AV-8909

B Sc –3rd Semester Zoology
LZC-302 (Parasitology and Economic Zoology)

Section: A

Answer 1. (i) b (ii) c (iii) b (iv) d (v) c (vi) c (vii) c (viii) c (ix) b (x) b

Section: B

Answer 2. *P. vivax* is the most common type of malarial parasite. *Plasmodium* is widespread in tropical and temperate countries. Where the migratory birds are hosts, the parasites are spread all over the world.

Systematic Position

Phylum	Protozoa
Class	Telosporea
Order	Eucoccida
Type	*Plasmodium vivax*

Life Cycle of Plasmodium

P. vivax is the most common of the human infecting malaria fever parasites. It is the causative organism of benign tertian or vivax malaria, which is characterized by a 48-hour cycle between the first malaria fever and subsequent recurrence of chills and fever. It is an intracellular parasite in man, living in the red blood corpuscles and liver cells, while extracellular in mosquito, living in its alimentary canal and salivary glands. Being digenetic, it completes its life cycle in two hosts, man and mosquito.

Primary host → man, intracellular parasite in RBC & Liver cells. Asexual life cycle – 2 phases-

(i) Liver Schizogony – multiple fission, forming merozoites
(ii) Erythrocytic schizogony – in RBC

Vector host → Female Anopheles, extracellular, in alimaentary canal & salivary gland; 2 phases

(i) Gametogony – production and fusion of gametes
(ii) Sporogony – postzygotic multiplication forms infective individuals- SPOROZOITES.

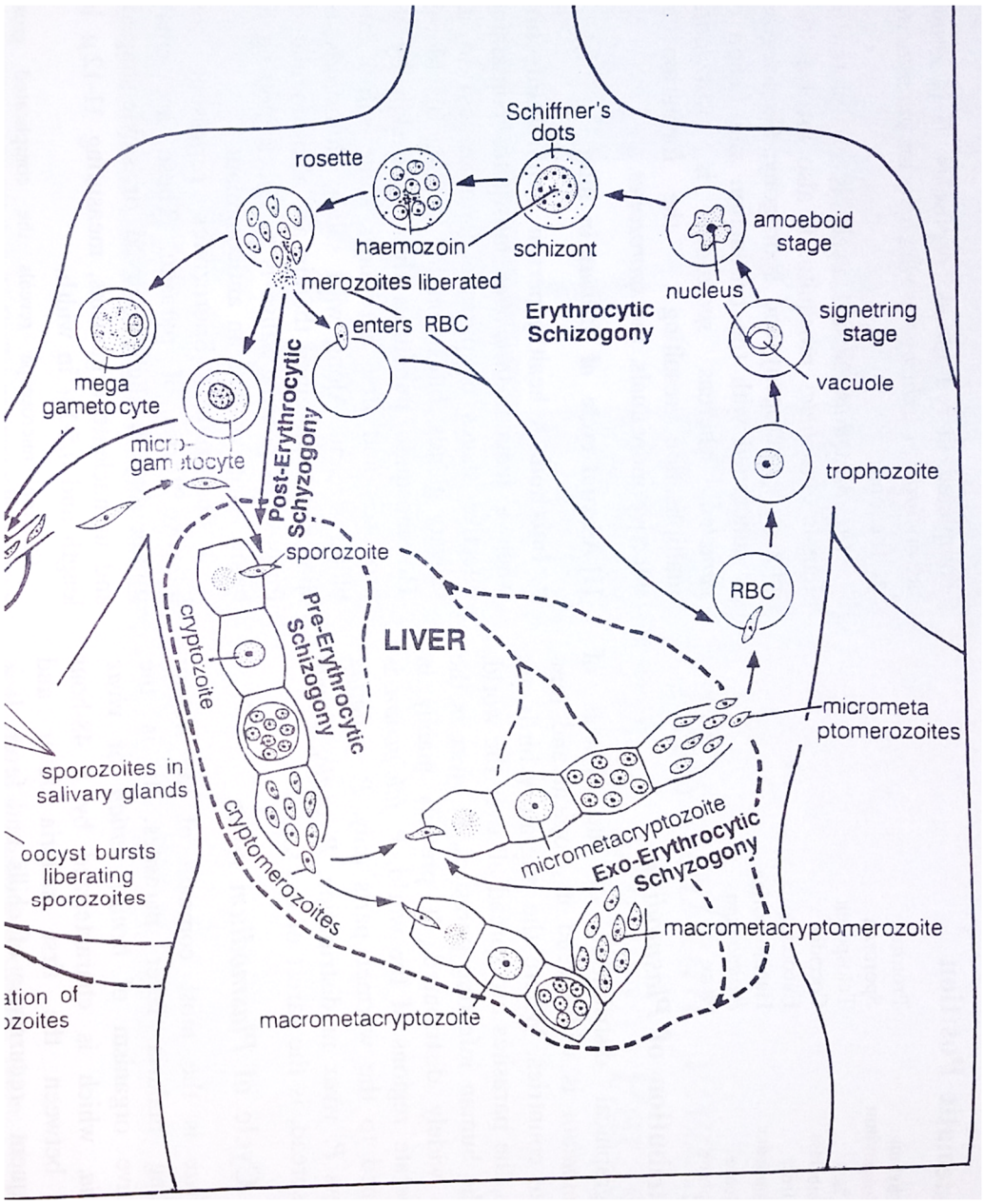
[I] Asexual cycle of *P. vivax* in man

1. Infection: A healthy person acquires infection when a female Anopheles mosquito, containing infective stages of parasite (sporozoites) in its salivary glands, bites him for sucking his blood.

