

Date: 25/03/2025



Question Paper Code

57/1/2

Aakash

Medical | IIT-JEE | Foundations

Corporate Office: AESL, 3rd Floor, Incuspaze Campus-2, Plot No. 13,
Sector-18, Udyog Vihar, Gurugram, Haryana - 122015

Time: 3 hrs.

BIOLOGY (Theory)

Max. Marks: 70

CBSE Board Class-XII Exam (2025)

Answers & Solutions

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

- (i) This question paper contains **33** questions. **All** questions are compulsory.
- (ii) This question paper has five sections: Section **A**, Section **B**, Section **C**, Section **D** and Section **E**.
- (iii) **Section A** contains sixteen questions, **12** Multiple Choice type questions (1-12) (MCQs) and **4** Assertion Reasoning (A-R) type questions (13-16) of **1 mark** each.
- (iv) **Section B** contains **5** Very Short Answer (VSA) type questions (17-21) of **2 marks** each.
- (v) **Section C** contains **7** Short Answer (SA) type questions (22-28) of **3 marks** each.
- (vi) **Section D** contains **2** Case-Based Questions (CBQ) (29 & 30) of **4 marks** each. Each question has subparts with internal choice in **one** subpart.
- (vii) **Section E** contains **3** Long Answer (LA) type questions (31-33) of **5 marks** each.
- (viii) There is no overall choice. However, an internal choice has been provided in 1 question in Section B, 1 question in Section C, 1 question in each **CBQ** in Section D and all 3 questions in Section E. A candidate has to attempt only **one** of the choices in such questions.
- (ix) Wherever necessary, neat and properly labelled diagrams should be drawn.

SECTION-A

Question Nos. 1 to 16 are Multiple Choice type Questions, carrying 1 mark each.

16 × 1 = 16

1. Mohit performed an analysis of two different soil samples from two areas A and B. He recorded these results:

Soil Sample A: Lignin 40%, Sugar 10%, Chitin 45%, Nitrogen 5%

Soil Sample B: Lignin 5%, Sugar 35%, Chitin 15%, Nitrogen 45%

Which of these is true about their rate of decomposition in both the soil?

- (A) Soil A has a slower rate of decomposition than Soil B.
- (B) Soil A has a faster rate of decomposition than Soil B.
- (C) Both have the same rate of decomposition.
- (D) No decomposition occurs in A and B.

Answer (A)

Sol. Soil sample B is richer in Nitrogen and sugar, substances which tend to decompose quickly. Whereas, soil sample A has more amount of chitin and lignin, therefore it will have a slower rate of decomposition. Taken together, the soil composition data suggests that rate of decomposition of soil sample A will be slower than soil sample B.

2. Diameter of the pollen grain generally is

- (A) 5 to 10 micrometer
- (B) 10 to 15 micrometer
- (C) 25 to 50 micrometer
- (D) 50 to 100 micrometer

Answer (C)

Sol. Diameter of a typical pollen grain generally is in the range of 25 to 50 micrometer. Pollen grains are the male gametophytes in the flowering plants.

3. Menstrual cycle in human females consists of various events.

Select the option that indicates the correct sequence of these events of menstrual cycle.

- (A) Menstrual phase, Follicular phase, Luteal phase, Ovulatory phase
- (B) Luteal phase, Follicular phase, Ovulatory phase, Menstrual phase
- (C) Menstrual phase, Follicular phase, Ovulatory phase, Luteal phase
- (D) Follicular phase, Luteal phase, Menstrual phase, Ovulatory phase

Answer (C)

Sol. Option (C) is the correct answer, because the correct sequence of events of menstrual cycle in human females is

Menstrual Phase → Follicular phase → Ovulatory phase → Luteal phase
(Lasts for 3-5 days) (Growth of ovarian follicles) (Release of ovum) (Development of corpus luteum and its secretions)

4. A Dihybrid cross is done between two parent pea plants (pure line) who differ in two pairs of contrasting traits: Seed colour and seed shape.

In the F₂ generation the number of phenotypes and genotypes will be:

- (A) phenotypes = 4; genotypes = 16
- (B) phenotypes = 9; genotypes = 14
- (C) phenotypes = 4; genotypes = 8
- (D) phenotypes = 4; genotypes = 9

Answer (D)

Sol. In a dihybrid cross, between two parent pea plant who differ in two pairs of contrasting characters will be, phenotypes = 4 and Genotypes = 9

Cross between seed colour and seed shape

Parental \Rightarrow $RRYY$ (Round and yellow) \times $rryy$ (Wrinkled and green)

\downarrow
F₁ generation $RrYy$
(Selfing of F₁)

\downarrow

| | | | | | |
|---------------------------|--|------|------|------|------|
| F ₂ generation | $\begin{matrix} \text{♀} \\ \text{♂} \end{matrix}$ | RY | Ry | rY | ry |
| | RY | RRYY | RRYy | RrYY | RrYy |
| | Ry | RRYy | RRyy | RrYy | Rryy |
| | rY | RrYY | RrYy | rrYY | rrYy |
| | ry | RrYy | Rryy | rrYy | rryy |

The phenotypic ratio is:

9 : 3 : 3 : 1
(Round yellow) (Round green) (Wrinkled yellow) (Wrinkled green)

Total phenotypes = 4

The Genotypic ratio

1 : 2 : 1 : 2 : 4 : 2 : 1 : 2 : 1

Total genotypes = 9.

