Biology

SECTION-A

1. Answer the following questions briefly.

i. Name the source of thermostable DNA polymerase. **[1]**

Bacterium *Thermus aquaticus* is the source of thermostable DNA polymerase.

ii. Mention the scientific name of a protozoan parasite that causes Amoebiasis. **[1]**

Amoebiasis is caused by the protozoan parasite *Entamoeba histolytica*

iii. What is *cryopreservation*? **[1]**

Cryopreservation is the method of use of very low temperatures typically at −196°C to preserve the cells and tissues with their intact structure.

iv. The maternal grandfather of a boy is colourblind, but his maternal grandmother is normal. The father of the boy is also normal. What is the probability of this boy being colourblind? **[1]**

The probability of boys being colourblind is 50%.

v. Name the type of antibody that can be transferred through the placenta. **[1]**

IgG is the only type of antibody that can be transferred through the placenta.

vi. During which phase of the cell cycle, does DNA replication take place? **[1]**

During S phase of cell cycle, replication of DNA takes place.

vii. How many sets of primers are required in each cycle of PCR? **[1]**

Two sets of primers are required in each cycle of PCR.

viii. Define perisperm. **[1]**

In some seeds, remnants of nucellus are persistent, this residual persistent nucellus is called perisperm.

ix. Which one of the following enzymes is used to join DNA fragments? **[1]**

(a) DNA polymerase
(b) Ligase
(c) Primase
(d) Endonuclease

Answer:- (b) Ligase

x. What type of ecological pyramid would be obtained from the following data?
Secondary consumer: 120 gm
Primary consumer: 60 gm
Primary producer: 10 gm **[1]**

(a) Inverted pyramid of biomass
(b) Pyramid of energy
(c) Upright pyramid of numbers
(d) Upright pyramid of biomass

Answer: (a) Inverted pyramid of biomass

xi. Assertion: A person who has received a cut from a sharp object and is bleeding needs to be given an anti-tetanus injection.
Reason: Anti-tetanus injection stimulates the production of antibodies for tetanus. **[1]**

(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

Answer: (c) Assertion is true, but Reason is false.

xii. Which one of the following factors is responsible for activation of protoxin into active Bt toxin of *Bacillus thuringiensis*? **[1]**

(a) Body temperature
(b) Moist surface of midgut
(c) Alkaline pH of gut
(d) Acidic pH of stomach

Answer: (c) Alkaline pH of gut

xiii. Give one significant contribution of each of the following scientists:

a. T.R. Malthus **[1]**

Answer: T. R. Malthus proposed the Malthusian theory of population, where he said that the population grows exponentially and the food supply grows arithmetically and that a balance between the two can be established through positive and preventive checks (includes war, disease, and famines).

b. R. Mishra **[1]**

Answer: Ramdeo Misra is revered as the Father of Ecology in India. He established teaching and research in ecology at the Department of Botany of the Banaras Hindu University, Varanasi. His research laid the foundations for understanding of tropical communities and their succession, environmental responses of plant populations and productivity and nutrient cycling in tropical

forest and grassland ecosystems.

xiv. Give a term for the following: **[2]**

a. An ART in which eggs are removed from the ovary of the female, fertilized and then placed in the fallopian tube.

b. Fusion of male gamete and secondary nucleus in angiosperm.

Answer:

(a) ZIFT- Zygote Intra fallopian transfer

(b) Triple fusion

xv. Expand the following abbreviations: **[2]**

a. NACO

b. PID

Answer:

(a) NACO - National Aids Control Organization

(b) PID - Pelvic Inflammatory Disease

xvi. Give a reason for each of the following: **[2]**

a. Cattle avoid browsing on *Calotropis* plant

b. DNA can not enter directly into the host cell

Answer:

(a) Cattle avoid browsing on *Calotropis* plant due to the presence of cardiac glycosidases in the plant

(b) DNA can not enter directly into the host cell through the cell membrane as the DNA molecule is polar while the cell membrane is nonpolar.

SECTION-B

2. Give one difference between the following pairs **[2]**

i. Sites of maturation of B - Lymphocytes and T - Lymphocytes

ii. Sources of Opioids and cannabinoids

Answer:

i.

	B - Lymphocytes	T - Lymphocytes
Site of maturation	B - Lymphocytes mature at Bone marrow	T - Lymphocytes mature at Thymus gland

ii.

