



**Benha University,
Faculty of Science,
Entomology Department
Final Examination, 2nd Semester, 2013
General Entomology (111 E)
Time allowed 1 Hour
Date 18/6/2013**

Answer the following questions (80 Marks)

- 1. Discuss one only from the following statements (20 Marks)**
 - a. Insects are the dominant organisms on the universe.**
 - b. Insects have a great role in the development of science and technology.**

- 2. Write on two only of the following (40 Marks):**
 - a. Reasons for insect success.**
 - b. Impacts of Insects**
 - c. Cultural Entomology**

- 3. Give reasons for two only from the following (20 Marks):**
 - a. Insects provide great benefits for flowering plants.**
 - b. Insects have different types of mouth parts.**
 - c. Insect have an important role in treating human diseases.**

WITH MY BEST WISHES

PROF. ABDELWAHAB IBRAHIM



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Answer the following questions

1. Discuss one only from the following statements (20 Marks)

a. Insects are the dominant organisms on the universe.

Dominance of insects can be proved regarding the following items:

Number of Species

- Over 800,000 insect species have been named and described.
- The entire plant kingdom contains between 400,000 and 500,000 species.
- The "lower" invertebrates account for around 200,000 species, while vertebrates total only about 50,000 species.
- Insects represent more than half (about 53%) of the 1.5 million species of living organisms known to science.
- Discovery of a new species of vertebrate is a rare. Entomologists describe hundreds of these new species each year.
- Two of every three living species may be insects.

Number of individuals

- A swarm of migratory locusts may contain up to 10 billion individuals, and have a total biomass of over 30,000 metric tons.
- Some colonies of ants which live in a square mile may contain over a million queens and 300 million workers.
- If insects were divided equally among each one of the earth's 6 billion human inhabitants, each of us would be allotted 1×10^{18} insects

Distribution

- Insects live everywhere from mountain tops in the Himalayas to tide pools at the seashore.
- Some insects spend their entire lives in underground caves.
- At least 40 species live on the polar ice in caps of Antarctica.
- Some insects can survive in hot springs (50°C); others inhabit deserts where water is scarce and daytime temperatures exceed 60°C.
- Insects live above and below the surface of water. One species of water strider lives nearly 2400 kilometers from the nearest land mass.
- The petroleum fly, develops in pools of crude oil in the California oil fields.
- The only place where insects are not plentiful is in the ocean depths.

b. Insects have a great role in the development of science and technology.

- Scientists demonstrating that flies had to lay eggs on meat before maggots would develop; this finding destroyed the theory of spontaneous generation.
- The study of insects, particularly their life cycles, physiology, genetics, and ecology, has contributed a great deal to our overall understanding of biology.
- The geneticist's fruit fly (*Drosophila melanogaster*) has contributed much to our knowledge of genetics.
- The first association between pathogens and disease grew out of Louis Pasteur's studies of silkworm diseases (1865-1870).
- Our knowledge of physiology has been advanced by studying the processes of growth and development in assassin bugs.
- Toxicology relies heavily on insects to assess the toxicity of products.

Insects as a tool in screening for explosives, drugs, chemical weapons, and land mines.

- Entomologists in the University of Georgia trained parasitic wasps to pick up a scent and stick to it but wasps don't respond to commands like "go" or "stop." They needed a way to control the wasps. So, they invented a device known as the "Wasp Hound", which is a 3-inch PVC pipe about 10 inches long. A fan and a Web camera close one end. Inside, a tray places four or five wasps. Through a USB wire, the Web camera, the software creates a graph that shows the level of crowding, or the wasps' response to the odor

they were trained to detect. The wasps can also be trained to detect explosives, and to help investigators find grave sites.

- Wasps are better than dogs in this field because wasps are cheap to produce, easily trained and are beneficial to farmer.
- A British company sells trained bees and mini-hives where the insects' response to scents from natural and man-made chemicals can be monitored. The company says the system can be used to screen for explosives, drugs, chemical weapons, land mines and for food quality control.
- A research professor at [Montana State University](#), is [using bees](#) for mine detection. The bees congregate over mines or other explosives and their locations are mapped using laser-sensing technology. Bees may be more appropriate for open areas, while the Wasp Hound may be better in buildings.

Insects are inspiring a new wave of robotics

- Insects are rarely held in high regard. Mosquitoes bite, flies annoy, locusts destroy crops, and cockroaches just give us the creeps. Perhaps that's why scientific research has most often focused on how to destroy them rather than on learning about the ways in which they function. How does a fly land with such precision, a bee find its way from flower to hive, or a cockroach move so quickly?
- Scientists have only recently started answering such questions. And increasingly they realize that insects are the superheroes of the planet, with unique attributes that could guide the next wave of advances in biomimetic robotics.

2. Write on two only of the following (40 Marks):

a. Reasons for insect success.