5. RNA interference (RNAi) helps in making tobacco-plant resistant to a nematode (*Meloidogyne incognita*)

Choose the correct option that shows how RNAi is achieved:

- (A) Preventing the process of translation of mRNA of the nematode.
- (B) Preventing the process of replication of DNA of the nematode.
- (C) Preventing the process of transcription of DNA of the plant.
- (D) Preventing the process of replication of DNA of the plant.

Answer (A)

Sol. Option (A) is the correct answer because

RNAi involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA. So, the translation of mRNA of the nematode is prevented.

6. The sequence of nitrogenous bases in a segment of a coding strand of DNA is 5' - AATGCTAGGCAC - 3'. Choose the option that shows the correct sequence of nitrogenous bases in the mRNA transcribed by the DNA.

- (A) 5' - UUACGAACCGAG - 3'
- (B) 5' - AAUGCUAGGCAC - 3'
- (C) 5' - UUACGUACCGUG - 3'
- (D) 5' - AACGUAGGCAGC - 3'

Answer (B)

Sol. The sequence of the coding strand is given below

Coding strand \Rightarrow 5' - AATGCTAGGCAC - 3'

mRNA \Rightarrow 5' - AAUGCUAGGCAC - 3'

So, the correct answer is 'B'.

7. A man whose father was colour-blind marries a woman who had a colour-blind mother and normal father. What percentage of male children of this couple will be colour-blind?
- (A) 25% (B) 0%
(C) 50% (D) 75%

Answer (C)

Sol. Genetic complement of man = XY

Genetic complement of woman = X^cX

| | | | | |
|----------|-----------------------|---|----------------------|---|
| | Father | * | Mother | |
| | XY | | X ^c X | |
| Children | XX ^c | | XX | <div style="border: 1px solid black; display: inline-block; padding: 2px;">X^cY</div> |
| | (Carrier , female) | | (Normal , female) | Affected , Normal male male |

So, the % of affected male children is $\frac{1}{2}$ or 50%.

8. Evolution of modern man involves the following man-like primates. Choose the correct series of human evolution.
- (A) *Dryopithecus* → *Homo erectus* → *Australopithecines* → *Homo sapiens*
 (B) *Australopithecines* → *Homo erectus* → *Neanderthal* → *Homo sapiens*
 (C) *Australopithecines* → *Ramapithecus* → *Dryopithecus* → *Homo sapiens*
 (D) *Homo erectus* → *Australopithecines* → *Homo sapiens* → *Neanderthal*

Answer (B)

Sol. Option (B) is the correct answer because

- About 15 mya, primates called *Dryopithecus* and *Ramapithecus* were existing.
- Two mya, *Australopithecines* probably lived in East African grasslands.
- *Homo erectus* were existing about 1.5 mya.
- The *Neanderthal* man lived between 1,00,000 - 40,000 years back.
- During ice age between 75,000 - 10,000 years ago *Homo sapiens* arose.

Hence the correct series of human evolution is

Australopithecines → *Homo erectus* → *Neanderthal* → *Homo sapiens*

9. GEAC stands for
- (A) Genome Engineering Action Committee
 (B) Ground Environment Action Committee
 (C) Genetic and Environment Approval Committee
 (D) Genetic Engineering Approval Committee

Answer (D)

Sol. The correct answer is (D).

GEAC stands for Genetic Engineering Approval Committee.

10. Transplantation of tissues/organs to some patients often fails due to rejection of such tissues/organs by the body of the patient. Which type of immune response is responsible for such rejections?
- (A) Autoimmune response (B) Humoral immune response
 (C) Physiological immune response (D) Cell mediated immune response

Answer (D)

Sol. The correct answer is (D) because,

Cell mediated immune response is responsible for graft rejection.

Humoral immune response is antibody mediated.

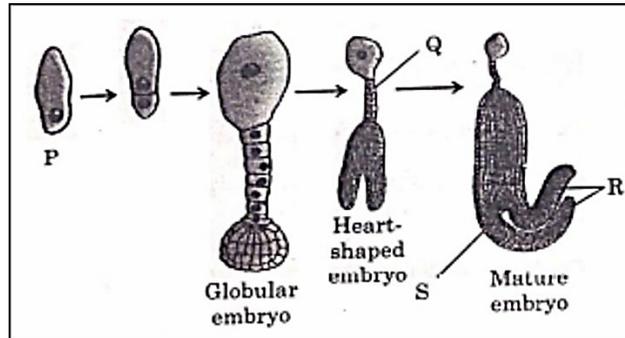
The T-lymphocytes mediate CMI.

11. Amplification of gene of interest by using DNA polymerase may go upto
 (A) 0.1 million times (B) 1 million times
 (C) 1 billion times (D) 1 trillion times

Answer (D)

Sol. The correct answer is (D) because with the help of PCR, any gene of interest can be amplified to greater quantity. For instance, 30 cycles of PCR can produce 1 billion copies of dsDNA fragment. Similarly, around 40 cycles of PCR can produce trillion copies of the desired DNA fragment.

12. The diagram given below shows labelling of four parts of a dicot embryo during its development as P, Q, R and S.



Choose the option that indicates correct labelling of 'P', 'Q', 'R' and 'S' of embryo in different stages of its development:

- | P | Q | R | S |
|------------|-----------|-----------|-----------|
| (A) Egg | Suspensor | Radicle | Cotyledon |
| (B) Zygote | Suspensor | Cotyledon | Plumule |
| (C) Egg | Radicle | Suspensor | Cotyledon |
| (D) Zygote | Suspensor | Cotyledon | Radicle |

Answer (B)

Sol. In the figure, given labels are as follows

"P" is the zygote

"Q" is the suspensor

"R" is the cotyledon

"S" is the plumule

The corresponding correct answer is (B)

Question Number 13 to 16 consists of two statements - Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

- (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.