	Opioids	Cannabinoids
Sources	It is obtained from *Papaver somniferum.*	It is obtained from *Cannabis sativa.*

3. Briefly discuss any two methods by which plants avoid self-pollination. **[2]**

Answer:

There are a variety of mechanisms by which plants avoid self-pollination. Some of these are

(i) **Different time of maturation**: The male and female gametes mature and are released during different times. For example, anthers in the flower mature before the stigma becomes receptive to the pollen grains in the flower or vice versa.

[1]

(ii) **Hypogynous flower:** Hypogynous flowers are flowers in which gynoecium occupies the highest position while other parts are situated below. Due to the difference in height of the stigma and the anthers, the pollen grain do not fall on the the stigma of the same flower and hence no self-pollination occurs. **[1]**

4. Mention the location and function of Leydig cells. **[2]**

Answer:

The interstitial cells or Leydig cells are located in the regions outside the seminiferous tubule known as interstitial spaces. **[1]**

Leydig cells synthesize and secrete testicular hormones called androgens. **[1]**

5. What are vestigial organs? Give any one example of a vestigial organ in human body. **[2]**

Answer:

Vestigial organs are those which are present in reduced form and do not perform any function in the body but are functional in related animals. They are remnants of organs which were complete and functional in their ancestors.

[1]

E.g. Vermiform appendix. **[1]**

OR

State Hardy Weinberg's principle. Give a mathematical expression for this principle.

Answer:

Hardy Weinberg principle states that the allele frequencies in a population are stable and is constant from generation to generation.
The sum total of all the allelic frequencies is 1.
$p+q=1$
where,
p= frequency of dominant allele
q = frequency of recessive allele
The binomial expansion of this equation is-
$p^2+2pq+q^2 = 1$
where,
p^2= frequency of individuals with homozygous dominant genotype
q^2= frequency of individuals with homozygous recessive genotype
2pq= frequency of individuals with heterozygous genotype

6. Riya went to the hospital to meet her sister who was undergoing some treatment. The hospital was crowded with patients suffering from various types of allergies, pneumonia and Ascariasis. Name the disease that Riya is most likely to get infected with. Give one reason for your answer. [2]

Answer:

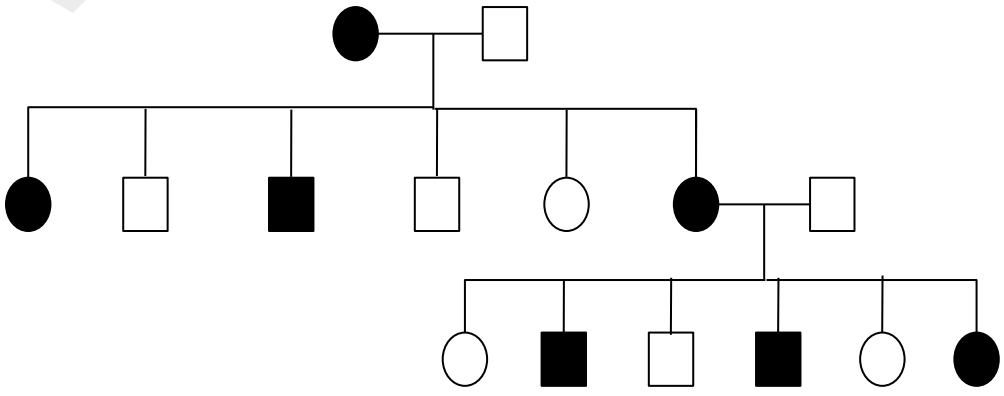
The disease that Riya is most likely to get infected with is Pneumonia. **[1]**
Pneumonia is caused by a bacteria Streptococcus pneumoniae. The bacterium is transmitted through droplets or air particles or use of glass or utensils used by an infected person. **[1]**

7. State the steps involved in the process of gene therapy for the treatment of ADA deficiency. [2]

Answer:

(i) First, lymphocytes from the blood of the patient are grown in a culture plate outside the body.
(ii) A functional cDNA coding for ADA is then introduced into these lymphocytes using a suitable vector.
(iii) Recombinants are identified and isolated.
(iv) These are subsequently introduced back into the blood of the patient.
However, as these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes.