2. Sporozoites: It is the infective forms of the parasite. These are small spindle-shaped, slightly curved or sickle-shaped, and uninucleate organisms, measuring 11-12µ in length and 0.5-11µ in width.

3. Liver schizogony: After half an hour of infection, sporozoite get into liver and invade the hepatic cells. Here they multiply asexually by schizogony. Liver schizogony has two phases:

(a) Pre-erythrocytic phase: In hepatic cells, each sporozoite becomes a cryptozoite. It grows for a number of days and becomes a spherical and non-pigmented schizont. It divides by schizogony (multiple fission) and forms a large number of uninucleate cells, the cryptomerozoites. Their reported number varies from one thousand to several thousands. They are liberated when the liver cell bursts. This is the end of pre-erythrocytic phase. During pre-erythrocytic schizogony, blood remains sterile and its inoculation does not produce infection.



(b) Exo-erythrocytic phase: Cryptomerozoites enter fresh liver cells to become metacgptozoites. They undergo schizogony similar to the previous one producing enormous number of metaciypto-merozoites. This may be repeated several times and each time new liver cells are infected. All these succeeding schizogonic divisions are referred to as exoelythrocytic or phanerozoic schizogony. It has been reported that metacryptomerozoites produced are of two types. Smaller and more numerous are micro-metacrypto merozoites. They enter the red blood corpuscles to start the erythrocytic stage. Larger and less numerous are macro-metacrypto merozoites. They invade fresh liver cells to continue the exo-erythrocytic schizogony. Both types of schizogony continue side by side. Pre- and exo-erythrocytic phases of parasite remain immune to the resistance of host and parasites are not susceptible to the action of any anti-malarial drug. Also little damage to the host is done during this stage.

(c) Incubation periods: It has an incubation period which is of about 10-17 days in P. vivax.

4. Erythroytic schizogony. Micrometacryptomerozoites, after escaping into blood stream, invade the erythrocytes or red blood corpuscles. This starts the erythrocytic schizogony, which includes the following stages.

(a) Trophozoite stage: Inside R.B.C., the micro-metacryptomerozoite becomes rounded and modified into a young trophozoite.

(b) Signet ring stage: As the trophozoite grows in size, a central vacuole is developed so that the nucleus is pushed to one side into peripheral cytoplasm. This stage is clincially referred to as signet ring stage as it resembles the signet ring with the peripherally located nucleus looking like the gem of the ring. Signet ring trophozoite ingests a large portion of cytoplasm of red blood corpuscle forming a food vacuole into which it secretes digestive enzymes. Besides, a number of pinocytotic vesicles are also formed around the periphery of parasite into which digestion takes place. The enzymes bring about proteolysis of blood haemoglobin, which breaks down into its protein component and hematin. Protein is used as food by the trophozoite, while the unused hematin forms the toxic malarial pigment, called haemozoin.

(c) Amoeboid stage: Meanwhile, the signet ring trophozoite develops into an active amoeboid trophozoite. It sends pseudopodial processes into cytoplasm of the blood corpuscle. At this time, small red eosinophilic granules appear in the cytoplasm of the host corpuscle which are known as Schuffner's granules.

(d) Schizont: The amoeboid trophozoite, after active feeding, becomes rounded, grows in size and becomes schizont. It now undergoes sschizogony. Its nucleus divides to form 12-24 nuclei whichget arranged at the periphery and cytoplasmic masses surrounding them. Each cytoplasmic mass with one nucleus becomes an oval-shaped merozoite. The haemozoin granules are gathered at the centre. With the rupture of the red blood corpuscle, the merozoites are liberated into the blood plasma. These invade fresh corpuscles to repeat the erythrocytic cycle. The 'ghost', left behind after the merozoites escape, are destroyed in the spleen. One complete erythrocytic cycle takes 48 hours in P. vivax.

5. Post-erythrocytic schizogony: Sometimes some merozoites produced in erythrocytic schizo-gony reach the liver cells and undergo schizogonic development in liver cells. This is referred to as post-erythrocytic schizogony.

