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Biology

12

Model Question Papers

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Model Solved Question Paper- 4

Biology

Part-I

Bio-Botany

Section-I

8 x1=8

Answer all the questions

Choose the most suitable answer from the given four alternatives and write the option code with corresponding answer

1. Pure line breed

a) *Homozygosity* b) *Heterozygosity* c) *Offspring* d) *Hybrids*

2. Match the following and choose the correct combination from the options given below:

Column I (Interaction)	Column II (Examples)
I. <i>Mutualism</i>	i) <i>Trichoderma and Penicillium</i>
II. <i>Commensalism</i>	ii) <i>Balanophora, Orobanche</i>
III. <i>Parasitism</i>	iii) <i>Orchids and Ferns</i>
IV. <i>Predation</i>	iv) <i>Lichen and Mycorrhiza</i>
V. <i>Amensalism</i>	v) <i>Nepenthes and Dionaea</i>

a) I - i, II - ii, III - iii, IV - iv, V - v b) I - ii, II - iii, III - iv, IV - v, V - i
c) I - iii, II - iv, III - v, IV - i, V - ii d) I - iv, II - iii, III - ii, IV - v, V - i

3. At what stage of prophase I, is the intimate pairing between two homologous chromosomes initiated?

a) *Leptotene* b) *Diplojene* c) *Pachytene* d) *Zygotene*

4. Consider the following statements:

I. Recombinant DNA technology, popularly known as genetic engineering, is a stream of biotechnology which deals with the manipulation of genetic materials by man invitro

II. pBR322 is the first artificial cloning vector developed in 1977 by Boliver and Rodriguez from *E. coli* plasmid

III. Restriction enzymes belong to a class of enzymes called nucleases.

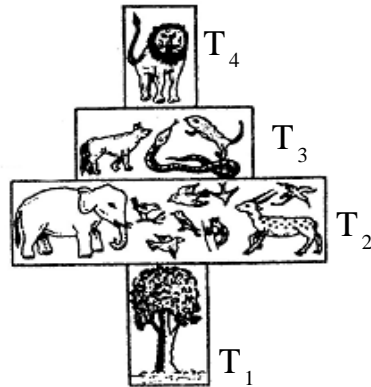
Choose the correct option regarding above statements

- a) I & II b) I & III c) II & III d) I, II & III

5. Match the following:

- | | |
|-----------------------------------|-----------------------------------|
| a. <i>Prosopis juliflora</i> | - i. Protein bank |
| b. <i>Robinia pseudoacacia</i> | - ii. Endemic plant |
| c. <i>Acacia nilotica</i> | - iii. Plant indicator |
| d. <i>Hardwickia binata</i> | - iv. Invasive species |
| a) a - ii, b - iv, c - iii, d - i | b) a - iv, b - iii, c - i, d - ii |
| c) a - iii, b - ii, c - iv, d - i | d) a - i, b - iii, c - ii, d - iv |

6. The following diagram represents



- a) Pyramid of number in a grass-land ecosystem
 b) Pyramid of number in a pond ecosystem
 c) Pyramid of number in a forest ecosystem
 d) Pyramid of biomass in a pond ecosystem

7. Match Column I with Column II

Column I	Column II
i) William S. Gaud	I) Heterosis
ii) Shull	II) Mutation breeding
iii) Cotton Mather	III) Green revolution
iv) Muller and Stadler	IV) Natural hybridization

- a) i - I, ii - II, iii - III, iv - IV b) i - III, ii - I, iii - IV, iv - II
 c) i - IV, ii - II, iii - I, iv - III d) i - II, ii - IV, iii - III, iv - I

8. The Latin word 'puls' means

- a) Thick oil b) Thick soup c) Thin oil d) Thin soup

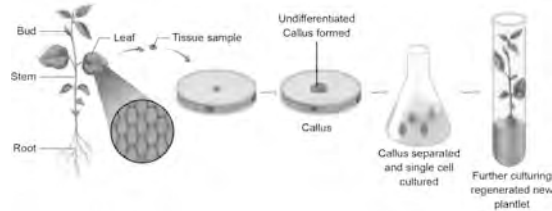
Section-II

4 x 2 = 8

Answer any four from the following questions

9. A detached leaf of *Bryophyllum* produces new plants. How?
 10. What is the difference between missense and nonsense mutation.
 11. List out the microorganisms utilized to produce different types of PHA.
 12. Define epiphytes. Give examples.

