

**BIOLOGY (Theory)***Time Allowed: 3 hours**Maximum Marks: 70***General Instructions:**

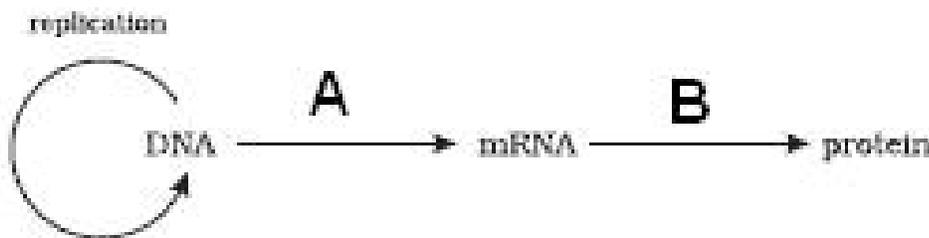
- (i) *All questions are compulsory.*
- (ii) *This question paper consists of five Sections A, B, C, D and E. Section A contains 5 questions of **one** mark each, Section B is of 5 questions of **two** marks each,*
- (iii) *Section C has 12 questions of **three** marks each, Section D is of 4 marks weightage is a Value Based Question.*
- (iv) *Section E has 3 questions of **five** marks each.*
- (v) *There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and all the three questions of 5 marks weightage. A student has to attempt only one of the alternatives in such questions.*
- (vi) *Wherever necessary, the diagrams drawn should be neat and properly labelled.*

**Section A**

1. Identify the vegetative propagule in the following –



2. Why is it advisable for vehicles fitted with catalytic converters use unleaded petrol? 1
3. Mention the importance of Atlas 66. 1
4. How is the action of exonuclease different from that of an endonuclease? 1
5. Identify 'A' and 'B' in the image given below- 1



### Section B

6. Describe the process of somatic hybridisation. 2
7. How do mycorrhizae act as biofertilizer? Explain. Name the genus of the fungi that forms mycorrhizal associations with plants. 2

**OR**

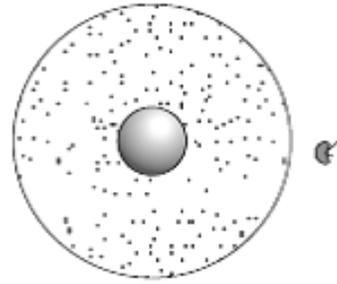
- Name the source of Streptokinase. What is the role of this bioactive molecule in the human body. 2
8. State two reasons why more than 10 species of invertebrates became extinct within a year in the rocky intertidal communities of the American Pacific Coast. 2
9. Observe the images a and b and answer the following questions:
  - a. Type of gametes represented by a and b

b. Appropriate examples of a and b

a.



b.



2

10. Explain the two special techniques used in **test tube baby** programme.

2

### Section C

11. a. Name a disease in which there is an uncontrolled division of cells resulting in formation of tumors? How is this disease detected?  
b. How do biological response modifiers help in controlling the disease?  
c. Mention the cause of abnormality in a child suffering from Turner's syndrome?

3

12. a. Name the yellowish fluid secreted by mother during the initial days of lactation. Why is it considered very essential for the newborn infant?  
b. How does *Saheli* the new oral contraceptive for females effectively prevent pregnancy?

3

13. a. Draw a Pyramid of numbers in a grassland ecosystem. How many top-carnivores are supported in such an ecosystem.  
b. Mention three limitations of ecological pyramids.