13. **Assertion (A):** Perisperm is a diploid tissue.

Reason (R): Perisperm is the remains of nucellus which surrounds the embryo in certain seeds.

Answer (A)

Sol. Nucellus is a diploid tissue and its remnant in mature seeds is termed as perisperm. Therefore, perisperm surrounds the embryo in certain seeds.

Thus, both assertion and reason are true and reason is the correct explanation of assertion.

14. **Assertion (A):** While working on Staphylococci, Alexander Fleming observed that Penicillium notatum inhibits the growth of bacteria.

Reason (R): The inhibiting chemical was commercially extracted and its full potential was established by Alexander Fleming.

Answer (C)

Sol. While working on Staphylococci, Alexander Fleming observed that Penicillium notatum inhibits the growth of bacteria because chemical (Penicillin, an antibiotic) was produced by fungi which inhibits the growth of bacteria. Thus, assertion is true.

The inhibiting chemical was commercially extracted and its full potential was established by Ernest Chain and Howard Florey, not Alexander Fleming. Thus, reason is incorrect statement. Hence, assertion is true but reason is false.

15. **Assertion (A):** One of the property of genetic code is degeneracy.

Reason (R): Some amino acids can be coded by more than one codon.

Answer (A)

Sol. Some amino acids are coded by more than one codon. Hence, genetic code is degenerate. Thus, both (A) and (R) are true and (R) is the correct explanation of (A).

16. **Assertion (A):** A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions.

Reason (R): The most commonly used bioreactors are of stirring type.

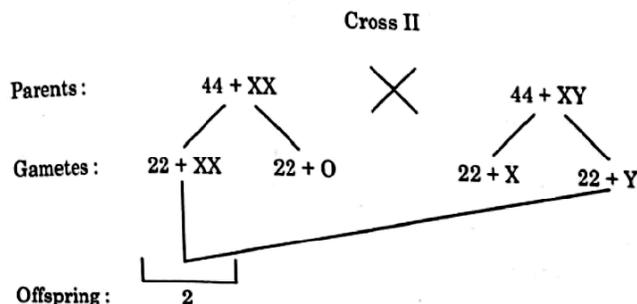
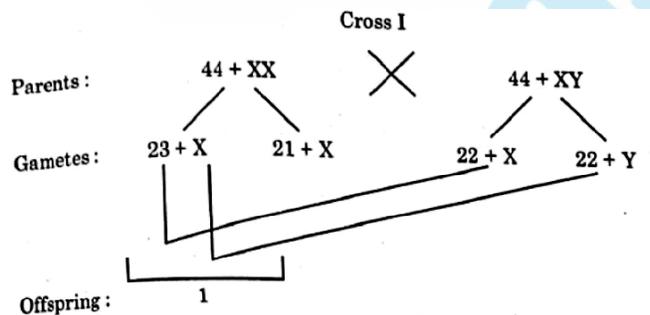
Answer (B)

Sol. The correct answer is (B), as both the Assertion (A) and Reason (R) are true that is, a bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions (temperature, pH, substrate, salts, vitamins, oxygen) and the most commonly used bioreactors are of stirring type. Thus, (R) does not explain (A) correctly.

SECTION-B

17. Study the two different crossing given below :

[2]



Identify the abnormalities 1 and 2 in the offspring of given crosses and distinguish between them.

Sol. In Case I

The offspring is inflicted with the disorder in which an extra copy of autosome is present

$$23 \times (22 + X)$$

The cause of this genetic disorder is the presence of an extra copy of autosome (trisomy of autosome) and the disorder is known as Down's syndrome.

In Case II

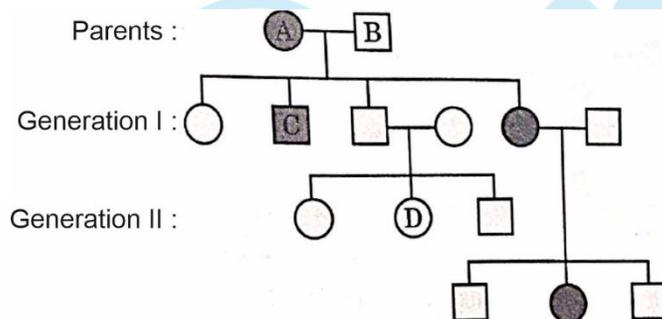
The offspring inflicted with this disorder has an extra copy of X chromosome (sex chromosome)

$$[(22 + XX) (22 + Y)]$$

This disorder would be due to trisomy of sex chromosome. Eg-Klinefelter's syndrome.

| Trisomy of autosome | Trisomy of sex chromosome |
|---|---|
| 1. Presence of additional copy of autosome | 1. Presence of the additional copy of X chromosome. |
| 2. This occurs due to the fusion of abnormal gamete (23 + X) and normal gamete (22 + X or 22 + Y) | 2. This occurs due to the fusion of abnormal gamete (22 + XX) with normal gamete (22 + Y) |

18. Study the pedigree analysis of Myotonic dystrophy given below:



Answer the following question:

- (a) Write genotype of A, B, C and D [1]
- (b) Identify whether the trait is [1]
 - (i) Sex linked or autosomal
 - (ii) Dominant or recessive

Sol. (a) The genotype of A, B, C and D in the given pedigree chart is as follows.