The insects do have a unique combination of characteristics which, as a whole, have given them an unusual survival advantage.

Exoskeleton

- Insect's skeleton is located on the outside of its body.
- This exoskeleton gives shape and support to the body's soft tissues, provides protection from attack or injury, minimizes the loss of body fluids in both arid and freshwater environments, and assures mechanical advantage to muscles for strength and agility in movement.
- The exoskeleton can resist both physical and chemical attack.
- It is covered by a layer of wax that prevents desiccation.
- It may be as elastic as rubber or as hard and rigid as some metals.
- Freedom of movement is ensured by membranes and joints in the exoskeleton.
- Muscles that attach directly to the body wall have maximum strength and optimum mechanical advantage (leverage). An ant, for example, can lift up to 50 times its own body weight.

Small Size

- Most insect species are between 2 and 20 mm in length.
- The smallest insect is a parasitic wasp of other insects' eggs (0.14 mm in length), nearly 1/3 smaller than some single-celled protozoa.
- Small size is a big advantage to insects due to the minimal resources needed for survival and reproduction, and allows them to avoid predation.
- Small size, together with adaptations in body shape and coloration, gives many species the ability to become virtually undetectable.

Flight

- Insects are the only invertebrates that can fly.
- Flight helps insects to escape from predators, transport easily from place to another and expand quickly into new habitats for new resources.
- Efficient use of energy allows some insects to travel great distances or remain airborne for long periods of time.
- More than 200 species migrate over long distances by air.

- The migratory locust, can fly for up to 9 hours without stopping. Large swarms occasionally traverse the Mediterranean Sea.
- The wings of a large insect can generate a considerable amount of lift. Green darner dragonflies are able to fly while carrying a load up to 15 times their body weight. Some of the tiny biting midges beat their wings over 1000 times per second.

Reproductive Potential

- In insect populations, females often produce large numbers of eggs (high **fecundity**), most of the eggs hatch (high **fertility**), and the life cycle is relatively short (often as little as 2-4 weeks). Together, these three characteristics enable insects to produce remarkably large numbers of offspring.
- If we ignore all the limiting factors, in two years of continuous reproduction, a pair of some fly species would fill a ball nearly 8 million kilometers in diameter. This helps explain sudden pest outbreaks.
- Many adaptations help maximize this reproduction potential. Most females, can store sperm for months or years within the spermatheca, a single mating can supply a female with enough sperm to fertilize all the eggs she will produce in her lifetime.
- There are many insect species that reproduce asexually.

Metamorphosis

- Most insects undergo significant developmental changes as they grow from immatures to adults. These changes known as metamorphosis, may involve physical, biochemical, and/or behavioral alterations that promote survival, dispersal, and reproduction of the species.
- In some cases, immatures and adults may consume different types of food, exploit different environmental resources, and even occupy different habitats.

Adaptability

- A combination of large and diverse populations, high reproductive potential, and relatively short life cycles, has equipped most insects with the genetic resources to adapt quickly in the face of a changing environment. Insects were among the first creatures to invade the arid environment, they were the first animals to use flight as an escape from predators, and they were the first organisms to develop a complex social life with division of labor and cooperative care of the young.
- The most remarkable example of insect adaptation in this century has been the speed with which pest populations have developed resistance to a broad range of chemical and biological insecticides.

b. Impacts of Insects

- Insects have a direct impact on agricultural food production by chewing the leaves of crop plants, sucking out plant juices, boring within the roots, stems or leaves, and spreading plant pathogens.
- Insects feed on natural fibers, destroy wooden building materials, ruin stored grain, and accelerate the process of decay.
- Insects have a profound impact on the health of humans and domestic animals by causing annoyance, inflicting bites and stings, and transmitting disease.
- The **economic impact** of insects is measured not only by the market value of products they destroy and the cost of damage they inflict but also by the money and resources expended on prevention and control of pest outbreaks.
- Economists generally agree that insects destroy around 10% of gross national product in large, industrialized nations and up to 25% of gross national product in some developing countries.

Insects as Food

- Insects represent an important food source for a wide variety of other animal species.
- Insects were an important source of nutrition for our early human ancestors. Today, they are still collected and eaten by people of many cultures.

Ecological Impact

- Biogeochemical cycling of nutrients

As consumers, scavengers, and decomposers, insects play a vital role in the biogeochemical cycling of nutrients. Insects help aerate the soil, improve its retention of rainwater, and enhance its fertility. Flies and dung beetles prevent the build-up of manure from large animals and speed up its decomposition by fungi and bacteria.

- Parasites and predators

As parasites and predators of other organisms, insects are part of a natural system of checks and balances that strengthens community stability and prevents explosive population growth from overrunning natural resources. So far, over 6000 insect species have been tested and released as biological control agents to fight insects and weeds that we regard as pests.

- Pollinators of flowering plants

Insects play an essential role as pollinators of flowering plants (angiosperms). Various flower types are adapted for luring different groups of insects -- not only bees and butterflies but also many species of wasps, moths, beetles, and flies.

