



# Competency Based Pedagogical Practice in Teaching of **Biology**

## **TWO Days Workshop for PGT Biology of KVS RANCHI Region**

# The workshop is equivalent to 10 hours of Inhouse Training as part of 25-hour CPD inhouse training requirement.

# **Competency Based Pedagogical Practice in Teaching of Biology**

**Two Days Workshop**

**For**

**Post Graduate Teachers in Biology.**

**Kendriya Vidyalaya Sangathan**

**Regional office Ranchi**

**16<sup>th</sup> – 17<sup>th</sup> October 2023**

**Venue: Kendriya Vidyalaya Hinoo, Ranchi**

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# From Desk of Deputy Commissioner

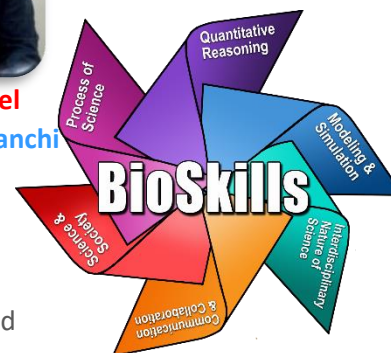
## RATIONALE OF WORKSHOP



Sri D P Patel

DC, KVS RO Ranchi

# Competency Based Teaching: Need of 21<sup>st</sup> Century



The NEP 2020 calls for a 'shift from [an assessment system] that is summative and primarily tests rote memorization skills to one that is more regular and formative, is more competency-based, promotes learning development for our students, and tests higher-order skills, such as analysis, critical thinking and conceptual clarity.

A student-centered method of instruction called competency-based teaching (CBT) concentrates on helping students acquire certain knowledge and abilities. Learners in competency-based teaching (CBT) advance at their own speed and are evaluated based on their capacity to exhibit material comprehension. Teaching which uses a CBE methodology works to empower students and provide them with a meaningful and positive learning experience. It places the learner at the center and actively engages them in the learning process. It emphasizes real-world applications of knowledge and skills and the authenticity of the learning experience.

Kendriya Vidyalayas are known for their high academic standards and holistic approach to education. KVS teachers use a variety of teaching methods and learning activities to implement CBT in their classrooms. Some common CBT teaching methods include:

**Inquiry-based learning:** Students are encouraged to ask questions and explore concepts on their own.

**Project-based learning:** Students work on projects that require them to apply their skills and knowledge to real-world problems.

**Differentiated instruction:** Teachers tailor instruction to the individual needs of each student.

In the subject of Biology, CBT plays a vital role. It helps the learners in varieties of ways including :

**Increased student engagement:** Students are more likely to be motivated when they are working towards specific goals and see that their learning is relevant to their lives.

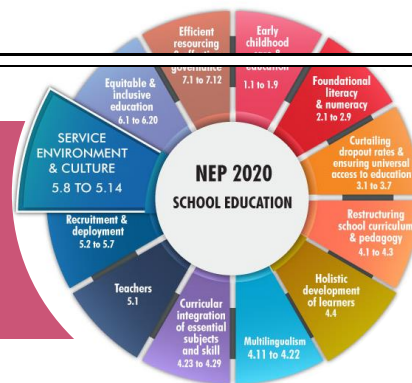
**Deeper understanding:** CBT allows students to master concepts and skills at their own pace, which leads to a deeper understanding of the material.

**Improved performance on standardized tests:** Studies have shown that students who are taught using a CBT approach tend to perform better on standardized tests in biology.

KVS is committed to providing its students with a high-quality education that prepares them for success in college and careers. CBT is a key component of KVS's educational philosophy, and it is helping KVS students to develop the skills and knowledge they need to succeed in the 21st century.



*"If a child can't learn the way we teach, maybe we should teach the way they learn."*



**The shift in method of Teaching Learning calls for attitudinal change in Learners, Teachers and whole School Ecosystem.**

**In the Present Work-Shop, following objectives were Kept:**

- a. Exchange of best Practices for qualitative improvement of Teaching ,Learning , Assesment and providing environment for Holistic Development of Learners.
- b. Development of Competency based Material for Students of XI and XII.
- c. Sharing of Teaching Skills in various Topics in Syllabi of Biology of Classes XI and XII
- d. Preparing Compendium of inquisitive and enriching Investigatory Project Topics in Biology From XI and XII.
- e. Preparation of Quality Sample Paper for Class XI and XII.

**This Booklet contains Competency based Material for Students of Class XII**

## Participant Details

The competency based pedagogical practice in Biology workshop involved 20 participants under the guidance of Sri Rajnish Kamal (Principal , KV Godda) , Ms Salomi Toppo ( Principal PM SHRI K V Hinoo.)

SL NO	NAME OF TEACHER	NAME OF KV	ROLE
1	MRS. NAMRATA PRASAD	HINOO 1ST SHIFT	PARTICIPANT
2	MRS. ALKA ASGAR	DIPATOLI	PARTICIPANT
3	RAMESH KUMAR SINGH	CTPS, CHANDRAPURA	PARTICIPANT
4	SHRI AJAY KUMAR SHARMA	TATANAGAR	PARTICIPANT
5	MRS ARCHANA KUMARI	JAMTARA	PARTICIPANT
6	MRS. RANO MARANDI	CHAKRADHARPUR	PARTICIPANT
7	MRS. SUSHMA DEEPIKA KUJUR	HAZARIBAGH	PARTICIPANT
8	<b>MR RAJEEV RANJAN SINGH</b>	<b>HINOO SHIFT-II</b>	<b>RESOURCE PERSON</b>
9	MD EFTEKHAR ALAM	GODDA	RESOURCE PERSON
10	MR.BRIJ BIHARI	SIMDEGA	PARTICIPANT
11	MR. NIRDOSH TIGGA	KHUNTI	PARTICIPANT
12	AJAY KUMAR JHA	NO.1 HEC RANCHI	PARTICIPANT
13	MRS ANKITA SHARMA	NO.3 BOKARO	PARTICIPANT
14	MR. SANTOSH KUMAR	BOKARO THERMAL	PARTICIPANT
15	MR. RAJIV KUMAR JHA	NO.1 BOKARO	PARTICIPANT
16	MS NANDITA HORO	PATRATU	PARTICIPANT
17	MRS MADHURI KUMARI	CCL RANCHI	PARTICIPANT
18	JYOTI BELA MINZ	NAMKUM RANCHI	PARTICIPANT
19	MRS. KHUSHBU KUMARI	NO 1 DHANBAD	PARTICIPANT
20	MRS. SHEELA TIGGA	GUMLA	PARTICIPANT

### CONTRIBUTOR OF CONTENT FOR CLASS XII

	Name of Contributor	Name of KV	Chapter
1	Mrs. Namrata Prasad	Hinoo 1s Ranchi	Sexual Reproduction in Flowering Plant
2	Shri Ajay Kumar Sharma	Tatanagar	Human Reproduction
3	Mr Rajeev Ranjan Singh	Hinoo 2s Ranchi	Reproductive Health
4	Mr Rajeev Ranjan Singh	Hinoo 2s Ranchi	Principles of Inheritance
5	Mr. Rajiv Kumar Jha	No.1 Bokaro	Molecular Basis of Inheritance
6	Ms Jyoti Bela Minz	Namkum Ranchi	Evolution
7	Sri Ramesh Kumar Singh	Ctps,Chandrapura	Human Health and Disease
8	Mrs. Alka Asgar	Dipatoli	Microbes in Human Welfare,
9	Mrs Ankita Sharma	No.3 Bokaro	Biotechnology : Principle & Process Biomolecules
10	Mr. Santosh Kumar	Bokaro Thermal	Application of Biotechnology
11	Ms Nandita Horo	Patratu	Organism and Population
12	Mr Rajeev Ranjan Singh	Hinoo 2s Ranchi	Ecosystem
13	Mr Rajeev Ranjan Singh	Hinoo 2s Ranchi	Biodiversity and its conservation
<b>MR RAJEEV RANJAN SINGH (PGT BIOLOGY , Hinoo S2)</b>		<b>Compilation of Question Bank from Various Chapters as submitted by Participants</b>	



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# Chapter-1

## Good Practices in School for Result improvement in Board Classes.



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## Good Practices in School for Result improvement in Board Classes.

CBSE/ACADEMIC/JS(SS)/2023/

6<sup>th</sup> April 2023  
Circular No. Acad-45/2023

**C**ompetency based questions (CBQs) in CBSE board class XII have a **weightage of 40%**. This increase in the CBQ is aligned with changing socioeconomic condition. The 21<sup>st</sup> Century skills are important to fetch employment and enhance quality of life. Sustainable Development Goal 4 (SDG 4) is to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Hence, CBQ lays strong foundation for learner and connects classroom with life. The same is adopted and promulgated via NEP 2020.

CBQs are designed to assess a student's ability to apply their knowledge and skills to real-world situations. They can be in the form of multiple-choice questions, case-based questions, source-based integrated questions, or any other type of question.

The types of question that promotes competency-based learning includes

- 👉 **A question that asks a student to analyze a data set and draw conclusions.**
- 👉 **A question that asks a student to design a solution to a real-world problem.**
- 👉 **A question that asks a student to evaluate a piece of writing or speech.**

CBQs can be challenging, but they are also rewarding. By preparing for CBQs, students can develop the skills they need to succeed in college and beyond.

(Classes XI-XII)		
Particulars	Academic Session 2022-23	Academic Session 2023-24
Composition of question paper/year-end examination/ Board Examination (Theory)	<ul style="list-style-type: none"> <li>• Competency Based Questions are 30% in the form of Multiple-Choice Questions, Case Based Questions, Source Based Integrated Questions or any other type.</li> <li>• Objective Question are 20%</li> <li>• Remaining 50% Questions are Short Answer/Long Answer Questions</li> </ul>	<ul style="list-style-type: none"> <li>• Competency Focused Questions in the form of MCQs/Case Based Questions, Source-based Integrated Questions or any other type = 40%</li> <li>• Select response type questions(MCQ) = 20%</li> <li>• Constructed response questions (Short Answer Questions/Long Answer type Questions, as per existing pattern) = 40%</li> </ul>

**For proper development of spirit of teaching learning, the following points may be considered to promote CBL in classroom.**

- ☞ By the end of the class or unit, students must understand what is expected of them and what they can achieve. Learning objectives can be made clear to students by teachers through explanation at the start of the class, examples, and the use of rubrics to assess their progress.
- ☞ Provide opportunities for students to practice and apply their skills. Competency-based learning is about more than just knowing information. Students need to be able to use what they know to solve problems and complete tasks. Teachers can provide opportunities for students to practice and apply their skills through hands-on activities, projects, and simulations.
- ☞ Use formative assessment to monitor student progress and provide feedback. Formative assessment is assessment that is used to monitor student progress and provide feedback to improve learning. Teachers can use a variety of formative assessment techniques, such as quizzes, observations, and self-assessments.
- ☞ Differentiate instruction to meet the needs of all learners. All students learn at different paces and in different ways. Teachers can differentiate instruction to meet the needs of all learners by providing different levels of support and challenge, offering different learning modalities, and allowing students to choose their own learning paths.
- ☞ Create a collaborative learning environment. Collaborative learning allows students to learn from each other and share ideas. Teachers can create a collaborative learning environment by grouping students together for projects and activities, and by encouraging students to discuss and debate their ideas.
- ☞ Use of ICT and Technology for understanding, sharing and archiving. Flipped classroom can be efficient apart of Hybrid mode of Teaching Learning.





# Chapter-2

## TIPS TO SCORE IN BIOLOGY

### TIPS TO SCORE IN BIOLOGY

#### Master the NCERT:

**Thorough understanding:** The NCERT textbook is your bible for CBSE Biology. Ensure you have a thorough understanding of all concepts, diagrams, and definitions. Don't just memorize, grasp the underlying principles.

**Annotate and highlight:** Actively engage with the text by highlighting key points, making notes in the margins, and drawing diagrams to visualize concepts.

**Solve NCERT in-text and exemplar questions:** These questions are designed to test your understanding of the NCERT content. Regularly practicing them will boost your confidence and identify areas needing improvement.

#### Beyond the Textbook:

**Reference books:** Supplement your NCERT studies with reference books like Arihant or Dinesh. They offer additional explanations, solved examples, and practice questions.

**Online resources:** Utilize online resources like Khan Academy or Crash Course Biology for interactive learning and concept visualization.

**Previous years' papers and sample papers:** Solve previous years' papers and sample papers to get familiar with the exam pattern, question types, and marking scheme. This will help you manage your time effectively during the exam.

#### Effective Study Techniques:

**Create a study schedule:** Allocate dedicated time for Biology studies each day, ensuring you cover all chapters systematically. Prioritize difficult topics and schedule regular revision slots.

**Active learning:** Don't just passively read. Engage in active learning methods like making flashcards, drawing mind maps, or explaining concepts to a study partner.

**Practice, practice, practice:** Regularly solve practice questions from reference books, online resources, and previous years' papers. This will hone your problem-solving skills and boost your confidence.

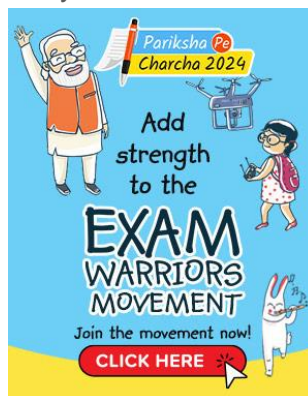
#### Exam Day Strategies:

**Time management:** Divide your time effectively between sections based on their weightage and difficulty level. Don't get stuck on any one question; move on and come back later if time permits.

**Read questions carefully:** Before attempting a question, read it carefully to understand exactly what is being asked. Pay attention to keywords and instructions.

**Neat and clear answers:** Write your answers neatly and clearly, using proper diagrams and labeling. Avoid ambiguity and stick to the point.

**Revision:** Before submitting your answer sheet, take some time to revise your answers and ensure you haven't missed anything.



**Rajeev Ranjan Singh**  
PGT Biology  
PM SHRI KV Hinoo ( SS)



## CHAPTER 2: SEXUAL REPRODUCTION in FLOWERING PLANTS

### MULTIPLE CHOICE QUESTION

- Perisperm is-
  - Degenerate secondary nucleus
  - Remnant of nucleus
  - Peripheral part of endosperm
  - Degenerate synergids
- Which of the following fruit is a case of parthenogenesis?
  - Fruit without seeds after pollination
  - Fruit with seeds after pollination
  - Fruit with viable seeds without fertilization
  - Fruit with viable seeds after fertilization.
- If an endosperm cell of an angiosperm has 24 chromosomes, the root cell of megaspore mother cell should have-
  - 8
  - 16
  - 4
  - 24
- How many meiotic divisions are needed for forming 100 grains of wheat?
  - 100
  - 25
  - 50
  - 20
- Aleurone layer is present in
  - The peripheral part of scutellum
  - The peripheral part of coleoptile
  - Cotyledons
  - The peripheral part of endosperm
- Which is the most logical sequence with reference to life cycle of angiosperm?
  - Pollination, fertilization, seed formation, germination
  - Germination, endosperm formation, seed dispersal, double fertilization
  - Cleavage, fertilization, grafting, fruit formation
  - Maturation, mitosis, differentiation, fertilization.
- Sporopollenin is secreted by
  - Cytoplasm of the pollen
  - Cytoplasm of the pollen mother cell
  - Cytoplasm of the tapetum
  - Cytoplasm of the endothecium
- Which one of these tissues is not produced from the embryonic mass of a dicotyledonous seeds?
  - Root tip
  - Plumule
  - Hypocotyl
  - Cotyledons
- If the flowering plant has 12 number of chromosomes in each of its meristematic cell, which of the following structures would have 6 chromosomes?
  - Root apex
  - Pollen and megaspore mother cells
  - Microspore and functional megaspores
  - Secondary nucleus within the embryo.
- The development of helobial endosperm is
  - Just like that of cellular endosperm
  - Exactly similar to that of nuclear endosperm
  - Intermediate between the nuclear and cellular endosperm
  - None of the above.
- Embryo sac of an angiosperm is homologous to
  - Megaspore
  - Female gametophyte
  - Sporangium
  - None of above.
- Anthesis is-
  - Dehiscence of anthers
  - Opening of floral bud
  - Entry of pollen tube into ovule
  - Emergence of anthers
- Entry of pollen tube through micropyle is called
  - Mesogamy
  - Pseudogamy
  - Chalazogamy
  - Porogamy.
- The outermost and innermost wall layers of microsporangium in an anther are respectively
  - Endothecium and tapetum
  - Epidermis and endodermis
  - Epidermis and middle layer
  - Epidermis and tapetum.
- In a fertilized embryo sac, the haploid, diploid and triploid structures are-
  - Synergid, zygote and primary endosperm nucleus
  - Synergid, antipodal and polar nuclei
  - Antipodal, synergid and primary endosperm nucleus
  - Synergid, polar nuclei and zygote
- Milky water in green coconut is
  - Free nuclear Liquid endosperm
  - Liquid female gametophyte
  - Liquid nucleus
  - Liquid chalaza
- A plant with both male and female flowers is
  - Unisexual
  - Bisexual
  - Monoecious
  - Dioecious.
- Filiform apparatus occurs in
  - Synergids
  - Antipodals
  - Egg nucleus
  - Secondary nucleus.
- A dicotyledonous plant bears flowers, but never produces fruits and seeds. The most probable cause for the above situation is
  - plant is dioecious and bears only pistillate flowers
  - plant is dioecious and bears both pistillate and staminate flowers
  - plant is monoecious
  - plant is dioecious and bears only staminate flowers
- 256 microspores will form by the meiosis of-
  - 512 microspore mother cells
  - 128 microspore mother cells
  - 64 microspore mother cells
  - 48 microspore mother cells

## ASSERTION REASON QUESTION

### Assertion and Reasoning based Questions

In each of the following questions, a statement of Assertion is given followed by a corresponding statement of Reason just below it. Of the statements mark the correct answer as:

- (a) Both Assertion and Reason are true and the reason is the correct explanation of the Assertion.
  - (b) Both Assertion and Reason are true and the reason is not the correct explanation of the Assertion.
  - (c) Both Assertion and Reason are true and the reason is the correct explanation of the Assertion.
  - (d) Both Assertion and Reason are true and the reason is the correct explanation of the Assertion.
1. Assertion. Maize is an albuminous seed. Reason. Its endosperm is completely absorbed by its growing embryo.
  2. Assertion. The megaspore mother cells divide by meiotic division to produce four spores. Reason. Megaspore Mother Cells (MMC) are diploid and megaspores are haploid.
  3. Assertion. 7-celled, 8 nucleate and monosporic embryo sac is Most common type of embryo sac in dicotyledonous plants. Reason. It was discovered first time in plant Polygonum.
  4. Assertion. Female gametophyte in angiosperm is eight nucleate. Reason. Double fertilization occurs in angiosperms
  5. Assertion. Parthenogenesis is an apomixis where seeds are developed from unfertilized female gamete. Reason. Parthenogenesis always occurs by the application of chemicals.
  6. Assertion. Pollen grains, in case of hydrophily, are covered by mucilaginous/oily layer. Reason. Mucilaginous is a viscous sticky substance that protects the pollen from water.
  7. Assertion. Exine of pollen grain is comprised of sporopollenin which is resistant to high temperature, strong acid or alkali. Reason. Sporopollenin is absent in the region of germ pore.
  8. Assertion. In Ophrys one petal of the flower bears an uncanny resemblance to the female bee. Reason. Two closely related species competing for the same resource can coexist simultaneously.
  9. Assertion. Majority of insect-pollinated flowers are large, colourful, fragrant and rich in nectar. Reason. Insects are attracted to flowers by colour, fragrance and or nectar.
  10. Assertion. The continued self-pollination results in inbreeding depression. Reason. The device to prevent self-pollination is the production of bisexual flowers.

### Case Based Questions

1. Read the following and answer questions given below from (i) to (v).

In major approaches of crop improvement programme as in crossing experiments, it is important to make sure that only the desired pollen grains are used for pollination and the stigma is protected from contamination from unwanted pollens. So, if the female parent bears bisexual flowers, removal of anthers from the flower bud before the anther dehisces is necessary (Emasculation). Emasculated flowers have to be covered with bags of suitable size to prevent contamination of their stigma with unwanted pollen-bagging. When the stigma of bagged flower attains receptivity, mature pollen grains collected from anthers of the male parent are dusted on the stigma and the flowers are re-bagged and the fruits are allowed to develop. If the female parent produces unisexual flowers, there is no need for emasculating.

(i) While planning for an artificial hybridisation involving dioecious plants, which of the following steps would not be relevant?

(a) Bagging of female flower (b) Dusting of pollen on stigma (c) Emasculation (d) Collection of pollen

(ii) Assertion- If the female parent produces unisexual flowers, there is no need of emasculating Reason- Emasculation is the removal of anthers from the flower bud before the anther dehisces.

(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 the assertion.

(c) Assertion is true but reason is false.

(d) Both assertion and reason are false.

- (iii) Artificial hybridization denotes to
- (a) production of seedless fruits (b) evolve seeds without fertilization  
(c) crop improvement programme (d) occurrence of more than one embryo in a
- (iv) The correct sequence to perform artificial hybridization is
- (a) Bagging--Emasculation --) Re-bagging --) Cross pollination  
(b) Emasculation --) Bagging--Cross pollination--) Re-bagging  
(c) Cross pollination--) Emasculation--) Bagging --) Re-bagging  
(d) Bagging--Re-bagging--) Cross pollination--) Emasculation seed
- (v) Bagging technique in artificial hybridization approach is done
- (a) To prevent contamination of stigma with unwanted pollens  
(b) After the anthers have been dehisced  
(c) Only in monoecious plants  
(d) To promote production of apomixis.

2. Read the following and answer questions given below from (i) to (v)

Pollen grains are generally spherical shaped and each is surrounded by two layers – exine and intine. Exine is made up of sporopollenin which is resistant to high temperatures and strong acids and alkali. Sporopollenin remains absent at germ pores. Pollen grains are well preserved as fossils because of the presence of sporopollenin. The inner wall of pollen grain is intine. The pollen grains are mainly shed at 2-celled stage- vegetative cell and generative cell when they are matured. Pollen grains of many species cause severe allergies and bronchial afflictions, leading to chronic respiratory disorders. It is mentioned that Parthenium or carrot grass that came into India as contaminant with imported wheat, has become ubiquitous in occurrence and causes pollen allergy. However, pollen grains are rich in nutrients which are used pollen tablets as food supplements. In western countries, large number of pollen products in the form of tablets and syrups are available in the market which are claimed to increase the performance of athletes and race horses.

(i) Assertion- Sporopollenin is an oxidative polymer of carotenoids which helps in fossilization.

Reason- Sporopollenin is a tough substance that provides resistant to biological decomposition, high temperature and alkali.

- (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 the assertion.  
(c) Assertion is true but reason is false.  
(d) Both assertion and reason are false.

(ii) Which of the following statements is not appropriate for pollen grains

- (a) Pollen grains can be stored for years in liquid nitrogen and can be used in crop breeding programmes,  
(b) Pollen grains are rich in nutrients and can be used as pollen tablets as food supplements.  
(c) Bee pollen are available in western countries in the form of tablets.  
(d) Pollen consumption has potential inhibitory action which results in decreased energy in athletes and race horses.

(iii) Pollen allergy is common in many people during spring, summer and fall as plants release tiny pollen grains in tremendous quantity. Which of the following is not associated with pollen allergy?

- (a) Sneezing, stuffy nose and watery, eyes (b) Asthma, bronchitis  
(c) Cough, itchy nose, roof of mouth or throat (d) Fever, diarrhoea and vomiting

(iv) Which of the following set does not cause allergy?

- (a) Ragweed parthenium (b) Sagebrush (c) Amaranthes (pigweed) (d) Acacia.

(v) The function of germ pore in pollen grain is

- (a) Emergence of radicle (b) Absorption of water for seed germination  
(c) Initiation of pollen tube (d) All of these

3. Read the following and answer questions given below from (i) to (V)

A flower of tomato plant following the process of sexual reproduction produces 240 viable seeds. The viable seeds are those which have the ability to remain alive and may develop into plants and reproduce themselves in the given appropriate conditions. This happens when one of the pollen grain reaches to the stigma by any agency at 2-celled stage vegetative cell and generative cell. The generative cell divides mitotically and forms two male gametes which enters into ovule after passing through pollen tube and undergoes the process of double fertilization in the ovule. The ovule is a large parenchymatous body formed in the ovary by megasporogenesis. The megaspore mother cell in an ovule diploid structure which undergoes meiotic division and forms one functional megaspore. The megaspore undergoes three subsequent divisions and forms 8 nuclei arranging themselves in 3 groups. After fertilization, the ovule converts into the seed and whole ovary develops into a complete fruit.

i) The minimum number of pollen grains that must have been involved in the pollination of its pistil are.....

