ZOO506 – APPLIED ENTOMOLOGY & PEST MANAGEMENT

MID TERM MOST IMPORTANT QUESTIONS

i. Discuss types of heads in insects on the basis of location.

There are three types of heads in insects on the basis of location, each of which will be discussed below.

a. Pro-gnathous:

In this type of mouthparts, head is extended longitudinally with body axis. Mouthparts are pointed forward. Examples are Weevils.

b. Hypo-gnathous:

In this type of mouthparts, head is directed perpendicular to longitudinal body axis. Mouthparts are pointed downwards. Examples are grasshoppers and locust.

c. Opitho-gnathous:

In this type of mouthparts, head is bent underneath thorax during rest. Mouthparts are pointed backwards. Aphids are an excellent example.

ii. Discuss nervous system in insects.

The nervous system of insects is composed of a series of interconnected nerve cells, or neurons, that transmit signals throughout the insect's body. It consists of a brain, a ventral nerve cord, and ganglia (clusters of neurons) distributed throughout the body.

The brain is located in the insect's head and is responsible for processing sensory information and coordinating responses. It receives input from the insect's compound eyes, antennae, and other sensory organs.

The ventral nerve cord runs along the underside of the insect's body and is similar to the spinal cord in vertebrates. It carries signals between the brain and the rest of the body, controlling various motor functions.

The ganglia, which are located in different segments of the insect's body, serve as local processing centers. They receive and process sensory information from specific body parts and can generate local responses without involving the brain.

Insects have specialized sensory organs that detect various stimuli, such as light, sound, touch, and chemical signals. These sensory inputs are converted into electrical signals that are transmitted through the nervous system for processing and response generation.

iii. How insects reproduce?

Insects reproduce through a process called sexual reproduction, which involves the fusion of male and female gametes (reproductive cells). The specific steps and mechanisms of insect reproduction can vary among different species, but the general process is as follows:

a. ***Courtship:*** In many insect species, courtship behaviors are essential for mating to occur. Males may perform intricate displays, produce pheromones, or engage in other behaviors to attract females.

b. ***Mating:*** Once a male has successfully courted a female, mating takes place. Insects typically have separate sexes, with distinct male and female individuals. During mating, the male transfers sperm to the female's reproductive system using specialized structures, such as a penis or claspers.

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c. ***Fertilization:*** After mating, the female stores the sperm in a specialized organ called the spermatheca. When she is ready to lay eggs, she retrieves the stored sperm and fertilizes the eggs internally. Some insects, such as bees and wasps, have a special organ called the oviduct or ovipositor that aids in the placement of eggs.

d. ***Egg-laying:*** The fertilized eggs develop within the female's body and are then deposited in an appropriate location for development. The specific egg-laying site depends on the insect species and can range from underground burrows to leaves, bark, water, or other suitable habitats.

e. ***Development:*** Once the eggs are laid, they undergo development. Insects have different life stages, typically including egg, larva (caterpillar, grub, or maggot), pupa (cocoon or chrysalis), and adult. The duration and characteristics of each stage vary greatly among insect species.

f. ***Metamorphosis:*** Many insects undergo metamorphosis, a process of dramatic physical changes during their development. Complete metamorphosis, seen in butterflies, beetles, and flies, involves distinct larval and pupal stages, while incomplete metamorphosis, seen in grasshoppers and cockroaches, includes nymph stages that resemble miniature adults.

g. ***Emerging as adults:*** After completing their development, insects emerge as adults. They undergo a final molt, shedding their old exoskeleton, and emerge with fully formed wings and reproductive organs. The adult stage is the reproductive phase, and insects engage in activities such as feeding, finding mates, and laying eggs to continue the life cycle.

iv. Write biological control of pests.

Biological control of pests is a method of managing pest populations using natural enemies, such as predators, parasites, and pathogens, to reduce pest populations and minimize the damage they cause. It is an alternative to chemical pesticides and aims to achieve long-term pest control with minimal harm to the environment.
Here are some key aspects of biological control of pests:

a. ***Natural enemies:*** Biological control relies on the use of natural enemies that have evolved to prey upon or parasitize specific pests. These natural enemies can include insects, mites, nematodes, bacteria, fungi, and viruses.

b. ***Predators:*** Predatory organisms feed directly on the pest species. For example, ladybugs are commonly used to control aphid populations in gardens and agricultural fields. Other predators include lacewings, predatory mites, and predatory beetles.