13. What is the name of the process given below? Write its four types.



14. Define afforestation

Section-III

3 x 3 = 9

Answer any three from the following questions

Question No. 19 is compulsory

15. What is the cross done to determine whether a tall plant is homozygous or heterozygous genotype? Write a note on it.
16. Write the benefits and risk of genetically modified foods.
17. What are the effects of temperature on the physiological processes?
18. What is autogenic succession?
19. **Who devoted his life at the international maize and wheat improvement centre at Sonord in Mexico? Write notes about him.**

Section-IV

2 x 5 = 10

Answer all questions

20. a. Explain the mechanism of crossing over. (OR)
b. Describe the protoplast culture.
21. a. Enumerate the anatomical adaptations of xerophytes. (OR)
b. Explain the mechanism of decomposition.

Bio-Zoology

Section-I

8 x 1 = 8

Answer all the questions

Choose the most suitable answer from the given four alternatives and write the option code with corresponding answer

1. The mode of reproduction in bacteria is by
a) *Formation of gametes* b) *Endospore formation*
c) *Conjugation* d) *Zoospore formation*
2. A person of AB negative blood group met with an accident and is in need of blood transfusion. Which blood group is not safe to be administered to this person?
a) *AB negative* b) *A negative* c) *O negative* d) *O positive*

3. What is the basis for the difference in the synthesis of the leading and lagging strand of DNA molecules?
- Origin of replication occurs only at the 5' end of the molecules.*
 - DNA ligase works only in the 3'→5' direction.*
 - DNA polymerase can join new nucleotides only to the 3' end of the growing strand.*
 - Helicases and single-strand binding proteins that work at the 5' end.*
4. Drug which accelerates the activity of the brain
- Nicotine*
 - Alcohol*
 - Opium*
 - Morphine*
5. _____ produced by the bacterium *Streptococcus* is used as 'clot buster'
- Streptococciase*
 - Streptocynaise*
 - Streptokinase*
 - Streptolipase*
6. Match the correct answer from the following
- | | |
|---------------------|-------------------------------------|
| 1. Insulin | - A) Eva Engvall and Peter Perlmann |
| 2. Gene therapy | - B) Ian Wilmut and Campbell |
| 3. ELISA | - C) Best and Banting |
| 4. Cloning of Dolly | - D) French Anderson |
- 1-A 2-C 3-B 4-D*
 - 1-C 2-D 3-A 4-B*
 - 1-D 2-B 3-C 4-A*
 - 1-B 2-A 3-D 4-C*
7. What happens to the temperature and density of oxygen as altitude increases?
- Temperature and density of oxygen decreases.*
 - Temperature increases and density of oxygen decreases.*
 - Temperature decreases and density of oxygen increases.*
 - Temperature and density of oxygen increases.*
8. Conservation of biodiversity within their natural habitat is
- In-situ conservation*
 - Ex-situ conservation*
 - In vivo conservation*
 - In vitro conservation*

Section-II

4 x 2 = 8

Answer any four from the following questions

- Distinguish between heterogametic and homogametic sex determination systems.
- How is juvenile phase different from reproductive phase?
- What is paleontology? Mention its importance.
- Give any two bioactive molecules produced by microbes and state their uses.
- Gene therapy is an attempt to correct a genetic defect by providing a normal gene into the individual. By this, the function can be restored. An alternate method would be to provide gene product known as enzyme replacement therapy,

which, would also restore the function. Which, in your opinion is a better option? Give reasons for your answer.

14. What does AQI stand for?

Section-III

3 x3=9

Answer any three from the following questions

Question No. 19 is compulsory

15. How is polyspermy avoided in humans?

16. The males, whose testes fail to descend to the scrotum, are generally infertile. Why?

17. What is diapause?

18. Differentiate natality and mortality.

19. Where are the bio-diversity hot spots normally located? Why?

Section-IV

2 x5=10

Answer all questions

20. a. i) What is a transcription unit in DNA? What are its components? State their functions.

ii) Why the human genome project is called a mega project? (OR)

b. In a population, 'M' allele has a frequency of 0.6 and 'm' allele has a frequency of 0.4. Estimate the genotype frequency using Hardy -Weinberg equation.

21. a. What are the factors that drive habitat loss? (OR)

b. What is "Biomagnification"? Explain.

Answers

Bio-Botany

Section-I

1. a) *Homozygosity*

2. d) I - iv, II - iii, III - ii, IV - v, V - i

3. d) *Zygotene*

4. d) I, II & III

5. b) a - iv, b - iii, c - i, d - ii

6. c) *Pyramid of number in a forest ecosystem*

7. b) i - III, ii - I, iii - IV, iv - II

8. b) *Thick soup*

Section-II

9. **Production of New Plant from Detached Leaf**

1. *Bryophyllum* has **adventitious buds** at the leaf notches in the margin. These adventitious buds are called

epiphyllous buds.

