B.Sc. (Semester III)
Session-2014-2015
LZC-302: Parasitology and Economic Zoology

SECTION-A (Multiple choice question)

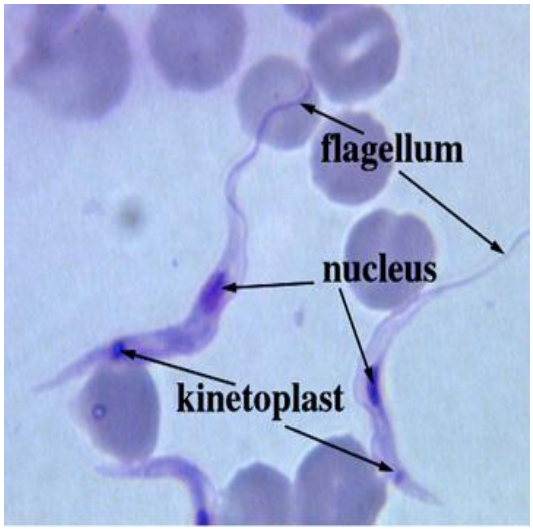
ANSWER 1

i. a
ii. b
iii. d
iv. a
v. b
vi. a
vii. d
viii. a
ix. a
x. d

SECTION (B)

ANSWER 2

Trypanosomiasis: Human African trypanosomiasis, also known as sleeping sickness is a parasitic disease transmitted by the bite of the 'Glossina' insect, commonly known as the tsetse fly. The disease affects mostly poor populations living in remote rural areas of Africa. Untreated, it is usually fatal. Travelers also risk becoming infected if they venture through regions where the insect is common. Generally, the disease is not found in urban areas, although some cases have been reported in suburban areas of big cities in some disease endemic countries.



Trypanosoma parasite

Various species of African sleeping sickness parasite

- *Trypanosoma brucei* (cattle)
- *Trypanosoma gambiense*
- *Trypanosoma rhodesiense*
- *Trypanosoma cruzi* (Chagas disease)

Transmission:

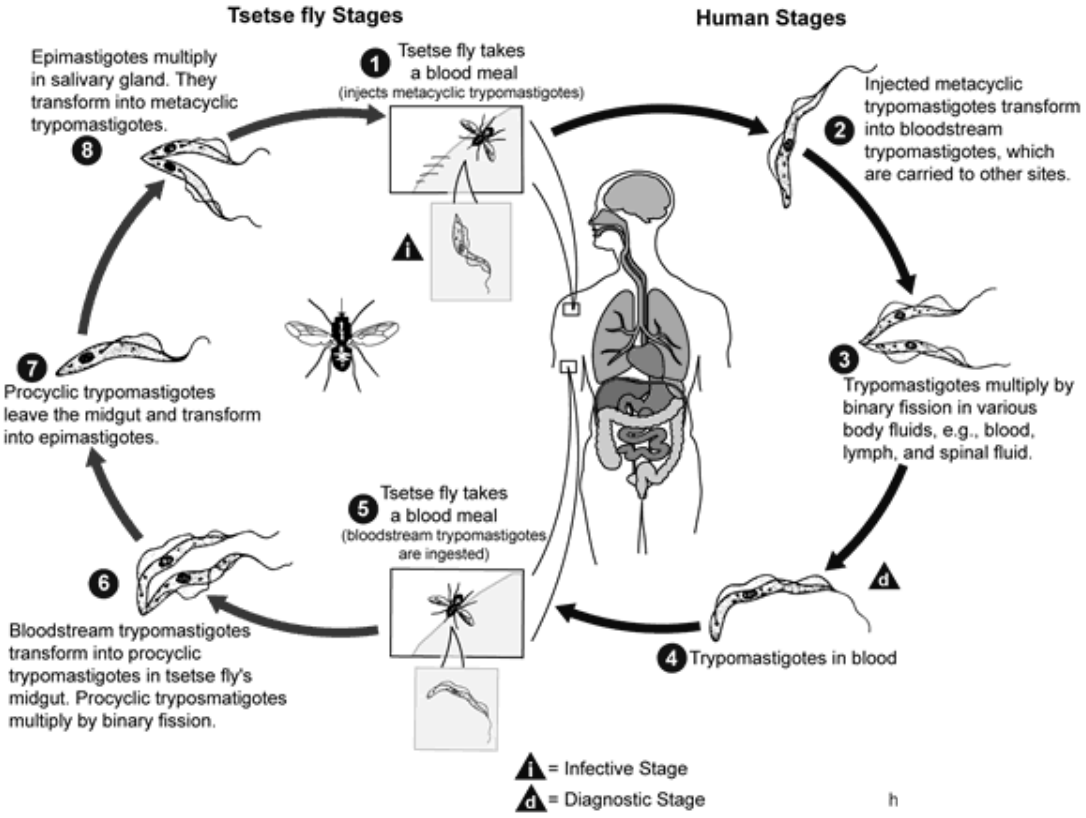
- Via vector- bite from the tse tse fly.
- Mother to child infection (prenatal death)
- Blood transfusion
- Sexual contact