6. Formation of gametocytes: When the impulse to multiply asexually by schizogony is exhausted, the merozoites do not proceed ahead with erythrocytic cycle, but, after entering the red blood corpuscles, increase in size to become rounded gametocytes. These show sexual dimorphism, being of two types. The male or microgametocyte is smaller and contains a large diffused nucleus. The female or megagametocyte is larger with a small compact peripheral nucleus. The gametocytes do not divide, but remain as intracellular parasites within their host's blood corpuscles, until they either die or are ingested by the vector, in which they continue their development.

Treatment of Malaria: Quinone, Quinine, Antabrin etc. Daraprim is most potent drug.

Prevention: (i) Defence against mosquito bite

(a) Building houses on high grounds
(b) Use of mosquito nets
(c) Screening of windows, doors and ventilators

(ii) Use of prophylactic drugs- quinine, daraprime, etc kill sporozoites before they become established in liver, if taken in small doses.

Answer 3. *Schistosoma* is a blood fluke parasite that causes a disease called Schistosomiasis. It is the third most damaging disease after malaria and intestinal helminthiasis in tropical countries such as Africa, South America, the Caribbean, the Middle East, and Asia. *S. hematobium* inhabits the pelvic venous plexuses, usually prostatic, vesical and uterine venules, and causes vesical schistosomiasis. More than 207 X 10^6 people, of whom 85% live in Africa, are infected with schistosomiasis. An approximated 700 million people are at risk of infection in 76 countries where the disease is endemic. It is due to their agricultural work, domestic everyday jobs, which expose them to infested water. Globally, 200,000 deaths occur due to schistosomiasis annually.

Systematic Position:

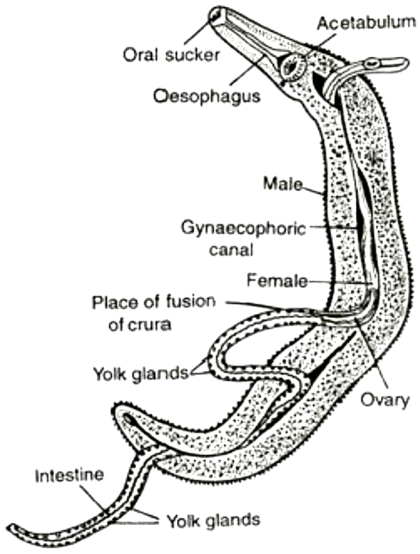
Phylum – *Platyhelminthes*

Class – *Trematoda*

Order – *Digenea*

Genus — *Schistosoma*

Species — *haematobium*



Life history:

Schistosoma hematobium is a digenetic parasite, that is, its life cycle is completed in two hosts. The primary or definitive host is man,

whereas the intermediate hosts are certain genera of snails (*Bulinus* and *Planobarius*). Adult worm resides in the blood vessels such as in the venous plexus of urinary bladder, prostate gland and urinary tract. It gets nourishment from blood.

Sexual dimorphism is well pronounced. Males are smaller and broader, measuring 1 to 1.5 cm in length and 1 mm in breadth, while the females are larger and narrower, measuring 2 cm in length and 0.25 mm in breadth. The head of both male and female bears 2 suckers — oral and ventral. In males, the ventral sucker is large and powerful. Behind the ventral sucker, the body of the male rolled ventrally to form a groove called "gynecophoric canal". During copulation female enters into the gynecophoric canal of the male in such a way that the anterior and posterior end of the body of female projects out of the canal while the middle part remain enclosed. It has been witnessed that a female worm becomes sexually mature only with association in males. Occasionally, female remain permanently associated with her male partner. Female, after copulation, become ready to lay eggs. She along with male, moves against the blood stream and enters the small venules of the portal system. Female lay eggs in sequence, one at a time like a chain of beads. After laying each egg, the worm retreats in the direction of the current so as the eggs get arrange linearly. The eggs, less frequently, may enter into intestine and moves out of the host's body through faeces. If these eggs are exposed to water, then ciliated miracidium larva hatches out from each egg, which move freely in water in search of intermediate host. Miracidium enters into the snail's body through the soft tissues and ultimately reaches the liver. Here, the larva loses its cilia and within 4 to 8 weeks transform into the "sporocyst." The sporocyst multiplies to form a second generation of sporocyst. Daughter sporocyst gives rise to forked tail "cercaria larvae" which are infective stage larvae. A single miracidium produces 100,000 to 250,000 cercaria. The cercaria larva breaks off from the sporocyst and finally makes its way out of the snail body to water. They freely swim into water for 48 hours and during this period if they encounter human beings, they penetrate the skin to enter into the body. The larvae cast off their tail and gain access to peripheral venules. Now, they are called "schistosomulae" which are carried to right heart from where they reach the lungs and follow the course as shown in the diagram. After attaining sexual maturity, the worms copulate to repeat the life cycle. The life span of adult worm in human body is about 30 years.

Mode of infection:

Man becomes infected when she/he come in contact with the infected water carrying the cercariae of *S. hematobium*.