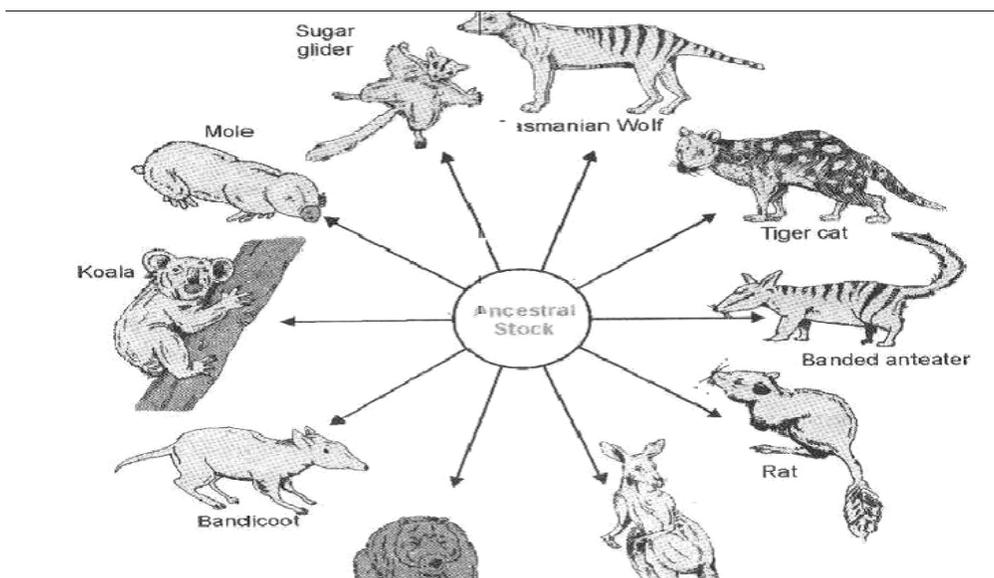
3

14. The codon for the sixth amino acid is GAG. The sixth codon GAG mutates to GAA as a result of mutation 'A' and to GUG as a result of mutation 'B'. Haemoglobin structure did not change as a result of mutation 'A' whereas it became sickle shaped as a result of mutation 'B'. Explain giving reasons how is this possible. 3

15. Explain the steps in the formation of mature RNA from the Primary transcript. 3

16. a. Explain the steps involved in carrying out MOET for cows.  
 b. Name four other animals for which this technology has been demonstrated. 3

17. Name and explain the evolutionary concept represented in the illustration given below. What type of evolution does it show – Convergent / divergent.



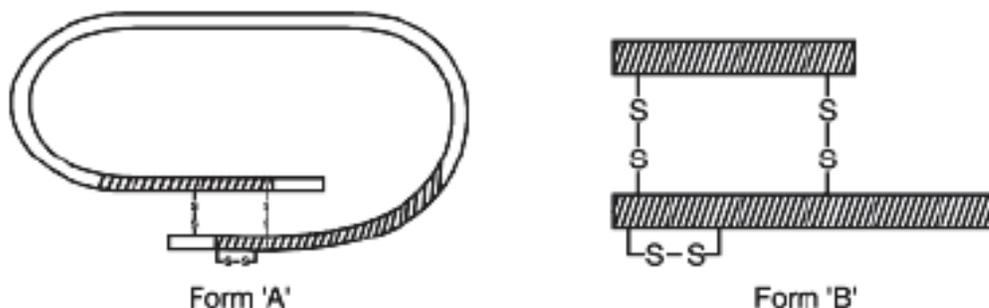
3

18. A specific gene sample of interest needs to be amplified by PCR. What are the main steps that are involved ? What is the special feature of the DNA polymerase used in PCR ? Name the organism

from which this enzyme is isolated ?

3

19. In the given figure, Form (A) and Form (B) represents different forms of a proteinaceous hormone secreted by pancreas in mammals.



- What type of bonding is present between chains of this hormone?
- What are these form (A) and form (B). How these forms differ from each other?
- Explain how this hormone was produced by Eli Lilly, an American company, using rDNA technology.

3

20. Give the schematic representation of spermatogenesis in Man.

3

**OR**

Give the schematic representation of Oogenesis in a human female.