- (a) 60                      (b) 120                      (c) 180                      (d) 240

(ii) The minimum number of microspore mother cells must have undergone reductional division prior to dehiscence of anther are:

- (a)60                      (b)90                      (c) 180                      (d) 240

(iii) The male gametes that might have involved in this case are:

- (a) 120                      (b) 240                      (c)360                      (d) 480

(iv) The minimal number of ovules present in the ovary would be:

- (a) 60                      (b) 120                      (c) 180                      (d) 240

(v) Megaspore mother cells involved in this process are

- (a) 120                      (b) 180                      (c) 240                      (d) 360

### VERY SHORT ANSWER TYPE QUESTIONS

- i. Name the parts of the gynoecium which develop into fruit and seeds.
- ii. In a case of polyembryony, if an embryo develops from the synergid and another from the nucellus which is haploid and which is diploid?
- iii. Can an unfertilised, apomictic embryo sac give rise to a diploid embryo? If yes, then how?
- iv. Which are the three cells found in a pollen grain when it is shed at the three-celled stage?
- v. Which is the triploid tissue in a fertilised ovule? How is the triploid condition achieved?

### LONG ANSWER QUESTION

1. Is pollination and fertilisation necessary in apomixis? Give reasons.
2. 'Fertilisation is not an obligatory event for fruit production in certain plants'. Explain the statement.
3. Why does the zygote begin to divide only after the division of primary endosperm cell?
4. The generative cell of a 2-celled pollen divides in the pollen tube but not in a 3-celled pollen. Give reasons.

## Answer Key

### Marking scheme of sexual reproduction in flowering plants

#### Answer MCQ

1-b 2-a 3-b 4-a 5-d 6-a 7-c 8-d 9-c 10-c 11-b 12-b 13-d 14-d 15-a 16-a 17-c 18-a 19-d 20-c

#### Answer Assertion and Reasoning based Questions

21-c 22-d 23-c 24-b 25-c 26-a 27-b 28-c 29-a 30-c

#### Answer Case Based Questions

1 i-c ii-b iii-c iv-b v-a

2 i-a ii-d iii-d iv-d v-c

3 i-d ii-a iii-d iv-d v-c

#### Answer short Questions

1. Ovary develops into fruit; ovules develop into seeds.
2. Synergid embryo is haploid and nucellar embryo is diploid.
3. Yes, if the embryo develops from the cells of nucellus or integument it will be diploid.
4. One vegetative cell and two male gametes.
5. The triploid tissue in the ovule is the endosperm. Its triploid condition is attained due to the fusion of two polar nuclei and one nucleus of male gamete (also referred to as triple fusion).

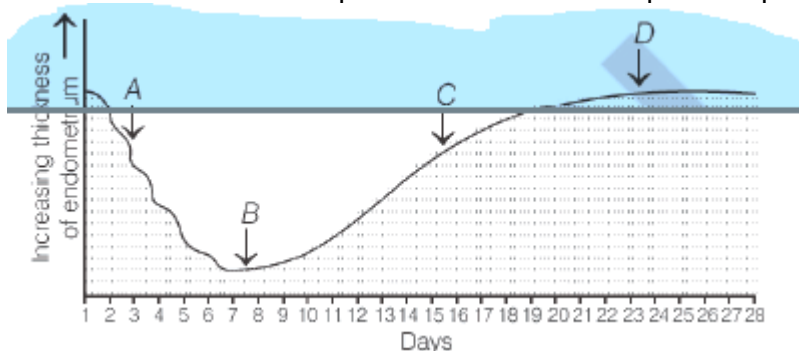
#### Answer long Questions

1. No, they are not necessary. Apomixis is actually an alternative to sexual reproduction although the female sexual apparatus is used in the process. In apomicts, embryos can develop directly from the nucellus or synergid or egg. Therefore, there is no need for either pollination or fertilisation.
2. Yes, it is observed in parthenocarpic fruits. The 'seedless fruits' that are available in the market such as pomegranate, grapes etc., are infact good examples. Flowers of these plants are sprayed by a growth hormone that induces fruit development even though fertilisation has not occurred. The ovules of such fruits, however, fail to develop into seeds.
3. The zygote needs nourishment during its development. As the mature, fertilised embryo sac offers very little nourishment to the zygote, the PEC divides and generates the endosperm tissue which nourishes the zygote. Hence, the zygote always divides after division of PEC.
4. In a 3-celled pollen, the generative cell has already divided and formed 2 male gametes. Hence, it will not divide again in the pollen tube. Since in a 2-celled pollen, the generative cell has not divided, it divides in the pollen tube.

## CHAPTER 3- HUMAN REPRODUCTION

### MCQ TYPE 20X1=20 .

- Medical Termination of Pregnancy is considered safe up to how many weeks of pregnancy  
(A). 6 (B) 8 (C) 12 (D) 18
- The immature male germ cell undergo division to produce sperms by the process of spermatogenesis. Choose the correct one with reference to above.  
(A) Spermatogonia have 46 chromosomes and always undergo meiotic cell division  
(B) Primary spermatocytes divide by mitotic cell division  
(C) Secondary spermatocytes have 23 chromosomes and undergo second meiotic division  
(D) Spermatozoa are transformed into spermatid
- The developmental changes in human embryo by week 12  
(A) Foetus fully formed  
(B) All organs are developed  
(C) Sex organs also developed  
(D) All of the above
- The below diagram describe the changes that occurs in endometrium during normal menstruation. choose the option with correct description for point A,B,C,D



- (A) A- Ovulation B-Menstruation` (B) A- Ovulation C-Menstruation  
(C) A- Menstruation C- Ovulation (D) B- Ovulation D-Menstruation
- Foetal ejection reflex in human female is induced by  
(A) Release of oxytocin pituitary (B) Fully developed foetus and placenta  
(C) Differentiation of mammary gland (D) Pressure exerted by amniotic fluid
- Seminal plasma in human males is rich in  
(A) DNA and testosterone (B) Ribose and potassium  
(C) Fructose and calcium (D) Glucose and calcium
- Sperm acrosome is derived from  
(A) Golgi body (B) Endoplasmic reticulum  
(C) Lysosome (D) Mesosome
- What is the correct sequence of sperm formation?  
(A) Spermatogonia, spermatozoa, spermatocyte, spermatid  
(B) Spermatogonia, spermatocyte, spermatid, spermatozoa  
(C) Spermatid, spermatocyte, spermatogonia, spermatozoa  
(D) Spermatogonia, spermatocyte, spermatozoa, spermatid
- In human females the ovarian cycle begins when the  
(A) Levels of Oestrogen reach near their maximum  
(B) Hypothalamus stimulates the anterior pituitary to increase the output of FSH and LH  
(C) Level of Progesterone drops  
(D) Hypothalamus increases its release of FSH and LH
- If you are a gynaecologist and wants to induce parturition in a pregnant woman suffering from delay in giving birth to child. Which one of the following hormone you may use:  
(A) Estrogens.  
(B) Progesterone.

(C) Oxytocin.

(D) Relaxin.

- 11 A hormonal drug is prescribed by a medical practitioner to a woman having complain of delayed menstruation. The hormone present in the drug is:
- (A) Estrogens.
  - (B) Progesterone.
  - (C) FSH
  - (D) LH
- 12 An adult male ejaculates 200-300 millions sperms during coitus out of which 40 percent are of normal shape, size and motile. He will be considered as:
- (A) Having normal fertility.
  - (B) Having infertility.
  - (C) Having impotence.
  - (D) Both B and C.
- 13 Cowper's glands secrete a substance to
- (a)Nourish plasma
  - (b) neutralize the acidity
  - (c)Kill pathogens
  - (d) Lubricate female vagina to facilitate copulation
- Choose the correct answer
- (A)1,2,3 are correct
  - (B)1 and 2 are correct
  - (C) 2 and 4 are correct
  - (D) 1 and 3 are correct
- 14 Which one of the following is the correct matching of the events during menstrual cycle ?
- (A)Ovulation-LH and FSH in peak level and Sharp fall in secretion of progesterone
  - (B)Proliferative phase – rapid regeneration of myometrium and maturation of Graffian follicle
  - (C) Developing of corpus luteum – secretary phase and increased secretion of progesterone
  - (D) Menstruation –breakdown of myometrium and ovum not fertilized
- 15 The difference between spermiogenesis and spermiation is
- (A) In spermiogenesis spermatozoa from Sertoli cells are released into cavity of seminiferous tubules while in spermiation spermatozoa are formed
  - (B) In spermiogenesis spermatozoa are formed while spermiation spermatids are formed
  - (C) In spermiogenesis spermatids are formed while in spermiation spermatozoa are formed
  - (D) In spermiogenesis spermatozoa are formed while in spermiation spermatozoa are released through seminiferous tubules.
- 16 Read the following statements
1. Each testis has about 25 compartment called testicular lobules
  2. Each testicular lobule contains one to three highly coiled seminiferous tubules in which sperm are produced.
  3. Sertoli cells act as nurse cells act as nurse cells of testicles
  4. Sertoli cells are activated by FSH secreted
- Which of the above statement are incorrect?
- (A) 1 and 3
  - (B) only 1
  - (C) 2 and 4
  - (D) 3 and 4
- 17 What information would you use to support that pregnancy has been established in a female.
- (a)presence of human chorionic gonadotropin hormone in urine
  - (b)Low estrogen level
  - (c) progesterone surge
  - (d) luteinizing hormone influx
- 18 Fructose is produced in the male reproductive tract by the seminal vesicles. What is the function of fructose
- (A) Helps in the lubrication of penis
  - (B) Fructose is the energy source for sperm motility
  - (C) Fructose is an enzyme which help in penetration of ovum
  - (D) Fructose increases the number of sperm count
- 19 The first meiotic division in the meiocytes of female reproductive system is unique as
- (A) In a very regulated manner it allows equal distribution of cytoplasm and genetic material to the daughter cells
  - (B) Cytoplasm is unequally distributed to the daughter cells



(C) Both cytoplasm and nuclear content will be unequally distributed

(D) It occurs in reproductive system

20 Read the following statements.

I. Each testis has 25 compartments called testicular lobules.

II. Each testicular lobule contains one to three highly coiled seminiferous tubules in which sperms are produced.

III. Sertoli cells provide nutrition to testicles

IV. Sertoli cells are activated by FSH

Which of above statements are incorrect?

a. I and II

b. only I

c. II and IV

d. III and IV

11 Choose the correct option.

(A) Both assertion and reason are true and reason is correct explanation of assertion.

(B) assertion and reason both are true but reason is not the correct explanation.

(C) Assertion is true, reason is false

(D) Assertion is false, reason is true

1 **Assertion:** The testes are situated outside the abdominal cavity within the scrotum.

**Reason:** Muscles in scrotum helps to maintain low temperature of testes, necessary for spermatogenesis.

2 **Assertion:** The endometrium undergoes cyclical changes during menstrual cycle.

**Reason:** The myometrium exhibits strong contractions during delivery of the baby.

3 **Assertion:** Embryonic development proves inter-relationship and common ancestry of metazoans.

**Reason :** It involves similar sequence of five dynamic processes during development.

4 **Assertion:** Zona pellucida disappears when blastocyst reaches the uterus.

**Reason:** Role of zona pellucida is to check the implantation of the blastocyst at an improper site.

5 **Assertion:** The bulbourethral gland is a male accessory gland.

**Reason:** Its secretion helps in the lubrication of the penis, thereby facilitating reproduction.

6 **Assertion:** Each seminiferous tubule is lined on its inside by three types of cells.

**Reason:** These cells are male germ cells, Sertoli cells and Leydig cells.

7 **Assertion:** Fimbriae are finger-like projections of the infundibulum part of oviduct which is closest to ovary.

**Reason:** They are important for collection of ovum after ovulation from ovary.

8 **Assertion:** Production of FSH increases, while that of LH decreases in the ovulation phase.

**Reason:** Due to decrease in the level of LH, ovulation (releasing of ova) takes place.

9 **Assertion:** In a Graafian follicle, the primary oocyte and the follicular cells may be regarded as sibling cells.

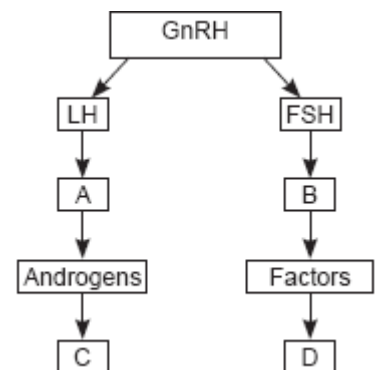
**Reason:** Both arise from the same parent cell the oogonium by mitotic division.

10 **Assertion:** Ovum retains most of the contents of the primary oocyte and is much larger than a spermatozoa.

**Reason:** Ovum requires energy to go about in search of a spermatozoa for fertilization.

### SA TYPE QUESTION (5X2=10)

1 I) Identify A, B, C and D with reference to gametogenesis in humans, in the flow chart given below:



II) Where are sperms produced in a human testis?

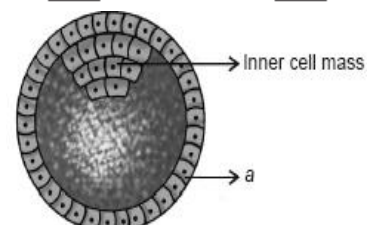
2 Study the figure given below and answer the questions that follow:

(a) Name the stage of human embryo the figure represents.

(b) Identify 'a' in the figure and mention its function.

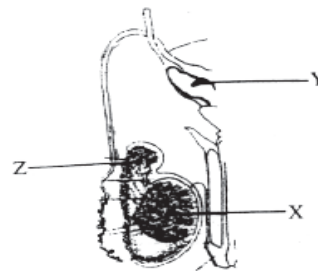
(c) Mention the fate of the inner cell mass after implantation in the uterus.

(d) Where are the stem cells located in this embryo?



- 3 Differentiate between the major structural changes in the human ovary during the follicular and luteal phases of the menstrual cycle.
4. The diagram shows human male reproductive system (one side only).

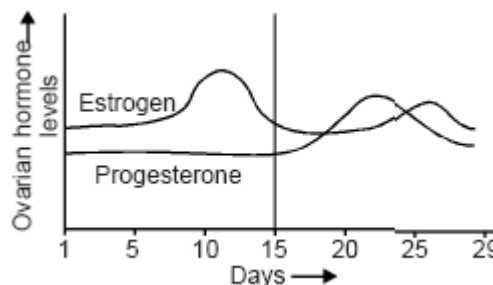
- (a) Identify 'X' and write its location in the body.  
 (b) Name the accessory gland 'Y' and its secretion.  
 (c) Name and state the function of 'Z'.



5. (a) Where do the signals for parturition originate from, in humans?  
 (b) Why is it important to feed the new born babies on colostrum?

**SA TYPE 5X3=15**

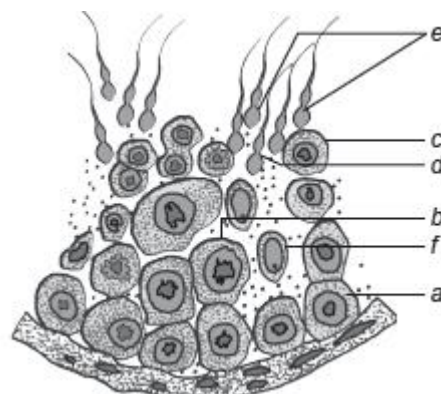
- 1 (a) Read the graph given above and correlate the uterine events that take place according to the hormonal levels on:  
 (i) 6 – 15 days  
 (ii) 16 – 25 days  
 (iii) 26 – 28 days (if the ovum is not fertilised).



- (b) Specify the sources of the hormones mentioned in the graph.

2. Study the figure given:

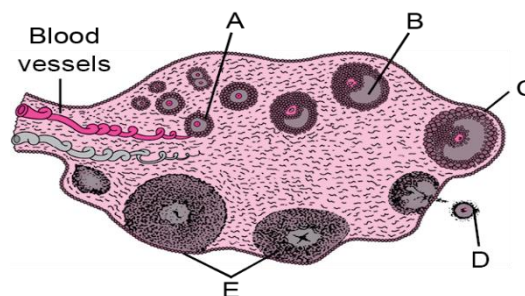
- (i) Pick out and name the cells that undergo spermiogenesis.  
 (ii) Name 'a' and 'b' cells. What is the difference between them with reference to the number of chromosomes?  
 (iii) Pick out and name the motile cells.  
 (iv) What is 'f' cell? Mention its function.  
 (v) Name the structure of which the given diagram is a part.



3. a) Mention the event of meiosis that occurs in the tertiary follicle in a human ovary.  
 (b) Name the phase of menstrual cycle, when a Graafian follicle transforms into an endocrine structure. Write its action thereafter.
4. Human female is not fertile after menopause whereas males can produce gamete at any age after puberty. Analyze the statement and schematically represent a comparison between gametogenesis in males and Females.

5. Study the given diagram and answer the following.

- (a) How are the ovaries held in position in the pelvic region?  
 (b) Identify in the figure:  
 (i) Corpus luteum  
 (ii) Secondary oocyte  
 (c) Name (i) the hormone that influences the development of 'A' into 'C' in the diagram, and (ii) the hormone secreted by 'A', 'B' and 'C'.  
 (d) Name the process and the hormone responsible for the liberation of 'D' from the ovary.  
 (e) Name the hormone that  
 (i) influences the formation of corpus luteum.  
 (ii) is secreted by corpus luteum.



**CASE BASED QUESTIONS  
LIFE STYLE AND MENSTRUATION**

1

Adolescence is a high-risk group because during this stage major physical and mental change occurs. Menarche is a hallmark biological process of puberty beginning in adolescence girls and it leads to reproductive capacity. Menstrual abnormalities are common in adolescent and can lead to stressful conditions. All over the world around 75% of girls are experiencing problems associated with menstruation. The major abnormalities are dysmenorrhea, premenstrual syndrome (PMS), and menstrual irregularities. These disorders may lead to problems in daily activities such as academic excellence, achievements in sports, and loss of self-confidence. The lifestyle pattern of individual leads to menstrual disorders because female reproductive cycle directly or indirectly influences with diet, physical work, and mental stress. Menstrual disorder leads to symptoms such as pain, depression, and anxiety. In the present scenario, menstrual abnormalities are causing significant debility in adolescent girls. Hence, it is important to promote the health education programs which should include promoting adequate dietary habit, regular exercise, and awareness on menstrual hygiene in school level for improving the menstrual health. The improvement of menstrual health is important for preventing the many present and future gynaecological problems (infertility, obesity, and polycystic ovaries).

1 Which one of the following is not a factor causing menstrual disorders:

(A) Sedentary life style. (B) Junk food. (C) Physical work. (D) Mental stress

2 Which one of the following is not associated with menstrual disorders:

(A) Dysmenorrhea (B) Premenstrual syndrome.  
(C) Menopause. (D) Amenorrhea.

3 To overcome menstrual disorders, one should adopt:

(A) Moderate physical activity or exercise. (B) Eat balanced and nutritive food.  
(C) Say no to junk foods, alcohol and tobacco. (D) All of the above.

4 Obesity is one of the causes of menstrual disorder because:

(A) Obese women do less physical activity. (B) Obese women take junk foods.  
(C) An obese woman suffers mental stress. (D) Obesity causes imbalance in hormones.

2 **Read the following passage and answer the questions that follow:**

The reproductive cycle in the females of primate mammals (apes, monkeys and humans), is called menstrual cycle. Menstrual cycles occur during the reproductive phase, i.e., between menarche and menopause in human females. The cycle starts with menstruation and extends (for about 28 days) till the onset of the next menstruation; it includes four phases.

(a) Name in proper sequence, the four phases in menstrual cycle.

(b) How long does the menstrual phase last in a menstrual cycle?

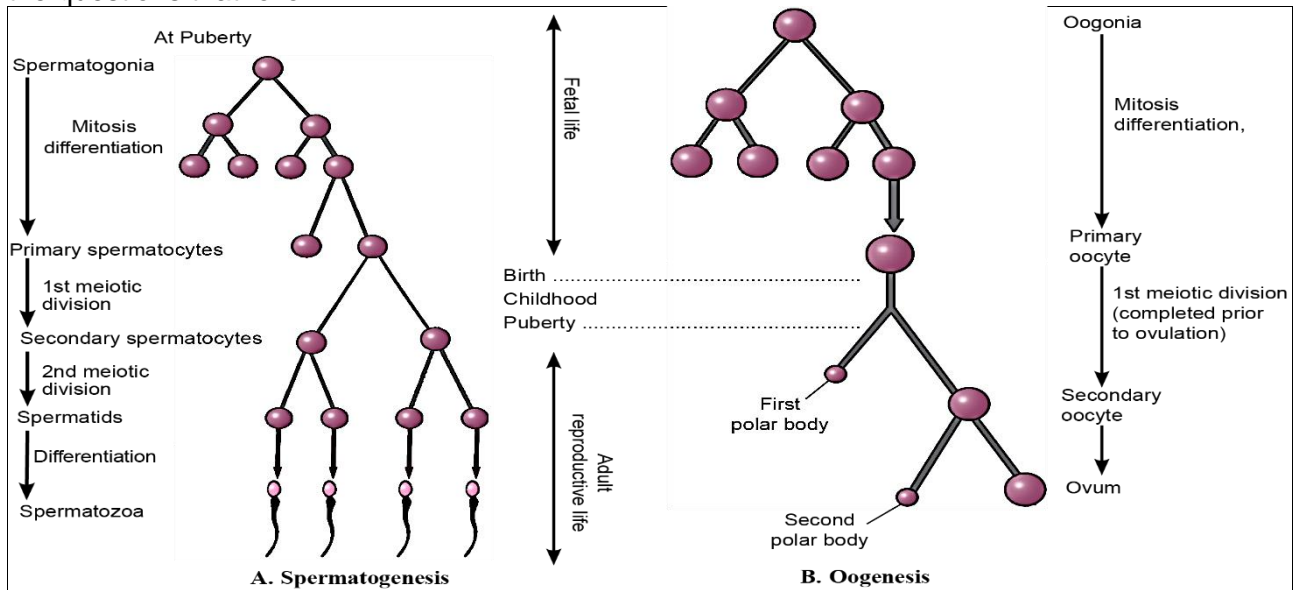
(c) When do the hormones estrogen and progesterone reach their peak levels, respectively, in the menstrual cycle? Give reasons.

(d) Define ovulation.

**LA TYPE 2X5=10**

1 **Read the following passage and answer the questions that follow:**

Spermatogenesis is the process of formation of spermatozoa in the testes of males while oogenesis is the formation of ova in the ovaries of females. Spermatogenesis starts at puberty whereas oogenesis is initiated in the embryonic stage in the foetal ovaries. Observe the schematic diagram of A. spermatogenesis and B. oogenesis given below and answer the questions that follow:



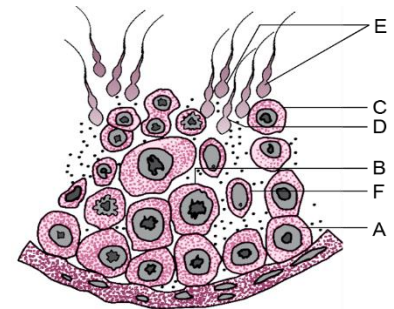
- About 300 million spermatozoa may be present in a human male ejaculate at one time. Calculate how many primary spermatocytes will be involved to produce this number of spermatozoa. Justify your answer.
- How many spermatids will be formed? How many chromosomes does each of them have?
- How many chromatids are found during Oogenesis in (i) Primary oocyte and (ii) First polar body in a human female?
- How many functional spermatozoa are formed from a primary spermatocyte and how many functional female gamete(s) is/are formed from a primary oocyte?
- Mention the number of chromatids in each of the (i) spermatozoa and (ii) ovum, respectively.

2. Read the following passage and answer the questions that follow:

Each testicular lobule in a human testis contains one to three highly coiled seminiferous tubules, where sperms are produced. Each seminiferous tubule is lined on its inner side by two types of cells-the spermatogonia and Sertoli cells.

The diagram given below shows an enlarged view of a section of a human seminiferous tubule, showing the various stages of spermatogenesis.