c. ***Parasitoids:*** Parasitoids are organisms that lay their eggs inside or on the bodies of pests. The developing parasitoid larvae feed on the pest, eventually killing it. Parasitoid wasps are often used in biological control programs to control pests like caterpillars and fruit flies.

d. ***Pathogens:*** Certain microorganisms, such as bacteria, fungi, and viruses, can infect and kill pests. These pathogens are selected for their ability to specifically target the pest species while posing minimal risk to beneficial organisms. For example, the bacteria Bacillus thuringiensis (Bt) is commonly used to control caterpillar pests.

e. ***Augmentation and conservation:*** Biological control can involve both augmentation and conservation strategies. Augmentation involves the release of large numbers of natural enemies to control pest populations. Conservation, on the other hand, focuses on creating and maintaining habitats that support the natural enemies already present in the environment.

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v. Define oviviparous.

While the majority of insects reproduce through oviparity (laying eggs), there are a few examples of viviparous insects. These insects exhibit a unique reproductive strategy where the female gives birth to live offspring instead of laying eggs. Few examples are: Aphids, Tsetse fly, Strepsiptera, Rove beetles.

vi. What is ovipositor?

At the end of the abdomen in the females of those insects which lay their eggs within objects is a combination of pieces known as an ovipositor. Ovipositor usually consists of about three pairs of parts, long or short, slender or stout, as the case may be, for the purpose of making a hale or sawing a slit in the object in which the eggs are placed and in guiding the eggs into the hole thus made.

vii. Differentiate between exoskeleton of arthropods and Mollusca.

Exoskeleton of Arthropods and Mollusca may seem resembled but there is a distinct difference in composition of these skeletons. Exoskeleton of Mollusca is mainly composed of Calcium Carbonate; while on the other hand, exoskeleton of arthropods is composed of Chitin, which resembles horns. Sometimes, arthropods may have calcareous salts deposited in their exoskeletons.

viii. What are benefits of insects?

Insects play important roles in ecosystems and provide numerous benefits to humans and the environment. Here are some of the key benefits of insects:

1. ***Pollination:*** Insects, particularly bees, butterflies, and other pollinators, play a crucial role in pollinating flowers and crops. They transfer pollen between plants, allowing them to reproduce and produce fruits, seeds, and vegetables. It is estimated that insects contribute to the pollination of approximately 75% of global food crops.

2. ***Pest control:*** Many insects are natural predators or parasitoids of pests that can damage crops and plants. Ladybugs, praying mantises, and certain wasp species, for example, feed on harmful insects like aphids, caterpillars, and mites. This natural pest control reduces the need for synthetic pesticides, making it an environmentally friendly approach to managing pests.

3. ***Decomposition and nutrient cycling:*** Insects play a vital role in breaking down organic matter, such as dead plants and animals. They assist in the process of decomposition, recycling nutrients back into the soil and contributing to the fertility of ecosystems. Without insects, organic waste would accumulate, and nutrient cycling would be impaired.

4. ***Food source:*** In many cultures around the world, insects are consumed as a source of protein and nutrients. They can be a sustainable and affordable food option, requiring fewer resources than traditional livestock farming. Additionally, some insects, like mealworms and black soldier flies, can be used to convert organic waste into nutritious animal feed.

5. ***Research and medicine:*** Insects have contributed significantly to scientific research and the development of medical treatments. For example, the fruit fly (Drosophila melanogaster) has been

extensively studied to understand genetics and developmental processes. Moreover, compounds derived from insects, such as ants and beetles, have been used in traditional medicine and are being investigated for potential therapeutic applications.

6. ***Ecological balance:*** Insects are a vital part of the food chain and serve as a food source for many other animals, including birds, reptiles, amphibians, and mammals. They help maintain the balance of ecosystems and ensure the survival of various species. Removing insects from the ecosystem could disrupt the food web and have cascading effects on other organisms.

ix. Define coxa.

The coxa is the segment that articulates with the body, frequently partly lying in a more or less cup-shaped hollow of the latter. It may be short or long and is generally freely movable on the body and powerful.

x. What are tracheal gills?

Tracheal gills in insects are specialized structures that allow for efficient gas exchange in aquatic or semi-aquatic species. While most insects have a respiratory system based on tracheae, which are tubes that deliver oxygen directly to the cells, some species have evolved tracheal gills to extract dissolved oxygen from water.