Pathology:

The disease schistosomiasis or bilharziasis has following characteristics:

1. Headache, anorexia, pain in back and extremities, fever with rigor and sweating.

2. Hemorrhages due to erosion of blood vessels by the terminal-spinned eggs of *S. hematobium*

3. Irrational behavior leading to abscess formation and fibrosis (pseudotubercle) around eggs producing inflammatory changes

4. Itching swimmer's itch) at the site of the entrance of cercariae into host body (, a condition called as cercarial dermatitis.

5. Hepatitis, diarrhea, anemia, eosinophilia

Treatment:

The effective drugs are dehydroemetine, nilodin and hycanthone. The specific drugs - trivalent antimony compounds like fouadian, anthiomaline, tartemetic, antimony dimercaptosuccinate. Nindazole (Ambilhar) is also used.

Prophylaxis:

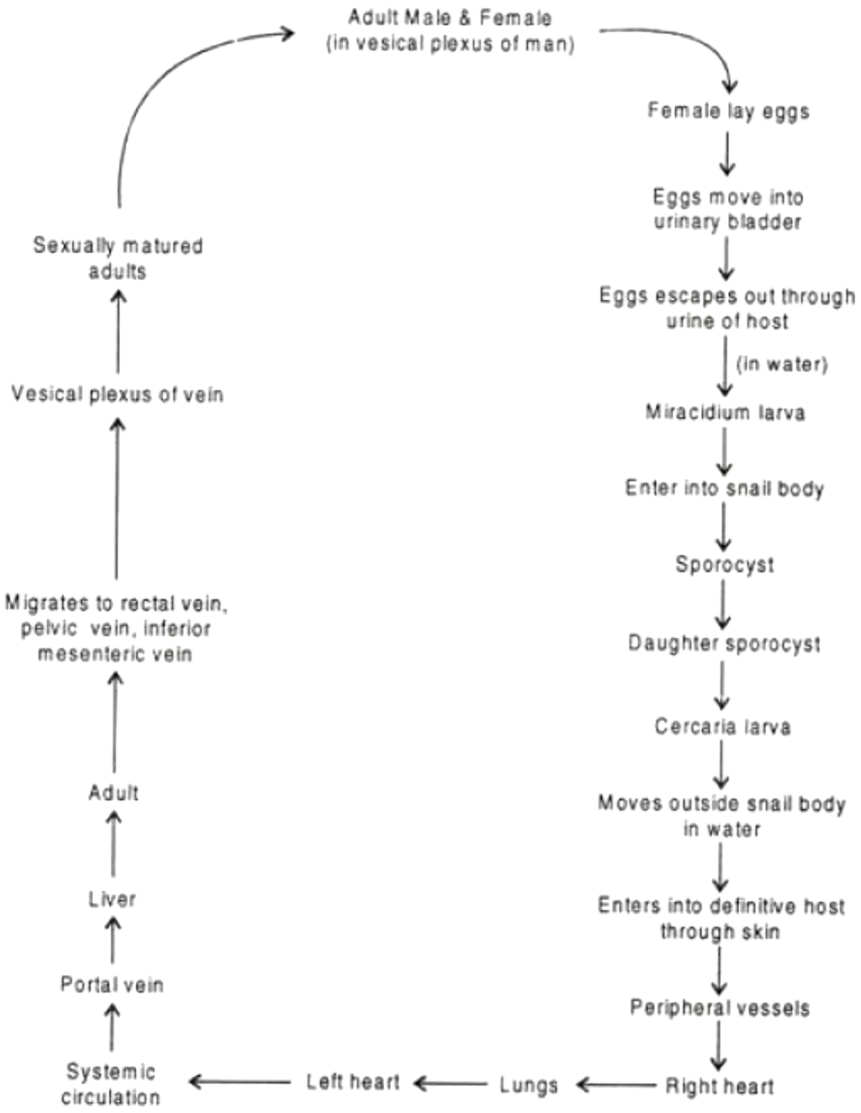
1. Effective sanitary and urinary disposal

2. Prevention of water pollution by human urine and faeces

3. Destruction of snails in endemic areas

4. Avoidance of swimming, bathing, washing in infected water

5. Treatment of the patient



Answer 4. Animal husbandry is the branch of science, which deals with the study of various breeds of domesticated animals and their management for obtaining better products and services from them.

Importance of domestic animals

On the basis of utility, domestic animals are categorised into the following functional groups

Milk giving animals	Cattle, buffalo, goat, sheep etc.
Draught (used for load bearing) animal	Bullock, horse, donkey, mule, camel, elephant, yak etc.
Fibre, hide and skin yielding	Sheep, goat, cattle, buffalo, camel etc
Meat and egg yielding animals	Fowl (hen) and duck, goat, buffalo, pig etc.

Cattle mainly include cow, bull, oxen, goat, sheep etc. The females of the species provide milk, which in turn contribute animals protein to the diet of people. While the female species of these cattle are used for milk, the male species play an important role in the agricultural economy by providing labour, meat and hide. Milk itself is taken in many forms like ghee, curd, butter and cheese etc. The excreta of these animals (dung) is used as manure, in biogas and as fuel. There are several important breeds of cattle in India and abroad.