- Identify and name the cell(s) which undergo(es) spermatogenesis.
- Name the cell F and mention its function.
- Identify and name the cells which have 92 chromatids in them.
- Identify and name the cell(s) which undergo(es)
  - meiosis I
  - meiosis II
- Name and define the process, which the cell D undergoes.



**ANSWER KEY**

### 1. MCQ

1	C	2	C	3	D	4	C	5	B
6	C	7	A	8	B	9	C	10	C
11	B	12	B	13	C	14	C	15	B
16	B	17	D	18	B	19	D	20	C

### A-R TYPE

1	A	2	B	3	A	4	A	5	A
6	D	7	B	8	C	9	A	10	C

### SA TYPE 2 MARKS

- A) A – Leydig cells  
 B – Sertoli cells  
 C – Spermatogenesis  
 D – Spermiogenesis.  
 B) seminiferous tubules
- (a) It is a blastocyst.  
 (b) 'a' is trophoblast; it forms the chorionic villi and the embryonal part of placenta.  
 (c) The inner cell mass gets differentiated into ectoderm and endoderm.  
 (d) They are located in the inner cell mass.

Follicular phase	Luteal phase
- The primary follicles in the ovary grow to become a mature follicle.	- The ruptured Graafian follicle transforms into corpus luteum.
- Follicular cells secrete estrogens.	- Corpus luteum secretes progesterone.

- (a) X is testis. It is located outside the abdominal cavity in the scrotum.  
 (b) Y is prostate gland. Its secretion along with the secretions of other reproductive glands, is called seminal plasma.  
 (c) Z is epididymis; it temporarily stores the spermatozoa and transports it to vas deferens.
- (a) The signals for parturition originate from the fully-developed foetus and the placenta, which cause foetal ejection reflex.  
 (b) Colostrum contains several antibodies, essential to develop resistance in the new-born babies.

### SA TYPE 3 marks

- (a) (i) It is the follicular phase, when the endometrium of uterus regenerates through proliferation.  
 (ii) Secretion of progesterone maintains the endometrium, which is necessary for implantation of embryo.  
 (iii) In the absence of fertilisation, the endometrium disintegrates, leading to menstruation.  
 (b) – Estrogen is secreted by the follicle cells of the ovary.  
 Progesterone is secreted by the corpus luteum of ovary.
- (a) A - Spermatogonium  
 (b) F - Sertoli cells, nourish the developing germ cells.  
 (c) A – Spermatogonium                      B - Primary spermatocyte                      F - Sertoli cells  
 (d) (i) Primary spermatocyte undergoes meiosis I  
 (ii) Secondary spermatocyte undergoes meiosis II  
 (e) – D undergoes spermiogenesis.  
 – Spermiogenesis is the transformation of spermatids into motile spermatozoa.
- a) –The primary oocyte grows in size and completes meiosis I, forming a larger haploid cell, the secondary oocyte and a smaller cell, the first polar body.  
 (b) – In the luteal phase, the ruptured graafian follicle transforms into corpus luteum.  
 – Corpus luteum secretes large quantity of progesterone to maintain the endom
- A human female is not fertile after menopause, because ovulation and other events of

menstrual cycle cease with menopause.

Refer to Fig. 3.9 in the text.

Refer to Fig. 3.13 in the text.

Gametogenesis in males	Gametogenesis in females
<ul style="list-style-type: none"><li>- It starts at puberty.</li><li>- Primary spermatocytes are formed only from puberty as and when required.</li><li>- One primary spermatocyte produces four functional male gametes.</li><li>- It occurs continuously even in old age.</li></ul>	<ul style="list-style-type: none"><li>- It starts at the embryonic developmental stage.</li><li>- All primary oocytes are formed before birth and none after birth.</li><li>- One primary oocyte produces only one functional female gamete.</li><li>- It is a cyclical process and ceases at the age of about 50.</li></ul>

5. (a) Each ovary is attached to the pelvic wall and uterus by ligaments and is held in position.

(b)(i) E is corpus luteum

(ii) D is secondary oocyte

(c)(i) Follicle-stimulating hormone (FSH)

(ii) Estrogens

(d) - The process is ovulation.

- Luteinising hormone (LH) is responsible for it.

(e)(i) Luteinising hormone

(ii) Progesterone

#### Case Based Question

1. 1 C 2 C 3 D 4 D

2. a) Menstrual phase → Proliferative/Follicular phase → Ovulatory phase → Luteal/Secretory phase

(b) 3-5 days

(c) - Estrogen reaches its peak level towards the end of proliferative phase, just before ovulation; it is because estrogen is secreted by the follicular cells.

- Progesterone reaches its peak level around the middle of the luteal phase; it is because progesterone is secreted by the corpus luteum formed after ovulation.

(d) Ovulation is the process of rupture of mature Graafian follicle and the release of the ovum from it.

#### LA TYPE 5 MARKS

1.(a) - 75 million primary spermatocytes.

- Because each primary spermatocyte undergoes meiosis and forms four spermatozoa.

(b) - 300 million spermatids

- 23 chromosomes

(c)(i) 92 chromatids

(ii) 46 chromatids

(d) - Four spermatozoa

- Only one ovum

(e)(i) 46 chromatids in a spermatozoan (ii) 46 chromatids in an ovum.

2. (a) A - Spermatogonium

(b) F - Sertoli cells, nourish the developing germ cells.

(c) A - Spermatogonium

B - Primary spermatocyte

F - Sertoli cells

(d)(i) Primary spermatocyte undergoes meiosis I

(ii) Secondary spermatocyte undergoes meiosis II

(e) - D undergoes spermiogenesis.

- Spermiogenesis is the transformation of spermatids into motile spermatozoa.

Submitted By : Sri Ajay Sharma  
PGT Biology  
KV TATANAGAR

## Chapter 4: Reproductive Health

- In vitro fertilization is a technique that involves transfer of which one of the following into the fallopian tube?
  - Embryo only, upto 8 cell stage
  - Either zygote or early embryo upto 8 cell stage
  - Embryo of 32 cell stage
  - Zygote only
- The permissible use of the technique amniocentesis is for
  - Detecting sex of the unborn fetus
  - Artificial insemination
  - Transfer of embryo into the uterus of a surrogate mother
  - Detecting any genetic abnormality
- Cu ions released from copper-releasing Intrauterine Devices (IUDs):
  - Makes uterus unsuitable for implantation
  - Increases phagocytosis of sperms
  - Suppress sperm motility
  - Prevent ovulation
- Medical Termination of Pregnancy (MTP) is considered safe up to how many weeks pregnancy?
  - 12 weeks
  - 18 weeks
  - 6 weeks
  - 8 weeks
- If for some reason, the vasa efferentia in the human reproductive system get blocked, the gametes will not be transported from
  - Epididymis to vas deferens
  - Ovary to uterus
  - Vagina to uterus
  - Testes to epididymis
- Which one of the following is the most widely accepted method of contraception in India at present?
  - Tubectomy
  - Diaphragms
  - IUDs (Intrauterine Devices)
  - Cervical caps
- The technique called Gamete Intra Fallopian Transfer (GIFT) is recommended for those females
  - Who cannot produce an ovum.
  - Who cannot retain the foetus inside uterus.
  - Whose cervical canal is too narrow to allow the passage for the sperms.
  - Who cannot provide suitable environment for fertilization.
- What does the given below figure depicts in particular?
  - Ovarian cancer
  - Uterine cancer
  - Tubectomy
  - Vasectomy
- One of the legal methods of birth control is
  - Abortion by taking an appropriate medicine.
  - By abstaining from coitus from day 10 to 17 of the menstrual cycle.
  - By having coitus at the time of day break.
  - By a premature ejaculation during coitus.
- Which of the following cannot be detected in a developing fetus by amniocentesis?
  - Klinefelter syndrome
  - Sex of the fetus
  - Down syndrome
  - Jaundice
- Artificial insemination means
  - Transfer of sperms of a healthy donor to a test tube containing ova.
  - Transfer of sperms of husband to a test tube containing ova.
  - Artificial introduction of sperms of a healthy donor into the vagina.
  - Introduction of sperms of a healthy donor directly into the ovary.
- Tubectomy is a method of sterilization in which
  - Small part of the fallopian tube is removed or tied up.
  - Ovaries are removed surgically.
  - Small part of vas deferens is removed or tied up.
  - Uterus is removed surgically.
- Which of the following is a hormone releasing Intrauterine Device (IUD)?
  - Multiload 375
  - LNG-20
  - Cervical cap
  - Vault
- Assisted reproductive technology, IVF involves the transfer of

- (a) Ovum into the fallopian tube
- (b) Zygote into the fallopian tube
- (c) Zygote into the uterus
- (d) Embryo with 16 blastomeres into the fallopian tube

15. Which of the following viruses is not transferred through semen of an infected male?

- (a) Hepatitis B virus
- (b) Human immunodeficiency virus
- (c) Chikungunya virus
- (d) Ebola virus

16. Which of the following is not a sexually transmitted disease?

- (a) Syphilis
- (b) Acquired Immuno Deficiency Syndrome (AIDS)
- (c) Trichomoniasis
- (d) Encephalitis

17. A childless couple can be assisted to have a child through a technique called GIFT. The full form of this technique is

- (a) Gamete intra fallopian transfer
- (b) Gamete internal fertilization and transfer
- (c) Germ cell internal fallopian transfer
- (d) Gamete inseminated fallopian transfer

18. In context of Amniocentesis, which of the following statements is incorrect?

- (a) It is usually done when a woman is between 14–16 weeks pregnant
- (b) It is used for prenatal sex determination
- (c) It can be used for detection of Down syndrome
- (d) It can be used for detection of Cleft palate

19. Which of the following approaches does not give the defined action of contraceptive?

- (a) Barrier methods : Prevent fertilization
- (b) Intra uterine devices: Increases phagocytosis of sperms suppress sperm motility and fertilizing capacity of sperms
- (c) Hormonal contraceptives :Prevent retard entry of sperms, prevent ovulation and fertilization
- (d) Vasectomy :Prevents spermatogenesis

20. Which of the following is hormone releasing IUD?

- (a) Multiload 375
- (b) Lippes loop
- (c) Cu7
- (d) LNG-20

Answers Questions 1. (b) 2. (d) 3. (c) 4. (a) 5. (d) 6. (c) 7. (a) 8. (c) 9. (a) 10. (d) 11. (c) 12. (a) 13. (b) 14. (b) 15. (c) 16. (d) 17. (a) 18. (d) 19. (d) 20. (d)



## ASSERTION AND REASON TYPE QUESTION

Read the assertion and reason carefully to mark the correct option out of the options given below:

- (a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.
- (b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion.
- (c) If the assertion is true but the reason is false.
- (d) If both the assertion and reason are false.

1. Assertion: Statutory ban on amniocentesis for sex determination is done.

Reason: There is increase in female foeticides.

2. Assertion: There is decrease in maternal and infant mortality rates nowadays.

Reason: Better awareness about sex related matter, increased number of medical assisted deliveries and better post-natal care leading to it.

3. Assertion: Couple avoid coitus from day 10 to 17 of the menstrual cycle and it is one of the easy method of contraception.

Reason: Ovulation occurs during these days (fertile period) so there is no chance of conception by abstaining from coitus during this period

4. Assertion: Barrier method is one of the contraceptive methods.

Reason: Barrier method prevents physical meeting of ovum and sperm.

5. Assertion: Spermicidal creams, jellies and foams are usually used along with nutrients.

Reason: All of the above products increases their contraceptive efficiency.

Assertion and Reason Questions

6. Assertion: Copper releasing IUDs are used as contraceptives.

Reason: Cu ions released form IUDs suppresses the sperm motility and the fertilizing capacity of sperms.

7. Assertion: Intentional or voluntary termination of pregnancy before full term is called MTP.

Reason: MTP has a insignificant role in decreasing the population.

8. Assertion: GIFT is gamete intra fallopian transfer.

Reason: ZIFT is zygote intra fallopian transfer.

9. Assertion: IUT is ART.

Reason: IVF embryo is transferred to uterus to complete (more than 8 blastomere) its further development.

10. Assertion: Inability to conceive or produce children even after years of unprotected sexual cohabitation is called infertility.

Reason: ART is commonly used for such couples.

Answer 1. (a) 2. (a) 3. (a) 4. (a) 5. (a) 6. (a) 7. (c) 8. (b) 9. (a) 10. (b)

### SA-I 2 Marks Question

1. Lactational Amenorrhea is a method of contraception. Justify. What is the maximum effectiveness of this method in terms of period/duration?

Ans: (a) Ovulation and menstrual cycle do not occur during the period of intense lactation following parturition. Therefore, as the mother breast feeds, chances of conception are nil.

(b) It is effective only up to a maximum period of six months following parturition.

2. Why is cut considered a good contraceptive device to space children?

Ans : (a) Copper releasing IUDs (CuT, Multiload 325) → These increase phagocytosis of sperms within uterus and release copper ions which suppress sperm motility and fertilising capacity of sperm.

(b) Hormone releasing IUDs – Progestasert, LNG-20 – These makes uterus unsuitable for implantation and the cervix hostile to sperms.

3. What are implants? How do they help in preventing fertilisation?

Ans : The structures which contain hormones like progesterone and estrogen and are placed under the skin. They prevent ovulation and hence prevent fertilization.

4. Briefly explain two natural barriers for birth control.

Periodic abstinence – couple should avoid coitus from 10th to 17th day of menstrual cycle.

Coitus interruptus – Male partner withdraws his penis from the vagina just before ejaculation of semen.

5. Write any four characteristics of an ideal contraceptive.

User friendly, easily available, effective, reversible with no side effects

### SA-II 3 Marks

1. Give another name for sexually transmitted diseases. Name two sexually transmitted diseases which are curable and two diseases which are not curable.

Ans: Venereal disease (VD)/Reproductive tract infection (RTI) Curable – Syphilis, Gonorrhoea Non Curable – Hepatitis B, AIDS

2. Differentiate between Vasectomy and Tubectomy.

#### Vasectomy

1. Method of sterilization in males
2. Vasa deferential of both sides and tied
3. Prevents movement of sperms at cut end.

#### Tubectomy

1. Method of sterilization in females.
2. Fallopian tube of both sides are cut
3. Prevent movement of egg at cut end.

3. Name the techniques which are employed in following cases :

(a) Transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce ova but can provide suitable environment for fertilisation and development.

Ans: (a) Gamete intra fallopian transfer.

(b) Embryo is formed in laboratory in which sperm is directly injected into ovum.

Ans (b) Intra cytoplasmic sperm injection

(c) Semen collected either from husband or a healthy donor is artificially introduced either into vagina or uterus.

Ans (c) Intra uterine insemination

4. Mention the various precautions one has to take in order to protect himself/ herself from STDs.

(i) Avoid blood transfusion from an infected person.

(ii) Avoid sex with an unknown partner and multiple partners.

(iii) Always use condom.

(iv) Avoid sharing of injections needles and syringes and surgical instruments.

5. MTP is not considered safe in second trimester. Give reasons

Ans : Majority MTPs performed illegally by unqualified quacks, misuse for female foeticide, Risk of Health to mother

### **Long Answer**

Q1. Briefly explain the various reproductive technologies to assist an infertile couple to have children

Answer: The couple can be assisted to have children through certain special techniques commonly known as assisted reproductive technologies (ART).

(i) In Vitro Fertilisation (IVF) : Fertilization outside the body in almost similar conditions as that in the body, followed by embryo transfer (E.T.).

Test Tube baby Programme : Ova from the wife/donor female and sperm from husband/donor male are allowed to fuse under simulated condition in the laboratory.

ZIFT : Zygote intra fallopian transfer – Zygote or early embryo upto Eight blastomeres is transferred into the fallopian tube.

IUT : Intra Uterine Transfer – Embryo with more than eight blastomeres are transferred.

(ii) Gamete intra fallopian transfer (GIFT) : Transfer of an ovum collected from a donor to fallopian tube of another female who can not produce ova, but can provide suitable conditions for fertilization and further development of the fetus up to parturition,

(iii) Intra Cytoplasmic sperm injection (ICSI) : The sperm is directly injected into the ovum to form an embryo in the laboratory and then embryo transfer is carried out.

(iv) Artificial Insemination : This method is used in cases where infertility is due to the inability of the male partner to inseminate the female or due to very low sperm counts in the ejaculates. In this method, the semen collected from the husband or a healthy donor is artificially introduced into the vagina or into the uterus (IUI-Intra uterine insemination).

## Chapter 5: Principles of Inheritance

- All genes located on the same chromosome
  - Form different groups depending upon their relative distance
  - Form one linkage group
  - Will not form any linkage group
  - Form interactive group.Ans-b. Form one linkage group
- Conditions of a karyotype  $2n+1$  and  $2n+2$ 
  - Trisomy
  - Nullisomy
  - Both
  - None of these.Ans-a. Trisomy
- Distance between the genes and percentage of recombination shows
  - A direct relationship
  - An inverse relationship
  - No relation
  - A parallel relationshipAns-c- No relation
- Which of the following will not result in variations among siblings?
  - Independent assortment of genes
  - Crossing over
  - Linkage
  - MutationAns-c Linkage
- In a certain taxon of insects some have 17 chromosomes and the others have 18 chromosomes. The 17 and 18 chromosome-bearing organisms are
  - All males
  - All females
  - Male and female
  - Not possible combinationsAns c Male and Female
- Identify the name/ names of the scientists who rediscovered Mendel's work.
  - Hugo DeVries
  - Carl Correns
  - Tschermak
  - All of these

Ans: D

- What is the karyotype of Klinefelter's Syndrome and Turner's syndrome?
  - 45 XO
  - 47 XYY
  - 47 XXY
  - 45 XXYAns: 47, XXY and 45 with XO
- Which of the following represents the XO type of sex determination?
  - Grasshopper
  - Lizard
  - Human
  - EarthwormAns: Grasshopper
- Write the Dihybrid cross ratio when self-cross is carried out between two heterozygous gametes.
  - 1:2:1
  - 9:3:3:1
  - 1:1:1:1
  - None of theseAns: A
- For which types of reproduction Mendel's laws of inheritance are applicable?
  - Asexual Reproduction
  - Sexual Reproduction
  - Both asexual and sexual reproduction
  - None of theseAns: B
- If a genetic disease is transferred from a phenotypically normal but carrier female to only some of the male progeny, the disease is
  - Autosomal dominant
  - Autosomal recessive
  - Sex-linked dominant
  - Sex-linked recessiveAns. d. Sex-linked recessive
- Person having genotype IAIB would show the blood group as AB. This is because of
  - Pleiotropy
  - Co-dominance
  - Segregation
  - Incomplete dominanceAns. b. Co-dominance
- ZZ/WW type of sex determination is seen in



## ASSERTION – REASON QUESTIONS

In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

a. Assertion and reason both are correct statements and reason is correct explanation for assertion.

b. Assertion and reason both are correct statements and reason is not correct explanation for assertion.

c. Assertion is correct statement reason is wrong statement.

d. Assertion is wrong statement reason is correct statement.

1. Assertion: The law of independent assortment can be studied through dihybrid cross.

Reason: Only those genes show independent assortment which are linked.

Ans. c

2. Assertion: There is expression of only one gene of the parental character in a Mendelian Monohybrid cross in F<sub>1</sub> generation.

Reason: In a dissimilar pair of factors one member of the pair dominates the other. Ans. b

3. Assertion: ABO blood group system is a good example of pleiotropic genes. Reason: In ABO blood group system, when I<sup>A</sup> and I<sup>B</sup> alleles are present together, both express themselves.

Ans. d

4. Assertion: Sickle-cell anemia is an autosome – linked recessive disorder.

Reason: It appears only in human male which can be transferred to their grandson through carrier daughter.

Ans. c

5. Assertion: All genetic disorders, Mendelian or chromosomal, are transmitted from one generation to the other.

Reason: Genes are located on chromosomes.

Ans. d.

## Short Answer Question

1. To detect the underlying genotype of an organism with a dominant phenotype, one must do a type of breeding analysis called a test cross. The test cross is another fundamental tool devised by Gregor Mendel. A cross is represented below.

Based on the cross, answer the given questions:

i- Write the genotype of the final offspring.

ii- How it is different from phenotype?

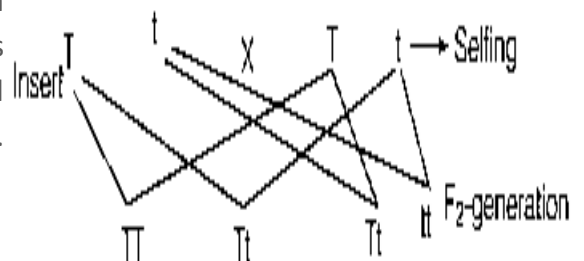
Ans: i- TT: Tt: tt= 1:2:1

iii- The genotype is its specific combination of alleles for a given gene. The phenotype is the physical manifestation of an organism's alleles combination (genotype).

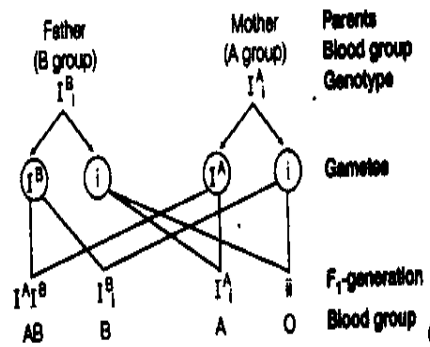
2. The ABO blood group antigens are encoded by one genetic locus, the ABO locus, which has three alternatives (allelic) forms—A, B, and O. A child receives one of the three alleles from each parent, giving rise to six possible genotypes and four possible blood types (phenotypes). The genotype is indicative of the protein type that is found in the RBCs (red blood cells).

i- How is it possible for a child to have a blood group O if the parent's blood group A and B?

ii- In which condition only offspring with blood group O will be produced.



Ans: i-



ii-when parents are homozygous for blood group O.

3. Give an example of the following types of sex determination-

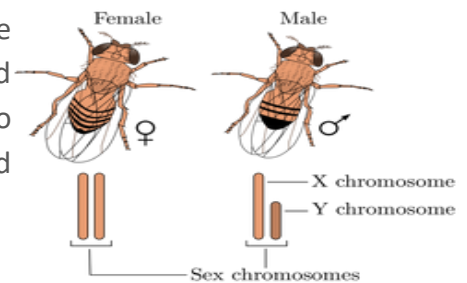
- XO type**
- XY type**
- ZW type**

Ans: XO - insects

XY – human

ZW – Birds

4. T H Morgan worked on fruit flies and observed that the closer the genes, the greater the linkage and vice-versa. He also discovered the white eye mutation in *Drosophila*. He chooses *Drosophila* to study the sex-linked genes. He said that the mutation is inherited differently by male and female flies.



a. Why did Mendel not get a linkage in his experiment on garden pea plants?

b. How distance between gene affects linkage and crossing over?

Ans: Ans: i- the traits Mendel selected were located on different chromosomes and those, which were on the same chromosome, were located very far from each other.

ii- closely situated genes show more linkage while distantly situated genes show more crossing over.

5. An antigen is a foreign substance that enters your body. This can include bacteria, viruses, fungi, allergens, venom, and other various toxins. An antibody is a protein produced by your immune system to attack and fight off these antigens. Blood also has its own antigen or antibody. The four main blood groups A, B, AB, and O are controlled by three alleles: A, B, and O. these are designated by various allelic abbreviations. The blood group shows dominance, codominance as well as multiple allelism property.

i- In the following table fill the correct answer in place of a, b, c and d.

Blood group	Genotype
A	$I^A I^A$
A	a
B	$I^B I^B$
B	b
$I^A I^B$	c
O	d

ii- Which group is a universal donor and why?

Ans: i- a-  $I^A I^O$ , b-  $I^B I^O$  c- AB d-  $I^O I^O$

ii- Blood group O is the universal donor. It has neither A nor B surface antigens on the RBC.