2. When the detached leaf gets decayed, the adventitious buds form a **root system**.

3. Then, they become **independent** plants.

10.

Missense Mutation	Nonsense Mutation
1. Codon for <i>one amino acid</i> is changed into a codon for <i>another amino acid</i> .	1. Codon for <i>one amino acid</i> is changed into a <i>termination</i> or <i>stop</i> codon.
2. New codon encodes a <i>different amino acid</i> .	2. New codon leads to <i>premature termination</i> of <i>translation</i> .

11. Microorganisms that Produce PHA

Gram-positive Bacteria

- *Bacillus megaterium*
- *Bacillus subtilis*
- *Corynebacterium glutamicum*

Gram-negative Bacteria

- *Pseudomonas sp.*
- *Alcaligenes eutrophus*

12. Epiphytes

The plants which are found *growing on other plants without harming them*.

Examples

- *Vanda*
- *Peperomia*

- *Usnea*
- *Orchids*
- *Lianas*
- *Money plant*

13. Name of the Process

Plant Tissue Culture

Types

1. Organ culture
2. Meristem culture
3. Protoplast culture
4. Cell culture

14. Afforestation

It is *planting of trees*, where there was *no previous* tree coverage. The conversion of *non-forested lands* into forests by planting suitable trees.

Section-III

15. Cross to Determine Tall plant is Homozygous or Heterozygous

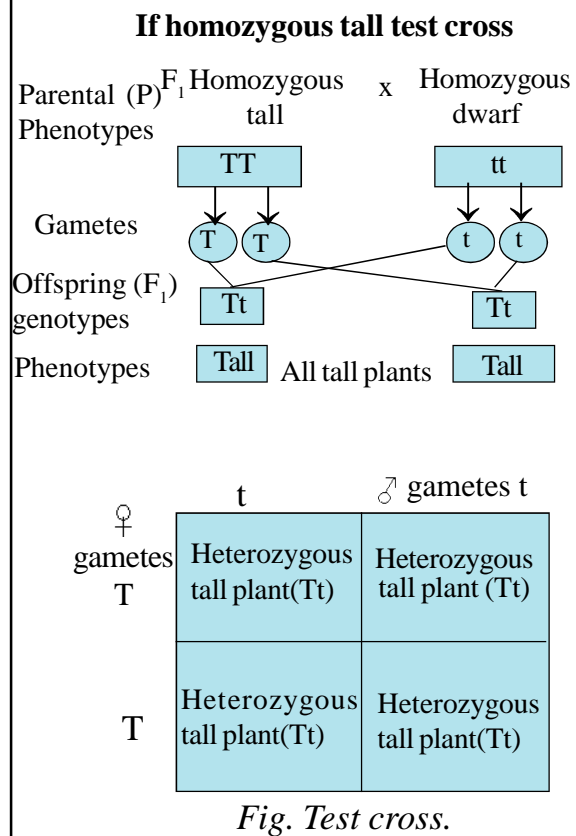
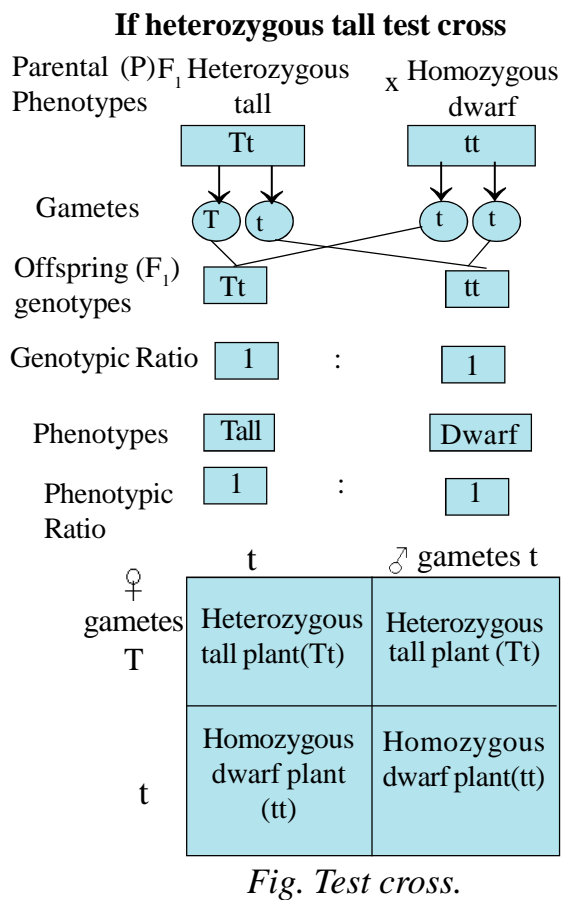
Test cross is the cross done to determine the genotypes of tall plant.