3

21. Write the steps in its proper sequence involved in producing nematode resistant tobacco plants based on the process of RNAi . Two of the steps involved in producing nematode resistant tobacco plants based on the process of RNAi are mentioned below:

- .....
- Using Agrobacterium as vector introduce it into tobacco
- .....
- .....
- Initiates RNA interference

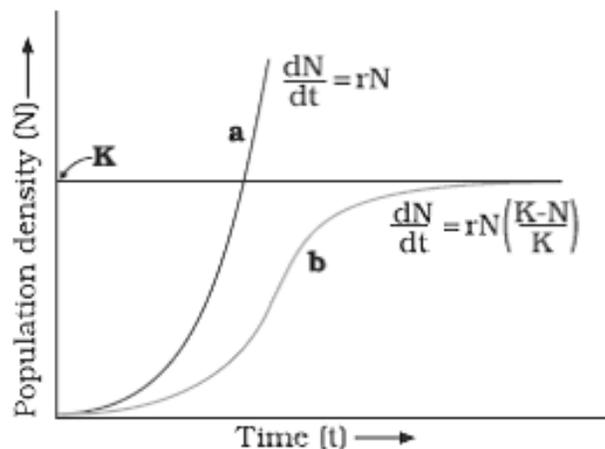
f. ....

g. ....

h. ....

3

22. A population 100 frogs were living without any carnivores in an enclosure. The frogs census was taken after a few years. Now study the graph given below and answer the questions that follow



- Identify the curve that represents the frog population.
- What is this type of population growth curve called as? What is 'K' in the graph?
- Amazonian rain forest has the greatest biodiversity on earth. List any two reasons that are proposed by biologists to account for the greater biological diversity.

3

### Section D

23. a. Sanchit drives from Delhi to NOIDA in a decade old car. The car was emitting dark smoke. His friend Deepak advised him to take three measures to control the emissions and help to bring about marked improvement in air quality. What were these three measures and how did they reduce air pollution?
- b. What is the norm set by Euro II for petrol and diesel vehicles?

4

### Section E

24. a. Draw the embryo sac of a flowering plant and label
1. central cell
  2. Chalazal end of the embryo sac
  3. synergids.
- b. Name the cell that develops into the embryo sac and explain how this cell leads to the formation of Embryo sac . Also mention the role played by the various cells of the embryo sac. 5

**OR**

Explain diagrammatically the stages of embryonic development from zygote up to implantation in humans. 5

25. A dihybrid heterozygous round, yellow seeded garden pea (*Pisum sativum*) was crossed with a double recessive plant.
- a. What type of cross is this?
  - b. Work out the genotype and phenotype of the progeny.
  - c. What principle of Mendel is illustrated through the result of this cross? 5

**OR**

What is meant by semi conservative replication? How did Meselson and Stahl prove it experimentally? 5

26. a. Create a flow chart of Secondary treatment of effluents in an Effluent treatment.
- b. Briefly explain Primary treatment of effluents in an Effluent treatment. 5

**OR**

Why is the sobriquet. The Evil Quartet. used in context of

biodiversity? Name the members of this quartet. Why do we grieve for the genes when a species is lost?

5

## **ANSWERS**

## Section A

1. Bulbil of Agave
2. It is desirable to use unleaded petrol because lead in the petrol inactivates the catalysts like platinum-palladium and rhodium present in the Catalytic converters.
3. It is a biofortified wheat having a high protein content and has been used as a donor for improving cultivated wheat.
4. Exonucleases remove nucleotides from the ends of the DNA whereas endonucleases make cuts at specific positions within the DNA.
5.
  - a. Transcription
  - b. Translation

## Section B

6. The process of somatic hybridisation is as follows:
  - a. Isolation of single cells from plants
  - b. Digestion of their cell walls and isolation of naked protoplasts
  - c. Isolated protoplasts from two different varieties of plants with desirable characters can be fused to get hybrid protoplasts
  - d. Hybrid protoplasts can be further grown to form a new plant.
7. The fungal symbiont in mycorrhizae absorbs phosphorus from soil and passes it to the plant. The Plants also show resistance to root-borne pathogens, tolerance to salinity and drought, and an overall increase in plant growth and development.