## Chapter 6: MOLECULAR BASIS OF INHERITANCE

### Multiple Choice Questions(MCQs)

- Which of the following enzymes is used for transcription?
  - Amino acid synthetase.
  - DNA polymerase III.
  - RNA polymerase.
  - DNA ligase.
- In the DNA molecule –
  - Proportion of *adenine* in relation to *thymine* varies with the organism.
  - There are two strands which runs *antiparallel* - one in the 5"-3" direction and the other in 3"-5" direction.
  - The total amount of *purine nucleotides* is not always equal.
  - There are two strands which runs *parallel* -both in the 5"-3" direction.
- Which one of the following pairs of codons is correctly matched with its function or a signal for a particular amino acid?
  - AUG; ACG -Start/ Methionine.
  - UUA; UCA -Leucine.
  - GUU; GCU -Alanine
  - UAG; UGA -Stop.
- Choose the „*wrongly*” matched following pairs of nitrogenous bases in nucleic acids.
  - Guanine -Adenine -purines
  - Adenine -Thymine -purines.
  - Thymine -Uracil -pyrimidines.
  - Uracil -Cytosine -pyrimidines.
- According to *Chargaff's rule*, which one of the following is correct?
  - A+T =G+C
  - A+C =G+T
  - A+G =T+C
  - Both (a) and (c).
- DNA has genetic properties was revealed for the first time by –
  - Avery.
  - Griffith.
  - Wilkins.
  - Chargaff.
- Choose the particular process used by Matthew Meselson and Franklin Stahl in order to study the *semi-conservative* replication of DNA.
  - Centrifugation.
  - Chromatography.
  - Buoyant density centrifugation.
  - Density gradient centrifugation.
- Copying genetic information from one strand of DNA into RNA is –
  - Translation.
  - Transcription.
  - Transformation.
  - Transduction.
- The portion of the DNA which contains the information for an entire polypeptide is called –
  - Cistron.
  - Muton.
  - Recon.
  - Operon.
- Repressor protein is produced by –
  - Operator gene.
  - Structural gene.
  - Regulator gene.
  - Promotor gene.
- Retrovirus has the genetic material –
  - DNA only.
  - RNA only.
  - Both DNA and RNA.
  - Either DNA or RNA only.
- Out of 64 codons, only 61 codons code for the *twenty different amino acids*. This character of the genetic code is called –
  - Degeneracy.
  - Non -ambiguous nature.
  - Redundancy.
  - Overlapping.
- Which one is referred to as „*soluble RNA*”?
  - mRNA.
  - rRNA.
  - tRNA.
  - ssRNA.
- If the percentage of *cytosine* is 18%, then the percentage of *adenine* will be –
  - 64%
  - 32%
  - 36%
  - 23%
- Removal of *introns* and joining of *exons* in a defined order in a transcription unit is

called

- a) Tailing.
- b. Transformation.
- c. Capping.
- d. splicing

16. What will be the correct gene expression pathway?

- a) Gene -mRNA -Transcription -Translation -Protein.
- b) Transcription -Gene -Translation -mRNA -Protein.
- c) Gene -Transcription -mRNA - Translation -Protein.
- d) Gene -Translation -mRNA -Transcription

17. In genetic fingerprinting, the „probe“ refers to ....

- a) A radioactively labelled single stranded DNA molecule.
- b) A radioactively labelled single stranded RNA molecule.
- c) A radioactively labelled double stranded RNA molecule.
- d) A radioactively labelled double stranded DNA molecule. DNA molecule.

- Protein.

18. The main aim of the Human Genome Project is –

- a) To introduce new genes into Humans.
- b) To identify and sequence all the genes present in Human DNA.
- c) To develop better techniques for comparing two different human DNA samples.
- d) To remove disease causing genes from Human DNA.

19. DNA gyrase that participates in the process of DNA replication is a type of –

- a. Enzyme
- b. DNA
- c. RNA
- d. Protein

20. In bacteria, the formation of peptide bond during translation is affected by –

- a) Lysozyme.
- b) Nucleosome.
- c) Ribozyme.
- d) Microsome.

### Assertion Reason Type Questions

Choose from the following

- (A) Both Assertion and Reason are true and reason is the correct explanation of assertion.
- (B) Both Assertion and Reason are true and reason is not the correct explanation of assertion.
- (C) Assertion is true and reason is false.
- (D) Assertion is false and reason is true.

21. Assertion (A): hn RNA is larger than mRNA..

Reason (R): hn RNA has non-translating introns which are not Required for translation.

22. Assertion(A): Genetic code is degenerate.

Reason (R): Most amino acids are coded by more than one codon.

23. Assertion (A): Split gene concept is applicable only to the prokaryotes.

Reason (R): Eukaryotic genome is divided into exons and introns.

24. Assertion (A): The genetic code are commaless.

Reason (R): Genetic codes are overlapping.

25. Assertion (A): The operon is a unit of gene expression.

Reason (R): Lac operon in E. coli is an inducible control.

26. Assertion: The two strands of DNA are antiparallel

Reason: Only antiparallel polynucleotides form a stable double helix

27. Assertion (A): DNA replication occurs in small replication forks and not in its entire length.

Reason(R): Replication of DNA does not initiate randomly and DNA polymerases on their own cannot initiate replication.

28. Assertion: The anticodon loop of the tRNA contains bases that are complementary to the codes.

Reason(R): The stop codons are UAA, UAG and UGA.

29. Assertion: Primary transcripts in eukaryotes are nonfunctional.

Reason: Methyl guanosine triphosphate is attached to 5' – end of hnRNA

30. Assertion: tRNA is called an 'adaptor'

Reason: tRNA on one hand bind to a specific amino acid and on the other hand reads the codon of the amino acid bound to it through its anticodon

### Short Answer Questions

31. Three codons on mRNA are not recognized by tRNA during the translation process. Mention these codons? Write the importance of these in protein synthesis

32. Describe any three steps required for the maturation of nascent mRNA into the cell.

33. List the features which must be present in good genetic material

34. RNA was the first genetic material, DNA evolved later on. Explain

35. Describe the role of the following Sigma factor, Rho factor, Release factor, Histone protein.

### SA Type II Questions

36. a- What is DNA fingerprinting?

b- What are the steps of DNA fingerprinting?

C-Mention its application

37. i- Write the stages at which the Regulation of gene expression can be achieved in eukaryotes.

ii-What is the meaning of I, p, and o in operon?

38. Provide any five silent features of human genome.

39. a- Differentiate between the characteristics of genetic codes given below:

(i) Unambiguous (ii) Degenerate

b- What is the significance of the Severo Ochoa enzyme?

40. - i- Why is DNA molecule a more stable genetic material than RNA?

(ii) Explain ii-Draw a double helical diagram of DNA showing phosphodiester bonds.

### Long Answer Questions

1. One chromosome contains one molecule of DNA. In Eukaryotes, the length of the DNA molecule is enormously large. Explain how such a long molecule fits into the tiny chromosomes seen during metaphase. (5)

2.(a) Draw a neat and labelled diagram of a „Replicating fork“ showing „polarity“. Why does DNA replication occur within such replication fork?

(b) Name the enzyme involved in the process of DNA replication along with their properties. (5)

3.(a) Describe the series of experiments conducted by Frederick Griffith. Comment on the significance of the results obtained.

(b) State the contributions of Oswald Avery, Colin McLeod and Maclyn McCarthy. (5)

4.(a) Describe the structure and function of the tRNA molecule.

(b) Why is the tRNA referred to as an „adaptor“ molecule?

(c) Explain the process of „splicing“ of hnRNA in a Eukaryotic cell. (5)

5.(a) Why did Hershey and Chase use radio isotopes of Phosphorus (P32) and Sulphur (S35) in their experiments? Explain the experiment. (5)

(b) Following the experiments conducted by them, state the conclusion they arrived at and how?

6. One chromosome contains one molecule of DNA. In Eukaryotes, the length of the DNA molecule is enormously large. Explain how such a long molecule fits into the tiny chromosomes seen during metaphase. (5)

### Answers

(ANSWER KEY) MCQ

- |  |  |
|--|--|
| 1. c) RNA polymerase   | 16 c) Gene -Transcription -mRNA - Translation -Protein             |
| 2. b) There are two strands which runs antiparallel -one in the 5"-3" direction and the other in 3"-5" direction | 17 b) To identify and sequence all the genes present in Human DNA. |
| 3. d) UAG; UGA -Stop   | 18 c) DNA topoisomerase  |
| 4. b) Adenine -Thymine -purines  | 19 a) A radioactively labelled single stranded DNA molecule.       |
| 5. b) A+T =G+C   | 20 c) Ribozyme.  |
| 6. a) Avery.   | 21.A   |
| 7. d) Density gradient centrifugation.   | 22.A   |
| 8. b) Transcription.   | 23.A   |
| 9. a) Cistron  | 24.D   |
| 10. c) Regulator gene.   | 25.B   |
| 11. b) RNA only  | 26.A   |
| 12. a) Degeneracy.   | 27.B   |
| 13. c) tRNA.   | 28.B   |
| 14. b) 32%   | 29.B   |
| 15. d) Splicing.   | 30.A   |

### 2 MARKS QUESTIONS

31. Ans: Stop codons- UAA, UAG and UGA Help in termination of the translation process and release of polypeptide into cytoplasm.

32. Ans: Splicing- Primary transcripts contain both the exons and the introns. Introns are removed by splicing process and exons are joined in a defined order. Capping- addition of unusual nucleotide (methyl guanosine triphosphate) at 5' end (capping) Tailing- adding polyadenylate residue at 3' end.

33. Ans: (i) It should be able to generate its replica (Replication).

(ii) It should be stable chemically and structurally.

(iii) It should provide the scope for slow changes (mutation) that are required for evolution.

(iv) It should be able to express itself in the form of 'Mendelian Characters'

34. Ans: RNA can directly code for the synthesis of proteins, and hence can easily express the characters.

RNA is used to act as a genetic material as well as a catalyst.

Essential life processes like metabolism, translation, splicing, etc. evolved around RNA.

35. ▪ Sigma factor- initiate transcription process

▪ Rho factor- termination of the transcription process

▪ Release factor- helps in the termination of translation and dissociation of ribosome subunits, the release of the polypeptide

▪ Histone Protein- help in the formation of nucleosome

### THREE MARK QUESTIONS

36.a- DNA fingerprinting is a technique of determining nucleotide sequences of certain areas(VNTRs) of DNA which are different in different individual

b- 1- Isolation of DNA 2- Digestion of DNA by restriction endonucleases 3- Separation of DNA

fragments by electrophoresis 4- Transferring (blotting) of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon 5- Hybridization using labeled VNTR probe 6- Detection of hybridized DNA fragments by autoradiography

c- Paternity disputes can be solved by DNA fingerprinting It is useful in the detection of crime and legal pursuits.

37. Ans: i-transcriptional level (formation of primary transcript), processing level (regulation of splicing),

transport of mRNA from the nucleus to the cytoplasm, translational level.

ii-Regulator gene (i) Codes for the repressor of the lac operon, promoter (p) is the binding site for RNA Polymerase and operator gene (o) It is the binding site for the repressor

38. Ans: The human genome contains 3164.7 million bp., The total number of genes is estimated at 30,000, Almost all (99.9 percent) nucleotide bases are exactly the same in all people, The functions are unknown for over 50 percent of the discovered genes, and Less than 2 percent of the genome codes for proteins, Chromosome 1 has most genes (2968), and the Y has the fewest (231), there are about 1.4 million locations where single base DNA differences (SNPs – single nucleotide polymorphism : 'snips') occur in humans.

39. a- i- Unambiguous: one Condon code for only one amino acid.

ii-Degenerate: When an amino acid is coded by more than one codon b- Severo Ochoa enzyme (polynucleotide phosphorylase) is useful in polymerizing RNA with defined sequences in a template-independent manner (enzymatic synthesis of RNA

40. Ans: the hydrogen between purine and pyrimidine provides stability to DNA. The DNA lacks a 2'OH group which makes it less reactive than RNA.

The thymine in DNA is less reactive than Uracil in RNA. RNA mutates easily.

ii-Fig6.2, page 98.

## Chapter 7: Evolution

### MCQs

- 1) The hypothesis that Life originated from pre existing non living organic molecules was proposed by
  - a) Oparin and Haldane
  - b) Louis Pasteur
  - c) S.L Miller
  - d) Hugo de vries
- 2) "Killed yeast" experiment was performed by
  - a) Haldane
  - b) Oparin
  - c) Pasteur
  - d) Miller
- 3) Louis Pasteur demonstrated that
  - a) Early life came from outer space
  - b) Non- living chemicals produced living molecules
  - c) Life comes from pre-existing life
  - d) Life originated spontaneously
- 4) Miller's experiment did not include
  - a) Methane
  - b) Hydrogen
  - c) Ammonia
  - d) Carbon dioxide
- 5) The theory of origin of life which states that units of life called spores were transferred to earth is called
  - a) Theory of abiogenesis
  - b) Theory of biogenesis
  - c) Theory panspermia
  - d) Cosmozoic theory
- 6) Who proposed that first form of life could have come from pre existing non-living organic molecules?
  - a) S.L Miller
  - b) Oparin and Haldane
  - c) L Pasteur
  - d) Wallace and Darwin
- 7) Darwin judged the fitness of individual by
  - a) Ability to defend itself
  - b) Strategy to obtain food
  - c) Number of offspring produced
  - d) Dominance over other individuals
- 8) Homologous organs indicate
  - a) Convergent evolution
  - b) Divergent evolution
  - c) Adaptive radiation
  - d) Natural selection
- 9) Thorns of Bougainvillea and tendrils of Cucurbita are examples of
  - a) Analogous organs
  - b) Convergent evolution
  - c) Homologous organs
  - d) Vestigial organs
- 10) Analogous structures are
  - a) Anatomically different, but performs similar functions
  - b) Anatomically similar but performs different functions
  - c) Anatomically different and performs different functions
  - d) Anatomically similar and performs similar functions
- 11) Evolutionary convergence is development of a
  - a) Common set of functions in groups of different ancestry
  - b) Dissimilar set of functions in closely related groups
  - c) Common set of structures in closely related groups
  - d) Dissimilar set of functions in unrelated groups
- 12) Darwin's Finches are an excellent example of
  - a) Seasonal migration
  - b) Broad parasitism
  - c) Adaptive radiation
  - d) Connecting links
- 13) Adaptive radiations has been exhibited by
  - a) Darwin's finches
  - b) Australian marsupials
  - c) Australian placental mammals
  - d) All of these

- 14) Modern synthetic theory of organic evolution stresses on
- Mutation
  - Isolation
  - Selection
  - All of these
- 15) Human population grows geometrically, but factors of sustenances grow arithmetically, is the statement given by
- Darwin
  - Wallace
  - Malthus
  - Bateson
- 16) The concept of inherihence of acquired characters is
- Lamarckism
  - Neo-lamarckism
  - Darwinism
  - Neo-darwinism
- 17) Hugo de Vries proposed the mutation theory of organic evolution after this experiments on
- Garden pea
  - Evening prime rose
  - Fruit fly
  - Four O'clock plant
- 18) Single step large mutation leading to speciation is also called
- Branching decent
  - Founder effect
  - Saltation
  - Adaptive radiation
- 19) Genetic drift can best be explained as
- A drastic change in allele frequencies in small population due to some change events
  - Change in allele frequency due to emigration and immigration
  - Addition of new allele of all the genes present in a population
  - The sum total of all the alleles of all the genes present in a population
- 20) Select the correct statement from the following options
- Mutation are random and directional
  - Darwinian variation are small and direction less
  - Fitness is the end result of the ability to adopt and get selected by nature
  - All mammals evolved vivipary as an adaptation

### ASSERTION REASONING QUESTIONS

**In the following question, a statement of assertion followed by a statement of reason is given. Choose the correct answer of the following choices:**

- assertion and reason both are correct statements and reason is correct explanation for assertion
- assertion and reason both are correct statements but reason is not correct explanation for assertion
- assertion is correct statement but reason is wrong statement
- assertion is wrong statement but reason is correct statement

Q.1. Assertion : According to big-bang hypothesis about 20 billion years ago universe was a big ball of only neutrons.

Reason : Movement of these particles is known to generate tremendous heat which caused explosion due to temperature and pressure changes

Q.2. Assertion : Big-bang theory is based on studies of Sir James Jeans.

Reason : He gave the theory of steady state.

Q.3. Assertion : Milky way is the galaxy in the universe.

Reason : Our Earth is part of milky way.

Q.4. Assertion : The primitive atmosphere was reducing once i.e., without oxygen.

Reason : In the primitive atmosphere, oxygen was involved in forming ozone.

Q.5. Assertion : Organic compounds first evolved in earth required for origin of life were protein and nucleic acid.

Reason : All life forms were in water environment only.

Q.6. Assertion: Theory of chemical evolution proposed that life comes from pre-existing nonliving organic molecules.

Reason: The primitive earth conditions led to production of organic molecules.

Q.7. Assertion: Louis Pasteur showed that in flask open to air, new living organisms appeared in the heat killed yeast culture.

Reason: Life arises from pre-existing life.

Q.8. Assertion: Primitive atmosphere was of reducing type.

Reason: First hydrogen atoms combined with all oxygen.

Q.9. Assertion : Stanley Miller could work on experimental evidence of origin of life because of Harold Urey.

Reason : H. Urey was geochemist, cosmochemist and teacher of S. miller.

Q.10. Assertion : Darwin's finches show a variety of beaks suited for eating large seeds, flying insects and cactus seeds.

Reason : Ancestral seed-eating stock of Darwin's finches radiated out from South America main land to different geographical areas of the Galapagos Islands, where they found competitor-free new habitats.

### Very Short answer type question 2 marks

- 1) a) what was the idea of early Greek thinkers about origin of life?  
b) name the scientist who disproved spontaneous generation theory
- 2) how does 'fitness' of a population help in evolution
- 3) how does palaeontological evidence support evolution of organism on earth?
- 4) a) name any 2 vertebrate parts that are homologous to human forelimbs/hand  
b) 'sweet potato tubers and potato tubers are the result of convergent evolution' justify the statement
- 5) how is the mechanism of evolution explained by de Vries

### Short answer type questions 3 marks

- 1) Study the diagrammatic representation of S.L Millers experiment given below and answer the questions

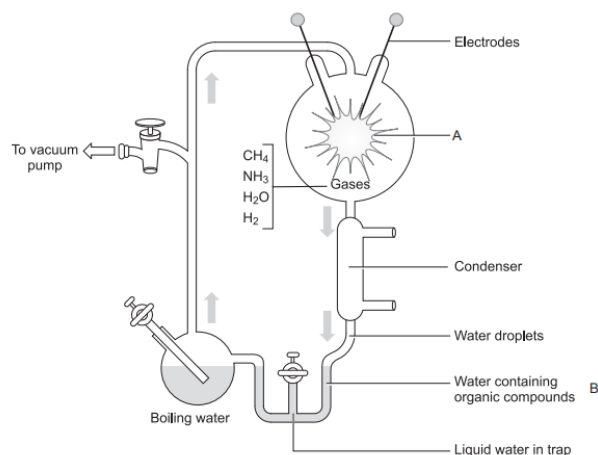
A) how did S.L Miller create the conditions, which existed before the origin of life on earth

B) Name the organic compound formed and collected at the end of the experiment

C) Mention the kind of evolution his experiment supported

2) Mention and explain the type of evolution the thorns of Bougainvillea and tendrils of Cucurbita are a result of. Write a similar example of animal kingdom.

3) Explain convergent evolution with the help of examples





- 4) Describe Lamarck's theory of evolution
- 5) A) When and where did Neanderthal man lived?  
B) What was his brain capacity?  
C) Mention the advancement he showed over Homo erectus?

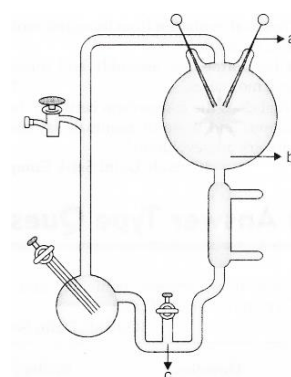
### LONG ANSWER TYPE QUESTIONS 5 MARKS

- 1) Explain Darwinian theory of evolution. State the 2 key concept of the theory.
- 2) Explain Hardy-Weinberg principle with the help of an algebraic equation

### CASE BASED QUESTIONS

1) The origin of life is considered a unique event in the history of universe. Earth was supposed to have been formed about 4.5 billions years ago and life appeared about 4 billion years ago. Many theories have been proposed for the origin of life on earth.

The diagrammatic representation of experiment set up used by S.L Miller is shown below, answer the question



- a) Name the organic compound miller observed in the sample collected at 'c' in the figure
  - b) Miller created electric discharge in the closed chamber containing the gases what is the temperature he maintains in the chamber
  - c) Name the gases that miller enclosed in the chamber
- 2) When the reptiles came down, mammals took over the earth. There' were mammals in South America, which resembled some of the modern day mammals. But due to continental drift, they disappeared whereas the pouched mammals of Australia flourished and evolved into the various forms of pouched mammals that we see today.
- i) What event led to the rise of mammals on Earth?
    - A) The arrival of birds
    - B) The disappearance of reptiles
    - C) Continental drift
    - D) The evolution of pouched mammals
  - ii) What unique type of mammals flourished and evolved in Australia?
    - A) Rodents
    - B) Primates
    - C) Pouched mammals
    - D) Hoofed mammals
  - iii) What is the primary reason cited for the disappearance of certain mammals in South America?
    - A) Predation by reptiles
    - B) Continental drift
    - C) Climate change
    - D) Overpopulation

## ANSWERS

### CHAPTER EVOLUTION

#### MCQS

1. (a)
2. (c)
3. (c)
4. (d)
5. (c)
6. (b)
7. (c)
8. (b)
9. (c)
10. (a)
11. (a)
12. (c)
13. (d)
14. (d)
15. (c)

16. (a)
17. (b)
18. (c)
19. (a)
20. (c)

#### Assertion reasoning

1. A
2. B
3. D
4. C
5. B
6. A
7. B
8. A
9. A
10. A

### VERY SHORT ANSWER TYPE 2 MARKS

A) according to theory, it was believed that units called 'spores' came on the earth along with meteorites. They must have evolved into the various light forms

b) Louis Pasteur

2) -fitness according to Darwin refers ultimately and only to reproductive fitness

-they will survive better and are selected by nature to reproduce and increase their population size

3) paleontology is the study of fossils. It indicates- the geological time period in which the organism existed

-life forms varied overtime and certain lifeforms are restricted to certain geological time spans

-new form of life have appeared at different times in the history of life

4) a) wings of birds, flippers of whales, forelimbs of dogs/cat, wings of bats (any 2)

b) sweet potato tubers and potato tubers are analogous structures evolve for the same function i.e storage of food, analogous structure result from convergent evolution as adaption to similar habitat

5) -according to de Vries it is mutation, the large differentiation arising suddenly causes evolution and not the minor variation as held by Darwin

-Mutation are random and directionless.

-he believed that single step large mutation, called saltation causes speciation (any 2)

### 3 MARKS QUESTION

A) S. L Miller created conditions similar to that existed on the earth before origin of life in laboratory scale

He created electric discharge in a closed flask which contains gas methane, hydrogen, ammonia and water vapour at 800o C

B) amino acids

c) the experiment supported abiogenesis i.e origin from life from pre existing non living organic molecules preceded by chemical evolution

2) they are the result of divergent evolution. Divergent evolution is the evolutionary process in which anatomically the same structure develops in different directions in different groups of organism as adaptation to different needs.

Forelimbs (hands) of man and wings of birds

3)convergent evolution is the process in which anatomically different structures in different groups of organism evolve towards same functions in similar habitats

-it is the similar habitat that results in the selection of similar adaptive features in different groups of organism for the same function

Example-plants, sweet potato tubers(root modification) and potato tubers(stem modification)

Animals-flippers of penguin and those of dolphins

Eyes of octopus and those of mammals (any 1)

4)- lamarck's theory is known as theory of inheritance of acquired characters

- according to this theory, organism undergo certain changes to adopt themselves to the environment

-these characters acquired by an organism during its lifetime, are passed on to the progeny i.e the long neck of giraffe was explained by lamarcks, as an outcome of these animals having to stretch their neck constantly to eat the leaves on the upper branches of the trees

5)A)Neanderthal man lived in near east and central Asia between 1,00,000 -40,000 years before

B)His brain capacity was 1400 cc

C)He used hides to protect their body. He buried the dead.

