

Date: 19/03/2024

Question Paper Code

57/5/1

Time: 3 hrs.

**BIOLOGY (Theory)**  
**CBSE Board Class-XII Exam (2024)**  
**Answers & Solutions**

Max. Marks: 70

**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 (MCQs) and **4** Assertion Reasoning (A-R) type questions 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 (29 and 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. A single gene that controls the expression of more than one trait is said to show [1]
- (A) Multiple allelism (B) Polygenic inheritance  
(C) Incomplete dominance (D) Pleiotropism

**Answer (D)**

**Sol.** When a single gene can exhibit multiple phenotypic expression, such a gene is called a pleiotropic gene.

2. A person with trisomy of 21<sup>st</sup> chromosome shows [1]
- (i) Furrowed tongue (ii) Characteristic palm crease  
(iii) Rudimentary ovaries (iv) Gynaecomastia

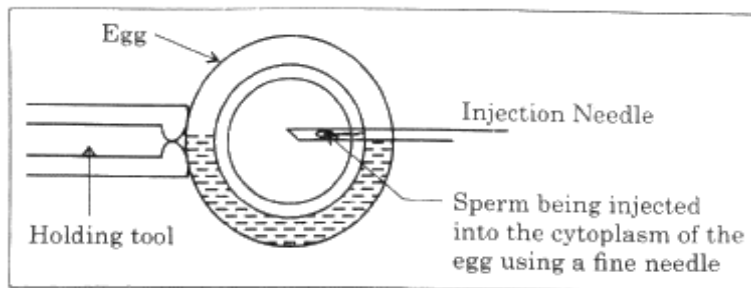
Select the correct option, from the choices given below:

- (A) (ii) and (iv) (B) (i), (ii) and (iv)  
(C) (ii) and (iii) (D) (i) and (ii)

**Answer (D)**

**Sol.** A person with trisomy of 21<sup>st</sup> chromosome will be inflicted with Down's syndrome and will show small round head, furrowed tongue, partially open mouth and characteristic palm crease.

3. Observe the schematic representation of assisted reproductive technology given below: [1]



Identify the most appropriate technique depicted in the above diagram.

- (A) IUT (B) IUI  
(C) ICSI (D) ZIFT

**Answer (C)**

**Sol.** The correct answer of this question is option (C) because in the given figure, the sperm is being injected into the cytoplasm of the egg using a fine needle. This ART is called ICSI (Intra Cytoplasmic Sperm Injection).

Options (A), (B) and (D) are incorrect as:

- IUT is Intra Uterine Transfer
- IUI is Intra Uterine Insemination and
- ZIFT is Zygote Intra Fallopian Transfer

4. Interferons are proteins secreted by [1]
- (A) RBC (B) WBC  
(C) Bacteria infected cell (D) Virus infected cell

**Answer (D)**

**Sol.** The correct answer of this question is option (D) as interferons are proteins secreted by the virus infected cells. These interferons protect the non-infected cells from further viral infection.

Options (A), (B) and (C) are incorrect as RBCs and WBCs are formed elements and bacterial infected cells do not secrete interferons.

5. During biological treatment of sewage, the masses of bacteria held together by fungal filaments to form mesh like structures are called [1]
- (A) Primary sludge (B) Floccs  
(C) Activated sludge (D) Anaerobic sludge

**Answer (B)**

**Sol.** Floccs are the masses of bacteria associated with fungal filaments to form mesh like structures.

6. Which one of the following statements is correct in the context of observing DNA separation by agarose gel electrophoresis? [1]
- (A) DNA can be seen in visible light.  
(B) DNA can be seen without staining in visible light.  
(C) Ethidium bromide-stained DNA can be seen in visible light.  
(D) Ethidium bromide-stained DNA can be seen under UV light.

**Answer (D)**

**Sol.** The correct answer of this question is option (D) as after gel electrophoresis, the separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation.

Options (A), (B) and (C) are incorrect as one cannot see pure DNA fragments in the visible light without staining or with staining.

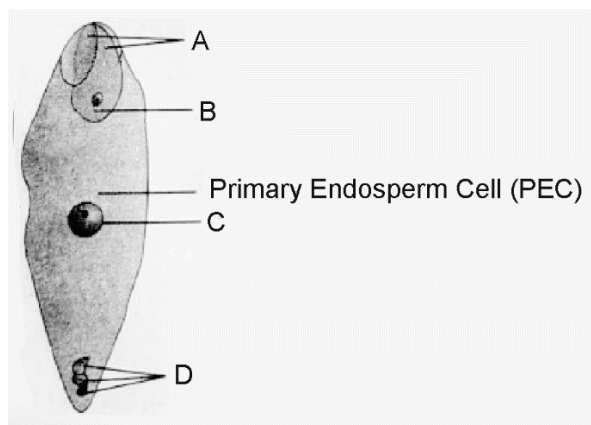
7. A phenomenon where a male insect mistakenly identified the patterns of a orchid flower as the female insect partner, and tries to copulate and thereby pollinates the flower is said to be [1]
- (A) Pseudocopulation (B) Pseudopollination  
(C) Pseudoparthenocarpy (D) Pseudofertilisation

**Answer (A)**

**Sol.** The Mediterranean orchid *Ophrys* employs 'Sexual deceit' to get pollination by a species of bee.

One petal of its flower bears an uncanny resemblance to the female of the bee in size, colour and markings. The male bee is attracted to what it perceives as a female, 'pseudocopulates' with the flower.