- Individual A – Aa
- Individual B – aa
- Individual C – Aa
- Individual D – aa

- (b) (i) The given trait is autosomal.
- (ii) The given trait is dominant.

19. Student to attempt either option-(A) or (B):

(A) A patient with ADA deficiency requires periodic infusion of genetically engineered lymphocytes. Explain why such periodic infusion is required and also suggest a permanent cure for such ADA deficiency.

OR

(B) Describe in brief any two techniques that can be utilised to transfer recombinant DNA into the host cell directly without using any vector.

- Sol.** (A) • Periodic infusion of genetically engineered lymphocytes is required as these cells are not immortal.
- The permanent cure for ADA deficiency is introduction of ADA producing gene isolated from marrow cells into patient's cells at early embryonic stages.
- (B) • Techniques that can be utilised to transfer recombinant DNA into the host cell directly without using any vector are as follows:
- (a) **Micro-injection:** rDNA is directly injected into the nucleus of an animal cell.
 - (b) **Biolistics or gene gun:** Cells are bombarded with high velocity micro-particles of gold or tungsten coated with DNA.

20. Student to attempt either option (a) or (b)

- (A) How are morphine and heroin related? Mention their effect on the human body.

OR

- (B) (i) Name an alcoholic drink which is produced by the help of microbes:

- (1) With distillation
- (2) Without distillation

(ii) Explain how cyanobacteria can be used as bio-fertilizer.

- Sol.** (A) Heroin, commonly called smack is chemically diacetylmorphine which is a white odourless, bitter crystalline compound. This is obtained by acetylation of morphine.

Heroin and morphine are opioids. Opioids are depressants as they slow down body functions.

OR

- (B) (i) (1) Wine and beer are produced without distillation.

- (2) Whisky, brandy and rum are produced by distillation.

(ii) Cyanobacteria are autotrophic microbes widely distributed in aquatic and terrestrial environment, many of which can fix atmospheric nitrogen.

In paddy fields, cyanobacteria serve as an important biofertilizer. Cyanobacteria also add organic matter to the soil and increase its fertility.

21. Student to attempt either option-(A) or (B):

- (A) Analyse the following ecosystems and discuss, which will be more productive in terms of primary productivity:

A young forest, a natural old forest, a shallow polluted lake.

OR

- (B) Differentiate between Net primary productivity and Gross primary productivity in an ecosystem. **[1]**

- Sol.** (A) An old forest will be more productive in terms of primary productivity.

This ecosystem has more diverse plant as compare to other options.

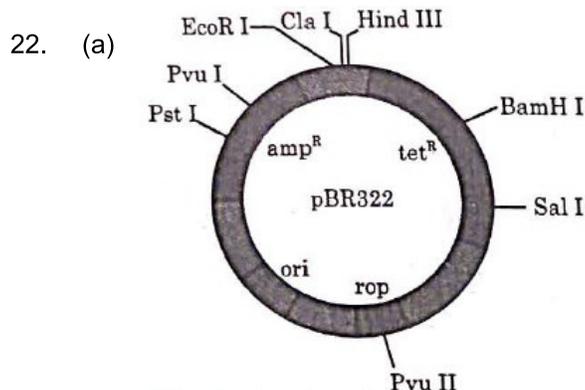
A shallow polluted lake will have least primary productivity.

OR

- (B) Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis.

GPP minus respiratory losses is net primary productivity. Net primary productivity is the available biomass for the consumption to heterotrophs.

SECTION-C



Explain the importance of 'ori' and 'rop' in the *E. coli* cloning vector shown in the above given diagram.

(b) Differentiate between exonucleases and endonucleases.

Sol. (a) 'ori' stands for origin of replication. It is a specific DNA sequence in a chromosome which is responsible for initiating replication. Therefore, for multiplication of any alien piece of DNA in an organism it needs to be a part of a chromosome(s) which has a specific sequence known as origin of replication.

This sequence is also responsible for controlling copy number of the linked DNA.

'rop' is the DNA sequence which codes for the proteins involved in the replication of the plasmid.

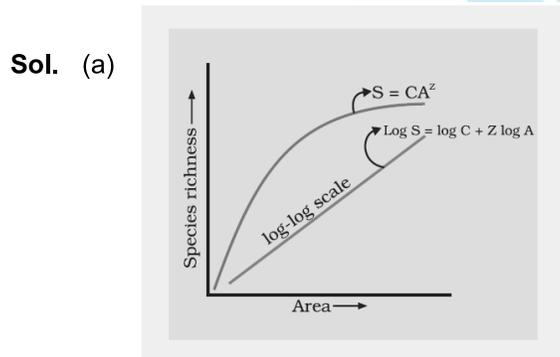
'rop' sequence contains restriction site for *Pvu II* restriction enzyme.

| (b) | Exonucleases | Endonucleases |
|-----|--|--|
| | Restriction enzymes that remove nucleotides from the ends of DNA e.g., Exonuclease I, Exonuclease II | Restriction enzymes that make cuts at specific positions within the DNA e.g., <i>Eco RI</i> , <i>Bam HI</i> etc., |

23. The great German naturalist and geographer Alexander Von Humboldt observed that within a region species richness increased with increasing explored area, but only upto a limit.

(a) For the above situation, construct a graph and write an equation.

(b) Also write various values of Z (regression coefficient).



On a log scale, species-area relationship is described by the equation, 'log S = log C + Z log A'.

(b) Ecologists have discovered that the value of Z lies in the range of 0.1 to 0.2 regardless of the taxonomic group or the region.