8. The pedigree chart given below represents the pattern of inheritance of sickle cell anaemia in a family. Study it carefully and answer the questions that follow.



(i) What is the genotype of the father?
(ii) What is the phenotype of the mother?

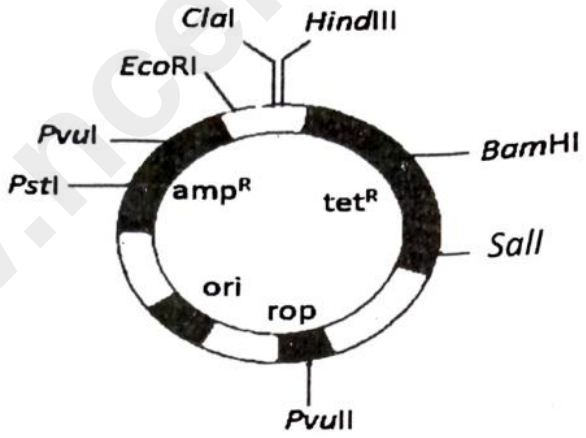
Answer:
(i) Hb^AHb^S
(ii) Sickle cell-anemic

SECTION-C

9. Discuss any three major causes of loss of biodiversity. **[3]**

Answer:
(i) **Habitat loss and fragmentation**: Habitat loss refers to the decrease in the extent of natural habitats driving animals and plants to extinction. Whereas, habitat fragmentation happens when parts of habitat are destroyed leaving behind unconnected areas. **[1]**
(ii) **Over-exploitation**: Over-exploitation refers to the overuse of natural resources. **[1]**
(iii) **Co-extinctions**: When a species becomes extinct, the plant and animal species associated with it in an obligatory way also become extinct. **[1]**

10. **[3]**
(i) Name and describe the technique that helps in the separation and isolation of DNA fragments.
OR
(ii) Study the diagram given below and answer the questions that follow.



(a) Name the cloning vector shown above. In which organism is this cloning vector inserted?
(b) Mention *any two* restriction sites shown in the diagram.
(c) Name *any two* selection markers shown in the diagram.

Answer:
(i) **Gel electrophoresis** is the technique that helps in the separation and isolation of DNA fragments. **[1]**

Steps involved in gel electrophoresis **[2]**
Step 1: DNA sample to be separated is loaded into the agarose gel, a natural polymer extracted from sea

weeds.

Step 2: Electric current is applied to the gel. Under the influence of the lectric field, the negatively charged DNA will migrate towards the positively charged electrode. The DNA fragments separate according to their size through the sieving effect provided by the agarose gel. Shorter strands of DNA move more quickly through the gel than longer strands resulting in the fragments being arranged in order of size, thereby getting separated.

Step 3: The eparated DNA fragments is visualised by staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation.

Step 4: The separated bands of DNA are then eluted and extracted from the agarose ge

OR

(ii)

(a) Cloning vector pBR322 is interested in Escherichia coli. **[1]**

(b) Hind III **[½]**

EcoR I **[½]**

BamH I

Sal I

Pvu II

Pst I

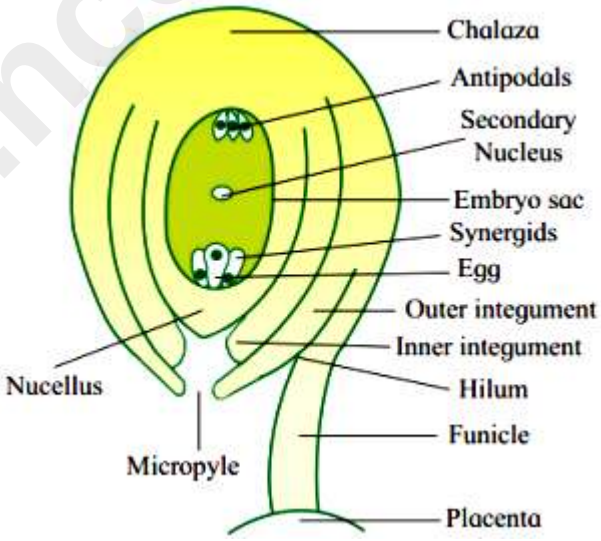
Cla I

(c) ampR **[½]**

tetR **[½]**

11. Draw a neat and well labelled diagram of L.S of an anatropous ovule. **[3]**

Answer:



[Diagram: 1 + Labelling: 2]

12. **[3]**

(i) Explain the process of sex - determination in grasshopper.