Life cycle: The African trypanosomes reside almost exclusively in the bloodstream and are transmitted by the bite of the tse-tse fly which acquires the infection while taking a blood meal, and returns the trypanosome to a vertebrate host in its saliva when it takes another blood meal. Because this mode of transmission is by inoculation during biting this group of trypanosomes are also referred to as saliva-type or "Salivarian". (*T. cruzi*, on the other hand, is transmitted by fecal contamination and is referred to as a "Stercorarian"). The range of African trypanosomiasis is determined by the range of the vector. Interestingly, only newly hatched tse-tse flies are competent to transmit the disease. *Glossina* is in fact a poor vector in nature since less than 1% of the flies are infected. They passing from different life stages which are Amastigote, Promastigote, Epimastigote and Trypomastigote. Infective stage for vertebrate is metacyclic trypomastigote. Infective stage for the invertebrate is trypomastigote.

The ingested form that is infectious for the fly is termed the short-stumpy bloodstream trypomastigote, which is a non-dividing form. Following ingestion, the bloodmeal is retained within the midgut, and the parasite differentiates into a procyclic form and divides by binary fission. After about two weeks some procyclics migrate from the midgut through the hemocoel eventually reaching the salivary glands. At this point they differentiate through an epimastigote stage into a metacyclic trypomastigote stage, which is a non-dividing form infectious for the mammalian host. Metacyclic trypomastigotes are found in the salivary glands ~ 20 days after the bloodmeal and there are ~ 40,000 trypomastigotes/bite, but it takes only 400 to initiate an infection.

In the mammalian host

The metacyclic trypomastigotes replicate at the site of infection. There may be an immune response causing inflammation (trypanosomal chancre) at the site of the bite. From there the trypomastigotes move via the lymphatics to the lymph nodes and then to the bloodstream. In *T. gambiense* infection, swollen cervical (neck) lymph nodes are referred to as Winterbottom's sign. Long- slender bloodstream trypomastigotes divide by binary fission in the bloodstream, generating, on occasion, short-stumpy forms to continue the cycle in the tse-tse fly. The long-slender trypomastigotes are not infectious for the fly.



Life cycle of Trypanosoma

Symptoms: The bite of the infected fly, the parasite multiplies in the lymph and the blood, causing headaches, fever, weakness, pain in the joints, and stiffness. People who become infected may or may not show signs of illness immediately. With time the parasite crosses the blood-brain barrier and migrates to the central nervous system. Here it causes various neurological changes which include psychiatric disorders, seizures, coma and ultimately death.

Diagnosis: Diagnosis of the disease requires confirming the presence of the parasite in any body fluid, usually in the blood and lymph system. Early diagnosis is difficult because of the lack of specific signs or symptoms in the first stage of the disease and also because of the lack of sensitivity of the parasitological methods available.

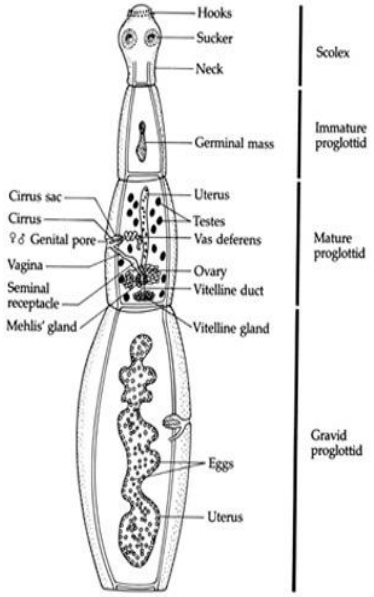
Confirmation of infection requires the performance of parasitological tests to demonstrate the presence of trypanosomes in the patient. The parasites can be present in any body fluids. However, the number of parasites can be so low (mainly in the *gambiense* form of the disease) that available parasitological methods may not be sensitive enough to find them.