Value of Z for a very large area (entire continent) is 0.6 to 1.2

Value of Z for frugivorous birds and mammals in the tropical forests of different continents is 1.15.

24. Shyam and Radha are expecting their first child with Radha being in her second month of pregnancy with no complications. Shyam's family has a history of cystic fibrosis while Radha's family has a history of Down's syndrome, leading to a concern that the baby may have one of these conditions.

- (a) Suggest and explain a way of testing if their baby is at risk for any genetic disorders.
- (b) In case of presence of one or both of the abnormalities and posing a risk to the mother's health, mention one possible option for them to consider. Is that option safe for Radha at the current gestational age? Justify.
- (c) Under the what condition is the process mentioned in (b) is illegal?

Sol. (a) Shyam and Radha's baby can be tested for any genetic disorders by amniocentesis. In this procedure, some of the amniotic fluid of the developing fetus is taken to analyse the fetal cells and dissolved substances.

- (b) In case of presence of one or both the abnormalities and risk to mother's health, medical termination of pregnancy can be done. As Radha is in her second month of pregnancy, this procedure is safe for her as, MTP is relatively safe upto 12 weeks of pregnancy.
- (c) This procedure is illegal, if the foetus is found to be female and then followed by MTP or if performed by unqualified quacks.

25. (a) Write the palindromic nucleotide sequence for following sequence of DNA segment:

5' – GAATTC – 3'

- (b) Name the restriction endonuclease that recognizes this sequence.
- (c) How are sticky ends produced? Mention their role.

Sol. (a) The palindromic nucleotide sequence of the given DNA segment will be

3' – CTTAAG – 5'

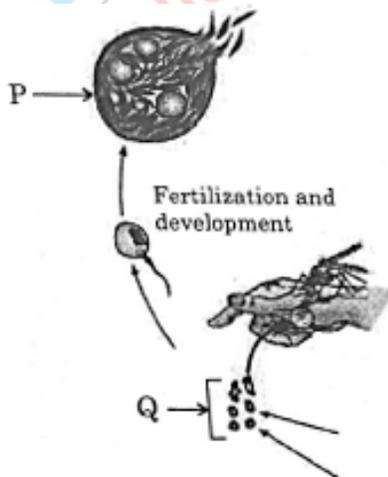
(b) *EcoRI* recognises the given sequence i.e.

5' – G↓AATTC – 3'

3' – CTTA↑G – 5'

- (c) Restriction enzymes cut the DNA strand a little away from the centre of palindromic sites, but between the same two bases on the opposite strands. This leaves single stranded portion on each strand. These are overhanging stretches called sticky ends on each strand. This stickiness assists in joining the staggered ends by forming hydrogen bonds between complementary base pairs.

26. Study a part of life cycle of *Plasmodium* given below:



Answer the following questions:

- Name the infective stage of *Plasmodium* that is stored in the female *Anopheles* mosquito.
- Where does fertilization and development of parasite take place?
- Identify labels P and Q in the given diagram.
- Asexual and sexual phase of the life cycle of the *Plasmodium* takes place in two different hosts. Write their names.

- Sol.**
- 'Sporozoite' is the infective stage of *Plasmodium* which is stored in the female *Anopheles* mosquito's salivary glands.
 - Both fertilization and development of malarial parasite takes place in *Anopheles* mosquito's gut.
 - 'P' represents – Salivary glands containing sporozoites of female *Anopheles* mosquito.
'Q' represents – Gametocytes in human blood.
 - Parasite reproduces asexually in – Human hepatocytes and RBCs.
Parasite reproduces sexually in – Gut of female *Anopheles* mosquito.

27. Compare and contrast convergent and divergent evolution.

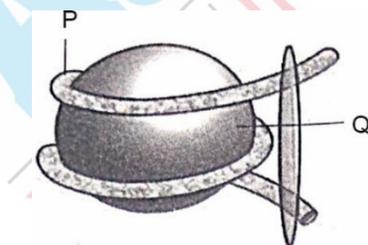
[3]

Sol.

| Convergent evolution | Divergent evolution |
|---|--|
| <ul style="list-style-type: none"> Different ancestor Converge to produce analogous structures (Perform same functions) Species appearance becomes more similar over time Anatomically different structures Example-Vertebrates hearts or brains, Thorns of <i>Bougainvillea</i> and Tendrils of <i>Cucurbita</i>. | <ul style="list-style-type: none"> Common ancestor Diverge to produce homologous structures (Perform different functions) Species appearance becomes more different over time. Anatomically similar structures Example-Flippers of penguins and Dolphins. Eye of <i>Octopus</i> and of mammals. |

28. Study the diagram given below and answer the questions that follows:

[3]



- Identify the structure shown in the above figure.
- Identify the labels P and Q.
- Write the nature of histone proteins.
- Distinguish between Euchromatin and Heterochromatin.

