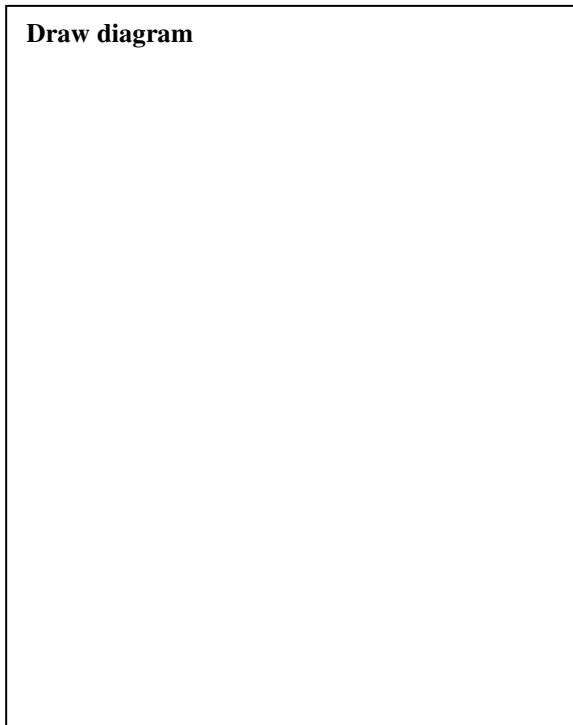
**Write the Characters of Order Hemiptera: (Sub order 1-Heteroptera):**

- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....

**Family (with one Example):**

- .....
- .....
- .....
- .....

**Draw diagram**



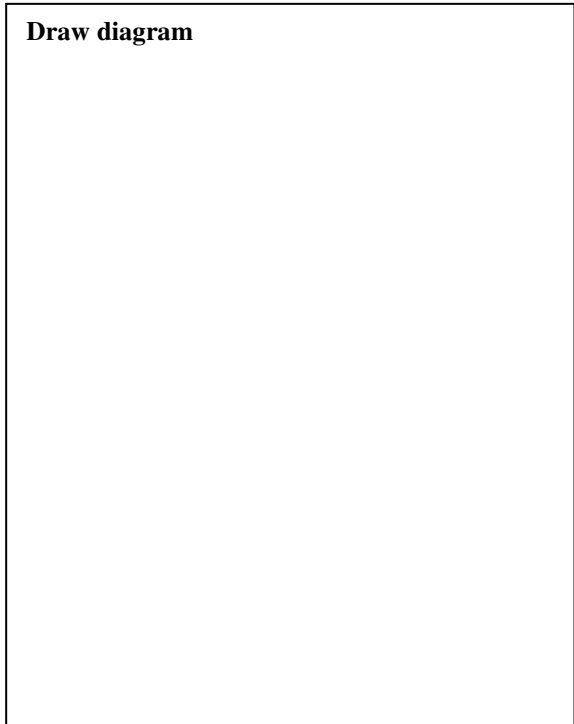
**Write the Characters of Order Hemiptera: (Sub order 1-Homoptera):**

- .....
- .....
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- .....
- .....
- .....
- .....
- .....
- .....

**Family (with one Example):**

- .....
- .....
- .....
- .....