Test Cross

- ❖ It is a *cross* between *unknown genotype* (F_1 tall plant) and *homozygous recessive dwarf parent* (tt).
- ❖ The *unknown genotype* of the *tall plant* may be,
 - ☞ *TT* or *Homozygous dominant*
 - ☞ *Tt* - *Heterozygous*
- ❖ When the *unknown tall plant* is

crossed with the *dwarf parent*, two types of *results* are possible.

1. 50% tall : 50% dwarf - 1:1
 2. 100% tall - All tall plants
- ❖ When 50% of the *offspring* are *tall* and the other 50% of the offspring are *dwarf* in the 1:1 ratio, the unknown plant is heterozygous tall (Tt). This cross is **Heterozygous tall test cross**.
 - ❖ When all the *offspring* (100%) are *tall*, the unknown plant is homozygous tall (TT). This cross is **Homozygous tall test cross**.



16. Benefits of Genetically Modified Foods

1. **High yield**
2. 70% **reduction of pesticide** usage.
3. **Reduce soil pollution** problem.
4. **Conserve microbial population** in the soil.

Risks of genetically modified foods

1. Affect **liver** and **kidney function**.
2. Cause **cancer**.
3. Hormonal **imbalance**.
4. Physical **disorder**.
5. **Anaphylactic shock**-Sudden hypersensitive reaction.
6. **Adverse effect** in immune system.
7. **Loss of viability** of seeds.

17. Effects of Temperature on the Physiological Processes

1. The **enzymatic action** of all the **biochemical reactions** in a plant body is affected.
2. It influences **CO_2** and **O_2 solubility** in the biological systems.
3. It **increases respiration**.
4. It **stimulates** growth of the **seedlings**.
5. **Low temperature with high humidity** can spread **diseases** to plants.
6. The **varying temperature with moisture** determines the distribution of the **vegetation types**.

18. Autogenic Succession

The vegetation reacts with its environment and modifies its own environment; it causes its own replacement by new communities.

a) It occurs due to **biotic factors**

b) Example: **Forest ecosystem.**

✧ The **larger trees produce broader leaves.**

✧ They provide **shade to the forest floor area.**

✧ The shade **affects heliophytes** which require more light.

✧ **Heliophytes** include **shrubs and herbs.**

✧ The **shade support sciophytes**, the shade tolerant species, to grow well.

19. Plant Pathologist - International Maize and Wheat Improvement Centre
Norman E Borlaug

1. Plant pathologist
2. Plan breeder
3. He devoted his life at the **international maize and wheat improvement centre.**

4. This centre located at Sonord in **mexico**

5. He developed the following dwarf wheat varieties;

◆ *Norin - 10* ◆ *Sonora - 64*

◆ *Lerma rojo-64 etc*

6. They have the following characteristics

◆ *High yielding*

◆ *Non-lodging*

◆ *Rust resistance*

7. This formed the base for "**green revolution**".

8. He was awarded a **Nobel prize** for peace in 1970.

Section - IV**20. a. Mechanism of Crossing Over**

Crossing over is the biological process that produces new combination of genes by interchanging the corresponding segments between non-sister chromatids of homologous pair of chromosomes.

It involves the following stages:

1. *Synapsis*
2. *Tetrad formation*
3. *Cross over*
4. *Terminalization*

1. Synapsis

✧ It is the **intimate pairing** between two **homologous chromosomes.**

✧ It is initiated during **zygotene stage** of **prophase I** of **meiosis I.**

✧ **Homologous chromosomes** are aligned side by side.

✧ It results in a pair of homologous chromosomes called **bivalents.**

2. Tetrad Formation

• Each homologous chromosome of a bivalent begin to form two **identical sister chromatids.**

- These sister chromatids **remain together**.

- They are attached to the **centromere**.
- Each, bivalent has **four chromatids**.

Hence, this stage is called **tetrad stage**.

3. Cross Over

- Crossing over occurs in **pachytene stage**.

- **Non-sister chromatids** of homologous pair make contact at **one or more points**.