Tracheal gills typically consist of thin, elongated extensions of the tracheal system that extend outside the body and come into contact with the surrounding water. These gills are often located on the abdomen, thorax, or legs of the insect. The gills may be feathery or filamentous in structure, which increases the surface area available for gas exchange.

xi. What is physical transmission?

Physical transmission in insects refers to the process by which certain pathogens, such as bacteria, viruses, or parasites, are directly transmitted from one organism to another through physical contact or mechanical means involving insects. In this context, insects act as mechanical vectors, carrying the pathogen on their bodies or through their feeding activities.

There are various mechanisms through which physical transmission can occur:

1. ***Mechanical Transmission:*** Insects may carry pathogens on their body surfaces, mouthparts, or in their feces. When they come into contact with a susceptible host, the pathogens can be transferred. For example, houseflies can pick up pathogens from fecal matter or decaying organic material and subsequently transfer them to food or surfaces that humans come into contact with.

2. ***Regurgitation:*** Some insects, such as mosquitoes and ticks, regurgitate saliva containing pathogens into the host during feeding. This enables the pathogens to enter the host's bloodstream, potentially causing infection. Mosquitoes are known to transmit diseases like malaria, dengue fever, and Zika virus through this mechanism.

3. ***Biting or Piercing:*** Insects with piercing mouthparts, such as mosquitoes, fleas, and ticks, can directly introduce pathogens into the host's body through their bites. These insects may harbor pathogens in their salivary glands or gut, which are then injected into the host during feeding.

4. ***Fecal Transmission:*** Insects like tsetse flies and kissing bugs can transmit pathogens through their feces. They defecate while feeding, and if the feces come into contact with a host's skin or mucous

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membranes, the pathogens present in the feces can enter the host's body, potentially leading to infection.

xii. On what basis we can identify the insects?

Insects can be identified based on various characteristics and features. Here are some common factors used to identify insects:

1. ***Body Structure***: Insects have a distinct body structure consisting of three main parts: head, thorax, and abdomen. The number and structure of appendages, such as antennae, wings, and legs, can also vary between different insect species.

2. ***Number of Legs:*** Insects typically have six legs, attached to the thorax. This distinguishes them from other arthropods like spiders (which have eight legs) and millipedes (which have many more legs).

3. ***Wings:*** Many insect species have wings, although some may be wingless. The structure, shape, and size of the wings can vary significantly, providing important clues for identification.

4. ***Antennae:*** Insects have a pair of antennae on their head, which can vary in shape, length, and the presence of specific segments or sensory structures. Antennae are often important for sensing the environment and can help differentiate between insect groups.

5. ***Mouthparts:*** Different insects have distinct mouthparts adapted for various feeding habits. For example, butterflies and moths have a long proboscis for sipping nectar, while beetles have chewing mouthparts.

6. ***Coloration and Patterns:*** The color and pattern on an insect's body, wings, or legs can be unique to a particular species or group. Observing these features can aid in identification.

7. ***Life Cycle:*** The study of an insect's life cycle, including its eggs, larvae (caterpillars, grubs, etc.), pupae, and adult stages, can provide valuable information for identification. Notable characteristics at different stages can be used as identifying features.

8. ***Habitat and Behavior:*** Understanding an insect's preferred habitat, behavior, and feeding habits can narrow down the possibilities for identification. Different species tend to occupy specific ecological niches or exhibit particular behaviors.

9. ***Taxonomic Keys and Guides:*** Experts and enthusiasts often use taxonomic keys and field guides to identify insects. These resources provide detailed descriptions, illustrations, and identification criteria to assist in the identification process.

xiii. Describe artificial control of insects.

Artificial controls of insects refer to various methods and techniques employed by humans to manage or regulate insect populations. These controls can be categorized into several broad categories:

a. ***Chemical control:*** The use of insecticides or pesticides to kill or repel insects. This can involve the application of chemical sprays, baits, or systemic treatments to crops, buildings, or other areas affected by insect infestations.

b. ***Biological control:*** The utilization of natural enemies or predators to control insect populations. This approach involves introducing or enhancing the presence of beneficial organisms such as predatory insects, parasitic wasps, or pathogenic microorganisms to reduce the population of target pests.

c. ***Cultural control:*** The modification of agricultural or environmental practices to minimize insect damage. This may include crop rotation, intercropping, sanitation measures, or the use of physical barriers to prevent insect access.

d. ***Genetic control:*** The manipulation of insect genes or genetic material to control populations. This can involve techniques such as the release of sterile insects, genetic modification to render insects infertile, or the use of genetically modified crops resistant to specific insect pests.

e. ***Mechanical control:*** The use of physical methods to manage insects. This can include trapping, vacuuming, or physically removing insects or their breeding sites.

xiv. Write names of pollination plants. Which plants are required for pollination?