**Draw diagram**



**Exercise No. 15**

**Objective: To study characters of orders Lepidoptera, Neuroptera and their families of agricultural importance.**

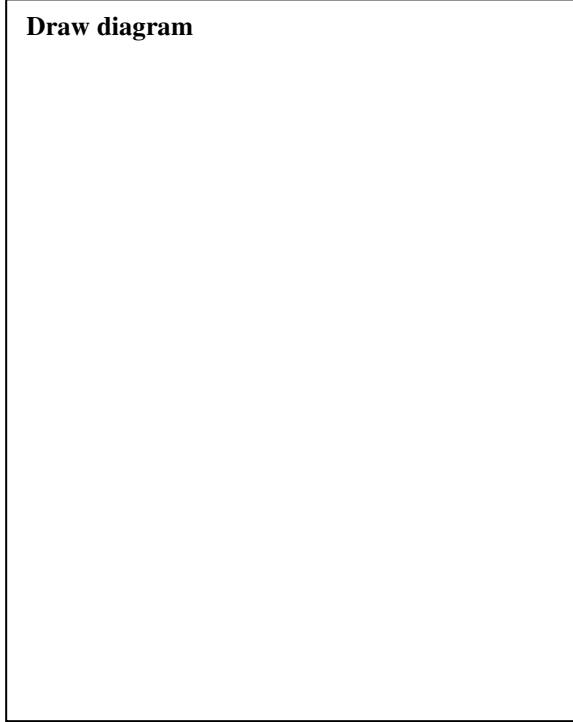
**Write the Characters of Order Lepidoptera:**

- .....
- .....
- .....
- .....
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- .....
- .....

**Family (with one Example):**

- .....
- .....
- .....
- .....

**Draw diagram**



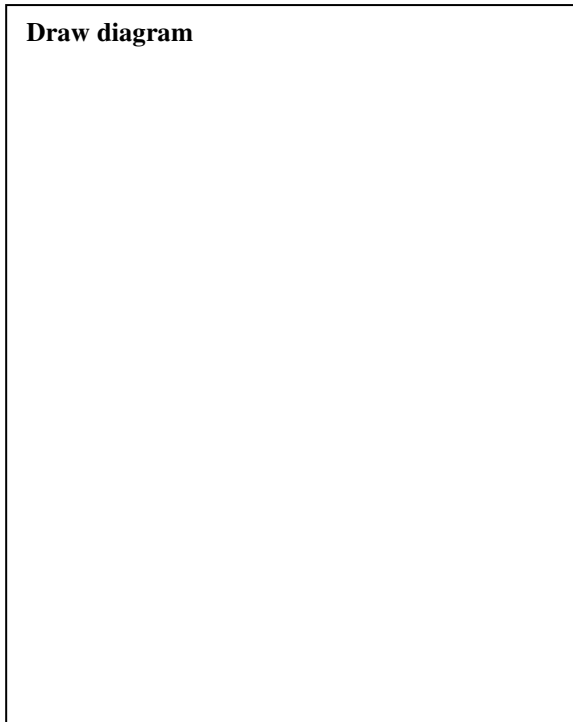
**Write the Characters of Order Neuroptera:**

- .....
- .....
- .....
- .....
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- .....
- .....
- .....
- .....

**Family (with one Example):**

- .....
- .....
- .....
- .....

**Draw diagram**



**Exercise No. 16**

**Objective: To study characters of orders Coleoptera, Hymenoptera, Diptera and their families of agricultural importance.**

**Write the Characters of Order Coleoptera:**

- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....

**Family (with one Example):**

- .....
- .....
- .....
- .....

**Draw diagram**

**Write the Characters of Order Hymenoptera:**

- .....
- .....
- .....
- .....
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**Family (with one Example):**

- .....
- .....
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- .....

**Draw diagram**

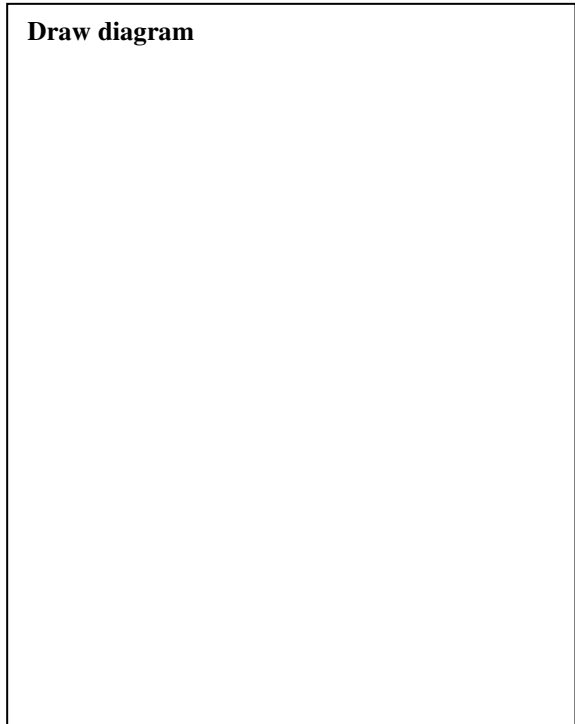
**Write the Characters of Order Diptera:**

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- .....