- Sol.**
- The given figure represents the structure of a nucleosome.
 - Label 'P' represents – DNA
Label 'Q' represents – Histone octamer
 - Histone proteins are basic in nature

| (d) | Euchromatin | Heterochromatin |
|-------|------------------------------------|--------------------------------------|
| (i) | Loosely packed chromatin | Densely packed chromatin |
| (ii) | Stains light in colour | Stains dark in colour |
| (iii) | Transcriptionally active chromatin | Transcriptionally inactive chromatin |

SECTION-D

Q. No. 29 and 30 are case based questions. Each question has 3 sub-questions with internal choice in one sub-question.

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

In nature, we rarely find isolated, single individuals of any species; majority of them live in groups in a well-defined geographical area, share or compete for similar resources, potentially interbreed and thus constitute a population. The population has certain attributes whereas, an individual organism does not. A population at a given time is composed of individuals of different ages. The size of the population tells us a lot about its status in the habitat. Whatever ecological processes we wish to investigate in a population, be it the outcome of competition with another species, the impact of the predator or the effect of pesticide application, we always evaluate in terms of any change in the population size. The size, in nature, could be low or go into millions. Population size, technically called population density (N) need not necessarily be measured in numbers only. The size of a population for any species is not a static parameter. It keeps on changing with time depending on various factors including food availability, predation pressure and adverse weather.

- (a) The Monarch butterfly is highly distasteful to its predator because of a special chemical present in its body. How does the butterfly acquire this chemical?
- (b) If population density at a time $t + 1$ is 800, Emigration = 100, Immigration = 200, Natality = 200 and Mortality = 150, calculate the population density at time t and comment upon the type of age pyramid that will be formed in this case.

Student to attempt either sub-part (c) or (d):

- (c) What is the difference in a method of measuring population density in an area if there are 200 carrot grass plants to only single huge banyan tree?

OR

- (d) Name two methods to measure the population density of tigers.

Sol. (a) The Monarch butterfly acquires this chemical during its caterpillar stage by feeding on a poisonous weed.

- (b) $N_{t+1} = 800$, $E = 100$, $I = 200$, $D = 150$, $B = 200$

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

$$800 = N_t + [(200 + 200) - (150 + 100)]$$

$$800 = N_t + [150]$$

$$\therefore N_t = 800 - 150 = 650$$

$$\therefore \text{The population density at time } t = 650$$

as we can see that $N_{t+1} > N_t$

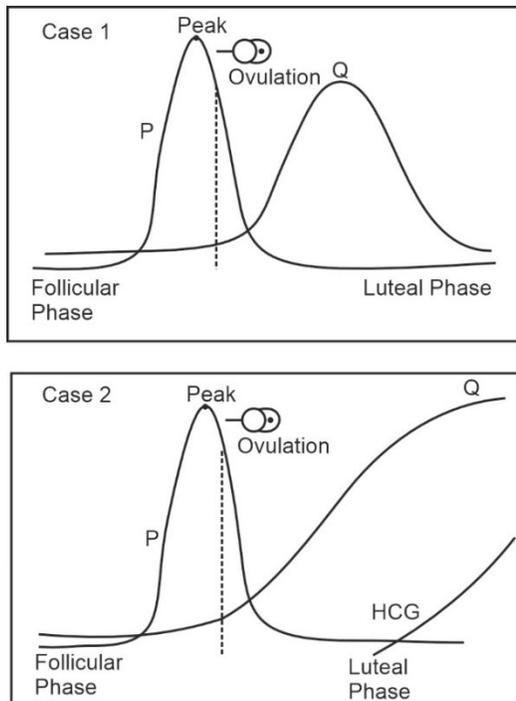
\therefore It is going to represent an expanding population

- (c) In an area, if there are 200 carrot grass plants but only a single huge banyan tree with a large canopy, stating that the population density of banyan is low relative to that of carrot grass plants accounts to underestimating the enormous role of the Banyan in that community. In such cases, the per cent cover or biomass is a more meaningful measure of the population size.

OR

- (d) The tiger census in national parks and tiger reserves is based on
- Pug marks
 - Fecal pellets

30. Study the graphs given below for Case 1 and Case 2 showing different levels of certain hormones and answer the questions that follows:



- Which hormone is responsible for the peak observed in Case 1 and Case 2? Write one function of that hormone.
- Write changes that take place in the ovary and uterus during follicular phase.
Student to attempt **either** sub-part (c) or (d) :
- Name the hormone Q of Case 2. Write one function of hormone Q.

OR

- (d) Which structure in the ovary will remain functional in Case 2? How is it formed?

Sol. (a) LH is the hormone which is responsible for the peak observed in both case 1 and case 2.

Function of LH: LH hormone plays a crucial role in triggering ovulation, maintaining corpus luteum during luteal phase and regulating menstrual cycle (any one).

(b) **During Follicular Phase**

(i) **Ovary:** The primary follicles in the ovary grow to become a fully mature Graafian follicle.

(ii) **Uterus:** The endometrium of uterus regenerates through proliferation hence called proliferative phase. This phase is preceded by menstruation phase in which menstrual flow results due to breakdown of endometrial lining of the uterus and its blood vessels which form liquid that comes out through vagina only when released ovum is not fertilised.

(c) Hormone Q of case 2 is progesterone.

Function of progesterone: This hormone plays a vital role in maintaining pregnancy by supporting endometrium and also preparing the uterus for pregnancy.

OR

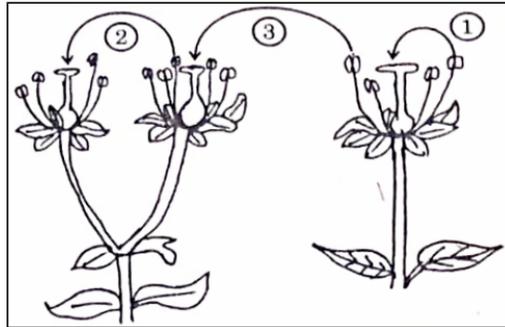
- (d) Corpus luteum formed after ovulation, remains functional in ovary in case of pregnancy (case 2). This structure is formed by ruptured Graafian follicle. It secretes large amount of progesterone which is essential for maintenance of the endometrium.