His brain size was more (1400cc) then that of homo erectus which was 900cc

### LONG ANSWER TYPE QUESTIONS 5 MARKS

-individual with those characters which enable them to survive better in environment would out beat the others who are less adapted

-fitness according to Darwin is reproductive fitness ie. Individuals who are more fit in an environment leave more progeny then others

-these progenies survive better and better and more and more fit individuals are added to the population ie. Natural selection

-the population thus comes to possess more fit individual ie. Nature selects the better the better fit individual and over a long period of time through a number of generation, the population slowly becomes modified into the different forms or species in the process called evolution

Ex-evolution of DDT resistant mosquitoes

The 2 key concept of Darwinian theory are- branching descent, natural selection

$P^2+2pq+q^2=1$

-equation represents Hardy- Weinberg equilibrium

-this principle stated that allele frequencies in a population are stable and remain constant from generation-to-generation i.e. The gene pool remains a constant. This is genetic equilibrium

-the sum total of all the allele frequencies is 1

-individual frequencies are named as p and q which represent the frequencies of alleles A and a respectively in a population of deployed organisms

-the frequency of AA individuals is  $p^2$ , while that of Aa is  $2pq$  and aa is  $q^2$ . Hence  $p^2+2pq+q^2=1$

Any deviation in the frequency of alleles represents evolutionary change

#### CASE BASED QUESTIONS

A) formation of amino acids, sugar, nitrogen bases, pigment, and fats

B)  $800^\circ\text{C}$

c)  $\text{CH}_4$ ,  $\text{NH}_3$ ,  $\text{H}_2$

i) b

ii) c

iii) b

## CHAPTER 8: HUMAN HEALTH AND DISEASE

### 1. Multiple Choice Questions:

- Which of the following is not a viral disease?
  - Influenza
  - Typhoid
  - HIV/AIDS
  - Chickenpox
- What is the primary causative agent of malaria?
  - Bacteria
  - Virus
  - Protozoa
  - Fungus
- What is the common name for Varicella zoster virus?
  - Measles virus
  - Herpes simplex virus
  - Chickenpox virus
  - Human papillomavirus
- Which of the following diseases is caused by a deficiency of iron?
  - Rickets
  - Beriberi
  - Scurvy
  - Anemia
- Which of the following is a communicable disease?
  - Diabetes
  - Cancer
  - Tuberculosis
  - Hypertension
- What is the causative agent for dengue fever?
  - Bacteria
  - Virus
  - Protozoa
  - Fungus
- The transmission of HIV can occur through which of the following ways?
  - Mosquito bites
  - Blood transfusion
  - Shaking hands
  - Sharing utensils
- Which of the following is not a symptom of tuberculosis?
  - Coughing up blood
  - Persistent cough for more than three weeks
  - Unexplained weight loss
  - Muscle cramps
- What is the primary causative agent of typhoid?
  - Salmonella typhi
  - Escherichia coli
  - Streptococcus pyogenes
  - Vibrio cholerae
- Which of the following is not an autoimmune disease?
  - Rheumatoid arthritis
  - Type 1 diabetes
  - Lupus
  - Parkinson's disease
- The type of immunity that is not specific and is the first line of defense against pathogens is called:
  - Adaptive immunity
  - Active immunity
  - Passive immunity
  - Innate immunity
- Allergies are exaggerated responses of the immune system to normally harmless substances known as:
  - Antibodies
  - Pathogens
  - Allergens
  - Toxins
- Which of the following is a common symptom of an allergic reaction?
  - Fever
  - Joint pain
  - Redness and itching
  - Loss of appetite
- The human immunodeficiency virus (HIV) primarily targets which type of immune cell?
  - B cells
  - T cells
  - Macrophages
  - Eosinophils
- Cancer refers to the uncontrolled growth of abnormal cells in the body, leading to the formation of a:
  - Tumor
  - Cyst
  - Abscess
  - Lesion

16. The process of the maturation of reproductive organs and the development of secondary sexual characteristics during adolescence is primarily regulated by:

- a) Insulin      b) Testosterone and estrogen  
c) Thyroxine   d) Melatonin

17. Substance abuse during adolescence can have a detrimental effect on the development of the:

- a) Liver      b) Heart  
c) Brain      d) Kidneys

18. Which of the following is not a commonly abused drug?

- a) Alcohol      b) Nicotine  
c) Caffeine      d) Antibiotics

19. Which of the following is an example of a psychoactive drug?

- a) Antibiotics      b) Antihistamines  
c) Opioids      d) Antipyretics

20. Which of the following types of immunity is acquired naturally through the placenta or breast milk?

- a) Innate immunity      b) Active immunity  
c) Passive immunity      d) Adaptive immunity

Answers-

1. b) Typhoid
2. c) Protozoa
3. c) Chickenpox virus
4. d) Anemia
5. c) Tuberculosis
6. b) Virus
7. b) Blood transfusion
8. d) Muscle cramps
9. a) Salmonella typhi
10. d) Parkinson's disease
11. d) Innate immunity
12. c) Allergens
13. c) Redness and itching
14. b) T cells
15. a) Tumor
16. b) Testosterone and estrogen
17. c) Brain
18. d) Antibiotics
19. c) Opioids
20. c) Passive immunity

## 2. Assertion-Reason type questions:

For the following questions, two statements are given-one labelled Assertion(A) and other labelled Reason(R). Select the correct answer to these questions and answer as follows-

- If both A and R are true and R is the correct explanation of A, then mark (a).
  - If both A and R are true but R is not the correct explanation of A, then mark (b).
  - If A is true, but R is false, then mark (c).
  - If A is false, but R is true, then mark (d).
1. A: The body's innate immune system provides a generalized defense mechanism against pathogens.  
R: Innate immunity is antigen-specific and generates memory cells upon exposure to pathogens.
  2. A: Allergies are primarily caused by the hyperactivity of B cells in response to foreign substances.

R: Allergic reactions involve the release of histamines and other inflammatory mediators by mast cells and basophils.

3. A: The human immunodeficiency virus (HIV) targets macrophages and dendritic cells in addition to T cells.

R: HIV weakens the immune system by interfering with the function of B cells and their production of antibodies.

4. A: The excessive use of certain drugs can lead to physiological dependence and withdrawal symptoms.

R: Drug addiction is solely a behavioral issue and does not have any physiological consequences.

5. A: The development of cancer is closely associated with genetic mutations and abnormalities in cellular regulatory mechanisms.

R: Cancer cells can be controlled and eliminated by the body's immune system without any external intervention.

6. A: Antibiotics are effective against viral infections.

R: Viruses lack cellular machinery to carry out metabolic processes.

7. A: Tuberculosis is caused by a bacterium that primarily affects the lungs.

R: The tuberculosis bacterium, *Mycobacterium tuberculosis*, primarily targets the central nervous system.

8. A: The human immunodeficiency virus (HIV) weakens the immune system by destroying T-helper cells.

R: HIV primarily affects the central nervous system, leading to cognitive impairments and dementia.

9. A: Vaccination is a preventive measure for infectious diseases.

R: Vaccines stimulate the body's immune response by inducing the production of memory cells that provide immunity against specific pathogens.

10. A: Malaria is transmitted through the bite of an infected *Anopheles* mosquito.

R: Malaria is primarily transmitted through contaminated food and water, leading to gastrointestinal infections.

Answers:

1. (c)
2. (a)
3. (c)
4. (c)
5. (c)
6. (d)
7. (c)
8. (c)
9. (b)
10. (c)

### 3. Short Answer Type Questions (2-marks each):

1. Discuss the major types of hypersensitivity reactions associated with allergies, highlighting their underlying mechanisms.
2. Differentiate between HIV and AIDS, emphasizing the modes of transmission and the clinical stages of the disease.

3. Explain the role of the thymus gland in the immune system, outlining its significance in T cell development.
4. Describe the common signs and symptoms of drug addiction, highlighting the neurological changes associated with substance abuse.
5. Elaborate on the physiological changes that occur during adolescence, focusing on the role of hormones in shaping behavioral patterns.

Answers:

1. Hypersensitivity reactions associated with allergies are classified into four types. Type I involves immediate hypersensitivity and is mediated by IgE antibodies. Type II reactions involve cytotoxic hypersensitivity, type III reactions are immune complex-mediated, and type IV reactions are delayed-type hypersensitivity mediated by T cells.
2. HIV (Human Immunodeficiency Virus) is the virus that attacks the immune system, while AIDS (Acquired Immunodeficiency Syndrome) is the final stage of HIV infection when the immune system is severely damaged. HIV can be transmitted through blood, semen, vaginal fluids, and breast milk. The clinical stages of HIV include acute infection, clinical latency, and AIDS.
3. The thymus gland plays a critical role in the maturation and selection of T cells. It provides the necessary microenvironment for the differentiation and maturation of T cells, leading to the development of self-tolerant and competent T cells that are capable of recognizing and eliminating foreign antigens.
4. Drug addiction is characterized by compulsive drug-seeking behavior, continued use despite harmful consequences, and long-lasting changes in the brain. Neurobiological changes associated with substance abuse involve alterations in the reward pathway, leading to increased dopamine release and changes in neural circuits that control decision-making and self-control.
5. Adolescence is marked by the release of hormones such as testosterone and estrogen, leading to physical changes such as growth spurts, development of secondary sexual characteristics, and emotional changes. Hormonal fluctuations during adolescence can influence mood swings and behavioral fluctuations in teenagers.

#### **4. Short Answer Type Questions (3-marks each):**

1. Compare and contrast the roles of B cells and T cells in the immune response, emphasizing their specific functions and mechanisms of action.
2. Explain the principles of chemotherapy in cancer treatment, discussing the challenges associated with targeting cancer cells specifically.
3. Discuss the major challenges in managing and preventing the spread of HIV/AIDS, highlighting the importance of public health interventions and awareness programs.
4. Analyze the impact of prolonged drug abuse on the central nervous system, outlining the neurobiological changes that lead to addiction and dependence.
5. Elucidate the immune evasion strategies employed by pathogens to counteract the host's immune responses, emphasizing their implications for disease progression and treatment strategies.

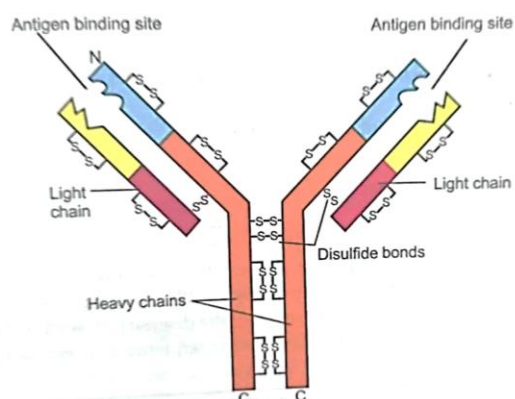


Answers:

1. B cells are responsible for the production of antibodies and the humoral immune response. They mature in the bone marrow. T cells, on the other hand, are involved in cell-mediated immunity and are produced in the bone marrow but mature in the thymus. B cells recognize antigens and produce antibodies, while T cells recognize antigens and directly kill infected cells.
2. Chemotherapy in cancer treatment involves the use of drugs to destroy cancer cells. It works by disrupting the cell cycle and targeting rapidly dividing cells. However, it can also affect normal, healthy cells, leading to side effects such as hair loss, nausea, and compromised immune function. Targeting cancer cells specifically is challenging due to the similarities between cancer cells and normal cells.
3. Managing and preventing the spread of HIV/AIDS involves implementing comprehensive prevention programs, promoting safe sexual practices, providing access to antiretroviral therapy, and addressing the social stigma associated with the disease. Public health interventions and awareness programs play a crucial role in educating communities about prevention and treatment strategies.
4. Prolonged drug abuse can lead to neurobiological changes in the central nervous system, including alterations in the brain's reward system, changes in neurotransmitter levels, and structural changes in neural circuits. These changes contribute to the development of tolerance, dependence, and addiction, leading to compulsive drug-seeking behavior and impaired cognitive function.
5. Pathogens employ various immune evasion strategies to counteract the host's immune responses, including antigenic variation, suppression of the immune response, and hiding within host cells. These strategies allow pathogens to evade recognition and destruction by the immune system, leading to persistent infections and challenges in developing effective treatment strategies.

### 5. Case Based Questions (4-marks each):

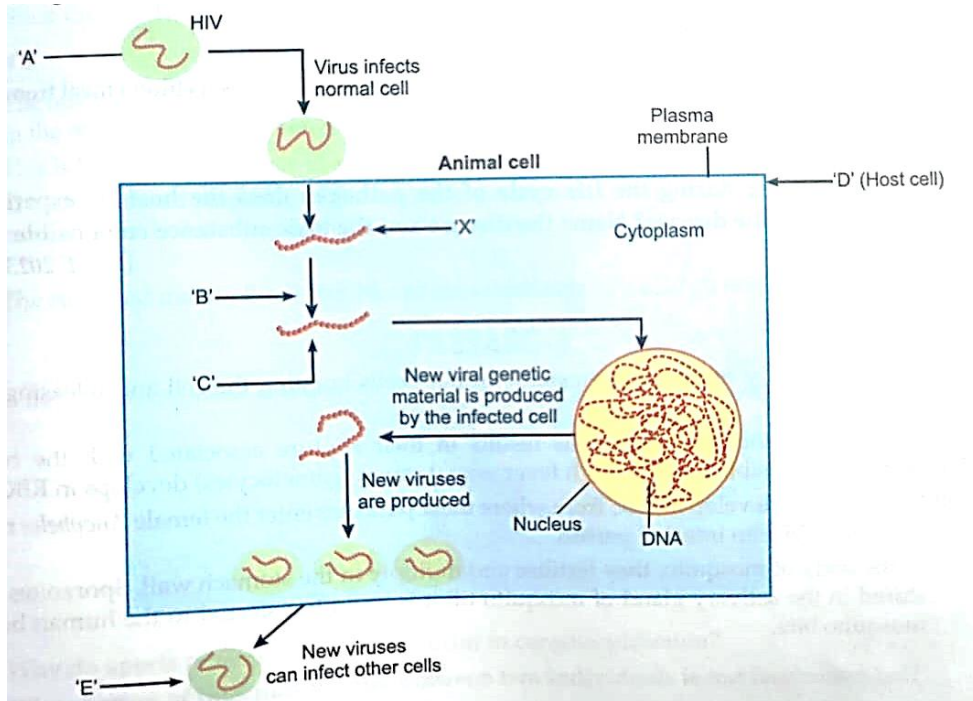
1. Observe the structure of an antibody given below and answer the questions that follow-



- a) A boy of 10 years had chickenpox. He is not expected to have the same disease for the rest of his life. Mention, how it is possible.
- b) Why is secondary immune response more intense than the primary immune response in humans?

- c) Some allergens trigger sneezing and wheezing in human beings. What causes this type of response by the body?
- d) State the functions of mast cells in allergy response.

2. Observe the given diagram showing the replication of HIV in humans and answer the questions that follow-



- a) What type of virus causes AIDS? Name its genetic material.
- b) List any two ways of transmission of HIV infection in human other than sexual contact.
- c) Name the enzyme 'B' acting on 'X' to produce molecule 'C'. Name 'C'.
- d) Name the type of cells the AIDS virus enters into after getting in the human body.

### Answers-

1)

- a) The boy, when encounters a pathogen for the first time, his body produces antibodies that results in the memory of the first encounter, to protect the body in future.
- b) This is because of presence of antibodies developed during primary response.
- c) The exaggerated response of the immune systems to certain antigens (allergens) present in the environment, is the cause of this type of response.
- d) The ruptured mast cell releases histamine which acts as an allergy mediator.

2)

- a) Retro virus causes AIDS. RNA is its genetic material.
- b) Infected blood transfusion, sharing needles, children born to HIV mothers.
- c) The enzyme 'B' is reverse transcriptase. 'C' is viral DNA.
- d) Macrophages and helper T-lymphocytes.

## 6. Long Answer type questions (5 marks each):

1.

- a) Cancer is one of the most dreaded diseases of humans. Explain 'Contact inhibition' and 'metastasis' with respect to the disease.
- b) Name any two techniques, which are useful to detect cancers of internal organs.
- c) Why are cancer patients often given  $\alpha$ -interferon as part of the treatment?

2.

- a) How does smoking tobacco in human lead to oxygen deficiency in their body?
- b) Name the plant source of Ganja. How does it affect the body of the abuser?

Answers-

1.

- a) Contact inhibition is the property of normal cells, in which contact with other cells inhibits their uncontrolled growth;  
Metastasis is the property in which tumour cells reach distant sites in the body, through blood.
- b) Biopsy/ radiography/ CT/MRI. (Any two)
- c)  $\alpha$ -interferon activates immune system and destroys the tumour.

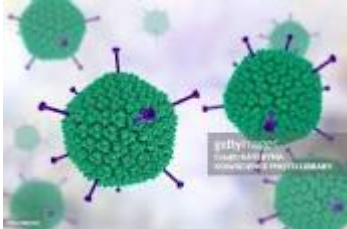
2.

- a) Smoking increases the carbon monoxide (CO) content in the blood, which has greater affinity to haemoglobin than oxygen. CO forms a stable bond with haemoglobin and does not allow binding of oxygen. Smoking also damages alveolar walls which reduces respiratory surface (emphysema).
- b) Cannabinoids are obtained from the inflorescence of the plant, *Cannabis sativa*. Marijuana, Hashish, Charas, Ganja are some cannabinoids. These chemicals interact with cannabinoid receptors of the body, mainly present in the brain cardiovascular system is affected adversely.

## CHAPTER 10: MICROBES IN HUMAN WELFARE

### MCQ

Q1 Identify the virus which causes respiratory infections.



- a) Adenovirus                      b) Bacteriophage  
c) TMV                              c) None

Q2 A blood cholesterol lowering agent is

- a) Cyclosporin A                  b) Streptokinase  
c) Lactobacillus                  d) Statin

Q3. It is ripened by growing a specific fungi on them for a particular flavour

- a) Swiss cheese                  b) Roquefort cheese  
c) Toddy                            c) Bread

Q4. It is called brewer's yeast

- a) *Saccharomyces cerevisiae*  
b) *Aspergillus niger*  
c) *Lactobacillus*  
d) *Monascus purpureus*

Q5 Bacteria present in the rumen of a cattle digest cellulose into

- a) polysaccharides                b) sucrose  
c) ethanol                          d) methane

Q6. Which among the biofertilisers does not fix atmospheric nitrogen?

- a) *Oscillatoria*                    b) *Rhizobium*  
c) *Azospirillum*                  d) *Glomus*

Q7. Some cyanobacteria in aquatic and terrestrial environment that enrich the soil by fixing nitrogen are

- a) *Rhizobium* and *Azotobacter*  
b) *Azospirillum* and *Glomus*  
c) *Anabaena* and *Nostoc*  
d) *Azospirillum* and *Azotobacter*

Q8. The bioactive molecules used as an immuno-suppressive agent during organ transplant, is

- a) Tetracycline                    b) Cyclosporin A  
c) Statin                            d) Streptomycin

Q9. The microbes commonly used in kitchen, are

- a) *Lactobacillus* and Yeast  
b) *Penicillium* and yeast  
c) *Microspora* and *E. coli*  
d) *Rhizopus* and *Lactobacillus*

Q10. Full potential as an effective antibiotic was established by

- a) Ernest Chain                  b) Howard Florey  
c) Alexander Flemming        d) Both a and b

Q11. Identify the picture.



- a) Primary treatment of sewage  
b) Secondary treatment of sewage  
c) Biogas plant  
d) Fermentor

Q12. BOD of waste water is estimated by measuring the amount of

- a) Total organic matter  
b) biodegradable organic matter  
c) Oxygen evolution  
d) oxygen consumption

Q13. Bottled fruit juices from market are clearer than that at home because of

- a) Antibiotics                    b) hormones  
c) enzymes                      d) filtration

Q14. Which one of the following alcoholic drinks is produced without distillation?

- a) Wine                            b) Whisky  
c) Rum                            d) Brandy

Q15. Wastewater treatment generates a large quantity of sludge, which can be treated by

- a) Anaerobic digester        b) floc  
c) chemicals                    d) oxidation pond

Q16 The vitamin whose content increases following the conversion of milk into curd by lactic acid bacteria is

- a) Vitamin c                      b) vitamin D  
c) vitamin B<sub>12</sub>                      d) vitamin E

Q17. The technology of biogas production from cow dung was developed in India largely due to the efforts of

- a) Gas Authority of India  
b) Oil and Natural Gas Commission  
c) Indian Agricultural Research Institute and Khadi and Village Industries Commission  
d) Indian Oil Corporation

Q18. Mycorrhiza does not help host plant in

- a) Enhancing its phosphorus intake capacity  
b) increasing its tolerance to drought  
c) enhancing its resistance to root pathogen  
d) increasing its resistance to insects

Q19. Methanogens do not produce

- a) Oxygen  
b) buried in land fills  
c) hydrogen sulphide  
d) carbon di oxide

Q20. The primary treatment of waste water involves the removal of

- a) Dissolved impurities  
b) stable particles  
c) toxic substances  
d) harmful bacteria

Q.NO	CORRECT OPTION
1	A Adenovirus
2	D Statin
3	B Roquefort Cheese
4	A Saccharomyces cerevisae
5	A Polysaccharides
6	D Glomus
7	C Anabeana and Nostoc
8	B Cyclosporin A
9	A Lactobacillus and Yeast
10	D Both a and b
11	B Secondary treatment of sewage
12	D Oxygen consumption
13	C Enzymes
14	A Wine
15	A Anaerobic digester
16	C Vitamin B12
17	C Indian Agricultural Research Institute and Khadi and Village Industries Commission
18	D Increase its resistance to insects
19	A Oxygen
20	B Stable particles

## MICROBES IN HUMAN WELFARE

### ASSERTION AND REASONING

For question numbers 1-10, two statements are given-one labelled Assertion and the other labelled Reason Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (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.

1. Assertion: Azotobacter fixes nitrogen in symbiotic form.

Reason: Azotobacter form root nodules in the roots of leguminous plants.

2. Assertion: Rhizobium forms nodules on the roots of legume plants. Reason: Rhizobium fixes atmospheric nitrogen into organic forms which is used by the plant as nutrients.

3. Assertion: Azolla is used as a biofertiliser in rice fields.

Reason: Azolla shows the presence of  $N_2$ - fixing bacteria in its leaf cavities.

4. Assertion: An organism which acts as herbicide is called bioherbicide.

Reason: Phytophthora palmivora is a mycoherbicide.

5. Assertion: Intercropping checks the population of insects.

Reason: Plant pests can be controlled biologically by their natural parasites and pathogens.

6. Assertion: Whisky develops colour during the aging process.

Reason: Vodka is colourless.

7. Assertion: Immobilised yeasts cause less fermentation.

Reason: Brewer's yeast produces beer not wine

8. Assertion: Curdling is required in the manufacture of cheese.

Reason: Lactic acid bacteria and rennet is used for the purpose.

9. **Assertion:** In ripening of cheese, insoluble proteins are cleaved to form soluble peptides.

**Reason:** Hard cheese and soft cheese, both are ripened by lactic acid bacteria.

10. **Assertion:** Enzymes application in industry is enhanced by its immobilisation.

**Reason:** Immobilisation provides protection to enzymes without affecting their activity.

## SOLUTIONS

### ASSERTION AND REASONING

Q.NO	CORRECT OPTIONS
1	d
2	b
3	a
4	b
5	b
6	b
7	d
8	b
9	c
10	a

## SA-1 Q

### 2 marks Questions

1 Your advice is sought to improve the nitrogen content of the soil to be used for cultivation of a non-leguminous terrestrial crop.

- (a) Recommend two microbes that can enrich the soil with nitrogen.  
(b) Why do leguminous crops not require such enrichment of the soil?

Ans : a) Azospirillum/ Azotobacter/ Anabaena/ Nostoc / Oscillatoria /Frankia (Any two correct names of microbes).

(If cyanobacteria mentioned= $\frac{1}{2}$ , but if along with cyanobacteria-anabaena / Nostoc / Oscillatoria mentioned then no mark on cyanobacteria).

(b) They can fix atmospheric nitrogen, due to presence of Rhizobium/N<sub>2</sub> fixing bacteria in their root nodules.

2 Name the microbes that help the production of the following products commercially:

- (i) Statins (ii) Citric acid  
(iii) Penicillin (iv) Butyric acid

Ans : (i) Monascus purpureus (ii) Aspergillus niger  
(iii) Penicillium notatum (iv) Clostridium butylicum

3 Name a genus of baculovirus. Why are they considered good biocontrol agents?

Ans : Nucleopolyhedrovirus

Species specific, narrow spectrum insecticidal application, no negative impact on non-target organisms

4 Mention a product of human welfare obtained with the help of each one of the following microbes.

- (i) LAB (ii) Saccharomyces cerevisiae  
(iii) Propionibacterium shermanii (iv) Trichoderma polysporum

Ans : (i) Milk to curd  
(ii) Bread / ethanol / alcoholic drinks / whisky / brandy/ beer/ rum  
(iii) Swiss cheese  
(iv) Cyclosporin A

5 Distinguish between the roles of flocs and anaerobic sludge digesters in sewage treatments.

Sl.	Flocs	Anaerobic Sludge Digester
(i)	Breakdown organic matter aerobically.	Breakdown organic matter anaerobically.
(ii)	Breaks down organic matter present in primary effluent.	Breaks down organic matter present in secondary effluent.
(iii)	They do not produce biogas.	They produce biogas (mixture of methane, H <sub>2</sub> S and CO <sub>2</sub> )

### L.A.3 MARKS

Q1. What is the key difference between primary and secondary sewage treatment?