(ii) What is the genotype of Turner's Syndrome? Mention *any one* symptom of this syndrome.

Answer:

(i) Grasshopper is an example of **XO** type of sex determination.

[1/2]

Here males are homogametic with genotype XO , have only one X-chromosome besides the autosomes. One gamete produced has an X chromosome and the other gamete is without any chromosome O.

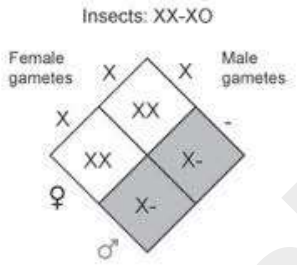
[1/2]

Whereas females are heterogametic with genotype XX, have a pair of X-chromosomes. All gametes are produced with X chromosome.

[1/2]

When two X gametes are combined it will be a female offspring and when there is only one X gamete, then the offspring produced will be a male.

[1/2]



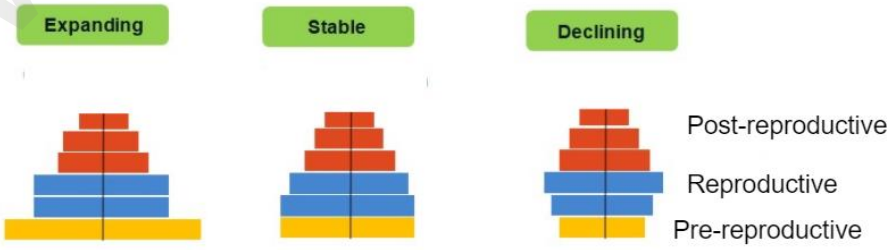
(ii) The genotype of Turner's Syndrome is **X0**. Here there is an absence of one of the X chromosomes. **[½]**

Symptoms of Turner's Syndrome includes: **[Any one: ½]**

- Particularly short, wide neck (webbed neck)
- Broad chest and widely spaced nipples
- Arms that turn out slightly at the elbows
- Low hairline
- Teeth problems
- Large number of moles
- Small, spoon-shaped nails
- Short 4th finger or toe

13. With the help of neatly labelled diagrams, explain the different types of age pyramids of human population. **[3]**

Answer:



There are three types of age pyramids of human population:

- When an age pyramid shows a broader base, that is, the number of individuals in the pre-reproductive and reproductive age groups are larger compared to the pre-reproductive age, which gives a triangular shape to the pyramid, then such type of age pyramid is said to be expanding. **[1]**

- When the number of individuals are more or less equal in all the age groups, it gives a bell shape to the pyramid, then such a type of age pyramid is said to be stable. **[1]**

- When the base of the pyramid is narrow with less number of individuals in the pre-reproductive age group, giving it an urn shape, this means that the age pyramid belongs to a declining type. **[1]**

14. The scientists from a research institute collected samples of water from sewage pipes of two different cities A and B. On analysis, the BOD value of the sample from city A was found to be 500 mg/L. The BOD value of the sample from city B was 200 mg/L. [3]

(i) Which one of the two cities needs the sewage treatment plant?
(ii) Briefly discuss the steps involved in the treatment of sewage.
(iii) What will be the effect of sewage treatment on the value of BOD?

Answer:

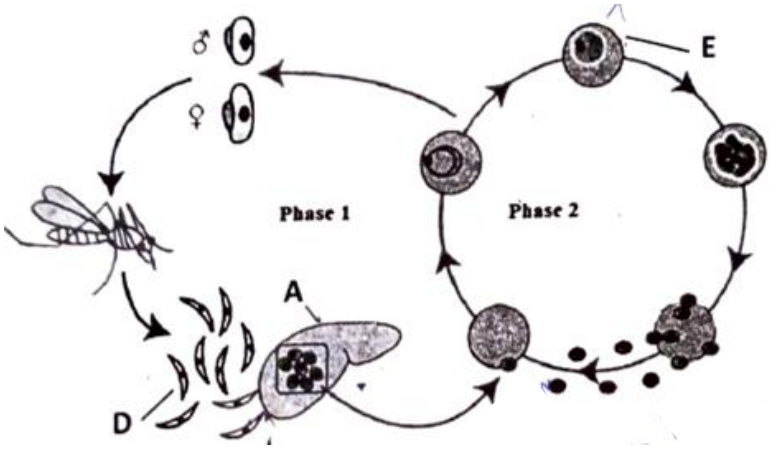
(i) Compared to city B, city A needs the sewage treatment plant as its BOD value is higher. The greater the BOD of sewage water, the more is its polluting potential. This is because the amount of organic matter present in the waste water from city B is higher and hence increases the amount of oxygen consumed by the bacteria. **[½]**