SECTION-E

31. Student to attempt either option-(A) or (B):

(A)

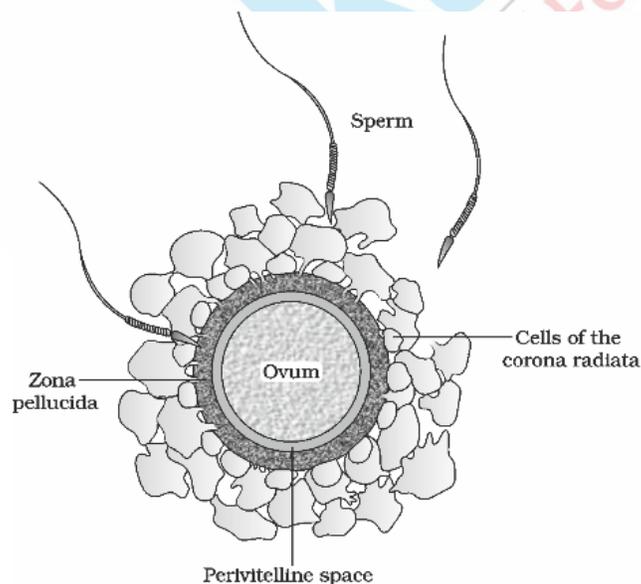
- (a) Distinguish between the two cells enclosed in a mature male gametophyte of an angiosperm.
 (b) Study the diagram given below showing the modes of pollination. Answer the questions that follow.



- (i) The given diagram shows three methods of pollen transfer in plants. Examine them carefully and write the technical terms used for pollen transfer in methods '1', '2' and '3'.
 (ii) How do the following plants achieve pollination successfully?
 (a) Water lily
 (b) Vallisneria
 (iii) Write advantages of pollen transfer method '3'.

OR

(B) Given below is the diagram of human ovum surrounded by a few sperms. Observe the diagram and answer the questions that follows:



- (i) Compare the fate of sperms 'P', 'Q' and 'R' shown in the diagram.
 (ii) Write the role of Zona pellucida in this process.
 (iii) Analyse the changes occurring in the ovum after the entry of sperm.
 (iv) How acrosome and middle piece are able to play an important role in human fertilization?

- Sol.** (A) (a) The pollen grains represent the male gametophytes. When the pollen grains mature, it contains two cells-generative and vegetative cells.

The generative cell is distinguished from vegetative cell:

| Generative cell | Vegetative cell |
|---|---|
| <ul style="list-style-type: none"> • Smaller in size | <ul style="list-style-type: none"> • Bigger in size |
| <ul style="list-style-type: none"> • Spindle shaped with dense cytoplasm and a nucleus | <ul style="list-style-type: none"> • Large irregularly shaped nucleus. |
| <ul style="list-style-type: none"> • It floats in cytoplasm of vegetative cell | <ul style="list-style-type: none"> • It has abundant food reserves. |

- (b) (i)
 - In the given diagram, method 1 is representing the “autogamy” type of pollen transfer as pollination is achieved within the same flower.
 - Method 2 is representing “Geitonogamy”, in which transfer of pollen grains from anther to stigma of another flower of the same plant occurs.
 - Method 3 represents “Xenogamy”, where transfer of pollen grains from anther to stigma of a different plant occurs.
- (ii)
 - In water lily, the flowers emerge above the level of water and are pollinated by insects or wind.
 - In *Vallisneria*, the female flower reaches the surface of water by the long stalk and male flowers or pollen grains are released on to surface of water. They are carried passively by water currents, some of them eventually reach the female flowers and the stigma.
- (iii) Method-3
 - Xenogamy: It is the only type of pollination in which pollination brings genetically different types of pollen grains to the stigma.
 - It enables creation of new variants, so that survival advantage is enhanced.

OR

- (B) (i) Sperm ‘P’ penetrates zona pellucida and fertilises the ovum while sperms ‘Q’ and ‘R’ will remain outside the ovum and will not enter the ovum due to changes in zona pellucida to form a stabilised membrane.
- (ii) In this process, zona pellucida undergoes structural changes to prevent multiple sperm from entering the ovum ensuring a single sperm fertilises the ovum.
- (iii) The entry of sperm induces the completion of the second meiotic division of the secondary oocyte. This results in the formation of a second polar body and a haploid ovum (ootid). Soon the haploid nucleus of sperm and that of ovum fuse together to form a diploid zygote.
- (iv) Acrosome is filled with hydrolytic enzymes that help sperm to penetrate/digest zona pellucida layer and therefore fertilisation to occur.

Middle piece of sperm possesses numerous mitochondria, which produces energy for the movement of tail that facilitate sperm motility essential for fertilisation.

32. Student to attempt **either** option (A) or (B):

(A) Answer the following questions:

- (i) State what do you understand by “MALT”? Where it is located inside our body?
- (ii) Explain cytokine barriers.
- (iii) Name the diagnostic test for AIDS. On what principle does not work?
- (iv) Bone marrow and thymus play an important role in human immune system. Explain how are they able to achieve this.

OR

(B) (i) Fill 'H', 'I', 'J', 'K', 'L', and 'M' in following table with suitable words:

| | Chemical/Bioactive Molecule | Micro-organism | Category | Use |
|-----|-----------------------------|---------------------------|----------|--|
| (a) | Butyric acid | H | I | Important applications in food, chemical & pharma industry |
| (b) | J | <u>Monascus purpureus</u> | K | Inhibit cholesterol biosynthesis |
| (c) | Cyclosporin A | L | Fungus | M |

(ii) Why are baculoviruses used as biological control agents?