There is following three categories of different breeds

1. Indian breeds 2. Exotic Breeds 3. Improved breeds

(a) Indian Breeds of cow

Gir, Sahiwal, Red Sindhi, Thararkar, Kankrej etc. are some high yielding varieties of Indian cattle

(b) Exotic Breeds of cow (Imported breeds)

Hilstein, Friesian, Jersey, Swiss etc. are some of the high yielding varieties that have been imported from abroad and reared widely in India.

(c) Improved breeds of cow

Certain improved breeds have been developed by making a cross between two desired breeds. A cross between Sahiwal and Friesian varieties has been named as Friewal, Karan Swiss is another improved breed for milk production in large quantities.

Breeds of Buffalos

Murrah - Haryana and Punjab

Bhadawari- Uttar Pradesh and Madhya Pradesh

Jaffarabadi --Gujarat

Surti --Gujarat

Mehsana --Gujarat (cross breed between Surti and Murrah)

Nagpuri --Maharastra

Nill Ravi --Punjab

Porlakmedi –Orissa

Breeds of Sheep

Sheep is the second largest species reared by mankind and it provides wool, meat, milk and hide. Their droppings form good manure. Important breeds of sheep in India are as follows:

Breeds of Sheep

Breed	Distribution
Chokla	Rajasthan
Nial	Rajasthan and Haryana
Marwari	Rajasthan and Gujarat
Magra	Rajasthan
Malpura	Rajasthan
Potanwadi	Uttar Pradesh and Delhi
Muzaffararanagari	Haryana
Hissardale	Himachal Pradesh and Haryana
Nellore	Andhra Pradesh
Bellary, Hassan,	Mandya Karnataka

Exotic Breeds

The main exotic breeds of sheep are Toggenberg, Saanen, French, Alpine and Nuibian and Angora.

Breeds of Goat

Important breeds of goats used for milk, meat and hide. There are about 19 well known Indian breeds, apart from a number of local non-descript breeds that are scattered throughout the country. The breeds are mentioned below on the basis of their location.

Himalayan Region (hilly track)

Cham, Gadd : Kashmir, Himachal Pradesh , Jammu and Kashmir

Pashmina : Himachal Pradesh, Ladakh, Lahul and Spiti valley

Chegu : Kashmir

Northern Region

Jamunaparu – Uttar Pradesh, Madhya Pradesh

Beetal – Punjab

Barhari – Delhi, Uttar Pradesh, Haryana

Central Region

Marwari, Mehsana and Zelwadi – Rajasthan, Gujarat and Madhya Pradesh

Kathiawar – Gujarat and Rajasthan

Southern Region

Surti – Gujarat

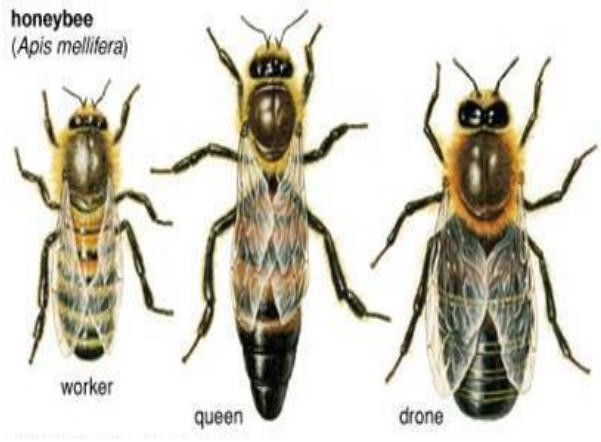
Deccani, Osmanabadi – Andhra Pradesh, Tamilnadu

Malabari – Kerala

Eastern Region

Bengali – West Bengal, Assam and Tripura

Answer 5. Honey bees are social insects, which means that they live together in large, well-organized family groups. Social insects are highly evolved insects that engage in a variety of complex tasks not practiced by the multitude of solitary insects. Communication, complex nest construction, environmental control, defense, and division of the labour are just some of the behaviors that honey bees have developed to exist successfully in social colonies. These fascinating behaviors make social insects in general, and honey bees in particular among the most fascinating creatures on earth. It shown polymorphism and labour division in their colony. A honey bee colony typically consists of three kinds of adult bees: workers, drones, and a queen. Several thousand worker bees cooperate in nest building, food collection, and brood rearing. Each member has a definite task to perform, related to its adult age. But surviving and reproducing take the combined efforts of the entire colony. Individual bees (workers, drones, and queens) cannot survive without the support of the colony. 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 for new site of food sources" 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. As the size of the colony increases up to a maximum of about 60,000 workers, so does the efficiency of the colony.