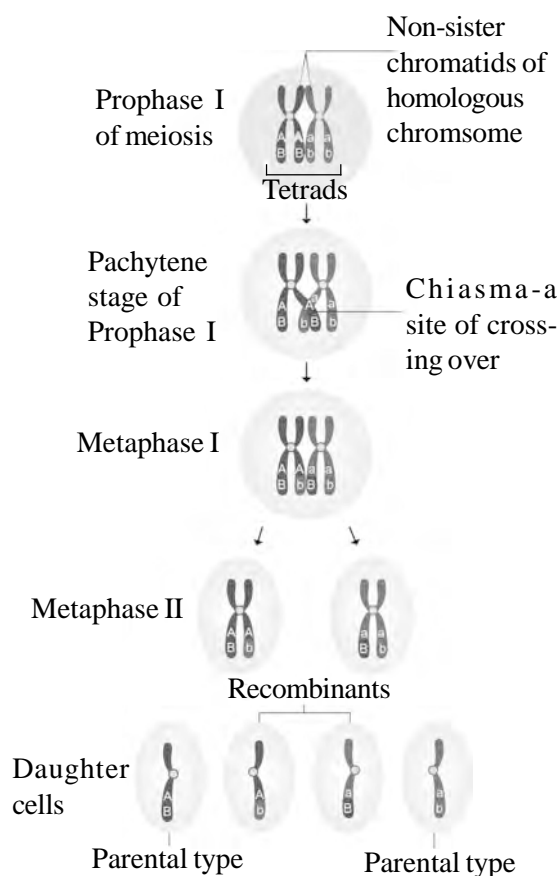


Fig. Mechanism of crossing over.

- These points are called **chiasmata**.
- **X-shaped** or **cross-shaped** structures are formed at **chiasmata**.

- **Breaking and rejoining** of two **chromatids** occur.

- This results in **reciprocal exchange** of **equal** and **corresponding segments** between them.

4. Terminalization

- After crossing over, **chiasma** moves towards the **terminal** end of chromatids.

- **Complete separation** of homologous **chromosomes** occurs.

b. Protoplast Culture

The culture of the protoplast in culture medium in vitro is called protoplast culture.

- Protoplasts are cells **without a cell wall** but **bounded by a cell membrane or plasma membrane**.

- It is possible to **regenerate whole plants** from single cells. It develops **somatic hybrids**.

Steps

1. Isolation of protoplast
2. Fusion of protoplast
3. Culture of protoplast
4. Selection of somatic hybrid cells

1. Isolation of Protoplast

1. A leaf is collected.
2. It is **washed** in running tap water.
3. It is **surface sterilized**.
4. Epidermis is **peeled**.
5. Peeled segments are **plasmolysed**.
6. The plasmolysed cells are immersed in the following dissolved in 13% **sorbitol** or **mannitol** at 5.4pH.
 - Macrozyme -0.5%
 - Onozuka cellulase enzyme-2%

7. **Incubated** over-night at **25° C**.
8. The cells are teased gently to obtain **protoplasts**.
9. This is followed by **centrifugation**.
10. The debris is collected.
11. It is washed to get protoplasts.
12. Then the protoplasts are transferred to **20% sucrose** solution to retain their viability.
13. It is **centrifuged** to get pure protoplast.

2. Fusion of Protoplast

- 1) **Polyethylene Glycol-PEG** is a **Fusogen**
- 2) Isolated protoplast is **incubated** in **25 to 30%** of **PEG**
- 3) PEG is added with **Ca⁺⁺ ion**.
- 4) The protoplast shows **agglutination - the formation of clumps of cells**
- 5) It is followed by **fusion** of protoplasts.

3. Culture of Protoplast

1. The **viability** of the protoplast is tested with **fluorescein diacetate**.
2. **Viable protoplast** is used for the protoplast culture.
3. It is culture by
 - ☞ **Droplet** technique or
 - ☞ **Plating** technique or
 - ☞ **Micro-drop array** technique
4. **MS liquid medium** is used as a culture medium.
5. The cultures are incubated at
 - * **25°C**
 - * In **1000-2000 lux** continuous light.
6. The **cell wall** formation occurs within **24-48 hours**.
7. The **new cells** start forming between **2-7 days** of culture.