Q2. How do biofertilizers enrich the fertility of the soil?

Q3. Name the blank spaces a,b,c,d,e,f given in the following table.

Type of Microbe	Name	Commercial product
Bacterium	a	Clot bluster enzyme
b	Aspergillus niger	Citric acid
Fungus	Trichoderma polysporum	c
Bacterium	d	Butyric acid
e	Monascus perpuricus	statin
Bacterium	f	Lactic acid

Q4. Secondary treatment of the sewage is also called Biological treatment. Justify this statement and explain the process.

Q5. Explain the different steps involved during primary treatment phase of sewage.

### 5 marks Question

Q1, Explain the role of baculovirus as biological control agents. Mention their importance in organic farming.

Q2. Explain the different steps involved in the secondary treatment of sewage.

## CASE BASED

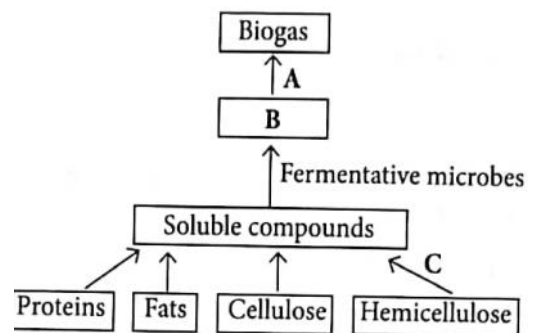
### MICROBES IN HUMAN WELFARE

1. Read the following and answer any four questions from (i) to (v) given below:

2.

Villagers in a place near Chembur started planning to make power supply for agricultural purposes from cow dung. They have started a biogas plant for the purpose.

Study the flow chart for biogas production given below and answer the following questions.



1) Biogas is composed of majorly

(a) methane, b) oxygen (c) CO<sub>2</sub> d) H<sub>2</sub>S

(ii) In the given flow chart, 'A' denotes

(a) aerobic bacteria (b) methanogenic bacteria (c) cellulose degrading bacteria  
(d) yeast and protozoa.

(iii) What is represented by 'B' in the flow chart?

(a) Carbohydrates (b) Protein polymer (c) Organic acids (d) Fat globules

(iv) 'C' in the given flow chart causes

(a) aerobic breakdown of complex organic compounds  
(b) anaerobic digestion of complex organic compounds  
(c) fermentation of organic compounds  
(d) fermentation of monomers.

v) If 'A' is not added in the procedure

(a) methane will not be formed  
(b) CO<sub>2</sub> will not be formed  
(c) organic compounds will not be converted to H<sub>2</sub>S  
(d) O<sub>2</sub> will not be formed.



2. Read the following and answer any four questions from (i) to (v) given below:

Enzymes are best known for their ability to catalyze biochemical reactions without undergoing large number of enzymes are being used in biotechnological industry. Most of them are obtained from microbes. Proteases degrade proteins and polypeptides. Most of the commercially applicable proteases are alkaline and are biosynthesized mainly by bacteria such as *Pseudomonas*, *Bacillus* and some fungi like, *Aspergillus*. These enzymes are used in clearing beer, softening of bread and meat, degumming of silk, etc. Alkaline serine proteases have the largest applications in bio-industry. Alkaline proteases have shown their capability to work under high pH, temperature and in presence of inhibitory compounds. Another important group of enzymes is amylases. Amylolytic enzymes act on starch. These are obtained from *Aspergillus*, *Rhizopus* and *Bacillus* sp. These are used in softening and sweetening of bread, production of alcoholic beverages from starchy materials, clearing of turbidity in juices caused by starch, etc.

(i) Polypeptides are degraded by

(a) amylases (b) proteases (c) pectinase (d) lipases.

(ii) Amylolytic enzymes are not obtained from

(a) *Aspergillus* (b) *Rhizopus* (c) *Mucor* (d) *Bacillus*

(iii) Clearing of turbidity in juices caused by starch is achieved by

(a) amylases (b) proteases (c) rennet (d) both (a) and (b).

(iv) Select the incorrect option from the following.

(a) Enzymes are proteinaceous substances. (b) Enzymes are substrate specific.

(c) Enzymes are large sized molecules.

(d) Microbial enzymes can work only in normal temperature and pH.

v) A farmer harvests corns and prepares corn starch. He wants to prepare some corn syrup from this.

For the conversion he needs to use enzyme

(a) amylase (b) glucoamylases (c) glucoisomerases (d) all of these

### SOLUTIONS CASE BASED QUESTIONS

Q. NO	CORRECT OPTION
1 i	c
ii	b
iii	c
iv	b
v	a
2.i	b
ii	c
iii	a
iv	d
v	d

# 11. BIOTECHNOLOGY- PRINCIPLES AND PROCESSES

## MULTIPLE CHOICE QUESTIONS: -

- PCR is used for:
  - In vitro synthesis of RNA
  - In vitro synthesis of DNA
  - In vitro replication of RNA
  - In vitro replication of DNA
- Which enzymes are called molecular scissor?
  - DNA polymerase
  - DNA ligase
  - Restriction endonucleases
  - Proteases
- Which step is catalyzed by DNA polymerase enzyme during PCR?
  - Denaturation of DNA
  - Annealing of DNA
  - Formation of RNA primer
  - None of the above
- Which bacteria is used to make thermostable DNA polymerase in PCR?
  - Agrobacterium tumefaciens
  - Thermus aquaticus
  - Hemophilus influenzae
  - Salmonella typhimurium
- Identify the site at which EcoRI cuts the DNA:
  - 3'GAATTC5'
  - 5'GTTAAC3'
  - 5'GAATTC3'
  - None of the above
- Enzyme that is used to dissolve bacterial wall is:
  - Chitinase
  - Cellulase
  - lysozyme
  - Protease
- Temperature ideal for denaturation of DNA in PCR is:
  - 72 °C
  - 94 °C
  - 40- 60 °C
  - 100 °C
- The sticky ends in DNA fragments are due to: -
  - Methylation
  - Unpaired bases
  - Endonucleases
  - Magnesium ion
- Which stain is used to visualize DNA as orange coloured band in the process of elution?
  - Diethidium chloride
  - Diethidium bromide
  - Ethidium bromide
  - Acetone
- Which of the following pair is mismatched?
  - Interferon- an enzyme that interferes with DNA replication
  - Myeloma- antibody producing tumor cells
  - Plasmid- a small piece of extrachromosomal DNA in bacteria
  - Cosmid- a vector for carrying large DNA fragments into the host
- Which of the following enzymes is not used in the process of isolation of genetic material?
  - Protease
  - DNase
  - Chitinase
  - Cellulase
- PCR process was discovered by?
  - Joshua Lederberg
  - Sanger
  - Boyer
  - Mullis
- Removal and incorporation of a gene is called: -
  - Genetic engineering
  - Gene therapy
  - Cryogenics
  - DNA fingerprinting
- Insulin is produced through rDNA technology with the help of:
  - Yeast
  - Agrobacterium tumefaciens
  - E. coli
  - Disarmed retroviruses
- Alec Jeffrey's name is associated with:
  - DNA fingerprinting
  - PCR
  - Biolistics
  - Plasmid Pbr322

16. "Gene gun" method is used in:
- DNA fingerprinting
  - DNA sequencing
  - Genomic library creation
  - Gene transformation
17. "Co" term used in EcoRI stands for:
- Coenzyme
  - Coli
  - Company
  - Corporation
18. DNA or RNA segment tagged with a radioactive molecule is called
- Plasmid
  - Probe
  - Clone
  - Vector
19. For transformation, microparticles coated with DNA to be bombarded with gene gun are made up of
- Gold or Tungsten
  - Silicon or Platinum
  - Platinum or Zinc
  - Silver or Platinum
20. The linking of antibiotic resistance gene with the plasmid vector became possible with
- Exonucleases
  - Endonucleases
  - DNA polymerase
  - DNA ligase

### Assertion Reason Based Question

**Directions:** In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:

- If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
- If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
- If Assertion is true but Reason is false.
- If both Assertion and Reason are false.

- Assertion: Restriction enzymes recognize palindromic sequence.  
Reason: Palindromic sequences read same in both directions of the two strands.
- Assertion: Restriction endonucleases are also called 'molecular scissors'.  
Reason: When fragments generated by restriction endonucleases are mixed, they join together due to their sticky ends.
- Assertion: Restriction enzymes cut the strand of DNA to produce sticky ends.  
Reason: Stickiness of the ends facilitates the action of the enzyme DNA polymerase.
- Assertion: In gel electrophoresis, DNA fragments are separated.  
Reason: DNA is negatively charged, so it moves towards anode under electric field.
- Assertion: In recombinant DNA technology, human genes are often transferred into bacteria (prokaryotes) or yeast (eukaryote).  
Reason: Both bacteria and yeast multiply very fast to form huge population which express the desired gene.
- Assertion- plasmids are extrachromosomal single stranded DNA.  
Reason- plasmids are found in eukaryotic cells.
- Assertion- for isolation of DNA from yeast cell, chitinase enzyme is necessary.  
Reason- cell wall of fungi is made up of chitin.
- Assertion- insertion of recombinant DNA within the coding sequence of beta-galactosidase results in colourless colonies

Reason- presence of insert results in inactivation of enzyme beta-galactosidase known as insertional inactivation.

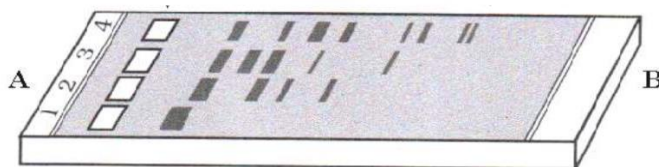
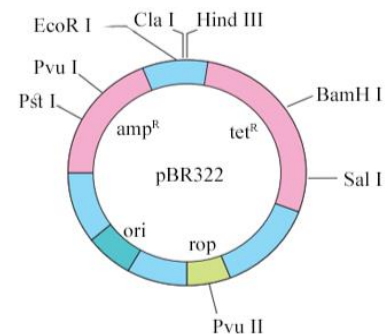
9. Assertion- PCR primers are oligonucleotides synthesized artificially.  
Reason- PCR involves use of Taq polymerase as it can withstand the high temperature of the process.
10. Assertion- in recombinant DNA technology both ligase and nuclease play an important role.  
Reason- ligase cuts the DNA at specific sites and nuclease joins the DNA fragments.

### SHORT ANSWER QUESTIONS (2 MARKS EACH)

1. What is EcoRI? How does EcoRI differ from an exonuclease?
2. Write any four ways used to introduce a desired DNA segment into a bacterial cell in rDNA technology experiment.
3. How is insertional inactivation of an enzyme used as a selectable marker to differentiate recombinants from non-recombinants?
4. Name the source of DNA polymerase used in PCR technique? Mention why it is used?
5. Write the role of 'ori' and 'restriction' site in a cloning vector pBR322.

### SHORT ANSWER QUESTIONS (3 MARKS EACH)

1. List the steps involved in rDNA technology.
2. a) Explain the significance of 'palindromic nucleotide sequence' in the formation of recombinant DNA.  
b) Write the use of restriction endonuclease in the above process.
3. a) Name the organism in which the vector shown is inserted to get the copies of desired gene.  
b) Mention the area labelled in the vector responsible for controlling the copy number of the inserted gene.  
c) Name and explain the role of a selectable marker in the vector shown.
4. Name and explain the technique used for separating DNA fragments and making them available for biotechnology experiments.
5. Observe the given diagram and answer the following questions:



- a) Mark the positive and negative terminal.
- b) What is the charge carried by DNA molecule and how does it help in the separation?
- c) How the separated DNA fragments are finally isolated?

**CASE BASED QUESTIONS-** (based on the given paragraph answer the given questions)

1. When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of 'sticky-ends' and, these can be joined together (end-to-end) using DNA ligases. The cutting of DNA by restriction endonucleases results in the fragments of DNA. These fragments can be separated by a technique known as gel electrophoresis. Since DNA fragments are negatively charged molecules, they can be separated by forcing them to move towards the anode under an electric field through a medium/matrix. Nowadays the most commonly used matrix is agarose which is a natural polymer extracted from sea weeds. The DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel. Hence, the smaller the fragment size, the farther it moves. The separated DNA fragments can be visualised only after staining the DNA with a compound followed by exposure to UV radiation (you cannot see pure DNA fragments in the visible light and without staining). You can see bright orange-coloured bands of DNA when exposed to UV light.

The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution. The DNA fragments purified in this way are used in constructing recombinant DNA by joining them with cloning vectors.

I) Which enzyme is used to join sticky ends of DNA.

- (a) DNA Ligase
- (b) DNA Host
- (c) DNA restriction
- (d) None of them

II) On the basis of ....., fragments of DNA get separated in the Gel electrophoresis.

- a) Nucleotide
- b) Colour
- c) Shape
- d) Size

III) After DNA fragments are separated, which stain is used to stain DNA for the visualization.

- a) Toluidine
- b) Ethidium bromide
- c) Sulphuric acid
- d) Phloroglucinol

IV) Describe the process of elution in the above process.

**OR**

Write the use of UV rays in electrophoresis.

2. Since DNA is a hydrophilic molecule, it cannot pass through cell membranes. In order to force bacteria to take up the plasmid, the bacterial cells must first be made 'competent' to take up DNA. This is done by treating them with a specific concentration of a divalent cation, such as calcium, which increases the efficiency with which DNA enters the bacterium through pores in its cell wall. Recombinant DNA can then be forced into such cells by incubating the cells with recombinant DNA on ice, followed by placing them briefly at 42°C (heat shock), and then putting them back on ice. This enables the bacteria to take up the recombinant DNA. This is not the only way to introduce alien DNA into

host cells. In a method known as micro-injection, recombinant DNA is directly injected into the nucleus of an animal cell.

In another method, suitable for plants, cells are bombarded with high velocity micro-particles of gold or tungsten coated with DNA in a method known as biolistics or gene gun. And the last method uses 'disarmed pathogen' vectors, which when allowed to infect the cell, transfer the recombinant DNA into the host.

a) **In which method, recombinant DNA is transferred into the host to infect the cell.**

1. Restriction method
2. Gene Gun
3. Biolistics
4. Disarmed pathogen

b) **Biolistics or Gene gun method is suitable for.....**

1. Reptiles
2. Plants
3. Birds
4. Insects

c) **Calcium cation increases efficiency of the bacterium for the entry of.....**

1. DNA
2. RNA
3. Ribosomes
4. Protein

d) **Explain the methods by which the bacterial cell can be made competent to take up DNA.**

OR

Give example of any two disarmed pathogen vector used in rDNA technology.

**LONG ANSWER QUESTIONS (5 MARKS EACH)**

1. If a desired gene is identified in an organism for some experiments, explain the process of the following:
  - (i) Cutting this desired gene at specific location.
  - (ii) Synthesis of multiple copies of this desired gene.
2. A) Illustrate how recombinants and non-recombinants are differentiated on the basis of colour production in the presence of a chromogenic substrate. Name that procedure.  
b) Describe the temperature treatment that enhances the bacteria to take up the rDNA.

## BIOTECHNOLOGY - PRINCIPLES AND PROCESSES

### (ANSWER KEY)

Q. NO.	ANSWER	MARKS
1	d	
2	c	
3	d	
4	b	
5	c	
6	c	
7	b	
8	b	
9	c	
10	a	
11	b	
12	d	
13	a	
14	c	
15	a	
16	d	
17	b	
18	b	
19	a	
20	d	
	<b>ASSERTION REASON</b>	
1	b	
2	b	
3	c	
4	a	
5	a	
6	d	
7	a	
8	a	
9	a	
10	c	
	<b>Short answer questions (2 marks each)</b>	
1	EcoRI is restriction endonuclease enzyme. Exonuclease removes nucleotides from the ends of DNA while EcoRI makes cuts at specific position within the DNA.	
2	Four ways to introduce the desired DNA segment into the bacterial host are: <ul style="list-style-type: none"><li>• Heat shock-based transformation.</li><li>• Electroporation.</li><li>• Using disarmed bacteriophages as vectors (Transduction)</li><li>• Micro-injection</li></ul>	
3	The insertion of rDNA into the coding sequence of an enzyme alpha-galactosidase leads to the inactivation of the enzyme called insertional inactivation. The recombinants do not produce a blue coloured colonies in the presence of chromogenic substrate while the non-recombinants produce a blue colour.	
4	Thermus aquaticus is a bacterium that lives in hot springs and hydrothermal vents, and Taq polymerase was identified as an enzyme able to withstand the protein-denaturing conditions like high temperature required during PCR. Therefore, is the source of the DNA polymerase used in PCR technique.	

5	<p>Ori: it is a genetic sequence that acts as the initiation site for replication of DNA. Any fragment of DNA when linked to the ori region can be initiated to replicate.</p> <p>Restriction site: It is the recognition site for restriction enzymes such as EcoRI, HindIII, PvuI and Bam HI.</p>
<b>SHORT ANSWER QUESTIONS (3 MARKS EACH)</b>	
1	<p><b>Steps of Recombinant DNA Technology</b></p> <ul style="list-style-type: none"> <li>• DNA Isolation. DNA is isolated in its pure form, which means they are devoid of other macromolecules. ...</li> <li>• Cutting of DNA/Restriction Enzyme Digestion. ...</li> <li>• Amplifying of DNA. ...</li> <li>• Joining DNA. ...</li> <li>• Insertion of rDNA into a Host. ...</li> <li>• Recombinant Cell Isolation.</li> </ul>
2	<p>(a) Palindromic nucleotide sequence is the recognition sequence present both on the vector and on a desired or alien DNA for the action of the same restriction endonuclease to act upon. Each restriction endonuclease recognises a specific palindromic nucleotide sequence in the DNA and then cuts each of the two strands of the double helix at the specified point.</p> <p>(b) The same restriction endonuclease binds to both vector and the foreign DNA and cuts each of the two strands of the double helix at specific points in their sugar phosphate backbone of the recognition sequence. This creates overhanging stretches called sticky ends. These sticky ends are then joined by DNA ligase to form recombinant DNA.</p>
3	<p>a) Escherichia coli</p> <p>b) Origin of replication or 'ori' controls copy number of inserted gene. The selectable markers are amp<sup>R</sup> and tet<sup>R</sup> selectable markers help to select the host cell which contain the vector (transformant) and eliminate the non-transformants.</p>
4	The technique is electrophoresis. (Correct explanation)
5	<p>a) Side A will be negative terminal and B will be positive terminal.</p> <p>b) DNA molecules are negatively charged. Because of its negative charge DNA moves towards the positive electrode (anode). The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece.</p>
<b>CASE BASED QUESTIONS</b>	
1	<p>I. A</p> <p>II. D</p> <p>III. B</p> <p>IV. <b>The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution.</b></p> <p style="text-align: center;"><b>OR</b></p> <p><b>The separated DNA fragments can be visualised only after staining the DNA with a compound followed by exposure to UV radiation. We can see bright orange-coloured bands of DNA when exposed to UV light.</b></p>
2	<p>a) 4</p> <p>b) 2</p> <p>c) 1</p> <p>d) <b>This is done by treating them with a specific concentration of a divalent cation, such as calcium, which increases the efficiency with which DNA enters the bacterium through pores in its cell wall. Recombinant DNA can then be forced into such cells by incubating the cells with recombinant DNA on ice, followed by placing them briefly at 42°C (heat shock), and then putting them back on ice. This enables the bacteria to take up the</b></p>



	<p><b>recombinant DNA</b></p> <p style="text-align: center;"><b>OR</b></p> <p>Ti plasmid and retro virus</p>
	<b>LONG ANSWER QUESTIONS</b>
1	<p>The desired gene is cut using the enzymes restriction endonucleases. Firstly, the restriction endonuclease recognises the palindromic nucleotide sequence of the desired gene. The endonuclease inspects the entire DNA sequences to find and recognise the site. It Cuts each of the double helix at a specific point which is a little away from the centre of the palindromic Site- The cutting site is between the same two bases on the opposite strands. This results in over-hanging single stranded stretches which acts as sticky ends. ,</p> <p>Mu1tiple copies of the desired gene are synthesised by polymerase chain reaction (PCR)method. In this method, the desired gene is synthesised m vitro. The double stranded DNA in denatured using high temperature of 94°C and the strands are separated. Each separated strand acts as template. Two sets of nucleotide primers are annealed to the denatured DNA strands. The thermostable Taq polymerase extends the primers using nucleotides added in the reaction mixture. Finally, the amplified fragments are ligated into recipient cells.</p>
2	<p>a) Alpha-galactosidase is inactivated by insertional inactivation, which is caused by the insertion of rDNA into its coding sequence. In the presence of a chromogenic substrate, the recombinant bacteria do not produce a blue colour while the non-recombinant bacteria produce a blue colour.</p> <p>The Recombinant DNA can be forced into the bacterial cell treated with divalent cations and incubating it with recombinant DNA on ice. This is to be followed by placing it briefly at 42°C (heat shock), and then putting it back on ice. This process would enable the bacteria to take up the recombinant DNA.</p>

## 12. BIOTECHNOLOGY AND ITS APPLICATION

### MCQ

- The process of RNA interference has been used in the development of plants resistant to \_\_\_\_\_.  
(A). Insects (B). Nematodes  
(C). Fungi (D). Viruses
- In Bt cotton, the Bt toxin present in plant tissue as pro-toxin is converted into active toxin due to \_\_\_\_\_.  
(A). Acidic pH of the insect gut  
(B). Alkaline pH of the insect gut  
(C). Presence of conversion factors in insect gut  
(D). Action of gut microorganisms
- The first ever human hormone produced by recombinant DNA technology is \_\_\_\_\_.  
A. Progesterone B. Insulin  
C. Estrogen D. Progesterone
- A transgenic food crop which may help in solving the problem of night blindness in developing countries is  
A. Golden Rice B. Bt cotton  
C. Starlink Maize D. Bt soyabean
- An important objective of biotechnology in the area of agriculture is \_\_\_\_\_.  
A. To decrease seed number  
B. To produce pest-resistant varieties of plants  
C. To increase phosphorous, nitrogen production  
D. To reduce the number of plants
- Bt toxin is produced by a bacterium called \_\_\_\_\_.  
A. *Bacillus thuringiensis*  
B. *Bacillus anthracis*  
C. *Bacillus thermophilus*  
D. *Bacillus subtilis*
- RNAi is a mechanism to silence genes with the help of  
A. SS RNA B. DS RNA  
C. SS DNA D. DS DNA
- Bt toxin is produced by a bacterium called \_\_\_\_\_.  
A. *Bacillus thuringiensis*  
B. *Bacillus anthracis*  
C. *Bacillus thermophilus*  
D. *Bacillus subtilis*
- The first transgenic crop was  
A. Tobacco B. Tomato C. Cotton D. Flax
- Biopiracy is  
A. Unauthorized use without permission  
B. Authorized use without permission  
C. None of these  
D. All of these
- The process of RNA interference has been used in the development of plants resistant to  
A. RNAi B. DNAi  
C. Insertional inactivation D. None of these
- ELISA is based on  
(A). Ag- IFN interaction  
(B). Ag- Ab interaction  
(C). DNA- RNA interaction  
(D). mRNA – DNA interaction
- How human protein ( $\alpha$ -1-antitrypsin) is used in the medical field.  
(A). To treat diabetic  
(B). To remove clot  
(C). Immunosuppressive agent  
(D). To treat emphysema
- What is the green revolution related to?  
(A). Milk (B) Agriculture  
(C). Water (D). Animals
- Cry protein is obtained from  
(A). *Bacillus thuringiensis*  
(B). *Bacillus subtilis*  
(C). *Clostridium welchi*  
(D). *E. coli*
- Bt Toxin is : (A) Intracellular lipid (B) Intracellular crystal protein (C) Extracellular Crystal protein (D). Lipid
- Somatic hybridization can be done by:  
(A). By Protoplast fusion  
(B). By Haploid anther  
(C). By cell culture  
(D). By Pollen culture
- The Ti plasmid used in genetic engineering is obtained from:  
(A) *Bacillus thuringiensis* (B) *E. Coli*  
(C) *Agrobacterium tumefaciens*  
(D) *Agrobacterium tumefaciens*
- From which one of the following plants, the insecticide pyrethrum is prepared.  
(A) *Cymbopogon* (B) *Tephrosia*  
(C) *Crysanthemum* (D) *Vitivera*
- First biochemical to be produced commercially by microbial cloning and genetic engineering:  
(A) Human insulin (B) Penicillin  
(C) Interferons (D) Fertility factor

### ASSERTION REASON QUESTIONS

A - Both A and R are true and R is the correct explanation of A.