(ii) The sewage treatment consists of two main steps: **[2]**

- Primary treatment: Involves the physical removal of particles from the sewage through filtration and sedimentation.
    - Initially, floating debris is removed by sequential filtration.
    - Then, the soil and small pebbles are removed by sedimentation.
- Secondary treatment: The effluent from the primary settling tank is passed into large aeration tanks for secondary treatment. The constant mechanical agitation with the supply of air allows aerobic microbes to consume the major part of the organic matter in the effluent. This reduces the BOD of the effluent and is ready to be released into natural water bodies.
- Tertiary treatment: In this step, additional filtration is done to remove any wastes that are left after the secondary treatment.

(iii) Sewage treatment reduces the BOD value of the sewage water. **[½]**

15. The diagram given below shows the life cycle of a malarial parasite. Study it carefully and answer the questions that follow: [3]



(i) Name the hosts in which the asexual phase and sexual phase of the life cycle take place.
(ii) Identify the infective stage labelled 'D'.
(ii) Name the structures labelled 'A' and 'E'.
(iv) Give *any one* symptom of malaria.

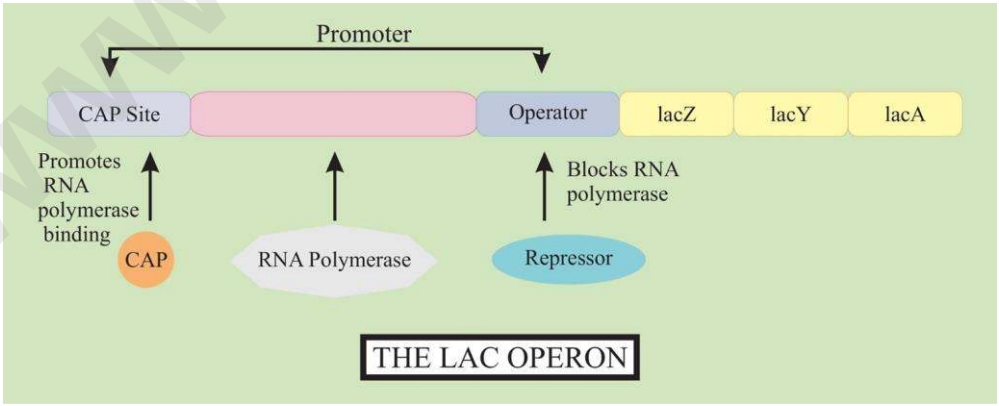
Answer:

(i) Asexual phase of the malarial parasite takes place in humans. **[½]**
Whereas, its sexual phase takes place in female Anopheles mosquito. **[½]**
(ii) The label D represents the infective stage called sporozoites. **[½]**
(ii) Label 'A' is the liver and label 'E' is a red blood cell. **[1]**
(iv) One of the malarial symptoms includes flu-like illness or chills and shivering. **[½]**

SECTION - D

16. Explain the components of the structural genes in the *Lac operon* system in *E. coli*. How does the operon function in the presence of lactose? [5]