4. Selection of Somatic Hybrid Cells

1. The **fusion of protoplast** occurs.

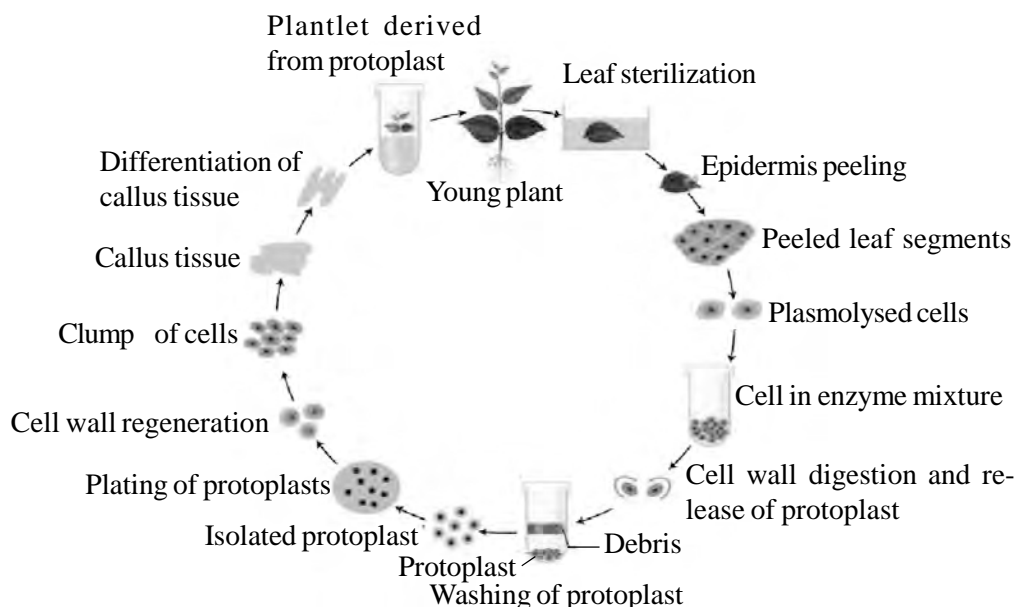


Fig. Protoplast culture.

2. The fusion product of protoplasts without nucleus of different cells is called a *cybrid*.

3. This is followed by *nuclear fusion*.

4. This process is called *somatic hybridization*.

5. A clump of *somatic hybrid cells* are formed.

6. The hybrid cell multiplies to form a mass or unorganised cells or tissue called *callus*.

7. The callus grows in the culture medium with *auxin* and *cytokinin*.

8. The callus differentiates to form embryos called **embryoids**.

9. The formation of embryos is called **embryogenesis**.

10. The embryos are sub-cultured to produce *plantlets*.

12. The plantlets are transferred to *green house* or *hardening chamber*.

13. Then the plantlets are transferred to *field*.

21. a. Anatomical Adaptations of Xerophytes

1. Presence of *multi-layered epidermis*.

2. *Heavy cuticle* to prevent water loss due to transpiration.

3. *Hypodermis* is well developed with *sclerenchymatous tissues*.

4. *Sunken shaped stomata* is present only in the lower epidermis.

5. *Hairs* are present in the sunken pits.

6. *Scotoactive* (stomata open in dark) stomata is present in succulent plants.

7. *Vascular bundles* are well developed.

8. *Bundle sheath* is many layered.

9. *Mesophyll* is well differentiated into *palisade* and *spongy parenchyma*.

10. A *water storage* region is present in *succulent stems*.

b. Mechanism of Decomposition

1) In decomposition *detritus* is broken down into *simpler organic matter* by *decomposers*.

2) It is mediated by *enzymatic reactions*.

3) *Detritus* acts as a *raw material* for decomposition.

4) *Microbes* do the decomposition.

5) It occurs in the following steps:

- i. Fragmentation
- ii. Catabolism
- iii. Leaching or Eluviation.
- iv. Humification
- v. Mineralisation.

i) Fragmentation

The breaking down of *detritus* into smaller particles by *detritivores* is called *fragmentation*.

* It is caused by *detritivores* like

- Bacteria
- Earthworm
- Fungi

* *Detritivores* secrete certain substances to

▪ *Enhance* the process of *fragmentation*.

▪ *Increase the surface area of detritus particles*.

ii) Catabolism

The *breakdown* of *complex organic* and *inorganic* compounds into *simpler forms*.

This is caused by the *extracellular enzymes* produced by *decomposers*.

iii) Leaching

The movement of decomposed, water soluble organic and inorganic compounds from surface to the lower layer of soil.

- ♦ Also called *Eluviation*
- ♦ The water soluble *organic* and *inorganic* compounds are carried by water.

iv) Humification

♦ *Simplified detritus is changed into dark coloured amorphous substance called humus.*

- ♦ Humus is *resistant to microbial action*.
- ♦ Thus, decomposition is very *slow*.
- ♦ It is the *reservoir of nutrients*.

v) Mineralisation

Release of inorganic nutrients from the humus of the soil by microbes.

Bio-Zoology

Section - I

1. c) Conjugation
2. d) O positive
3. c) *DNA polymerase can join new nucleotides only to the 3' end of the growing strand.*
4. a) *Nicotine*

5. c) *Streptokinase*
6. b) 1 - C 2 - D 3 - A 4 - B
7. a) *Temperature and density of oxygen decreases.*
8. a) *In-situ conservation*

Section - II

9.