Treatment: Only four drugs are registered for the treatment of human African trypanosomiasis: pentamidine, suramin, melarsoprol and eflornithine. However, none of them are anodyne as all have a certain level of toxicity. Pentamidine and suramin are used in the first or last stage of *T. gambiense* infections respectively.

ANSWER 3

Geographic Distribution: Worldwide, higher prevalence in South America (Argentina, Uruguay), Europe (Mediterranean bassin), Northern Africa, Middle East, South Central and East Asia.

i. Three known species of Echinococcus are medically important
ii. *Echinococcus granulosus*: causing hydatid disease
iii. *Echinococcus multilocularis*: causing alveolar hydatid disease
iv. *Echinococcus vogeli*: causing hydatid disease



Echinococcus

A zoonotic infestation by a tapeworm causing hydatid disease. Very rare disease in the continental US (less than 1 case per 1 million inhabitants)

Dogs are the definitive hosts

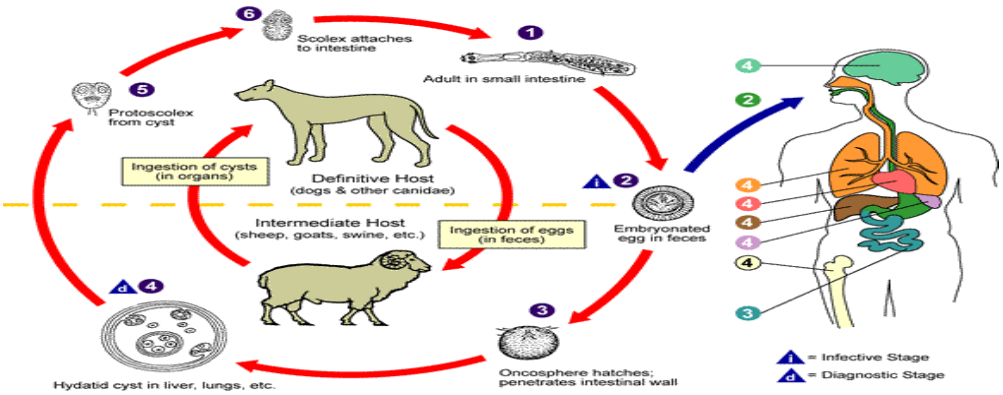
i. Adult worm develops in the small intestine
ii. Eggs are voided in the feces of the dogs

Sheep are intermediate hosts.

Humans are accidental intermediate hosts.

Larval form develops mainly in the liver and lungs.

The cycle is completed when a dog eats a cyst-infested liver or lungs.



Infection: Small intestine of a dog infected with *Echinococcus granulosus*

i. Adult tapeworms are small (2 mm) but they can be very numerous.
ii. Infective stage: Found in dog feces
iii. Resembles Taenia eggs

Metacestode (cyst):

i. Unilocular
ii. Sub spherical in shape
iii. Fluid-filled
iv. Pulmonary cyst are commonly found in the lower lobe on the right side

Human Host:

i. Each egg contains an embryo (oncosphere)
ii. Eggs hatch in the human stomach and release the oncosphere
iii. The oncosphere penetrate the intestinal lining and enter the blood stream
iv. Travel to any organ, usually lung and liver, and a cyst develops

Symptoms:

i. Vary by size and site of cyst
ii. Usually no symptoms until cyst becomes enlarged
iii. Liver: jaundice, portal hypertension, pain
iv. Lung: coughing, shortness of breath, chest pain
v. Brain: seizures, paralysis
vi. Rupture of cyst: anaphylactic shock, spread of scolices, death

Diagnosis:

i. Radiographic images of lungs and liver
ii. Examination of sputum or bronchial washes
    a. Protoscolices
    b. Membranes
    c. Hooklets

Serologic test:

a. Increase sensitivity if liver and lungs are infected

Treatment:

a. Surgery
    i. Risks of operative morbidity, recurrence of cyst, anaphylaxis or dissemination of the infection
    ii. Albendazole, mebendazole or praziquantal

ANSWER 4

Parasite: A parasite is a living organism that needs a host in order to survive. Parasites feed off the host's nutrients, which mean that the host gets debilitated. The tapeworm and flatworm are examples of parasites that live inside the host. Body lice and mites are examples of parasites that feed off the surface of the host. Parasites rarely kill the host.