Queen

Each colony has only one queen, except during and a varying period following swarming preparations or supersedure. Because she is the only sexually developed female, her primary function is reproduction. She produces both fertilized and unfertilized eggs. Queens lay the greatest number of eggs in the spring and early summer. During peak production, queens may lay up to 1,500 eggs per day. The second major function of a queen is producing pheromones that serve as a social "glue" unifying and helping to give individual identity to a bee colony.

Worker: These are all infertile females who perform all necessary tasks for the survival of the colony. They work on defense, nest construction, food cultivation, foraging and tend younger larvae. All workers are sterile. Workers only live for a few months.

Drones: Serve exclusively for reproduction and fertilize queens. Live for only a couple of months and die soon after mating and are often chased away from colony. Although drones perform no useful work for the hive, their presence is believed to be important for normal colony functioning.

Answer 6. *Trypanosoma gambiense* is a protozoan haemoflagellate endoparasite of man inhabiting the blood, lymph and the intercellular spaces of different tissues and organs of man. Dogs, goats, cattle and sheep act potential reservoir hosts. The parasite causes a disease called Gambian or West-African sleeping sickness in human-beings. The disease African sleeping sickness was first described by Atkins in 1724 and Winterbottom in 1803, but the causative parasite was described in human blood by Forde in 1901 and later on named as T. gambiense by Dutton in 1903.

Systematic Position:

Phylum – Protozoa

Class – Mastigophora

Order – Protomonadina/ Kinetoplastida

Genus – *Trypanosoma*

Species – *gambiense*

Geographical distribution: *T. gambiense* are found in West and Central Africa between 15° N and 15° S latitude. In Western part of Africa it is found between Senegal and Angola. Other endemic areas are Congo, Niger and Southern Sudan. Their distribution depends upon the areas where the vector of the parasite, Glossina palpalis actually exists.

Life cycle:

T. gambiens are digenetic parasites, completing their life cycle in two hosts.

Primary or definitive hosts - human-beings,

Secondary or intermediate hosts - tsetse fly (*Glossina palpalis*).

T. gambiense is microscopic, elongate, leaf-like, flattened and tapering at both ends. It measures 10-40µ in length and 2.5-10µ in width. The anterior end is pointed, while the posterior end is blunt. T. gambiense is a polymorphic species and occurs in two developmental forms,

(i) Trypanosome form: In blood stream of its vertebrate host (man), the trypanosome form may be long slender or short stumpy or intermediate between the two. In invertebrate host (tsetse fly), the trypanosome form is long slender in midgut, and short stump in salivary glands.

(ii) Crithidial form: It is represented only in salivary glands of tsetse fly.

Life Cycle

[I] Life cycle in man:

1. Infection: The infection to man by *T. gambiense* is always through the bite of the tsetse fly, *Glossina palpalis*, which harbours the infective metacyclic forms in the lumen of its salivary glands.

2. Multiplication: All stages of *T. gambiense* in man are extracellular as they are present in the blood not inside blood cells. In human blood,

metacyclic forms → long slender forms with flagella, divide by longitudinal binary fission.