Heterogametic Sex Determination System	Homogametic Sex Determination System
1. Sex chromosomes are <i>dissimilar</i> . 2. <i>Two types</i> of gametes are produced.	Sex chromosomes are <i>similar</i> . Only <i>one</i> type of gamete is produced.

10.

Juvenile Phase	Reproductive phase
1. It is the period of growth between <i>birth</i> and <i>reproductive maturity</i> of an individual. 2. The organisms <i>are not capable of reproduction</i> 3. This phase is also called <i>vegetative</i> phase	It is the period during which an <i>organism reproduces</i> and its offspring reach <i>maturity period</i> Organisms <i>reproduce</i> This phase is also called <i>maturity</i> phase

11. Paleontology

Paleontology is the *study* of *prehistoric life* through fossils.

Importance

1. Fossils are described as the true *witnesses* of evolution or documents of various *geological strata* of evolution.

2. Coprolites help in identifying the *nature of diet* of pre-historic animals.

12. Bioactive Molecules

1. Rennet
2. Lipases

Uses of Rennet

1. Rennet is an *enzyme*.
2. It is used in the *curdling* of *milk* in *cheese production*.

Uses of Lipases

1. Lipases are **enzymes**.
2. They are used in the formulation of **detergents**.
3. They remove *oily stains* from laundry.

13. Genetic Defect - Better Option

Gene therapy is better option than enzyme replacement therapy.

Reasons

- * Gene therapy is a *permanent corrective* therapy.
- * The patient is *cured permanently*.
- * In enzyme replacement therapy, patient needs *frequent injection* of enzyme.
- * It *does not offer permanent cure* and is *highly expensive*.

14. AQI

1. AQI is "*Air Quality Index*".
2. It is the number used by government agencies to communicate to the public about *air pollution*.
3. *0 to 50* score is considered to be good.
4. *51 to 100* is *moderate*.
5. *101 to 150* is unhealthy for sensitive group.
6. *151 to 200* means unhealthy.
7. *201 to 300* is very unhealthy.
8. *301* is Hazardous.

Section-III**15. Prevention of Polyspermy**

1. Polyspermy is fertilization of an egg by more than *one sperm*.

2. To prevent polyspermy, the *cortical granules*, from the *cytoplasm* of the ovum, form a *fertilization membrane*.

3. This membrane acts as a *barrier*.

4. This barrier prevents penetration of *other sperms*. Thus, polyspermy is prevented.

16. Failure of Testes to Descend

- Sperm production needs *optimum temperature* of testis.

- It should be *lower* than *body* temperature.

- If testes *fail* to descend to scrotum, the *temperature* of *testis* would be *same* as that of *body temperature*.

Due of this, *sperm production* will be *affected*.

• Hence the person becomes *infertile*.

17. Diapedesis

1. The *leakage* of vascular fluid from the *capillaries*. The fluid contains *chemotactic signals* like *serotonin*, *histamine* and *prostaglandins*.

2. This results in the *influx* of the *phagocytic cells* into the affected area.

3. It is induced by *tissue damage* and *infection*.

4. It is an *inflammatory barrier* in *innate immunity*.

18. Natality Vs Mortality

No	Natality	Mortality
1.	It is the production of <i>new individuals</i> in unit time.	It is the <i>loss of individuals</i> in unit time.
2.	Population <i>increase</i> .	Population <i>decrease</i> .
3.	It is equivalent to <i>birth rate</i> .	It is equivalent to <i>death rate</i> .
4.	It is expressed as <i>crude birth rate</i> .	It is expressed as <i>specific mortality</i> .
5.	It is the <i>number of organisms</i> born per female <i>per unit time</i> .	It is the number of <i>members</i> of an <i>original population</i> dying after the lapse of a given time.
6.	$\text{Birth rate}(b) = \frac{\text{Number of birth}}{\text{Average population}} \text{ per unit time}$	$\text{Death rate}(d) = \frac{\text{Number of deaths}}{\text{Average population}} \text{ per unit time}$

19. Bio-diversity Hot Spots - Location

1. The biodiversity hot spots are normally located in areas with high concentration of *endemic species*.

2. The area experiencing *unusual rapid* rate of *habitat modification loss*.

3. “Regions that harbour *great diversity* of endemic species-Norman Myers.

4. The areas that have been significantly

impacted and *altered* by *human activities*”-Norman Myers

5. A region that supports *1500 endemic* vascular plant. This is *0.5%* of the global total species

6. The area that has lost *more than 70%* of its original vegetation.

Reasons

1. Habitat loss
2. Anthropogenic activities

Section - IV

20. a. (i) Transcription Unit

1. It is a sequence of nucleotides in DNA that transcribes a single RNA.

2. It includes a linear sequence of DNA such as

- > Promoters
- > Structural gene

➤ Terminators.