Parasitism: Relationship between two species of plants or animals in which one benefits at the expense of the other, sometimes without killing it. Further, parasitism is the relationship of organisms of different species. The parasites are much smaller than their host. Parasites reduce the fitness of the host.

Commensalism, mutualism and parasitism are symbiotic microbial relationships. mutualism occurs when both parties are obligated to each other and both benefit. Bacteria in cud-chewing animals is an example. Commensalism is a relationship that benefits one and the other incurs no harm. An example is *S. aureus* and *H. influenzae* as *S. aureus* contributes nutrition. Parasitism is where one is harmed and the other is dependent as in dogs and fleas.

This is a symbiotic relationship between two organisms in which one species (parasite) benefits for growth and reproduction to the harm of the other species (host). It must be emphasized that parasite and host interact and that excessive harm done to a host, which makes it less competitive, also endangers the survival of the parasite species. Parasitism can be differentiated into

i. ectoparasites and
ii. endoparasites,

depending respectively, on whether they live on or in the host. Lice, flea, ticks, etc. are examples of ectoparasites. Tape-worms, bilharzia and the malaria parasite are examples of endoparasites.

Types of parasite

Parasites can be divided into different classes of parasite:

Obligatory parasites

These parasites can only survive in a host and therefore go directly from one host to another. This may involve complex life cycles.

Trichomonas, *Trichomonass vaginalis* in culture, Trophozoite, Taenia, Trichinella

Temporary parasites

These parasites spend only part of their lives as a parasite and another part as free-living organism.

Fasciola hepatica (Liver fluke (douve), Schistosoma, Ascaris, Haemonchus

Facultative parasites

These organisms are normally free living and infect a host only by accident.

Some free-living amoeba such as Naegleria, Acanthamoeba, Trophozoites of *Acanthamoeba castellani,* fungi such as Candida (vaginal candidosis, athlete foot).

Types of host

Like the parasites, the hosts can be divided in to several classes as well. These are:

Definitive host (DH): A definitive host is an organism that hosts the adult (sexual) form of the parasite.

Intermediate host (IH): An intermediate host is an organism that hosts the asexual form of the parasite (only when there is an obligatory passage through the host). Intermediate hosts can be divided into two groups:

Passive IH (molluscs in the case of Schistosoma)

Active IH (tsetse fly in the case of trypanosomes)

Also the vectors can be divided into two different types:

Biological vectors: Haematophagous athropodes such as mosquitoes and other biting insects

Mechanical vectors: Flies for transport of amoebal cysts

Mutualism

This is a symbiotic relationship in which both members of the association benefit. Mutualistic relationships often allow organisms to obtain food or to avoid pedation. This relationship can be differentiated into:

i. facultative, and
ii. obligate mutualism.

Facultative Mutualism

In this relationship both organisms benefit by living in close association, but is not essential.

Examples:

Many ants are found in the vicinity of aphids. The ants feed on the sugary fluid released by the aphids, and the aphids are protected by the ants;

small fish of several families, including a wrasse, feed on small organisms and parasites on the bodies of larger fish. These cleaner or barber fish in this manner, and the larger fish are relieved of unwelcome guests on their bodies.

Obligate Mutualism

As the name implies, an obligatory contact exists between different organisms.
Examples:
Lichens are plants made up of a fungus and an alga living in close association. They are usually found on rocks and tree trunks. The fungus is attached to the substratum by fungal treads. These fungal treads help to absorb inorganic substances which are then used by the alga during photosynthesis (when organic compounds are made). The fungus obtains organic substances manufactured by the alga; bees and birds visit flowers in search of pollen and nectar. In the process flowers are pollinated.

Commensalism

Commensialism means literally 'at table together'. This is a symbiotic relationship between two species in which one species benefits and the other neither benefits or harms. Often, the host species provides a home and/or transportation for the other species. Examples: Clown fishes live within the waving mass of tentacles of sea anemones; Because most fishes aviod the poisonous tentacles, the clown fishes are protected from predators. Perhaps this relationship borders on mutualism because the clownfishes actually may attract other fishes on which the anemone can feed. The sea anemone's tentacles quickly paralyze and seize other fishes as prey.