Many members of the genus *Glomus* form mycorrhiza.

### OR

The source of Streptokinase is the bacterium *Streptococcus*.

It is used as a 'clot buster' for removing clots from the blood vessels of patients who have undergone myocardial infraction leading to heart attack.

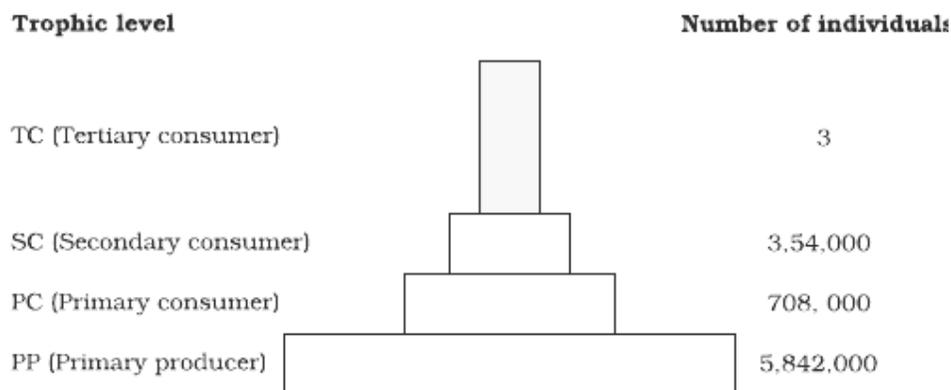
8. a. Removal of the predator starfish *Pisaster*  
b. Interspecific competition.
9. a. Isogametes of *Cladophora*  
b. Heterogametes of *Fucus*
10. a. **In vitro fertilisation (IVF)**—In this procedure ova from the wife/donor (female) and sperms from the husband/donor (male) are collected and fertilisation occurs outside the body in almost similar conditions as that in the body  
b. It is followed by **embryo transfer (ET)** into the uterus of the prospective mother.

### Section C

11. a. Cancer. Detection is based on biopsy and histopathological studies of the tissue and blood and bone marrow tests and by techniques like radiography, CT (computed tomography) and MRI.  
b. Biological response modifiers like interferon acts by activating the immune system which help in destroying the tumor.  
c. Due to aneuploidy there is failure of segregation of chromatids during cell division cycle resulting in the loss of X chromosome in human females.

12. a. **Colostrum** is the yellowish fluid secreted by mother during the initial days of lactation.  
It has abundant antibodies (IgA) to protect the infant.
- b. Saheli has high contraceptive value and contains a non-steroidal preparation and is a 'once a week' pill with very few side effects.

13. a.



Three top-carnivores are supported in a grassland ecosystem

- b. a. It does not take into account the same species belonging to two or more trophic levels.
- b. It assumes a simple food chain which is almost nonexistent in nature;
- c. It does not accommodate a food web.
- d. Saprophytes that play a vital role in the ecosystem are not given any place in ecological pyramids.
14. The codons GAG and GAA both code for the sixth amino acid glutamine of the beta globin chain of the normal haemoglobin molecule for the HbA peptide.  
The codon GUG formed due to mutation 'B' codes for Valine for HbS peptide exhibiting sickle-cell trait. The mutant haemoglobin molecule undergoes polymerisation under low oxygen tension causing the change

in the shape of the RBC from biconcave disc to elongated sickle like structure.