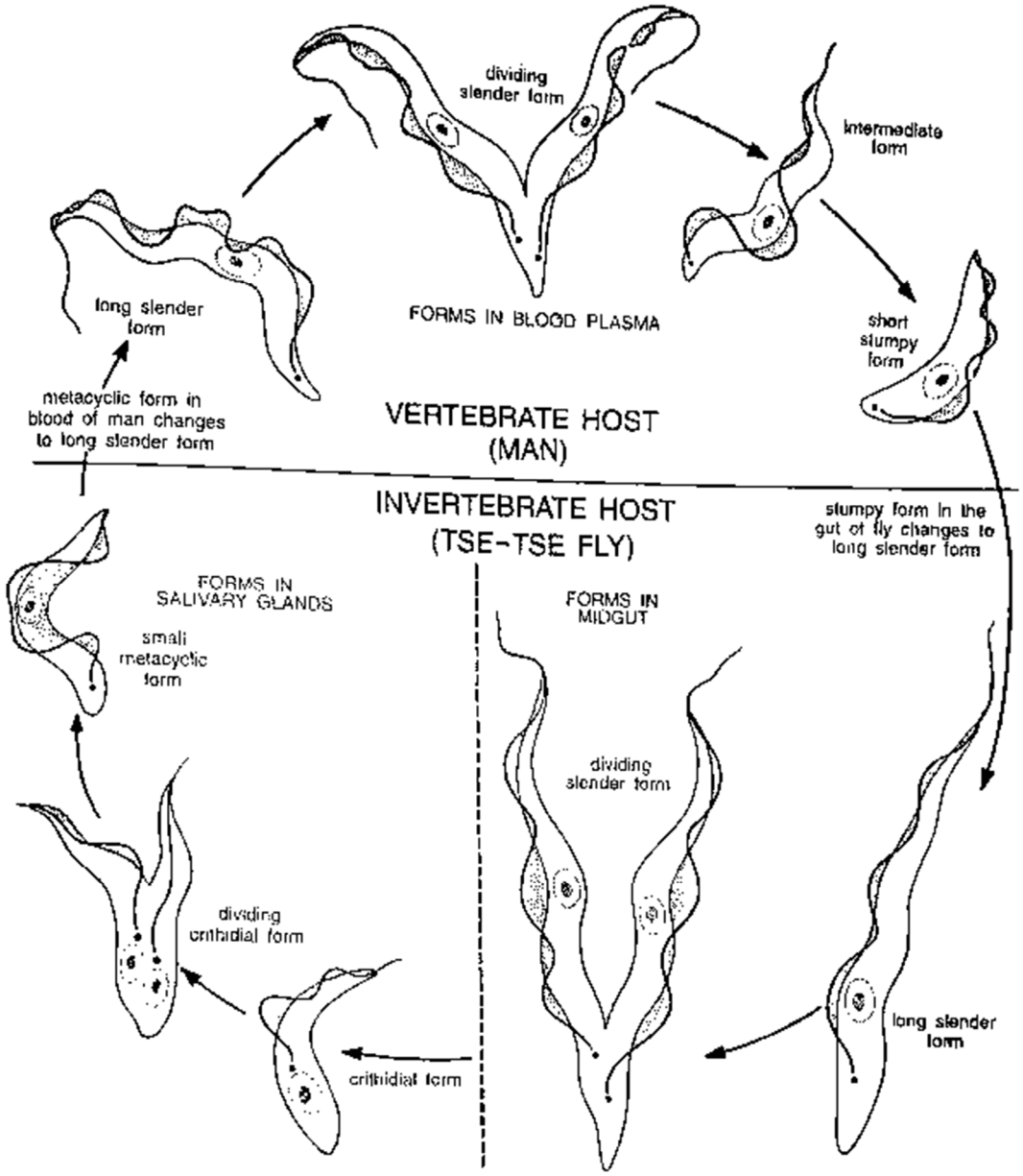
3. Metamorphosis: When the absorption of glucose ceases due to antibodies produced in blood, the glycolysis is hampered and the trypanosomes stop multiplying. They shrink to short stumpy forms, which are devoid of a free flagellum. The intermediate as well as the short stumpy forms obtain energy by aerobic oxidation of pyruvate. The stumpy forms do not feed and ultimately die if they are not sucked up by the tsetse fly along with the blood meal.

4. Relapse of infection: It has also been reported that some of the long and slender trypanosomes do not undergo transformation, but change the antigens of blood to which the host has produced antibodies. These unaltered slender forms survive and continue to multiply in blood leading to future relapses of the infection.

[II] Life cycle in tsetse fly: When tsetse fly sucks the blood of an infected person, it also takes in the short stumpy forms along with the sucked blood. It is the stumpy forms which continue development in the vector.

1. Development in mid-gut: Within peritrophic membrane of midgut, it transform into long slender forms and multiply by longitudinal binary fission. The kinetoplast moves farther from the posterior end of body. The energy-yielding process is related to mitochondrial oxidation of pyruvic acid.

2. Development in salivary glands: The long slender forms metamorphose into the crithidial forms with shortened body, reduced free flagellum and the kinetoplast in front of the nucleus. The crithidial forms multiply in the lumen of salivary glands and transform into slender metacyclic forms. At this stage, the mitochondrial activity is suppressed. When the tsetse fly bites a healthy person, it transfers the metacyclic forms, along with saliva into his blood where they initiate another infection.



Symptoms and pathogenesis: Sleeping Sickness is caused when the parasites invade cerebrospinal fluid of central nervous system. An irregular recurrent fever is the first symptom of the disease. Other symptoms which follow are weakness, loss of weight, anaemia, increase in pulse rate and severe headache. In due course the patient falls asleep, first at regular intervals and then lies prostrate in coma. Death is always the ultimate fate. The toxic effect is produced when the trypanosomes die in the cerebrospinal fluid and their autolytic decomposition starts.

Diagnosis: In laboratory, trypanosomes may be detected in fresh or stained blood films, or in extracts of enlarged lymph glands. In Sleeping Sickness stage, examination of cerebrospinal fluid, obtained by lumbar or cisternal puncture, becomes necessary.

Treatment: The Gambian or African trypanosomiasis can he treated in its early stage, but once the parasites have entered the CSF.

Drugs: Suramin sodium, Bager 205, Atoxy →in early stage

Orsamine → if CNS is involved

Prophylaxis: Following are the prophylactic measures:

1. Destruction of the habitat of the vector.

2. Destruction of the vector by the use of insecticides.

3. Isolation of human population from areas harboring the vector.

4. A single intramuscular injection of 4 mg/kg may be used as chemo-prophylactic measure, which remains effective for six months.