Parasitism in Animals

The bilharzia parasite, *Schistosoma haematobium*, a parasitc flatworm, is a good example of a successful parasite. It completes its life cycle in two hosts. The male and female adults live in the blood of humans while larval forms live in the bodies of a type of snail, *Bulinus africanus*. The adults posses suckers with which they attach themselves to the walls of blood vessels. Their bodies are covered with thick cuticles. When mature, adults meet in the blood of man. The male and female become 'associated' in that the slightely broader male rolls its body into a tube in which the long, thin female lives. When the female is ready to lay eggs she frees herself and moves into small blood vesels in the wall of the bladder. There she lay eggs. When the egg comes into contact with the water, its shell breaks and a ciliated larva, called a miracidium, is released. If it comes in contact with a host it works itself into the body of the snail by means of hydrolysis. Sporocysts are produced by the miracidium. Cercariae are produced after several generations of sporocysts. The cercariae make their way into the water and make contact with a human. Their it comes into the blood stream and live their. Within six to twelve weeks the larvae develop into adults and the cycle is reported once more.

Salient features of Phylum Platyhelminthes parasites:

1. The animals included under this phylum are of flatworms with dorsoventrally compressed and bilaterally symmetrical body.
2. They are the lowest triploblastic, acoelomate metazoans but they are advanced over coelenterates because their tissues are organized into organs.
3. The mesoderm forms a type of connective tissue called parenchyma which fills the body spaces between the ectoderm and endoderm so that there is no coelom; hence they are called as acoelomate animals.
4. The excretory system has one or two canals with branches which end in structures known as flame cells and the canals have no internal opening, but they open to the exterior.
5. Circulatory and respiratory systems are absent.
6. The nervous system consists of a network, but it has ganglia at the anterior end which serves as a brain.
7. Reproductive organs are well developed; most of flatworms are hermaphrodites.

ANSWER 5

Lac is Nature's gift to mankind and the only known commercial resin of animal origin. It is the hardened resin secreted by tiny lac insects belonging to a bug family. To produce 1 kg of lac resin, around 300,000 insects lose their life. The lac insects yields resin, lac dye and lac wax. Application of these products has been changing with time. Lac resin, dye etc. still find extensive. Use in Ayurveda and Siddha systems of medicine. There are six genera of lac insects, out of which only five secrete lac, and only one, i.e. *Laccifer* secretes recoverable or commercial lac. The commonest and most widely occurring species of lac insect in India is *Laccifer lacca* (Kerr) which produces the bulk of commercial lac. Lac insect of South East Asia is referred to as *Kerria chinensis*. Lac insects thrive on twigs of certain plant species, suck the plant sap, and grow all the while secreting lac resin from their bodies. These plants are called host plants. Although lac insect is natural pest on host plant, these insects enjoy the privileged position not being treated as pest.

Host: Plants such as, *Zizyphus mauritiana, Z. jujuba, Butea monosperma, Schleichera oleosa, Acacia arabica, A catechu, Cajanus cajan, Ficus benghalensis, F. cunia,* and *F.* religiosa are common hosts of the lac insect *Laccifer (Tachardia) lacca.*

Life cycle: *Laccifer lacca, (Tachardia lacca)* is the commercially cultured lac insect. It is mainly cultured in India and Bangladesh on the host plants such as ber, *Zizyphus mauritiana,* palas, *Butea monosperma* and kusum, *Schleichera oleosa.*

Female insect is viviparous, producing about 1000 nymphs, deep red in colour with black eyes. The larvae settle down on a suitable place of the host plant gregariously. A day or two after settlement, the larvae start secreting lac all around the body except on the rostrum, spiracles and on the tip of abdomen. Thus it gets encased in a cell of lac which gradually increases in size along with the increase in size of the insect. The insect moults twice before reaching maturity. The male larvae produce elongated lac cells while the females produce oval cells

After the first moult larvae lose their legs, antennae and eyes and become bag-like. After the 3rd moult, the larvae pass on to a pseudo-pupal stage. Males emerge and copulate with the females and die. The female larvae never regain appendages and continue to remain under the lac cell, become adults and reproduce. As the lac insects remain close together, lac secretion from adjacent cells coalesces with each other and forms a continuous encrustation on the tree branch.