8. Identify the correct labellings in the figure of a fertilised embryo sac of an angiosperm given below [1]



- (A) A – zygote, B – degenerating synergids, C – degenerating antipodals, D – PEN  
(B) A – degenerating synergids, B – zygote, C – PEN, D – degenerating antipodals  
(C) A – degenerating antipodals, B – PEN, C – degenerating synergids, D – zygote  
(D) A – degenerating synergids, B – zygote, C – degenerating antipodals, D – PEN

**Answer (B)**

**Sol.** In the given diagram:

A represents – Degenerating synergids

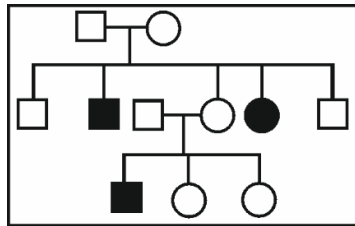
B represents – Zygote

C represents – Primary endosperm nucleus (PEN)

D represents – Degenerating antipodal cells

Thus, the correct option is (B)

9. Study the pedigree chart of a family showing the inheritance pattern of a certain disorder. Select the option that correctly identifies the nature of the trait depicted in the pedigree chart. [1]



- (A) Dominant X – linked (B) Recessive X - linked  
(C) Autosomal dominant (D) Autosomal recessive

**Answer (D)**

**Sol.** Since, the parents are not showing the trait but their son as well as daughter are affected so, the trait in consideration must be autosomal recessive.

10. Match the following genes of the lac operon listed in column 'A' with their respective products listed in column 'B': [1]

	A Gene		B Products
a.	'i' gene	(i)	$\beta$ -galactosidase
b.	'z' gene	(ii)	lac permease
c.	'a' gene	(iii)	repressor
d.	'y' gene	(iv)	transacetylase

Select the correct option:

**Options:**

- a      b      c      d  
(A) (i)    (iii)   (ii)   (iv)  
(B) (iii)   (i)    (ii)   (iv)  
(C) (iii)   (i)    (iv)   (ii)  
(D) (iii)   (iv)   (i)    (ii)

**Answer (C)**

**Sol.** The *i* gene codes for the repressor of the *lac* operon.

The *z* gene codes for the  $\beta$ -galactosidase.

The *a* gene codes transacetylase.

The *y* gene codes for *lac* permease.

Therefore, (a)-iii, (b)-i, (c)-iv, (d)-ii

Correct option is (C).

11. If both the parents are carriers for thalassaemia, the chances of an afflicted child to be born to them is: [1]
- (A) 25% (B) 50%
- (C) 75% (D) 100%

**Answer (A)**

**Sol.** According to the question, parents are carrier of thalassaemia and thalassaemia is an autosomal recessive disorder.

Parents  $\left[ \begin{array}{cc} \text{♀} & \text{♂} \\ \text{Aa} & \text{Aa} \end{array} \right.$

$\left[ \begin{array}{c} \text{♀} \backslash \text{♂} \\ \text{A} \\ \text{a} \end{array} \right.$	A	a	AA = Normal offspring
	AA	Aa	Aa = Carrier offspring
	Aa	aa	aa = affected offspring

$$\text{Affected offspring} = \frac{1}{4} \times 100 = 25\%$$

12. If the sequence of nitrogen bases of the coding strand in a transcription unit is 5' – ATGAATG – 3', the sequence of bases in its RNA transcript would be [1]
- (A) 5' – AUGAAUG – 3' (B) 5' – UACUUAC – 3'
- (C) 5' – CAUUCAU – 3' (D) 5' – GUAAGUA – 3'

**Answer (A)**

**Sol.** The sequence of coding strand which has the polarity [5' → 3'] is same as RNA, except thymine at the place of uracil.

Coding sequence → 5' – ATGAATG – 3'

mRNA → 5' – AUGAAUG – 3'

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):** AIDS is a syndrome caused by HIV.  
**Reason (R):** HIV is a virus that damages the immune system with DNA as its genetic material. [1]

**Answer (C)**

**Sol.** The correct answer of this question is option C as (A) is true, but (R) is false.

AIDS (Acquired Immunodeficiency Syndrome), caused by HIV (Human Immunodeficiency Virus), a member of a group of viruses called retroviruses, which have an envelope enclosing the RNA genome, not DNA as its genetic material.