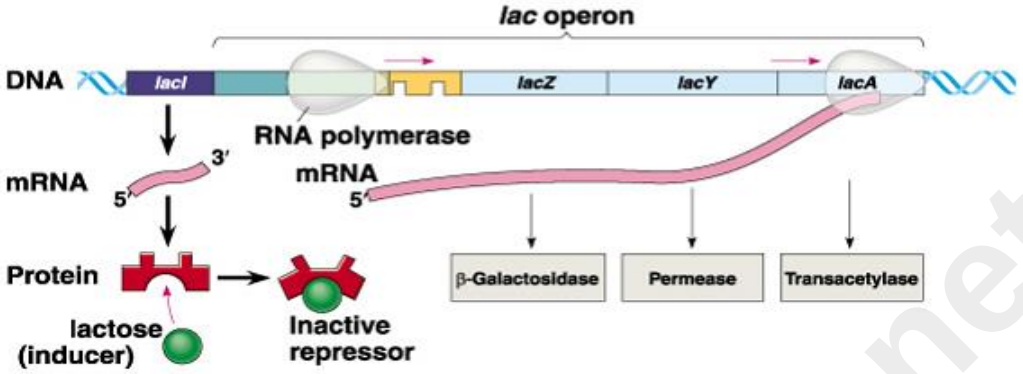
Answer:



Lac operon is composed of three structural genes:
(i) lacZ: Codes for β-galactosidase, which cleaves lactose into galactose and glucose. **[1]**
(ii) lacY: Codes for *lac* permease, which is a transmembrane protein that is necessary for lactose uptake.

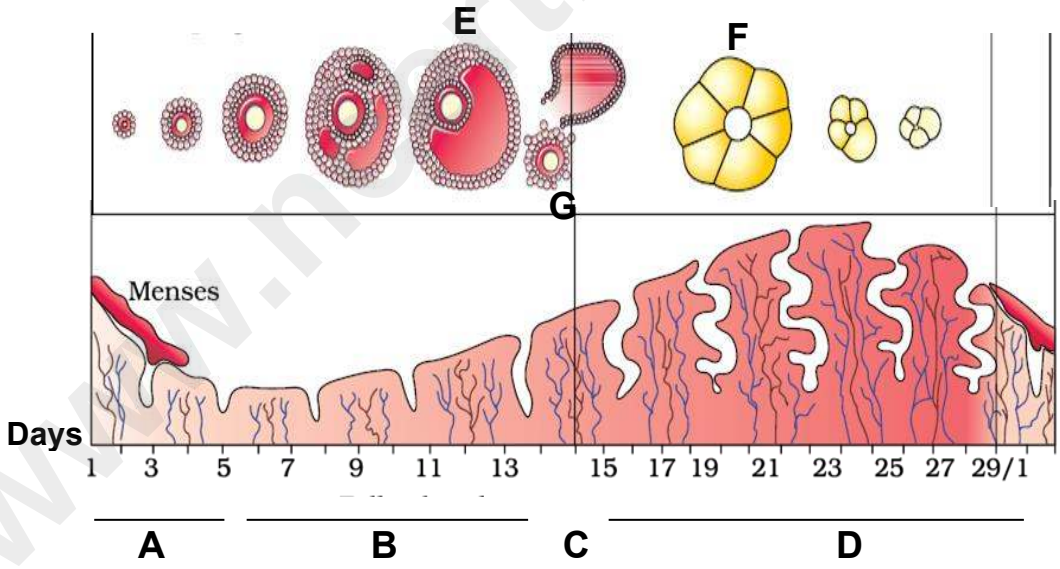
[1]

(iii) lacA: Codes for a transacetylase that transfers an acetyl group from coenzyme A to the hydroxyl group of galactosides. **[1]**



When lactose is present, it binds on to the repressor and inactivates it. That is, the repressor will not be able to bind on to the operator. As a result of this, the RNA polymerase can easily bind to the operator and translate the synthesis of proteins from the respective structural genes. **[2]**

17. Given below is the diagram depicting the menstrual cycle in human beings. Study it carefully and answer the questions that follow. [5]



(a) Which phases are indicated by "G and D?

(b) Name the structure labelled 'F' ? What is its role?

(c) Explain the changes in the level of progesterone during phases 'C' and 'D'.

(d) Which hormone present in the urine confirms pregnancy in human beings?

(e) Identify the structure labelled 'E'. Name the hormone released by it.

Answer:

(a) 'C' indicates ovulation phase and 'D' indicates Luteal phase. **[1]**

(b) Structure 'F' is Corpus luteum. It secretes progesterone hormone which is crucial for maintenance of the endometrium wall which is thickened by estrogen. **[1]**

(c) During phase C that is ovulation phase, the level of progesterone remains at zero. In luteal phase or D phase, corpus luteum is formed which secrete large amounts of progesterone hormone as a result it reaches its peak at this phase. **[1]**

(d) The confirmation of pregnancy in human beings is done by checking the presence of human chorionic gonadotropin (HCG) hormone in urine.