Some plants, as the Smyrna fig, clovers, melons, tomatoes, beans, peas and most of the common fruits, require the visits of insects before the seeds or fruits can form

xv. Write methods for natural control of pests.

Natural methods of pest control involve using environmentally friendly and non-toxic techniques to manage and prevent pest infestations. Here are some short descriptions of commonly used natural pest control methods:

1. ***Biological control:*** Introducing natural predators, parasites, or pathogens that target specific pests to keep their populations in check. For example, ladybugs can be used to control aphids in gardens.

2. ***Crop rotation:*** Rotating crops seasonally or annually to disrupt pest life cycles and reduce their buildup in the soil. This method helps prevent the recurrence of pest infestations.

3. ***Companion planting:*** Planting certain species together to repel pests or attract beneficial insects. For instance, marigolds are often interplanted with vegetables to deter nematodes and other harmful insects.

4. ***Mechanical barriers:*** Using physical barriers like nets, fences, or row covers to physically exclude pests from plants. This method is commonly employed to protect crops from birds, rabbits, or larger insects.

5. ***Traps and lures:*** Placing traps or lures to attract and capture pests. Sticky traps, pheromone traps, and light traps are commonly used to monitor and control pests like flies, moths, and beetles.

6. ***Handpicking:*** Physically removing pests from plants by hand. This method is effective for larger pests such as snails, slugs, and caterpillars, which can be manually collected and removed.

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7. ***Natural insecticides:*** Using organic or naturally derived substances to control pests. Examples include neem oil, garlic spray, and pyrethrin, which are effective against a range of insects while being less harmful to the environment than synthetic chemicals.

8. ***Habitat modification:*** Creating an environment that discourages pest activity. This can include proper sanitation, removing pest shelters (such as leaf litter or debris), and maintaining plant health through appropriate watering and fertilization practices.

xvi. Write characteristics of insects.

Arthropods are a diverse group of invertebrate animals that make up the largest phylum in the animal kingdom. They exhibit a wide range of characteristics, some of which are:

1. ***Exoskeleton:*** Arthropods have a hard, chitinous exoskeleton that provides support, protection, and attachment sites for muscles. The exoskeleton also serves as a waterproof barrier.

2. ***Segmented Body:*** Their bodies are divided into distinct segments, with the segments often bearing specialized appendages.

3. ***Jointed Appendages:*** Arthropods have jointed appendages, such as legs, antennae, and mouthparts, which are adapted for various functions like walking, feeding, sensing, and reproduction.

4. ***Bilateral Symmetry:*** Most arthropods exhibit bilateral symmetry, meaning their bodies can be divided into two equal halves along a central axis.

5. ***Open Circulatory System:*** Arthropods typically have an open circulatory system in which a fluid called hemolymph bathes the internal organs directly.

6. ***Molting:*** Arthropods undergo periodic molting or ecdysis to shed their old exoskeleton and grow a new one. This process allows for growth and regeneration.

7. ***Nervous System:*** Arthropods have a well-developed nervous system with a dorsal brain and a ventral nerve cord. They often have compound eyes and other sensory structures for vision, touch, taste, and smell.

8. ***Respiratory System:*** While the exact respiratory mechanisms vary among different arthropods, many employ gills, book lungs, tracheae, or spiracles for gas exchange.

9. ***Reproductive Diversity:*** Arthropods have diverse reproductive strategies, including internal and external fertilization, sexual and asexual reproduction, and various forms of parental care.

10. ***High Species Diversity:*** Arthropods are incredibly diverse, with over a million described species. They can be found in virtually all terrestrial, freshwater, and marine habitats, exhibiting an array of ecological roles.

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xvii. Name structural part of abdomen and thorax.

In insects, the structural parts of the abdomen and thorax are as follows:

Abdomen:

1. ***Abdominal segments:*** The abdomen is composed of a series of distinct segments, usually ranging from 8 to 11, although the number can vary among different insect species. These segments are connected by flexible membranes called intersegmental membranes.