- Sol.** (A) (i) MALT stands for Mucosa Associated Lymphoid Tissue. It is located within the lining of respiratory, digestive and urogenital tracts in our body.
- (ii) Cytokine barriers are one of the four types of barriers of innate immunity. Interferons are example of cytokine barriers, secreted from virus infected cells, which protect non-infected cells from further viral infections.
- (iii) ELISA *i.e.* Enzyme Linked Immuno Sorbent Assay is the widely used diagnostic test for AIDS. It works on the principle that involves antigen-antibody interaction.
- (iv) Both bone marrow and thymus are the primary lymphoid organs where immature lymphocytes differentiate into antigen-sensitive lymphocytes. Both bone marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes.
- The bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced.

OR

(B) (i)

| | Chemical/Bioactive Molecule | Micro-organism | Category | Use |
|-----|-----------------------------|-----------------------------------|--------------|--|
| (a) | Butyric acid | (H) <i>Clostridium butylicum</i> | (I) Bacteria | Important applications in food, chemical & pharma industry |
| (b) | (J) Statins | <u>Monascus purpureus</u> | (K) Fungus | Inhibit cholesterol biosynthesis |
| (c) | Cyclosporin A | (L) <i>Trichoderma polysporum</i> | Fungus | (M) Used as immunosuppressive agent in organ-transplant patients |

(ii) Baculovirus are used as biocontrol agents because they attack insects and other arthropods.

- These viruses are excellent candidates for species-specific, narrow spectrum insecticidal applications.
- They have been shown to have no negative impacts on plants, mammals, birds, fish or even on non-target insects.
- This is especially desirable when beneficial insects are being conserved to aid in an overall IPM, or when an ecologically sensitive area is being treated.

33. Student to attempt either option-(A) or (B):

- (A) (i) Haemophilia and red green colour-blindness is usually observed in men. Why?
 (ii) Perform a cross(es) where haemophilic daughter(s) and haemophilic son(s) are produced in same ratio.

OR

- (B) (i) Where do transcription and translation occur in bacteria and eukaryotes respectively?
 (ii) Draw a labelled schematic sketch of replication fork of DNA.
 (iii) A DNA segment has a total of 1000 nucleotides, out of which 240 of them are Adenine containing nucleotides. How many pyrimidines bases this segment possesses?

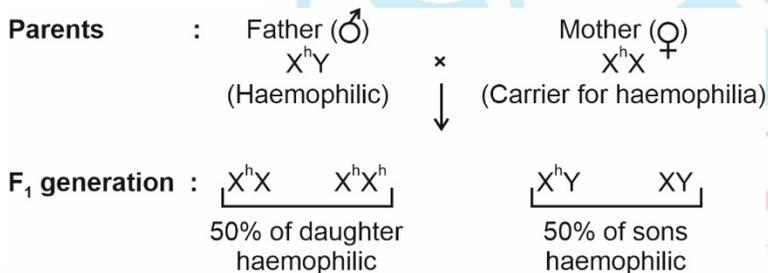
Sol. (A) (i) Haemophilia and colour blindness are sex-linked recessive disorders.

The defect is due to mutation in certain genes present in the X-chromosomes.

Both the disorder is usually observed in men because male have only one X-chromosome and females have two.

Thus, female can be carrier and not diseased while male can never be carrier rather, they are affected due to single X-chromosome.

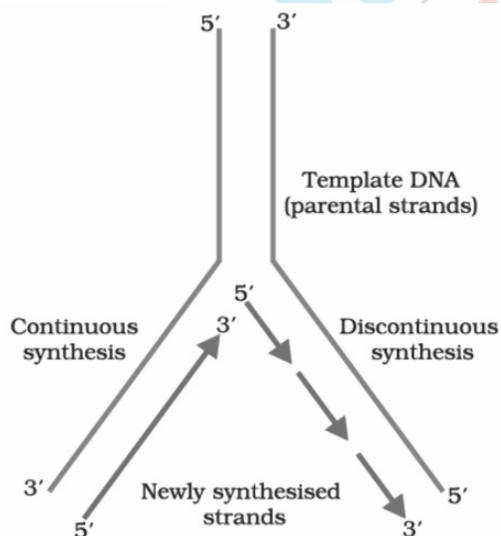
- (ii) For obtaining same ratio for haemophilic daughter and haemophilic son, the parents will be



OR

- (B) (i) • In prokaryotes, transcription and translation both occurs in cytoplasm.
 • In eukaryotes, transcription occurs inside nucleus and translation of mRNA occurs in cytoplasm after the processing of hnRNA occurred in the nucleus.

(ii)



(iii) According to Chargaff's rule

Adenine (A) = Thymine (T) (Pyrimidine)

Guanine (G) = Cytosine (C) (Pyrimidine)

∴ Total 1000 nucleotides

A = 240

∴ T = 240

A + T + G + C = 1000

240 + 240 + G + C = 1000

G + C = 1000 - 480 = 520

as G = C

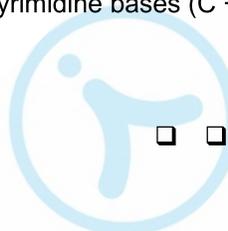
$$\therefore G = \frac{520}{2}$$

∴ G = 260

C = 260

Thus, total number of pyrimidine bases (C + T) = 260 + 240 = 500 nucleotides

□ □ □


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