B - Both A and R are true but R is NOT the correct explanation of A.

C - A is true but R is false.

D - A is false but R is true

21. Assertion: The milk of Rosie cow is nutritionally more balanced for infants.

Reason- Rosie's milk contain 2.4 g/L of human lactalbumin.

22. Assertion: Transgenic animals are used to test the safety of drugs and vaccine before these are administered on humans.

Reason: It is easy and quick to test toxicity of drugs and vaccine on transgenic organisms.

23. Assertion: RNAi is a natural method of defence in eukaryotes.

Reason: RNAi is used to produce nematode resistant tobacco plants.

24. Assertion: Biopiracy is the practice of commercially exploiting naturally occurring biochemical or genetic material, especially by obtaining patents that restrict its future use, while failing to pay fair compensation to the community from which it originates.

Reason: US patented turmeric and neem which is a case of biopiracy.

25. Assertion: Early detection of diseases caused by mutation in genes, HIV and cancer is possible .

Reason: r-DNA technology and its techniques have helped in early molecular diagnosis of genetic diseases, HIV and cancer.

26. Assertion (A) : Agrobacterium tumefaciens is popular in genetic engineering, because the bacterium is associated with the roots of all cereal and pulse crops Reason (R) : A gene incorporated in the bacterial chromosomal genome gets automatically transferred to the crop with which the bacterium is associated.

27. Assertion (A) : In recombinant DNA technology, human genes are often transferred into bacteria or yeast.

Reason (R) : Both bacteria and yeast multiply very fast to form huge populations, which express the desired genes.

28. Assertion (A) : GM crops can affect human health by causing allergic reactions.

Reason (R) : Transgenes in commercial crops can endanger native species e.g. the Bt toxin gene expressed in pollen might endanger pollinators like honeybees.

29. Assertion (A): Genetic engineering is also called recombinant DNA technology

Reason(R):It brings about improvement of genetic makeup of an organism.

30. Assertion (A) : Bt toxin gene has been cloned from bacteria expressed in plants to provide protections against insect without the use of insecticide.

Reason (R) : Bt toxin is produced from bacterium Bacillus thuringiensis.

### TWO MARK QUESTIONS

31. Name the insect pest that is killed by the products of cryIAC gene. Explain how the gene makes the plant resistant to the insect pest.

32. Name the process involved in the production of nematode-resistant tobacco plants, using genetic engineering. Explain the strategy adopted to develop such plants

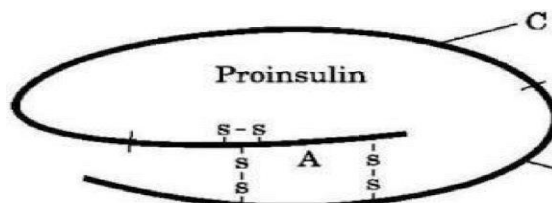
33. List any four beneficial effects of GM plants.

34. Explain the role of transgenic animals in (i) Vaccine safety and (ii) Biological products with the help of an example each.

35. What is RNA Silencing? How is this strategy used to create pest-resistant plants?.

### THREE MARK QUESTIONS

36. Insulin in the human body is secreted by pancreas as prohormone/proinsulin. The schematic polypeptide structure of proinsulin is given below. This proinsulin needs to undergo processing



before it becomes functional in the body. Answer the

questions that follow

(a) State the change the proinsulin undergoes at the time of its processing to become functional .

(b) Name the technique the American company Eli Lilly used for the commercial production of human insulin.

(c) How are the two polypeptides of a functional insulin chemically held together?

37. Name and briefly explain various techniques for early diagnosis of diseases

38. Explain different processes of Gene Therapy.

39. What are transgenic animals? Enlist any four reasons for their production.

40. How crystal protein acts in Bt Cotton?

### CASE BASED STUDY

41. Animals with manipulated genetic material (carrying recombinant DNA) are known as transgenic animals. Transgenic technology provides a method to rapidly introduce new genes into animals without cross breeding. It is a powerful technique for studying fundamental problems of mammalian development. Transgenic technology has been developed and found perfect in the laboratory on mice. The three most common gene transfer techniques namely: DNA microinjection, ES-cell mediated and Retrovirus mediated gene transfer are the most important to have enabled to produce transgenic cattle, sheep, goat, pig and other animals. Transgenic animals have the potential of agricultural applications like improved growth rate and carcass composition, improved resistance to disease, increased milk yield, improved wool production and so on. The scientific outlook of right and wrong opinions about transgenic animals is called ethics of transgenic animals. These ethical and animal welfare issues surround transgenic animal technology and be only minimized or avoided through awareness creation about the merit of this technology.

(i). Which option does not indicate that humans are benefitted from transgenic animals?

a) for study of diseases b) to determine vaccine safety c) to test safety of drugs d) to determine the safety of human alpha lactalbumin

(ii) Which of the following is a r-DNA vaccine? a) Cancer b) cystic fibrosis c) Hepatitis B d) Tuberculosis

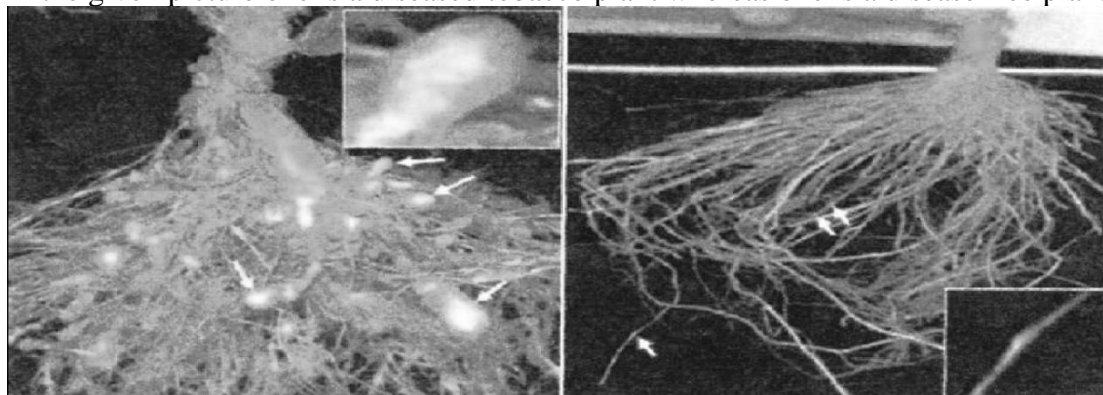
(iii) Name the vector which is most commonly used to produce transgenic animals. a) retrovirus b) Ti plasmid c) YAC d) BAC

(iv) Transgenic animals are a) Those animals whose entire genetic makeup is manipulated. b) Those animals where a foreign gene is not incorporated c) Mice d) Those animals in which a foreign gene which is beneficial for mankind is incorporated.

(v) .Name the organization set up by Indian Government to check safety of introducing transgenic animals for humanservices. a) WHO b) NBRI c) CDRI d) GEAC

42. **Read the following and answer any four questions from (i) to (iv) given below:**

In the given picture one is a diseased tobacco plant whereas one is a disease free plant



i) Name the process through the above plant is made disease free a) RNAi b) Gene therapy c) Antigen antibody interaction d) none of the above

ii) In this process, vector used is a) Retrovirus b) Plasmid c) Bacteriophage d) Agrobacterium

iii) This method is a type of \_\_\_\_\_ mechanism found in all the \_\_\_\_\_

Defence, prokaryotes b) Cellular defence, Eukaryotes c) Artificially induced, Eukaryotes

d) Artificially induced, Prokaryotes

- iv) The causative agent of the disease is  
bacteria b) virus c) nematode d) none of the above

### FIVE MARK QUESTIONS

43. (a) Mention the cause and the body system affected by ADA deficiency in humans.  
(b) Name the vector used for transferring ADA-DNA into the recipient cells in humans. Name the recipient cells.  
(c) Mention a possible permanent cure for a ADA deficiency patient.  
(d) Name the deficiency for which first clinical gene therapy was given.  
(e) What is gene therapy? Name the first clinical case where it was used.
44. Plants bacteria, fungi and animals whose genes have been altered by manipulation are called Genetically Modified Organisms (GMO). GM plants have been useful in many ways. Give at least five examples in support of the statement.

### ANSWER KEY

#### (BIOTECHNOLOGY AND ITS APPLICATION)

1.B 2.B 3.B 4.A 5.B 6.A 7. 8.A 9.A 10.A 11.A 12.B 13.D 14.B 15. A 16.B 17.A 18.D 19.C 20.A

#### ASSERTION & REASON

21.A 22.C 23.A 24.B 25.A 26.D 27.A 28.B 29.A 30.A

### Two Mark Questions

31. (a) cry gene produces Cry protein in inactive crystalline form. After ingestion by the insect, it becomes active due to the alkaline pH of the gut which solubilise the crystals.

**(b) The activated toxin binds to the surface of midgut epithelial cells thus creating pores which causes cell swelling and lysis, leading to death of the insects.**

Cotton bollworm is killed by products of cry IAc gene.

32. The process involved in the production of nematode-resistant plants is RNA interference or RNAi. Using Agrobacterium vectors, nematode -specific genes were introduced into the host plant. The introduction of DNA was such that it produced both sense and antisense RNA in the host cells. These two RNA's being complementary to each other are formed a double stranded RNA (dsRNA) that initiated RNAi and thus, silenced the specific mRNA of the nematode. The consequence was that the parasite could not survive in a transgenic host expressing specific interfering RNA. The transgenic plant thus protected itself from the parasite.

33. a) Four beneficial effects of GM plants.

(i) Increased tolerance against abiotic stresses (cold, drought, salt, heat).

(ii) Reduced reliance on chemical pesticides (pest-resistant crops).

(iii) Reduced post-harvest losses.

(iv) Increased efficiency of minerals used by plants (this prevents early exhaustion of fertility of soil).

(v) Enhanced nutritional value of food, e.g., vitamin 'A' enriched rice (golden rice). (Any four)

34. (i) Vaccine safety- Transgenic mice are developed to test safety of polio vaccine before being used on humans.

(ii) Human protein ( $\alpha$ -1-antitrypsin) is used to treat emphysema.

35. RNA silencing involves silencing specific mRNA. This causes a stoppage of translation. This is achieved in the tobacco plant against nematode *Meloidogyne incognita*. In RNAi complementary ds RNA is produced against specific mRNA. Using the Agrobacterium vector, nematode-specific genes were introduced into the host plant. The introduction of DNA was such that it produced both sense & anti-sense RNA in the host cell. These two RNA's being complementary to each other formed a ds RNA that initiated RNAi.

### **THREE MARK QUESTIONS**

**36.** (a) C' Peptide is removed

(b) r-DNA technology / Recombinant DNA Technology (c) Disulphide bonds.

37. r-DNA technology, PCR and ELISA are some techniques for early diagnosis of diseases. PCR is used for detection of HIV in suspected AIDS patient, to detect mutations in genes in suspected cancer patients. ELISA is used for detection of antigens of pathogens or antibodies synthesized by body against the pathogen. r-DNA technology can be used to produce clone of mutated gene and then it can be hybridized with probe made of normal gene, followed by its detection using autoradiography.

38. Lymphocyte culture - Lymphocytes from the blood of the patient are grown in a culture outside the body and a functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes using a retroviral vector which is returned to the patient. It is not a permanent method as lymphocytes are not immortal. •Enzyme replacement- in this functional ADA is given to the patient by injection. This required periodic infusion of injection. •Bone marrow transplantation- If the ADA gene from marrow cells is introduced into cells at early embryonic stages, it could be a permanent cure.

39. To study the effect of genes on normal physiology and development

• To study diseases like cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer's

• To obtain biological products. E.g. human protein ( $\alpha$ -1-antitrypsin)

• For study of Vaccine and chemical testing and safety

Transgenic animals or GMOs are those organisms whose genetic material has been altered by using genetic engineering techniques.

40. Cry gene of *Bacillus thuringiensis* is introduced in the cotton plant to form insect resistant plant. When insects feed on the cotton plant the inactive crystal protein becomes active due to the alkaline pH in the midgut of insects. The protein creates pores in the midgut and ultimately insects die.

### **CASE BASED STUDY**

**41.** (i) d) to determine the safety of human alpha lactalbumin (ii) c) Hepatitis B

(iii) a) Retrovirus (iv) d) Those animals in which a foreign gene which is beneficial for mankind is incorporated. (v) d) GEAC

**42.** (i) (a) (ii) .(d) (iii). (b) (iv) .(c)

### **FIVE MARK QUESTIONS**

43. (a) The cause is the deletion of gene responsible for producing ADA. The immune system is affected and one suffers from SCID

(b) A retroviral vector is used, recipient cells are lymphocytes.

(c) A possible permanent cure would be gene therapy. In this , c-DNA coding for ADA enzyme is introduced using retroviral vector in lymphocytes of the patient at early embryonic stage.

(d) Adenosine deaminase (ADA) deficiency.

(e) Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo. Normal functional genes are inserted into an individual's cells and tissues to treat disease.

44. (i) Made crops more tolerant to abiotic stresses (cold, drought, salt, heat).

(ii) Reduced reliance on chemical pesticides (pest-resistant crops).

(iii) Helped to reduce post-harvest losses.

(iv) Increased efficiency of mineral usage by plants.

(v) Enhanced nutritional value of food, e.g., golden rice, i.e., Vitamin 'A' enriched rice.

# CHAPTER 13: ORGANISM & POPULATION

## COMPETENCY BASED QUESTION

### MULTIPLE CHOICE QUESTIONS

1. Which of the following would necessarily decrease the density of population in a given habitat?

- (A) Natality > Mortality
- (B) Immigration Emigration
- (C) Mortality and Emigration
- (D) Natality and Immigration

2. A population has more young individuals compared to the older individuals. What would be the status of the population after some years?

- (A) It will decline
- (B) It will stabilize
- (C) It will increase
- (D) It will first decline and then stabilize

3. A Protozoan reproduces by binary fission. What will be the number of protozoans in its population after sixth generation?

- (A) 128
- (B) 24
- (C) 64
- (D) 32

4. Amensalism is an association between two species where

- (A) one person is harmed and the other is benefitted
- (B) one species is harmed and the other is unaffected
- (C) one species is benefitted and the other is harmed
- (D) both the species are harmed

5. Lichens are associations of

- (A) bacteria and fungus
- (B) algae and bacterium
- (C) fungus and algae
- (D) fungus and virus

6. Select the statement which explains best parasitism

- (A) One organism is benefitted
- (B) Both organisms are benefitted
- (C) One organism is benefitted, other is not affected

(D) One organism is benefitted, other is affected

7. Which of the following is partial root parasite?

- (A) Sandal wood
- (B) Mistletoe
- (C) Orobanche
- (D) Ganoderma

8. Which parameters are used for tiger census in our country's National Park and sanctuaries?

- (A) Pug marks only
- (B) Pug marks and faecal pellets
- (C) Faecal pellets only
- (D) Actual head count

9. Identify the incorrect statement

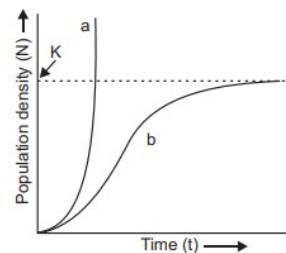
- (A) Exponential growth occurs in organism such as lemmings
- (B) Logistic growth is more realistic
- (C) Exponential phase has two phases lag and log
- (D) In logistic growth, population passes well beyond the carrying capacity of ecosystem.

10. The population growth is generally described by the following equation  $\frac{dN}{dt} = rN \left( \frac{K-N}{K} \right)$ . What does "r" represent in the given equation?

- (A) Population density at time Y
- (B) Intrinsic rate of natural increase
- (C) Carrying capacity
- (D) The base of natural logarithm

11. Study the population growth curves (A and B) in the given graph and select the incorrect statement:

- (A) Curve "a" shows exponential growth curve and represented by equation  $\frac{dN}{dt} = rN$
- (B) Curve "a" shows exponential growth curve and represented by equation  $\frac{dN}{dt} = rN \left( \frac{K-N}{K} \right)$
- (C) Exponential growth curve is considered more realistic than logistic growth curve.



(D) Curve "A" can also be represented by the equation  $N_t = N_0 e^{rt}$

12. The equations correctly represent Verhulst-Pearl logistic growth curve

(A)  $dN/dt = rN(K-N)K$

(B)  $dN/dt = rN/K$

(C)  $dN/dt = N(K-N)K$

(D)  $dN/dt = r(K-N)K$

13. Identify the correct equation that represent the exponential population growth curve

(A)  $dN/dt = rN$

(B)  $dN/dt = rN(K-N)K$

(C)  $N_t = N_0 e^{rt}$

(D) Both (A) and (C)

14. Competition for, space, food and light is most severe in

(A) Individual

(B) Population

(C) Community

(D) None of the above

15. Mycorrhiza helps in

(A) Food preparation

(B) Defence mechanism

(C) Nutrition uptake

(D) Both (A) and (B)

16. Intraspecific competition helps mainly in

(A) Sexual selection

(B) Succession

(C) Both (A) and (B)

(D) None of these

17. Which of the following type of interactions occur in predation and parasitism?

(A) (+,+)

(B) (+,0)

(C) (+,-)

(D) (-,-)

Answer to MCQ	
1	(C) Mortality and Emigration
2	(C) It will increase
3	(C) 64
4	(B) one species is harmed and the other is unaffected
5	(C) fungus and algae
6	(D) One organism is benefitted, other is affected
7	(A) Sandal wood
8	(B) Pug marks and faecal pellets
9	(D) In logistic growth, population passes well beyond the carrying capacity of ecosystem.
10	(B) Intrinsic rate of natural increase
11	(C) Exponential growth curve is considered more realistic than logistic growth curve.
12	(A) $dN/dt = rN(K-N)K$
13	(D) Both (A) and (C)
14	(B) Population
15	(C) Nutrition uptake
16	(A) Sexual selection
17	(C) (+,-)

### ASSERTION AND REASON QUESTION

Question No 1 to 10 consists of two statement – Assertion(A) and Reason (R.) Answer these questions selecting the appropriate option below:

A. Both A and R are true and R is the correct explanation of A.

B. Both A and B are true and R is not the correct explanation of A.

C. A is true but R is false.

D. A is False but R is true.



- 1 Assertion: The human population represents the logistic growth curve.  
Reason: When the resources are limited leading to competition between individuals and survival of the fittest, the population tends to grow in a logistic manner.
- 2 Assertion: Tropical rain forests are disappearing fast from developing countries such as India.  
Reason: No value is attached to these forests because these are poor in biodiversity.
- 3 Assertion: Flora contains the actual account of habitat and distribution of plants of a given area.  
Reason: Flora helps in correct identification.
- 4 Assertion: Species are groups of potentially interbreeding natural populations which are isolated from other such groups.  
Reason: Distinctive morphological characters are displayed due to reproductive isolation.
- 5 Assertion: "The Biological Species" concept helps us to ask how species are formed.  
Reason: The concept of biological species focuses our attention on the question of how reproductive isolation comes about.
- 6 Assertion: Cold deserts too exist. e.g., Tibet, Gobi.  
Reason: Desert can be hot, e.g., Thar, Sahara.
- 7 Assertion: Biotic community has higher position than population in ecological hierarchy.  
Reason: Population of similar individuals remains isolated in the community.
- 8 Assertion: Indo-Gangetic plains have high population density.  
Reason: These have favourable climate and fertile soil.
- 9 Assertion: Heliophytes, generally have low photosynthetic, respiratory and metabolic activities.  
Reason: This is an adaptation of heliophytes to high intensity of light.
- 10 Assertion: Animals adopt different strategies to survive in hostile environment.  
Reason: Praying mantis is green in colour which merges with plant foliage.

### MARKING SCHEME

- 1 (A) Both A and R are true and R is the correct explanation of A.
- 2 (C) A is true but R is false
- 3 (B) Both A and B are true and R is not the correct explanation of A.
- 4 (B) Both A and B are true and R is not the correct explanation of A.
- 5 (A) Both A and R are true and R is the correct explanation of A.
- 6 (B) Both A and B are true and R is not the correct explanation of A.
- 7 (C) A is true but R is false
- 8 (A) Both A and R are true and R is the correct explanation of A.
- 9 (D) A is False but R is true.
- 10 (A) Both A and R are true and R is the correct explanation of A.

### 2 marks Questions (5 questions)

**1. Mention how plants develop mechanical and chemical defense against herbivores to protect themselves. State with an example.**

Ans. Several plants has evolved various mechanisms both morphological and chemical to protect themselves against herbivores.

Morphological defense mechanisms

(i) Cactus plants (Opuntia) are modified into sharp spines to deter herbivores from feeding on them.

(ii) Sharp thorns along with leaves are present in Acacia to deter herbivores.

Chemical defence mechanisms.

- (i) All parts of Calotropis weeds contain toxic glycoside, which can prove to be fatal if ingested by herbivores.
- (ii) Chemical substances such as nicotine, caffeine, quinine and opium are produced in plants as a part of self-defence.

**2. Differentiate between the expanding age pyramid and the stable age pyramid.**

Ans. Expanding age Pyramid - Population of pre-reproductive age is greater than population of reproductive age.

Stable age Pyramid- Population of pre-reproductive age equals the population of reproductive age.

**3. Apart from being a part of food chain, predators play other important roles. Mention any two such roles supported by examples.**

Ans. (i) Predators act as conduits for energy transfer across trophic levels.

(ii) They keep prey population under control.

(iii) They help in maintaining species diversity in a community by reducing intensity of competition among competing prey species.

(iv) An efficient predator may cause extinction of prey species.

**4. Mention special adaptation evolved in parasite and list possible reason for such evolution?**

Ans. Parasitic adaptations are

(i) Absence of locomotor organs-they need not move in search of food.

(ii) Presence of cuticle- is to protect them from harmful effects of digestive enzymes.

(iii) Presence of adhesive organs or suckers- this helps parasite to cling to the host.

(iv) Small in size- intracellular parasites are very small in size so easy entry.

**5. Explain Verhulst-Pearl Logistic Growth of a population.**

] Ans. According to Verhulst–Pearl Logistic growth, a population growing in a habitat with limited resources initially shows a lag phase, followed by phases of acceleration and deceleration and finally an asymptote when the population density reaches the carrying capacity. It is given by the following equation:

$$\frac{dN}{dt} = rN \left[ \frac{K - N}{K} \right]$$

**3 marks Questions**

1. **i) Different organisms are found in different habitats. They have evolved themselves to survive in that particular environment. What is the adaptation shown by –a) whales, b) kangaroo rat, c) polar bear?**

**ii) a. Why do cold regions not have small animals?**

**b. Mammals from colder climates generally have shorter ears and limbs to minimize heat loss. Name the rule.**

a) Blubber a layer of fat to prevent heat loss from the body. b) The animal needs only the metabolic water to survive

c) Hibernation in polar bears

Ans:

ii) a. They lose heat faster than the rate of production as their surface area is large compared to its volume.

b. Allen's rule

2. **i) Plants have devised various mechanisms to protect themselves against their predator. Explain any two of them.**

**ii) If 18 individuals in a population of 80 butterflies die in a week, calculate the death rate of population of butterflies during the period.**

- Ans (a) Thorns are (morphological) means of defence.  
 (b) Plants may produce / store chemicals such as nicotine, strychnine etc. for defence which inhibit digestion / disrupts reproduction / kill the predator / Calotropis produces highly poisonous cardiac glycosides / plants may produce chemicals such as nicotine/ caffeine/quinine/ strychnine/ opium are produced as defence.  
 ii) Death rate =  $18/80 = 0.225$  therefore, death rate percentage will be =  $0.225 \times 100 = 22.5\%$  butterfly death per week

3 **Interspecific interactions arise from the interaction of populations of two different species. They could be beneficial, detrimental or neutral (neither harm nor benefit) to one of the species or both.**

Study the table given below in regard to population interactions and answer the questions that follow:

Species A	Species B	Name of Interaction
-	0	(a)
+	-	(b)
-	-	(c)
+	+	(d)
+	0	(e)

[Note : (+) plus = beneficial interaction; (-) minus = detrimental interaction; (0) zero = neutral interaction]

- (i) Identify the interactions.  
 (ii) Explain any one of them.

- Ans i) (a) = Amensalism  
 (b) = Parasitism/Predation  
 (c) = Competition  
 (d) = Mutualism  
 (e) = Commensalism  
 ii) Any one definition from points in notes.