In the United States, beekeepers provide pollination services which cost growers about 50 million dollars annually, but they produce a net gain of over nine billion dollars.

Products of Beneficial Insects

- Honey & Beeswax

Since ancient times, honey bees (*Apis mellifera*) have been valued for the **honey** and **beeswax** they produce. Many doctors applied honey as an antiseptic to treat burns and lacerations. The term Apitherapy is familiar in many countries against many diseases.

Beeswax is still used commercially in the manufacture of many cosmetics, candles, furniture waxes, and medicinal ointments.

Bee pollen is a "complete" dietary supplement. **Royal jelly** is a glandular secretion that nurse bees feed to larvae of future queens. It is rich in vitamins and proteins. It has become a major ingredient in some expensive skin care products that promise to reduce wrinkles and retard aging.

- Silk

A silkworm, *Bombyx mori*, is the source of a unique natural fiber used to make **silk** cloth. Silk is the strongest of all natural fibers. It is comparable to steel or nylon in tensile strength, but considerably more elastic. It can be dyed, woven into fabrics that are warm in winter, cool in summer, resistant to wrinkling, and light in weight.

- Shellac

Shellac, a product of a scale insect, was widely used as a varnish (protective coating) for floors, furniture, draperies, photographs, playing cards, and dried flower arrangements.

- Cochineal

Cochineal is a pigment extracted from a scale insect was highly valued for the intensity and permanence of its color, it is very expensive because of its scarcity. It is still used as a coloring agent in foods, beverages, cosmetics (especially lipsticks), and art products.

d. Cultural Entomology

- There is no question that insects have shaped and molded human civilizations. tsetse flies (*Glossina* spp.) prevent colonization of large parts of central Africa because they spread the trypanosome parasites that cause sleeping sickness in humans and nagana in cattle.
- Over the course of human history, more soldiers have died from lice and mosquitoes than from bullets and bombs. These insects spread diseases that have affected entire armies.
- Body lice are notorious for the spread of epidemic typhus, often called trench fever.
- Malaria and yellow fever, both transmitted by mosquitoes, have also taken a deadly toll in tropical and subtropical climates.
- The wartime impact of insect-borne disease has decreased ever since the discovery of modern chemical insecticides as DDT.

Culture, Religion, and Aesthetics

- In ancient Egypt, people considered the scarab beetle as a symbol of rebirth and immortality, and scarab-shaped gems and icons were a recurring motif in Egyptian jewelry and other decorative artifacts.
- Many insects are valued simply for their beauty.
- Insects appear in famous paintings of many artists.
- Many people regard insect sounds as a form of music.

Insects in Language and Literature

- Our language still reflects many traditional associations: busy as a bee, annoying as a fly, mad as a hornet. We still recognize the ant as a symbol of hard work, and the butterfly as an object of beauty.
- There are many references to insects in *The Bible*, Quran and many Islamic writings.
- Cinematographers usually portray insects as villains or monsters, Insects are often included for their "shock" value, to set a "creepy" mood.

3. Give reasons for two only from the following (20 Marks):

a. Insects provide great benefits for flowering plants.

- Insects play an essential role as pollinators of flowering plants (angiosperms). Various flower types are adapted for luring different groups of insects -- not only bees and butterflies but also many species of wasps, moths, beetles, and flies.
- In the United States, beekeepers provide pollination services which cost growers about 50 million dollars annually, but they produce a net gain of over nine billion dollars.

b. Insects have different types of mouth parts.

Insect mouthparts have modifications to suit the nature of food:

- Chewing (e.g. Cockroaches, Beetles)
- Piercing and sucking (e.g. Mosquitoes)
- Sponging (e.g. Houseflies)
- Rasping and sucking (e.g. Thrips)
- Sucking (e.g. Butterflies)

c. Insect have an important role in treating human diseases.

- Insects were studied for their medicinal value.
- During World War I, medics noticed that gunshot wounds infested with blow fly maggots seldom developed bacterial infections. Their observation led to the use of **maggot therapy** (sterile-reared fly larvae for cleaning necrotic tissue from deep wounds), and the later discovery of **allantoin**, a chemical secretion of the larvae that inhibits bacterial growth. Synthetically produced allantoin was commonly used as an antibacterial ointment until penicillin and other antibiotics became commercially available in the 1940's.
- Honey bees (or their products) have been used for medicinal purposes. This practice, known as **apitherapy**. Bee stings are used as a treatment for patients who suffer from arthritis, multiple sclerosis, Parkinson's disease, and other auto-immune conditions.
- Research has uncovered other substances with anti-viral, anti-fungal, and anti-inflammatory activity in a variety of other insects.
- Some entomologists believe that pharmaceutical companies will find enough new drugs in the class Insecta to keep them busy for many hundreds of years.