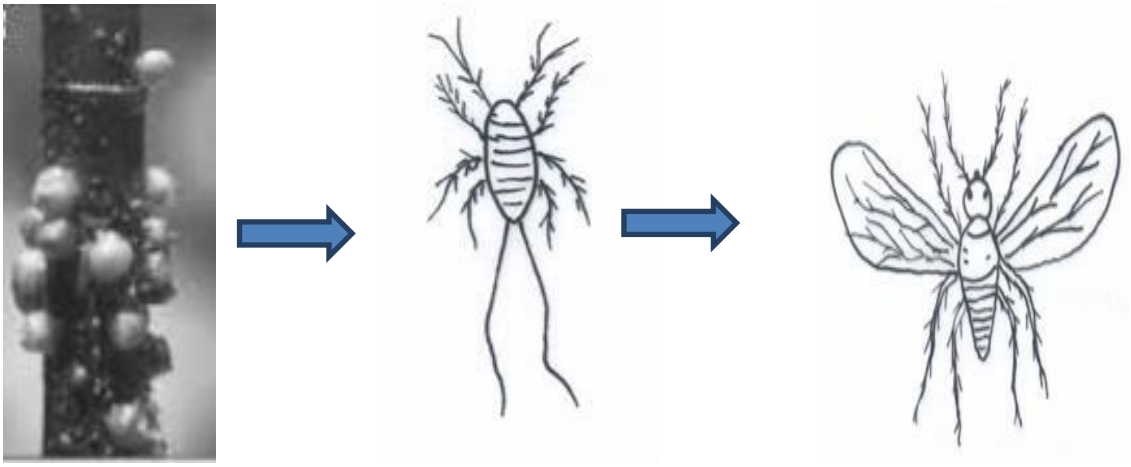
Lac cultivation: Lac culture involves two important steps: (i) inoculation, and (ii) cropping. Inoculation can be carried out through artificial infection of tender branches by brood lac stick obtained form mature lac trees immediately after harvesting. In this process, the brood lac sticks are tied in bundles of 2 or 3 sticks on the branches of the host tree, allowing maximum contact with the branches.

There are four seasons of lac cultivation and according to the Hindi calendar, they have been named as Kartiki, Aghani, Baisakhi, and Jethwi. The crop period, from inoculation to harvesting, for Kartiki, ranges from July to November, for Aghani, from July to February, Baisakhi, from November to July, and Jethwi, from February to July. When young shoots come up on branches, the brood sticks are tied adjacent to the growing tender branches in a way so that maximum contact between shoots takes place. Within a week or two the larvae emerge and settle down on tender shoots.

Uses of lac: The various applications of lac can be summarized as follows:

Lac resin is used in food processing industry; cosmetics and toiletries industry; varnish and printing industry; coating of fruits and vegetables; electrical industry; leather industry; adhesive industry; pharmaceutical industry; perfumery industry; miscellaneous applications. Lac dye (erythrolaccin) has been used in India as a skin cosmetic and dye for wool and silk. In China it is a traditional dye for leather goods. The use of lac for dye has been supplanted by synthetic dyes. It is used in medicine to protect liver and to fight obesity. Lac is used in food, confectionery and beverages industry and textile industry. Lac

wax is used in polishes for shoe, floor, car polishes etc. It is used in electric insulations, lamination of papers, hat proofing and coating of pictures and fossils.



Eggs Lac nymph Adult lac (winged)

ANSWER 6

Silk proteins are natural proteins which is combination of two types of proteins i.e. sericin and fibroin. It secreted at end of fifth instar of silkworm life stages.

Life cycle of *Bombyx mori*

Sericulture, the art and technique of silk production, is an ancient industry in India which is the second largest silk producing country in the world. Silk has played a vital role in the history of human civilisation ever since its discovery 4,000 years ago. It occupies an important place among all fabrics and is the "queen of textiles". It is traditionally associated with the socio-economic life of many countries. Silkworm, *Bombyx mori* being a monophagous insect derives almost all the nutrients essential for its growth from the mulberry leaf itself for production of silk. Mulberry silkworm passes from four different life stages i.e. egg, larva, pupa and adult or moth.

Silkworm eggs kept at 25 ^{0}C and 75 % RH for three days in incubation chamber for proper development of embryo. Further, these eggs transfer into black box for two days to get uniform hatching. Newly hatch out silkworm larvae known as ant. Young larvae, soon after hatching, start feeding on mulberry leaves and grow.

At the end of the first instar larvae stop feeding completely and undergoes in moulting for 18 to 24 hours. The period of ecdysis is called the first moult. After moulting they resume feeding, grow and repeat the moulting process. In common strains of silkworm, this repeated four times, so it called as tetramoulter. At the end of 5th instar, silkworm larvae start spinning of silk thread to form cocoon. Larvae spent 23-25 days in larval stage.