15. The steps in the formation of mature RNA from the Primary transcript are as follows:
- a. The primary transcript called the **heterogeneous nuclear RNA (hnRNA)** contain both the exons and the introns and are non-functional.
  - b. Removal of the introns by a process called **splicing**.
  - c. Joining of exons in a defined order.
  - d. hnRNA undergo two additional processing called as capping and tailing. In **capping** an unusual nucleotide (methyl guanosine triphosphate) is added to the 5'-end of hnRNA.  
In **tailing**, adenylate residues (200-300) are added at 3'-end in a template independent manner.
  - e. Formation of mRNA
  - f. Transport of mRNA out of the nucleus for translation.
16. a. The steps involved in carrying out MOET are as follows:
1. A cow is administered hormones, with FSH-like activity, to induce follicular maturation and super ovulation producing 6-8 eggs per cycle.
  2. The animal is either mated with an elite bull or artificially inseminated.
  3. The fertilised eggs at 8-32 cells stages, are recovered nonsurgically and transferred to surrogate mothers.
  4. The genetic mother is available for another round of super ovulation.
- b. Four other animals for which this technology has been demonstrated are sheep, rabbits, buffaloes, mares.

17. The evolutionary concept represented in the illustration given below is adaptive radiation of Australian marsupials each different from the other seen evolving from an ancestral stock within the Australian island continent starting from a point and literally radiating to other areas of geographical habitats.

It shows convergent evolution as more than one adaptive radiation appeared to have occurred in an isolated geographical area representing different habitats.

18. The main steps that are involved for amplification of gene sample of interest by PCR are as follows:

a. **Denaturation** . Heat denatures DNA to separate complementary strands.

b. **Annealing** : Primers hybridises to the denatured DNA strands.

c. **Extension** : Extension of primers resulting in synthesis of copies of target DNA sequence.

The special feature of the DNA polymerase used in PCR is Enzyme Tag polymerase isolated from the bacterium *Thermus aquaticus*

This enzyme induces denaturation of double stranded DNA at high temperature.

19. a. Disulphide bonds

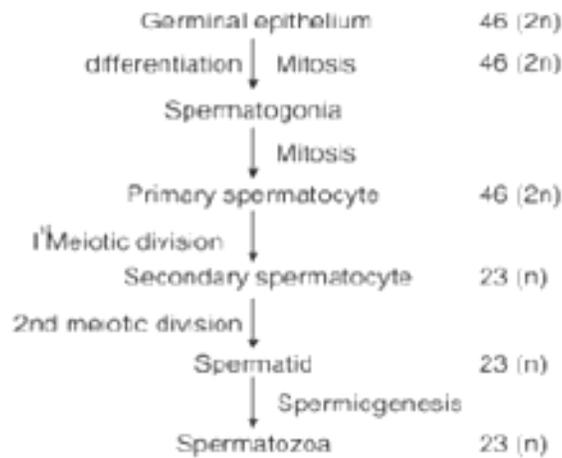
b. Form (A) . Proinsulin

Form (B) . Mature insulin.

Proinsulin contains an extra stretch called C . peptide which is absent in mature insulin.

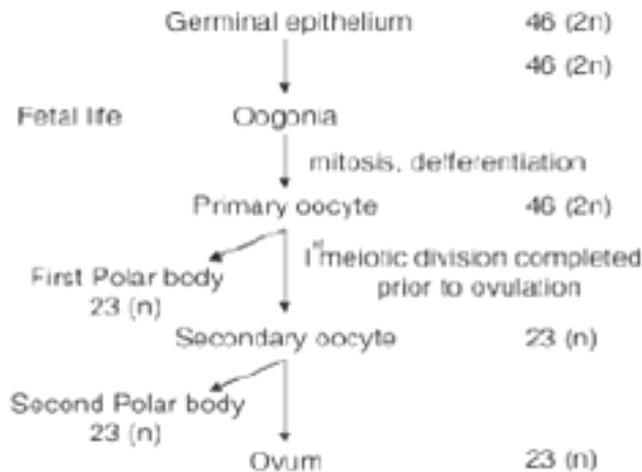
c. Eli Lilly company prepared two DNA sequences corresponding to A and B peptide chains of human insulin and introduced them in plasmid *E. coli* to produce insulin chains. Chains A and B were produced separately, extracted and combined by creating disulphide bonds to form insulin.

20. Below is given the schematic representation of spermatogenesis in Man



OR

Below is given the schematic representation of Oogenesis in a human female.