14. **Assertion (A):** In molecular diagnosis, single stranded DNA or RNA tagged with radioactive molecule is called a probe.

**Reason (R):** A probe always searches and hybridises with its complementary DNA in a clone of cells. [1]

**Answer (A)**

**Sol.** (A) is the correct answer to this question.

During molecular diagnosis, a single stranded DNA or RNA tagged with radioactive molecule (probe) hybridises its complementary DNA in a clone of cells, followed by detection using autoradiography.

The clone having the mutated gene will hence not appear on the photographic film, because probe will not have complementarity with the mutated gene.

15. **Assertion (A):** In birds the sex of the offspring is determined by males.

**Reason (R):** Males are homogametic while females are heterogametic. [1]

**Answer (D)**

**Sol.** In birds, female produces two different types of gametes in terms of sex chromosomes (female heterogamety) i.e. one Z and one W, whereas males have a pair of Z-chromosomes besides the autosomes. So, the given assertion is false statement. Sex of the offspring is determined by female birds. So, the correct option is D.

16. **Assertion (A):** Communities that comprise of more species tend to be more stable.

**Reason (R):** A higher number of species results in less year-to-year variation in total biomass. [1]

**Answer (B)**

**Sol.** Communities with more species, generally tend to be more stable.

David Tilman in his long-term ecosystem experiments found that plots with more species showed less year to year variation in total biomass.

Both are the true statements but reason is not the correct explanation of the assertion.

### SECTION-B

17. (a) "Farmers prefer apomictic seeds to hybrid seeds." Justify giving two reasons. [2]

OR

(b) Mention one advantage and one disadvantage of amniocentesis. [2]

**Sol.** (a) Farmers prefer apomictic seeds to hybrid seeds because

(i) Production of apomictic seeds are economical. [1]

(ii) There is no segregation of characters in the hybrid progeny if the hybrids are made into apomicts, then the farmers can keep on using the hybrid seeds to raise new crop year after year. [1]

(b) **Advantage of amniocentesis-** This procedure is used to test for the presence of certain genetic disorders such as down syndrome, haemophilia, sickle- cell anaemia, etc. [1]

**Disadvantage of amniocentesis-** Increasing menace of female foeticides in India. [1]

18. 
$$\begin{array}{c} \downarrow \\ 5' - G A A T T C - 3' \\ 3' - C T T A A G - 5' \\ \uparrow \end{array}$$

(a) Name the restriction enzyme that recognises the given specific sequence of bases. What are such sequence of bases referred to as? [1]

(b) What are the arrows in the given figure indicating? Write the result obtained thereafter. [1]

**Sol.** (a) The restriction enzyme '*EcoRI*' recognises the given specific sequence of bases.

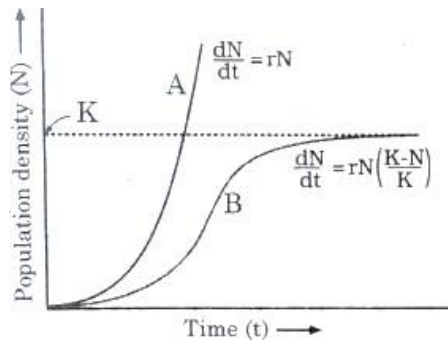
Such sequence of bases are referred to as palindromic nucleotide sequences. [1]

(b) In the given figure, the arrows indicate that the restriction enzyme *EcoRI* will cut between guanine (G) and adenine (A) in 5' → 3' direction. [1]

Result obtained after the action of *EcoRI*, is as follows:

$$\begin{array}{c} 5' - G \qquad \qquad \qquad A A T T C - 3' \\ 3' - C T T A A \qquad \text{and} \qquad \qquad G - 5' \end{array}$$

19. Observe the population growth curve and answer the questions given below:



- (a) State the conditions under which growth curve 'A' and growth curve 'B' plotted in the graph are possible. [1]
- (b) Mention what does 'K' in the graph represent. [1]

**Sol.** (a) Growth curve A is possible when resources are unlimited in the habitat. [½]

Growth curve B is possible when resources are limited in the habitat. [½]

- (b) 'K' represents carrying capacity. [1]

20. Explain how are plants benefitted by their association with "*Glomus* species". [2]

**Sol.** Many members of the genus *Glomus* form mycorrhiza. The fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant. Plants having such associations show benefits, such as resistance to root-borne pathogens, tolerance to salinity and drought, and an overall increase in plant growth and development. [2]

21. If the base adenine constitutes 31% of an isolated DNA fragment, then write what will be the expected percentage of the base cytosine in it. Explain how did you arrive at the answer given. [2]

**Sol.** Based on observations of Erwin Chargaff for a double stranded DNA, the ratios between Adenine and Thymine; and Guanine and Cytosine are constant and equals one.