5. Treatment of the patient.

Answer 7. (i) Broilers: The term broiler is applied to chicks that have especially been bred for rapid growth. Broiler strains are based on hybrid crosses between Cornish White, New Hampshire and White Plymouth Rock. Broliers have been bred in order to be eaten purpose. They grow very rapidly, putting on as much muscle as quickly as possible and generally being killed after a shockingly short time (6 weeks after hatching).

Layers: They have been selectively bred in order to lay as many eggs as possible in the first 18 months of life. As a result the birds are quite small, and don't have very much muscle (meat) on them. Layers are efficient egg producers, breeds used for egg production in the industrial production system are almost entirely based on the White Leghorn and Rhode Island Red. Selection and crossbreeding techniques have resulted in productive laying hens producing 15-19 kg of eggs per year. In layer production, sometimes 2 phases of production are recognised: (1) growing phase up to approximately 140 days; and (2) productive phase from 140 – 560 days.

(ii) Silkworm Diseases: Like many other insects, silk worms too are susceptible to pathogens causing them ill and eventually leading to their death. Some of the important among them are:

(i) Pebrine. It is the serious disease of silkworm caused by protozoan *Nosema bombycis*. The disease is transmitted through contaminated food and contact. It also spreads through the eggs of the diseased moths. The spores once ingested invade the gut tissue and are continuously discharged through the faecal matter. The infested moths show low fecundity, produce pepper like spots on body, wrinkled skin and sluggish behavior. Pebrine is of two types. One protozoan type already discussed and other is called viral pebrine caused by the virus namely *Borreline bombycis*, the larvae suffering from this disease get killed in 8-10 days of infection.

(ii) Flacherie. It's a bacterial disease caused by *Bacillus thuringiensis sotto*. The diseased larvae vomit green fluid through their mouth and are generally thin in body musculature. Due to high dysentric condition larvae appears flabby, feeble, weak, withered and loosely hanging. The body putrefies and becomes black or green.

The caterpillars die and their bodies give an offensive smell. This disease is generally caused by indigestion, therefore over feeding should be avoided. Regular feeding of the larva and maintaining good hygenic condition to prevent spread of disease.

(iii) Muscardine. It's a fungal disease caused by Fungus, *Beauveria bassiana* and commonly found during rainly season. The fungal spores adhering to the larval body germinate under suitable conditions and penetrate the body. The suffered caterpillars loose appetite, become soft bodied turn stiff. White muscardine is due to *Beauveria bassiana*, green due to *Spicaria parsinna* and yellow muscardine via *Iscaria farinosa*.

(iv) Glasseria. It's caused by **Borrelina virus**, causing swelling of body segments that ultimately results in bursting of skin, care should be taken that the larvae should not be fed on mature leaves first and tender leaves after wards. Use of resistant strains, chemical disinfectants like bleaching powder, formalin, etc. should he periodically used to check the infestation.

Answer 8. Dairy is a commercial establishment for processing or selling milk and milk product. Sound management practices are essential for profitable dairy farming.

I. Factors responsible for the increased milk production

a. Better feeding and management

b. Increased use of high quality bulls through artificial insemination

(Note: Artificial insemination is currently used on well over half the dairy cows and heifers in the several Countries and in 90% of the dairy herds.)

c. Better selection of high producing cows

d. More rigid culling of low producing cows

II. Sanitation and disease control and prevention

a. Keep cows clean at milking time, especially flanks and udders

b. Keep yards clean and well-drained

c. Barn floor kept clean, made of concrete

d. Utensils/milking equipment made of stainless steel or tinned iron, clean, good condition

e. Milk room

i). Concrete, sloped floor

ii). Screened and ventilated

iii). Separated from barn

iv). Hot water, wash and rinse vats

v). Tank for cooling and storing milk

III. Handling dairy bulls

a. Use caution; always keep safety in mind

b. Use a nose ring

IV. Guidelines for facilities for housing dairy bulls

a. Strongly constructed

b. Located away from other animals

c. At least a 12-foot-square stall

d. Adequate exercise area

e. Constructed so feeding and watering can be done from outside pen

V Conditions that could keep a bull from being an effective breeder

a. Poor semen

b. Physical defects or injuries

c. Excitement or inappropriate handling

d. Diseases

e. Lack of exercise

f. Improper feeding

g. Overworking

h. Using a young bull on too many or too large of cows

VI. Guidelines for housing calves

a. House separately until at least 1 week after discontinuing milk or milk substitute

b. House in dry, draft free areas with good ventilation

VII. Basic types of housing systems for dairy cattle

A. Confinement stall housing

a. Each cow is tied in an individual stall

b. Animals are either facing out with a common center alley or facing in with a common feeding area

c. Allows for better control and display of animals

d. Higher labor requirement

e. Higher housing expense

B. Loose housing

a. Cows are either provided free stalls or housed in a common, open area (Note: Most dairies have some kind of free stall system.)

b. Lower labour requirement

c. Lower housing expense

d. Less leg and udder injuries

e. Most popular system

Resources: Various textbooks and internet websites