[1]

(e) Structure 'E' is Graafian follicle and it secretes hormone estrogen **[1]**

OR

According to a survey conducted by the Government of India in the year 1950, the population of the country was 350 million. In the next survey conducted in the year 2010, the population had reached above 1000 million **[5]**

(a) List any two reasons for this rise in the population.

(b) Suggest any two steps which should be taken by the Government to control this rise.

(c)How does the population explosion affect the growth of a country?

(d) What is the difference between the natural and artificial contraceptive methods? Give one example of each method.

Answer:

(a) Two reasons for rise in population between 1950 and 2010 in India are as follows:

- A rapid decline in death rate, maternal mortality rate (MMR) and infant mortality rate (IMR). **[½]**
- Increase in the number of people in reproducible age. **[½]**

(b) Two steps that government should take to control the rising population are:

- Motivate smaller families by using various contraceptive methods and incentives given to couples with small families. **[½]**
- Statutory raising of the marriageable age of the female to 18 years and that of males to 21 years. **[½]**

(c) **Population explosion**: Sudden increase in the number of individuals in a specific area in a given time is called population explosion.

Population explosion results in: (any two) **[1]**

- Mass unemployment
- High consumption by individuals results in rapid depletion of natural resources.

- Reduces countries growth and development.

(d) **[2]**

Natural Contraceptive Method	Artificial Contraceptive Method
It works on the principle of avoiding chances of ovum and sperms meeting without the use of any drug or synthetic materials. Example: **Withdrawal or coitus interruptus** is another method in which the male partner withdraws his penis from the vagina just before ejaculation so as to avoid insemination.	Here, synthetic barriers or chemical/drugs are used to prevent the meeting of sperm and ova, production of sperm/ova or implantation or kill the sperm when in the female reproductive tract. Example: Condoms which is a barrier method which blocks the entry of sperm in the female reproductive tract.

18. Describe the mechanism of decomposition by explaining the various processes involved in it. [5]

Answer:

The breakdown of complex organic matter into inorganic substances like carbon dioxide, water and nutrients is called decomposition.

Steps of decomposition:

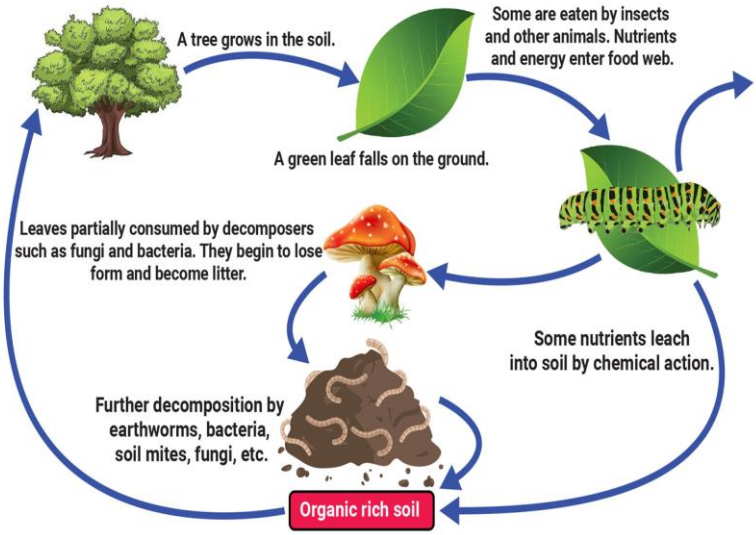
(i) **Fragmentation**: Breakdown of detritus (raw materials that are to be decomposed) into smaller particles is called fragmentation. **[1]**

(ii) **Leaching**: In this step, water- soluble inorganic nutrients go down into the soil and become salts. **[1]**

(iii) **Catabolism**: Is the process by which bacterial and fungal enzymes convert detritus into simple inorganic substances. **[1]**

(iv) **Humification** is the accumulation of a dark-coloured amorphous substance called **humus** in the soil. It acts as a reservoir of nutrients. **[1]**

(v) **Mineralisation**: The release of inorganic nutrients into soil from degradation of the humus is called mineralisation. **[1]**



Decomposition cycle in a terrestrial ecosystem