4 **In nature, animals, plants and microbes do not and cannot live in isolation but interact in various ways to form a biological community. Name the type of interaction.**

- when Koel lays eggs in crow's nest.
- interaction that exists between barnacles and whale.
- Between Cactus and moth.**
- Balanus and Chathamalus**
- the mycorrhizae are associations between fungi and the roots of higher plants.
- interaction between Penicillium and bacteria.

Ans a. Brood parasitism      b. Commensalism      c. Predation  
 d. Parasitism      e. Symbiosis/Mutualism      f. Amensalism

5 **Growth of population takes place according to the availability of food, habitat condition and presence of other biotic and abiotic factor.**

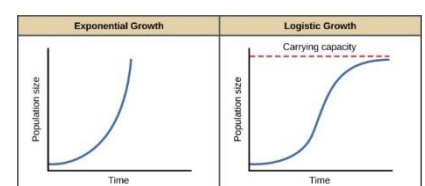
i) Name the two growth models that represent population growth and draw the respective growth curves they represent.

(ii) State the basis for the difference in the shape of these curves.

- i) (a) Exponential growth      (b) Logistic Growth

Ans:

Exponential growth	Logistic Growth
When the resources are unlimited, population tends to grow in an Exponential pattern.	When the resources are limited leading to competition between individuals and survival of fittest, the population tends to grow logistically.



6 **Parasites have evolved in various forms to for survival in their host's body. Mention the special adaptations evolved in them.**

Ans: a. Presence of adhesive organs / suckers / hooks, to cling to the host.  
b. Loss of digestive system, to absorb (digested) food from the host body.  
c. High reproductive capacity to survive inside host's body.  
d. Presence of adhesive organs or suckers  
e. Many parasites are host-specific in such a way that both host and parasite tend to co-evolve  
f. Loss of chlorophyll & leaves (Cuscuta), to derive its nutrition from the host plant which it parasitize.

7 **"The population of a Metro city experiences fluctuations in its population density over a period of time."**

**(a) When does the population in a metro city tend to increase?**

**(b) When does the population in metro city tend to decline?**

**(c) If 'N' is the population density at the time 't', write the population density at the time 't + 1'**

(a) Population in a metro city will tend to increase when natality and immigration will be higher.

(b) Population in metro city will tend to decline when mortality and emigration will be higher.

(c) The equation  $N_{t+1} = N_t + [(B + I) - (D + E)]$  represents the population density at time t + 1.

Here,

$N_{t+1}$  = Population density at time t+1.

$N_t$  = Population density at time t.

B = Natality

I = Immigration

D = Mortality

E = Emigration

### 5 marks questions (Case Based Questions)

1. In an aquarium two herbivorous species of fish are living together and feeding on phytoplankton. As the time passes by they are expected to follow Gause's principle. It has been observed that certain species coexists and avoids competition.

**(a) Explain Gause's principle.**

**(b) Give possible reasons, if the species are not affected by the Gause's principle.**

**(c) What is Resource Partitioning? Who gave it?**

Ans(a) Gause's principle states that when two species compete for the same resources, one species survives while the other is eliminated or they cannot exist in the same area at the same time.

(b) The species facing intraspecific competition may evolve a mechanism to co -existence rather than exclusion. This can also be done by a method known as 'resource partitioning'.

(c) Resource Partitioning is sharing of resources to avoid competition. MacArthur proposed this concept giving example of Warblers. The 5 related species of Warblers avoided competition by changing foraging time.

2. If  $N$  is the population density at time  $t$ , then its density at time  $t + 1$  is  $N_{t+1} = N_t + [(B + I) - (D + E)]$ .

(a) Which of the above represents the increase or decrease of population?

(b) If  $N$  is the population density at time  $t$ , then what would be its density at time  $(t+1)$ ? Give the formula.

(c) In a barn there were 30 rats. 5 more rats enter the barn and 6 out of the total rats were eaten by the cats. If 8 rats were born during the time period under consideration and 7 rats left the barn, find out the resultant population at time  $(t+1)$ .

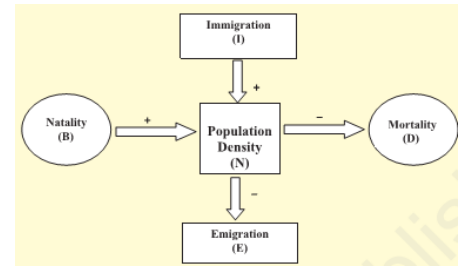
(d) If a new habitat is just being colonized, out of the four factors affecting the population growth, which factor contributes the most?

Ans : (a) a and d represents increase of population and b and c represent decrease of population.

(b)  $N_{t+1} = N_t + [(B + I) - (D + E)]$

(c) Here,  $N_t = 30$ ;  $I = 5$ ;  $E = 7$ ;  $D = 6$ ;  $B = 8$  Putting the value in  $N_{t+1} = N_t + [(B + I) - (D + E)]$   
 $N_{t+1} = 30 + [(8 + 5) - (6 + 7)] = 30 + [13 - 13] = 30 + 0 = 30$  rats

(d) Immigration contributes the most.



## CHAPTER 14: ECOSYSTEM

### MULTIPLE CHOICE QUESTIONS

- Which of the following is a man-made ecosystem  
(a) Forest (b) Aquarium (c) River (d) Desert
  - Vertical distribution of different species occupying different levels represents:  
(a) Productivity (b) Standing crop (c) Stratification (d) Trophic level
  - Based on the source of their nutrition or food, organisms occupy a specific place in the food chain is known as-----  
(a) Trophic level (b) Biomass (c) Ecological pyramid (d) None of these
  - Pyramid of is always upright, can never be inverted.  
(a) Biomass (b) Numbers (c) Energy (d) None of these
  - In a particular climatic condition, decomposition rate is slower if detritus is rich in -----  
(a) Nitrogen and sugar (b) Lignin and chitin (c) Sugar and chitin (d) None of these
- Ans. 1. (b) 2. (b) 3. (a) 4. (c) 5. (a)

### **ASSERTION REASON QUESTION**

- Assertion: Some aquatic ecosystem have inverted biomass pyramid  
Reason: The pyramid of energy is also inverted in such cases
- Assertion: Saprophytes play a vital role in ecosystem.  
Reason: Saprophytes are accorded the highest trophic levels in a food chain or food web.
- Assertion: There is no limitation of the number of trophic levels in a detritus food chain.  
Reason: The transfer of energy between successive trophic levels in a detritus food chain doesnot follow 10% rule.
- Assertion: Strongly vertically stratified habitats are very stable ecosystems. Reason: Through the formation of different layers a given habitat is better utilized.
- Assertion: Ecological pyramids of biomass are generally inverted in sea Reason: Biomass of fishes far exceeds that of phytoplankton

**Ans: 1. (c) 2. (c) 3. (d) 4. (a) 5. (a)**

### **SHORT ANSWER TYPE QUESTIONS**

- It is possible that a species may occupy more than one trophic level in the same ecosystem at the same time. Explain with the help of one example.

Ans: For example, sparrow is an omnivore. When it eats seeds, fruits or any other plant product, it occupies the primary trophic level. Whereas, when it eats worms and any other insect, it occupies the secondary trophic level. Thus, it occupies more than one trophic level in the same ecosystem.

2. Construct a pyramid of biomass starting with phytoplankton. Label-3 trophic levels. Is the pyramid upright or inverted? Why?

Ans: The pyramid of biomass starting with the phytoplankton is an inverted pyramid. This is because the biomass of fishes (SC) exceeds the biomass of Zooplanktons (PC) which in turn exceeds the biomass of phytoplankton (PP). See page 248 NCERT BOOK

3. State the difference between the first trophic levels of the detritus food chain and grazing foodchain.

Ans: The grazing food chain releases energy into the ecosystem. The detritus food chain uses a large amount of energy from the environment. In the grazing food chain, green plants form the first trophic level. In the detritus food chain, the first trophic level is occupied by the decomposers.

4. What are the limitations of ecological pyramids in the study of ecosystem?

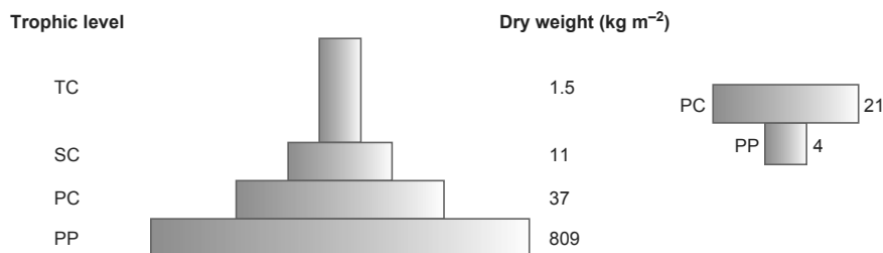
Ans: Limitations of Ecological Pyramid

More than one species may occupy multiple trophic levels as in case of the food web. Thus, this system does not take into account food webs. The saprophytes are not considered in any of the pyramids even though they form an important part of the various ecosystem.

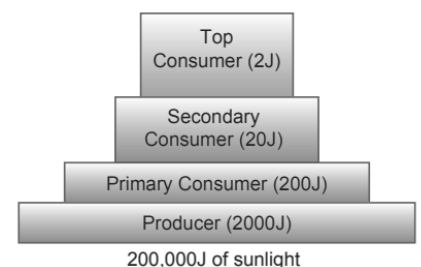
5. How does the chemical composition of detritus affect the rate of decomposition in a particular climatic condition?

Ans: In a particular climatic condition, decomposition rate is slower if detritus is rich in nitrogen and water soluble compounds like sugars. All of the above. Warm and moist environments inhibit decomposition. Rate of decomposition is quicker if detritus is rich in lignin and chitin.

6. Compare the two ecological pyramids of biomass given below and explain the situations in which this is possible. Also, construct an ideal pyramid of energy, if 200,000 joules of sunlight is available.



Ans : The first pyramid of biomass corresponds to a terrestrial ecosystem. Second pyramid refers to a small standing crop of phytoplankton supporting a large standing crop of zooplankton or an aquatic ecosystem



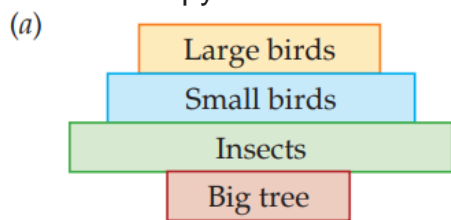
7. Construct a grazing food chain and detritus food chain using the following, with 5 links each: Earthworm, bird, snake, vulture, grass, grasshopper, frog, decaying plant matter

Ans : Grazing food chain: Grass → Grasshopper → Frog → Snake → Vulture  
 OR  
 Grass → Grasshopper → Bird → Snake → Vulture

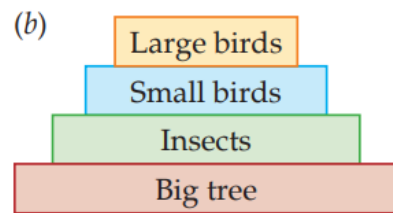
Detritus food chain: Decaying plant matter → Earthworm → Bird → Snake → Vulture

8. (a) Draw a 'pyramid of numbers' of a situation where a large population of insects feed upon a very big tree. The insects in turn, are eaten by small birds which in turn are fed upon by big birds.

(b) Differentiate giving reason, between the pyramid of biomass of the above situation and the pyramid of numbers that you have drawn.



Pyramid of number



Pyramid of biomass

Ans:

The pyramid of biomass is upright at the first two trophic levels because the biomass of a single tree is much more than total population of insects. Whereas, the pyramid of number is inverted at the first two trophic levels because the number of insects is much more than the number of trees.



## CHAPTER 15: BIODIVERSITY AND CONSERVATION

### MCQ

- One of the ex-situ conservation methods for endangered species is  
(a) Wild life sanctuaries  
(b) Biosphere reserves  
(c) Cryopreservation  
(d) National parks
- Which group of vertebrates comprises the highest number of endangered species?  
(a) Fishes (b) Reptiles  
(c) Birds (d) Mammals
- Which of the following is not an invasive alien species in the Indian context?  
(a) Lantana (b) Cynodon  
(c) Parthenium (d) Eichhomia
- Among the ecosystem mentioned below, where can one find maximum biodiversity?  
(a) Mangroves (b) Desert  
(c) Coral reefs (d) Alpine meadows
- The historic convention on Biological Diversity held in Rio de Janeiro in 1992 is known as:  
(a) CITES Convention  
(b) The Earth Summit  
(c) G-16 Summit  
(d) MAB Programme
- Which of the following group exhibit more species diversity?  
(a) Gymnosperms (b) Algae  
(c) Bryophytes (d) Fungi
- Which of the following statements is correct?  
(a) Parthenium is an endemic species of our country  
(b) African catfish is not a threat to indigenous catfishes.  
(c) Steller's sea cow is an extinct animal.  
(d) Lantana is popularly known as carrot grass.
- What is common to Lantana, Eichhomia and African catfish?  
(a) All are endangered species of India.  
(b) All are key stone species.  
(c) All are mammals found in India.  
(d) All the species are neither threatened nor indigenous species of India.
- Which one of the following is not a characteristic feature of biodiversity hot spots?  
(a) Large number of species  
(b) Abundance of endemic species  
(c) Mostly located in the polar regions  
(d) Mostly located in the tropics
- Which of the following countries has the highest biodiversity?  
(a) Brazil (b) South Africa  
(c) Russia (d) India

Ans: 1-c , 2-d , 3-b, 4-c, 5-b 6-d, 7-c, 8-d, 9-c 10-a,

### ASSERTION REASON QUESTIONS

In the following questions a statement of Assertion (A) is followed by statement of reason (R) Select the correct answer to these questions from code A B C & D as given below :

- (A) Both A and R are true and R is the correct explanation of A  
(B) Both A and R are true and R is not the correct explanation of A  
(C) If A is true but R is false  
(D) A is false but R is true

1.Assertion(A) : Genetic diversity within species increases with the increase in habitat variation.

Reason(R): It is essential for adaptation to varied environments.

2. Assertion (A) : Pollen banks are part of in situ conservation.

Reason(R): They are one of the offsite collections

3. Assertion (A): Zoological parks have well managed captive breeding programme.

Reason(R): They are engaged in producing improved varieties of wildlife.

4.Assertion (A):Now a days biodiversity is declining with an accelerated rate.

Reason(R): Exotic species are considered to be major cause of extinction of species.

5.Assertion (A): Rate of extinction of wildlife has become rapid in the last hundred years.

Reason(R): Unplanned human activities like population explosion, deforestation, industrialization, hunting etc. have destroyed the natural habitats of many spp.of wildlife.

## 2 marks Question

1.Differentiate between in situ and ex situ approaches of conserving biodiversity.

Ans.

In situ Conservation	Ex situ Conservation
<p>a. It is the conservation of endangered species in natural habitat.</p> <p>b. The endangered species are protected from predators.</p> <p>c. The depleting resources are augmented.</p> <p>d. The population recovers in the natural environment.</p>	<p>a. It is the conservation of endangered species outside natural habitat.</p> <p>b. The endangered species are protected from all adverse factors</p> <p>c. They are kept under human supervision and provide all the essentials.</p> <p>d. Offspring produced in captivity breeding are released in natural habitat for acclimatization.</p>

2.What is the IUCN red list? Give any two uses of it.

Ans. IUCN red list a catalogue of taxa facing risk of extinction.

The two uses of this list:

(i) It provides awareness to the degree of threat to biodiversity.

(ii) It is useful in identification and documentation of species which are at a high risk of extinction.

3.Where would expect more species Biodiversity in tropics or in polar regions? Give reasons in support of your answer.

Ans. Tropics have more biodiversity than the polar regions because of favourable environmental conditions as compared to the polar regions where harsh conditions are prevalent.

The reason behind maximum biological diversity of tropical regions are :

**(i)High productivity** - there is more solar energy available which contributes to higher productivity and greater diversity.

**(ii)Prolonged evolutionary time** - speciation is generally a function of time, unlike polar regions subjected to frequent glaciation remains relatively undisturbed for millions of years thus had a long evolutionary time for species diversification.

4.Mention the kind of Biodiversity more than a thousand varieties of mangoes represent. How is it possible?

Ans. More than thousand varieties of mangoes - exhibit genetic diversity. Genetic diversity represents the diversity in number and the types of genes as well as chromosomes present different species and variation in genes and their allele in some species.

**5. Why are sacred groves highly protected?**

Ans. Sacred groves are forest patches around places of worship held in high esteem by tribal communities. They are mostly undisturbed forest patches. Not a single branch is allowed to be cut from these forests and as a result many endemic species which are rare or have become extinct elsewhere can be seen to flourish here e.g., Jaintia and Khasi hills in Meghalaya.

**6. Justify with help of an example where a deliberate attempt by humans has led to the extinction of a particular species.**

Ans. Extinction of species due to human activities is known as anthropogenic extinction. Various human activities have led to extinction of particular species. The most common example is Nile perch, a large predator fish introduced in Lake Victoria for commercial purposes turned out to be problematic species. It started feeding the native fish cichlid fish, which resulted in extinction.

**7. What does the term genetic diversity refer to? What is the significance of large genetic diversity in a population?**

Ans. Genetic diversity is the measure of variety in genetic information contained in the organisms.

Significance of large genetic diversity are as follows:

(i) Larger genetic diversity provides adaptability at the time of environmental changes and helps the species in surviving.

(ii) Larger genetic diversity is also useful in the evolution of species.

**8. Sometimes introduction of an exotic species upsets natural species of the ecosystem. Substantiate the state with 2 examples from India.**

Ans. Exotic species have become invasive and drive away the local species. Water hyacinth was introduced in Indian waters to its aesthetic value. However, it has clogged the water bodies resulting in the death of several aquatic plants and animals. *Eupatorium odoratum* has reduced the population of *Tectona grandis* in North - East.

**9. *Eichhornia crassipes* is an alien hydrophyte introduced in India. Mention the problem posed by this plant.**

Ans. *Eichhornia crassipes*, an alien hydrophyte was introduced in Indian waters due to aesthetic value but it turned out to be a problematic species. It has clogged water bodies resulting in the death of aquatic plants and animals.

**10. How is the presently occurring species extinction different from the earlier mass extinctions?**

Ans. Species extinction occurring at present is due to anthropogenic or man-made causes whereas the earlier extinction was due to natural causes. Present extinction is occurring at 100 – 1000 times fast rate.

### 3 marks Question

1. It is advocated that biodiversity be conserved? List any two ethical arguments in its support.

Ans. The biodiversity should be conserved because of the following reasons:

- (i) Narrowly utilitarian arguments for deriving direct economic benefit from nature.
- (ii) Broadly utilitarian arguments as biodiversity plays a major role in many ecosystem services.
- (iii) Ethical reasons: There is a need to realise that every species has an intrinsic value and we need to pass on our biological legacy to future generations.

2. Alien species are highly invasive and are a threat to indigenous species. Substantiate this statement with any three examples.

Ans. Exotic species are defined as species that have been introduced from another geographic region to an area outside its natural range. For example, Parthenium, Lantana and Eichhornia are the exotic species of plants that have invaded the native species of India and caused environmental damage.

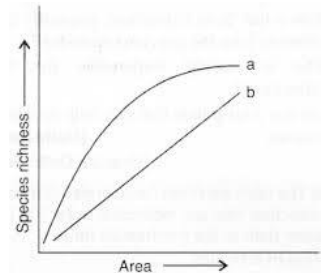
Introduction of African catfish *Clarias gariepinus* for aquaculture purpose is posing threat to many indigenous catfish.

Nile perch introduced into lake Victoria in East Africa led to the extinction of cichlid fish.

3. Explain 'rivet popper' hypothesis. Name the ecologist who proposed it.

Ans. Paul Ehrlich proposed the rivet popper hypothesis. This hypothesis states that in an airplane (ecosystem) all parts are joined together using thousands of rivets (species). If every passenger travelling in it starts popping a rivet to take home (causing a species to become extinct), it may not affect flight safety (proper functioning of the ecosystem) initially but as more and more rivets are removed, the plane becomes dangerously weak over a period of time. Also, which rivet is removed may also be critical like loss of rivets on the wings (key species) is more serious threat to flight safety than loss of few rivets on the seats or windows inside the plane.

4. The given graph alongside shows species–area relationship. Write the equation of the curve 'a' and explain.



Ans. The equation of the curve 'a' is  $S = CAZ$ . (i) Within a region, species richness increases with increasing explored area but only up to a limit. (ii) Relationship between species richness and area for a wide variety of taxa turns out to be rectangular hyperbola.

5. Explain the effect on the characteristics of a river when urban sewage is discharged into it.

Ans.

- Rise in organic matter, leads to increased microbial activity/growth of microbes.
- It results in decrease in dissolved oxygen/rise in Biochemical Oxygen Demand.
- Leads to fish mortality/algal bloom/colour change/foul odour/increase in toxicity.

6. Explain, giving three reasons, why tropics show greatest levels of species diversity.

Ans. (i) Tropical latitude have remained relatively undisturbed and had a long evolutionary time for species diversification.

(ii) Tropical environments have less seasonal variations, more constant and predictable environmental conditions. This promotes niche specialisation for greater species diversity. There is more availability of solar energy which contributes to higher productivity.

**7. What is the association between the bumble bee and its favourite orchid Ophrys?**

How would extinction or change of one would affect the other?

Commensalism because Ophrys employs sexual deceit to get pollination by species of bee as petal of its flower bears resemblance to female of the bee in size, colour and markings and so male bee is attracted to what it perceives as female; pseudo copulates with the flower and thus pollinates it. If the female bee's colour patterns change even slightly due to any reason during evolution, pollination success will be reduced unless the orchid flower co-evolves to maintain the resemblance of its petal to the female bee.

**8. Many plant and animal species are on the verge of their extinction because of loss of forest land by indiscriminate use by the humans. As a biology student what method would you suggest along with its advantages that can protect such threatened species from getting extinct?**

Ans : Ex situ conservation method can be used.

This approach involves placing threatened animals and plants in special care units for their protection.

India has 35 botanical gardens and 275 zoological parks where animals which have become extinct in wild are maintained.

By using cryopreservation (preservation at  $-196^{\circ}\text{C}$ ) technique, sperms, eggs, animal cells, tissues and embryos can be stored for long period in genes banks, seed banks, etc. Plants are propagated in vitro using tissue culture methods (micropropagation).

**9. What are sacred groves? What is their role in conservation?**

Ans. Sacred groves are forest patches for worship in several parts of India. All the trees and wildlife in them are venerated and given total protection. They are found in Khasi and Jaintia Hills in Meghalaya, Western Ghat regions of Karnataka and Maharashtra, etc. Tribals do not allow anyone to cut even a single branch of tree in these sacred groves, thus sacred groves have been free from all types of exploitations.

**10. The species diversity of plants (22 per cent) is much less than that of animals (72 per cent). What could be the explanations to how animals achieved greater diversification?**

Ans. Animals have achieved greater diversification than plants due to following reasons:

(i) They are mobile and thus can move away from their predators or unfavourable environments. On the other hand, plants are fixed and have fewer adaptation to obtain optimum amount of raw materials and sunlight therefore, they show lesser diversity.

(ii) Animals have well-developed nervous system to receive stimuli against external factors and thus can respond to them. On the other hand, plants do not exhibit any such mechanism, thus, they show lesser diversity than animals.

### Case Based Question:

The graph shows species-area relationship:

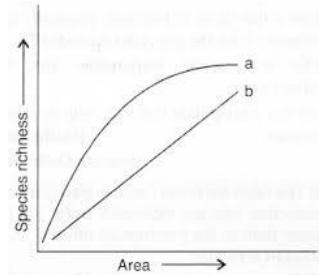
(a) If b denotes the relationship on log scale-

(i) Describe a and b.

(ii) How is slope represented? Give the normal range of slope.

(iii) What kind of slope will be observed for frugivorous

birds and mammals in a tropical forest? (b) Species diversity of plants (22%) is much less than that of animals (72%). Analyse the reasons for greater diversity of animals as compared to plants.



Ans : (a) (i) a is  $S = CA^Z$  b is  $\log S = \log C + Z \log A$

(ii) Slope is Z (regression coefficient). Its normal value ranges from 0.6 to 1.2.

(iii) In frugivorous birds and mammals, value of  $Z=1.15$

(b) Reasons for greater diversity of animals are:

(i) Animals are mobile and can avoid predator or unfavorable event.

(ii) Well developed nervous system to receive stimuli against external factors and respond to them.