21. a. Splicing of a specific mRNA  
 b. Formation of sense and antisense RNA in host cell  
 c. dsRNA (double stranded RNA)  
 d. Silenced specific mRNA of the nematode  
 e. Parasite could not survive.  
 f. The transgenic plant therefore got itself protected from the parasite
22. a. Curve a.

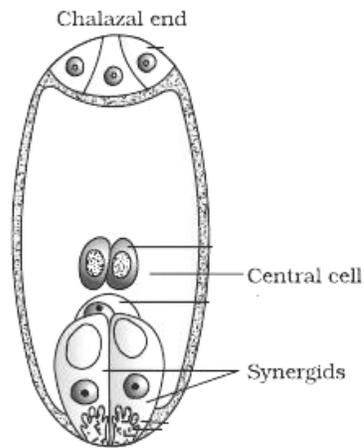
- b. Exponential curve.  $K$  is the carrying capacity.
- c. The two reasons proposed by biologists to account for the greater biological diversity are as follows:
  - 1. Long evolutionary time for species diversification as amazonian rain forest has remained relatively undisturbed for millions of years.
  - 2. There is higher productivity in the tropics due to more availability of solar energy that indirectly contributes to greater diversity.

### **Section D**

- 23.** a. The three measures to control the emissions and help to bring about marked improvement in air quality are as follows:
- 1. Use of unleaded /low-sulphur petrol
  - 2. Use of catalytic converters in vehicles that reduce emissions.
  - 3. Complying of stringent pollution level norms for vehicles,
  - 4. Switching over of the car to run on CNG as CNG burns most efficiently and very little of it is left unburnt.
- b. The norm set by Euro II for petrol and diesel vehicles are as follows:
- 1. Sulphur be controlled at 350 parts-per-million (ppm) in diesel and 150 ppm in petrol.
  - 2. Aromatic hydrocarbons are to be contained at 42 per cent of the concerned fuel.

### **Section E**

- 24.** a.



**b. Functional Megaspore.**

At first the nucleus of the functional megaspore divides mitotically to form two nuclei which move to the opposite poles, forming the **2-nucleate** embryo sac.

Two more sequential mitotic nuclear divisions result in the formation of the **4-nucleate** and later the **8-nucleate** stages of the embryo sac. These mitotic divisions are strictly free nuclear .

After the 8-nucleate stage, cell walls are laid down leading to the organisation of **embryo sac**.

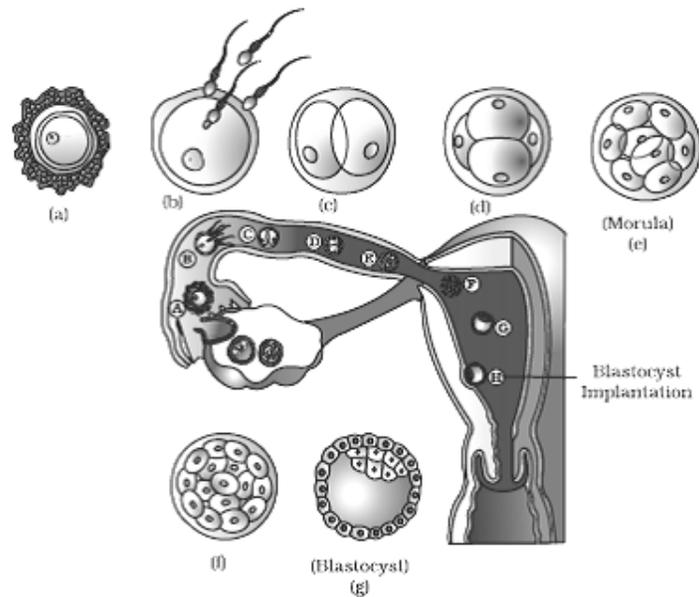
c. **Egg** : Fuses with male gamete to form zygote or future embryo

**Synergid** : Absorption of nutrient, attract and guides pollen tube.

**Central Cell** : After fusion with second male gamete forms Primary endosperm cell which gives rise to Endosperm.

**OR**

a.