**Family (with one Example):**

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**Draw diagram**



**Objective: Insecticides and their different formulations.**

Write the properties of a good Insecticide

- 1. ....
- 2. ....
- 3. ....
- 4. ....
- 5. ....
- 6. ....
- 7. ....
- 8. ....
- 9. ....
- 10. ....

Write the properties of formulations of Insecticides with at least 2 examples:

1. Dusts (D): .....

2. Granules or Pelleted insecticides (G): .....

3. Wettable Powders (WP): .....

4. Emulsifiable Concentrates (EC): .....

5. Soluble Powder or Water Soluble Powder (SP or WSP): .....

6. Suspension Concentrate (SC): .....

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**7. Flowables (F):**

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**8. Water Dispersible Granules (WDG):**

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**9. Solutions:**

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**10. Concentrated insecticide liquids:**

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**11. Insecticide aerosols:**

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**12. Fumigants:**

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**13. Micro-encapsulation:**

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**14. Insecticide Mixtures:**

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**15. Baits:**

**Objective:** To study properties of pesticide appliances and their uses

Write the Properties and uses of Pesticide appliances and also draw their diagram

**HAND SPRAYER:**

**Properties:** .....  
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**Uses:** .....  
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**ROCKER SPRAYER:**

**Properties:** .....  
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Uses: .....

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**FOOT SPRAYER:**

Properties: .....

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Uses: .....

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**KNAPSACK SPRAYER:**

Properties: .....

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Uses: .....

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**Draw Diagram**

**Draw Diagram**

**FOGGING MACHINE:**

**Properties:** .....  
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**Uses:** .....  
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**HAND ROTARY DUSTER:**

**Properties:** .....  
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**Uses:** .....  
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**HAND COMPRESSION SPRAYER:**

**Properties:** .....  
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**Uses:** .....  
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**CYNOGAS PUMP:**

**Properties:** .....  
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**Uses:** .....  
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## DIRECTIONS FOR WORKING IN LABORATORY

- ❑ Practical Manual; **HB & B** pencils, pencil eraser and sharpener or blade daily.
- ❑ Keep your instruments and practical notebook clean well arranged.
- ❑ Instruments should be sharp and according to the requirements.
- ❑ Before starting work listen or read carefully the instructions given by your teacher.
- ❑ Develop habit of removing your difficulties from your teacher directly. Never ask your neighbours for anything after you have once entered the laboratory.
- ❑ Maintain silence in laboratory.
- ❑ Clean your seat and wash instruments before you leave the laboratory.
- ❑ While doing dissection put every waste in the sink. Don't drop anything on table's top or on floor.
- ❑ While studying microscope preparations, never disturb the slide once fixed under microscope by your teacher.
- ❑ While studying museum specimens take following cares:
  - First study the characters or peculiarities of that particular animal you wish to draw.
  - See and find out in the specimen before you, all those characters and peculiarities, which you have studied.
  - Draw the view in which maximum structures are visible.
  - Shading should be avoided in your drawing.
  - Compare your drawing from the drawing of this manual for necessary details, corrections and labelling.
  - While drawing, special attention should be concentrated on the length and width proportions of the animal.
  - Label your drawing with the help of book and put classification of the animal.
- ❑ Put date on the left-hand corner of the page of notebook and details of the work in the top centre.
- ❑ While looking to a slide, never move the *coarse adjustment* too much for just clearing the image. Instead, use fine focus adjustment.
- ❑ Use both eyes ultimately with a microscope.
- ❑ Never tilt a microscope.