Climate required for rearing: Temperature and humidity is required for survival of silkworms is between 23-28^{0}C and 65-85%.

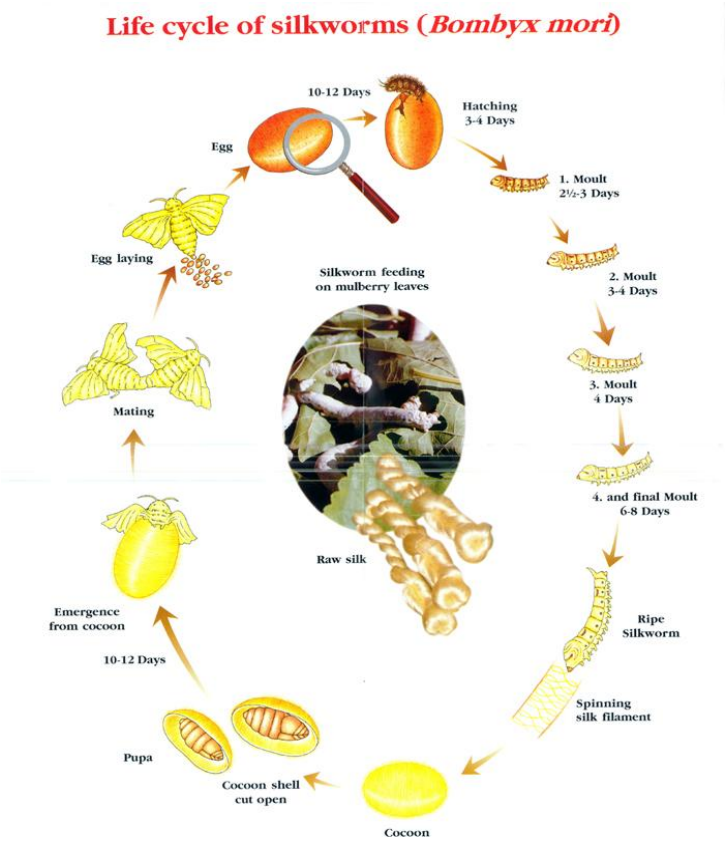
Larval and moulting duration

1st instar: 3 days	1st moult: 18-24 hours
2nd instar: 2 days	2nd moult: 18-24 hours
3rd instar: 2 days	3rd moult: 18-24 hours
4th instar: 4 days	4th moult: 36-48 hours

5th instar: 6 to 8 days

Pupal stage is known as resting, non-feeding or inactive stage. But this is transitional phase, the larval body & internal organs undergo a complete change into adult moth. The mature larva passes through a short transitory stage of 'pre-pupa' before becoming pupa. Pupa spent 5-6 days in pupal stage.

Soon after pupal stage, within 6-8 days pupa changes into moth and moths emerging from the pupa are incapable of flight due to long domestication about >4000 years. Newly emerged moths do not feed, their body surface covered with scales. Male and female moth copulating and female lays about 300-400 eggs.



ANSWER 7

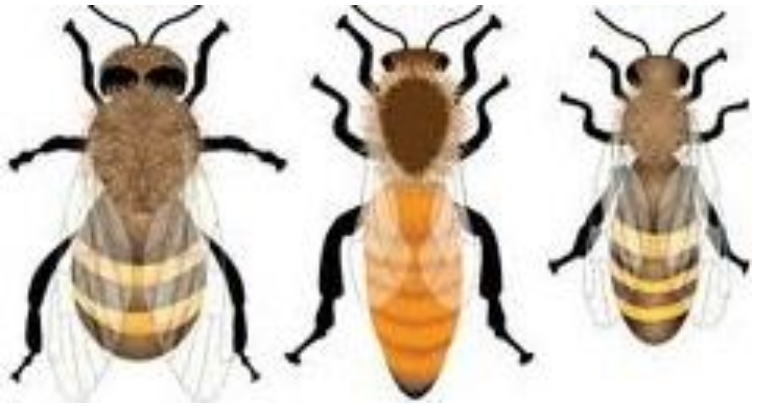
Rearing the bees in artificial hives for the production of honey is known as bee keeping or apiculture. In India the bee keeping industry was started about 50-60 years ago. In the old age people give smoke to comb at night for collection of honey. This was a crude method. Therefore artificial method of bee keeping was adopted.