- b. 1. As the zygote moves through the isthmus of the oviduct towards the uterus and it divides mitotically called **cleavage** and forms 2, 4, 8, 16 daughter cells called **blastomeres**.
2. The embryo with 8 to 16 blastomeres is called a morula.
3. As the morula moves further into the uterus it continues to divide and transforms into blastocyst
4. The blastomeres in the blastocyst are arranged into an outer layer called **trophoblast** and an inner group of cells attached to trophoblast called the **inner cell mass**.
5. The trophoblast layer then gets attached to the endometrium and the inner cell mass gets differentiated as the embryo.
6. After attachment, the uterine cells divide rapidly and covers the blastocyst.
7. The blastocyst gets **implanted** in the uterus leading to pregnancy.

25. a. It is a dihybrid test cross
- b. Parent RrYy (Round Yellow) rryy (Wrinkled green)
- Gametes RY , Ry , rY , ry X ry
- Gametes RY Ry rY ry
- F1 progeny ry RrYy Rryy rrYy rryy

Round, Round and Wrinkled Wrinkled,

Yellow Green Yellow Green

Phenotypic ratio : 1 : 1 : 1 : 1

Genotypic ratio : 1 : 1 : 1 : 1

- c. It illustrates the Principle of independent assortment.

### OR

Meselson and Stahl, performed an experiment using *E.coli* to prove that DNA replication is semi conservative.

- a. They grew *E.coli* in a medium containing  $^{15}\text{NH}_4\text{Cl}$ .
- b. Then separated heavy DNA from normal ( $^{14}\text{N}$ ) by centrifugation in  $\text{CsCl}$  density gradient.
- c. The DNA extracted, after one generation of transfer from  $^{15}\text{N}$  medium to  $^{14}\text{N}$  medium, had an intermediate density.
- d. The DNA extracted after two generations consisted of equal amounts of light and hybrid DNA.
- e. They proved that DNA replicates in a semiconservative manner.

26. a. Primary effluent is passed through large aeration tanks

↓

Pumping of air

↓

Vigorous growth of useful aerobic microbes into **flocs**.

↓

Decrease in the BOD of the effluent

↓

Collection in settling tank

↓

the bacterial 'flocs' are allowed to sediment. This sediment is called **activated sludge**. A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum.

↓

Pumping into anaerobic sludge digester

↓

Formation of biogas that can be used as source of energy.

↓

Release of effluent into natural water bodies.

b. The primary treatment involves the following steps:

1. Through filtration and sedimentation there is physical removal of large and small particles from the sewage
2. In the first stage initially, floating debris is removed by sequential filtration.
3. Next the grit consisting of soil and small pebbles are removed by sedimentation.
4. All solids that settle form the **primary sludge**, and the supernatant forms the effluent.
5. The effluent from the primary settling tank is taken for secondary treatment.

## OR

The Evil Quartet. is used as a sobriquet to refer to the cause of loss of biodiversity :

- a. **Habitat loss and fragmentation** : When large habitats are broken up into smaller fragments due to various human activities, the animals requiring large territories (elephants, birds etc.) are badly affected and their populations decline.
- b. **Over-exploitation** : When need of a resource becomes greed. e.g., over exploitation of passenger pigeon led to its extinction. Also marine fish is at brink of being endangered due to over exploitations.
- c. **Alien species invasion** : Intentional or non-Intentional introduction of a species to a nearby area may disturb the harmony

of existing species. e.g., Eichhornia after introduction posed a big threat to the native species.

- d. **Co-extinction** : Extinction of one species invariably leads to extinction of another when they are associated with each other in an obligatory way. e.g., when host species is extinct, obligate parasites dependent on it also die.
- e. We grieve for the loss of genes, because the wild forms are hardy and more resistant to pathogen attack and can be beneficial in crop breeding programmes.