2. ***Spiracles:*** These are small openings present on the lateral sides of the abdomen. Spiracles allow insects to exchange gases with the environment by enabling the entry of oxygen and the release of carbon dioxide.

3. ***Genitalia:*** In the posterior segments of the abdomen, insects have reproductive structures called genitalia. The form and complexity of genitalia can vary significantly among different insect species.

4. ***Tergites and sternites:*** The dorsal (top) and ventral (bottom) surfaces of each abdominal segment are typically divided into plates called tergites and sternites, respectively. These plates provide support and protection to the internal organs.

Thorax:

1. ***Prothorax:*** The anterior segment of the thorax is called the prothorax. It bears a pair of legs, and in winged insects, it may also have small wing-like structures called tegulae.

2. ***Mesothorax:*** The middle segment of the thorax is known as the mesothorax. It usually has a pair of wings attached to it in winged insects.

3. ***Metathorax:*** The posterior segment of the thorax is called the metathorax. It bears the hind pair of legs and, in winged insects; it may also have the second pair of wings attached to it.

4. ***Notum, pleuron, and sternum:*** Each segment of the thorax is further divided into several regions. The dorsal part is called the notum, which provides attachment sites for the wings and muscles. The lateral parts are known as the pleuron, and the ventral parts are called the sternum. These regions also serve as attachment points for muscles and support the movements of legs and wings.

xviii. Define cerci.

A pair of many-segmented, antenna-like structures, sometimes short, sometimes long, may occur at the end of the abdomen. These are called cerci. They probably serve as organs of touch and possibly organ of smell in some cases.

xix. How allergy is caused?

Allergies caused by insects, such as mosquitoes, bees, wasps, and ants, are typically a result of the immune system's reaction to specific proteins found in the insect's venom or saliva. When an insect bites or stings a person, it injects these proteins into the skin, which can trigger an immune response in some individuals.

The immune system of a person with an insect allergy recognizes these insect proteins as harmful and produces antibodies called immunoglobulin E (IgE) to fight against them. The next time the person is exposed to the insect's venom or saliva; the IgE antibodies recognize the proteins and trigger the release

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of histamine and other chemicals. These chemicals cause allergy symptoms, such as itching, swelling, redness, and in severe cases, anaphylaxis.

Symptoms of an insect allergy can vary from mild to severe. Mild reactions may include localized itching, swelling, and redness around the site of the bite or sting. However, in more severe cases, a person may experience widespread hives, difficulty breathing, dizziness, rapid heartbeat, and swelling of the face, throat, or tongue. Anaphylaxis is a potentially life-threatening reaction that requires immediate medical attention.

xx. What is role of insects in pollination?

Insects play a crucial role in pollination by transferring pollen from the male reproductive organs (stamens) of a flower to the female reproductive organs (pistils) of the same or a different flower, facilitating the fertilization process.

xxi. What commercial products are obtained from insects?

There are many commercial products that are synthesized by insects naturally. Some of them are:

a. Silk by silkworm (Bmbyx mori), sericulture
b. Honey by Honey bee (Apis mellifera), apiculture
c. Beeswax
d. Shell lac by lac insect (Kierra lacca), lac culture

xxii. What are contact insecticides?

Contact insecticides are a type of pesticide that is formulated to kill or control insects upon direct contact. When applied to the surfaces or areas where insects are present, these insecticides work by penetrating the insect's exoskeleton or interfering with their physiological processes, leading to their death.

Contact insecticides are generally available in various forms, including sprays, dusts, powders, liquids, and aerosols. They can be used indoors or outdoors, depending on the specific product and the target pest. These insecticides are commonly used for the control of a wide range of insects, including mosquitoes, flies, ants, cockroaches, beetles, and other crawling or flying pests.

The active ingredients in contact insecticides may vary, but common examples include pyrethroids (e.g., permethrin, cypermethrin), organophosphates (e.g., malathion), carbamates (e.g., carbaryl), and botanical extracts (e.g., neem oil). Each active ingredient has its own mode of action and targets specific types of insects.

xxiii. Name types of insect larvae.

Larvae of insects can be classified in four types:

i- Larvae of moths and butterflies are called caterpillars.
ii- Larvae of beetles are usually called grubs.
iii- Larvae of flies are called maggots.
iv- Larvae found in boring wood, of any insect either moth, butterfly or beetles are uniformly called borers.

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