Apisi ndica, Apis mellifera, Apis dorsata and Apis florea are very common species used for apiculture. *Apis indica* have black stripes on their abdomen and they live close to hilly areas and are sometimes seen in plains regions also. These are less aggressive and also display less swarming behavior than any other wild bees such as *Apis dorsata* and *Apis florea* and therefore can be easily used for beekeeping.

Honey is a light brown colour viscous fluid produced by honey bees. It contains 78% sugar, 17% water and 7% enzymes and minerals. To produce honey, honey bees suck the nectar from the flower with the help of their proboscis and glossa and collect in comb. During sucking process some saliva is also get mixed with to the nectar. This collected material is filled in the honey chamber and dried with the help of

fanning the wings. When it is ready the mouth of honey chamber is closed with the wax. Honey is a very nutritious food with medicinal value.

In addition to thousands of worker adults, a colony normally has a single queen and several hundred drones during late spring and summer. The social structure of the colony is maintained by the presence of the queen and workers and depends on an effective system of communication. The distribution of chemical pheromones among members and communicative dances are responsible for controlling the activities necessary for colony survival. Labor activities among worker bees depend primarily on the age of the bee but vary with the needs of the colony. Reproduction and colony strength depend on the queen, the quantity of food stores, and the size of the worker force.



Drone	Queen	Worker

Honey production

Honey hive

Smoker

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Leaf blower

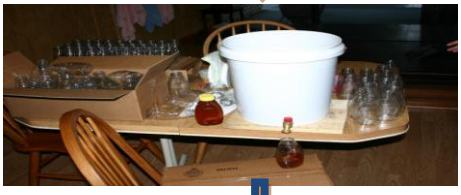
Wheel barrow

Decapping tank

Decapping knife

Pick

Extractor



Filter pipe

 Containers

ANSWER 8

Poultry farming is the raising of domesticated birds such as chickens, turkeys, ducks, and geese, for the purpose of farming meat or eggs for food. Poultry are farmed in great numbers with chickens being the most numerous.

Poultry farming

Features housing in poultry farming

i. Building a large poultry house ideal for chicken
ii. Be rainproof
iii. Be secure from windy rains
iv. Have smooth surface walls to stop mites and other pests from hiding
v. Periodically spraying the poultry unit with insecticide and disinfectants
vi. Periodically removing the dropping/cleaning the poultry house regularly
vii. Have good ventilation and in hotter areas at least 2 sides should be partly chicken wire mesh
viii. Preferably have cemented floor for ease of cleaning and disinfecting
ix. Be rat-proof
x. Using plenty of litter after cleaning the poultry house
xi. Keeping the right number of birds in poultry houses
xii. Separating chicks from old birds

Management of chicks

i. Before chicks arrive at home; make sure that;
ii. A brooder is in place
iii. Paraffin lamps/electric bulbs/charcoal stove is available
iv. Litter for the floor is available
v. 1m2 will accommodate 20 chicks upto 4 weeks old.
vi. Temperature control: 35^0
vii. C for day-old chicks, $24\text{-}27^0$
viii. C for 1 week. Reduce heat as they grow especially at night.

Management of Layers

Allow for good air circulation in laying house

i. Layer needs on average 120 gm of food per day

ii. Distribute food troughs and water troughs evenly (one basin/50 birds)
iii. Provide grit at 20 weeks
iv. Laying nests must be kept in dark places, collect eggs 3 times a day, allow
v. a nest/5 hens
vi. Provide soft clean litter
vii. Store eggs with small end down
viii. Clean dirty eggs with steel wool/coarse leaves (never wash them)
ix. Add greens to the diet and whenever possible vitamins to water
x. Debeaking at onset of lay
xi. Culling when egg production drops below 40%.

Selecting indigenous Egg Strains from the local stock

i. These are usually small chickens with elongated bodies
ii. They have tail feathers that stand higher than their head
iii. They are usually birds that lay 25 eggs and above in one laying season under the unimproved situation.
iv. When improvement is done in feeding, disease and parasite control, etc. such birds may not go broody.

Precaution during egg storage

i. Do not store eggs in a kitchen where it is hot. Heat may partially incubate the egg and kill the embryos in them
ii. Do not store them on top of a cupboard because heat from roof may incubate them.
iii. Keep eggs in a cool secure place.