Components of Transcription Unit

1. Promoter
2. Structural gene
3. Terminator

Transcription start site

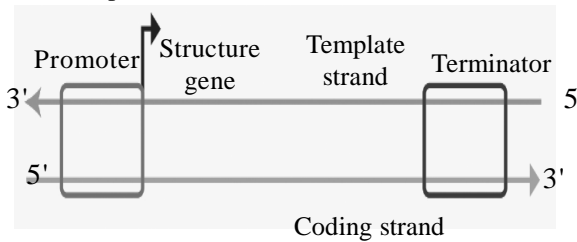
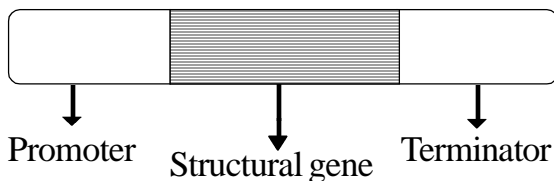
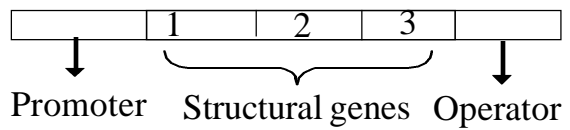


Fig. Structure of a transcription unit. Promoter has a *start site*.

Eukaryote has **one structural gene** in each transcription unit. It is called **monocistronic**.



Prokaryote has **many structural genes**. They are called **polycistronic**.



Functions

1. Promoter provides **binding** site for **RNA polymerase**.
2. **Promoter** region defines the **template** strand.
3. Start site **initiates** transcription.
4. **Structural** genes code for **mRNA** and **proteins**.
5. **Terminator** marks the **end** of a **gene**. It causes the **RNA polymerase** to **stop transcribing**.

(ii) Human Genome Project - A mega Project

1. The project was aimed to **identify all** the **genes** (about 30000) in human DNA.
2. Human genome has approximately **3×10^9 bp**.
3. Human genome is about **25 times larger** than the genome of other organisms.
6. It has taken **13 years** to complete this project.

b. Genotype Frequency using Hardy - Weinberg equation

$$\text{Hardy-Weinberg equation} = (p + q)^2 = p^2 + 2pq + q^2$$

$$\text{Frequency of M allele } p = M = 0.6$$

$$\text{Frequency of m allele } q = m = 0.4$$

$$\begin{aligned} \text{Frequency of the genotype MM} &= p^2 \\ &= (0.6)^2 = 0.36 \\ &= 36\% \end{aligned}$$

$$\begin{aligned} \text{Frequency of the genotype Mm} &= 2pq \\ &= 2(0.6)(0.4) \\ &= 2 \times 0.24 = 0.48 \\ &= 48\% \end{aligned}$$

$$\begin{aligned}
 \text{Frequency of the genotype mm} &= q^2 \\
 &= (0.4)^2 \\
 &= 0.4 \times 0.4 &= 0.16 \\
 &= 16\%
 \end{aligned}$$

$$\text{Ans: } MM = 36\%, \quad Mm = 48\%, \quad mm = 16\%$$

21. a. Factors that drive Habitat Loss

1. Development of *human* society
2. Human *settlement*
3. *Agriculture*
4. *Mining*
5. Construction of *industries*
6. Construction of *highways*
7. *Over* population
8. *Urbanization*
9. *Industrialization*
10. *Agricultural* advancements require more lands
11. *Water* and *raw materials* require more lands
12. *Wetlands*
13. *Ploughing* grasslands
14. Cutting down *trees*
15. Desilting *rivers*
16. Caving *mountains*
17. *Ore* extraction
18. Changing the course of *rivers*
19. Filling of *seashore*
20. Destruction of *forest*.

b. Biomagnification

“**Biomagnification**” is the *increased concentration* of *non-degradable* substances at *successive trophic levels* in the food chain.

Explanation

1. The non-degradable substances are
 - ☞ *Lead* ☞ *Cadmium*
 - ☞ *Mercury* ☞ *DDT*
2. This phenomenon of biomagnification is well established *in mercury* and *DDT*.
3. These substances do not get
 - ☞ *Metabolized* ☞ *Expelled*
 - ☞ *Broken down*
4. Instead, they get *transferred* up the trophic levels.
5. This results in *enhanced concentration* of these substances.
6. Biomagnification of DDT in aquatic food chain shows *concentration of DDT enhanced almost 10 times* at successive trophic levels from producer to top consumer.
7. This results in *increased toxicity* and may even *be lethal*.