Here,  $A = 31\%$

$$\therefore T = 31\%$$

Since  $A + T + G + C = 100\%$

$$(31\% + 31\%) + (G + C) = 100\%$$

$$62\% + G + C = 100\%$$

$$G + C = 100 - 62$$

$$G + C = 38\%$$

$$G = 19\%$$

$$\square G = C$$

$$\therefore C = 19\%$$

Hence, expected percentage of the base cytosine is 19% of adenine constituents 31% of isolated DNA. [2]

**SECTION-C**

22. Identify a, b, c, d, e and f in the table given below: [3]

Sl. No.	Organism	Bioactive Molecule	Use
1.	<i>Monascus purpureus</i>	a	b
2.	c	d	Antibiotic
3.	e	Cyclosporin A	f

**Sol.**

Sl. No.	Organism	Bioactive Molecule	Use
1.	<i>Monascus purpureus</i>	(a) Statins	(b) Blood cholesterol lowering agent
2.	(c) <i>Penicillium notatum</i>	(d) Penicillin	Antibiotic
3.	(e) <i>Trichoderma polysporum</i>	Cyclosporin A	(f) Immuno-suppressive agent in organ transplant patients

[½ × 6]

23. (a) Tropical regions harbour more species than the temperate regions. How have biologists tried to explain this in their own ways? Explain. [3]

**OR**

- (b) (i) What does an ecological pyramid represent?  
 (ii) The Ecological pyramids may have an 'upright' or an 'inverted' shape. Justify with the help of suitable examples. [3]

**Sol.** (a) Ecologists and evolutionary biologists have proposed various hypotheses to explain why tropical regions harbour more species; some important ones are:

- (i) Tropical environments, unlike temperate ones, are less seasonal relatively more constant and predictable. [1]  
 (ii) Tropical areas receive more solar energy, which contributes to higher productivity, this in turn might contribute indirectly to greater diversity. [1]  
 (iii) Speciation is generally a function of time. Unlike temperate regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for million of years and thus had a long evolutionary time for species diversification. [1]

**OR**

- (b) (i) Ecological pyramids are graphical representations of various ecological parameters at different trophic levels of food chain with producers at base or first trophic level while the apex represents tertiary or top level consumer. [1]  
 (ii) Pyramid of energy is always upright, can never be inverted, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step. The pyramid of biomass in sea is generally inverted because the biomass of fishes far exceeds that of phytoplankton. [2]

24. (a) What are transgenic animals?  
 (b) Name the transgenic animal having the largest number amongst all the existing transgenic animals.  
 (c) State any 3 reasons for which these types of animals are being produced. [3]

**Sol.** (a) Animals that have had their DNA manipulated to possess and express an extra (foreign) gene are known as transgenic animals. [½]



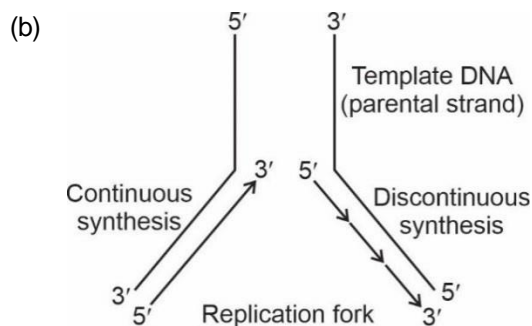
- (b) The transgenic animals having the largest number amongst all the existing transgenic animals are mice. Over 95 percent of all existing transgenic animals are mice. [½]
- (c) Three reasons for which transgenic animals are produced: [2]
- Normal physiology and development** : Transgenic animals can be specifically designed to allow the study of how genes are regulated, and how they affect the normal functions of the body and its development, e.g., study of complex factors involved in growth such as insulin-like growth factor.
  - Study of disease** : Many transgenic animals are designed to increase our understanding of how genes contribute to the development of a disease.
  - Chemical safety testing** : Transgenic animals are made that carry genes which make them more sensitive to toxic substances than non-transgenic animals.

25. If the cells in the leaves of maize plant contain 10 chromosomes each, write the number of chromosomes in its endosperm and zygote. Name and explain the process by which an endosperm and a zygote are formed in maize. [3]

- Sol.**
- The leaves of a maize plant is diploid ( $2n = 10$ )
  - When one male gamete ( $n$ ) fuses with two polar nuclei ( $n + n$ ) leads to the production of triploid ( $3n$ ) primary endosperm nucleus (PEN) through process of triple fusion. [1]
  - Thus, the number of chromosomes in endosperm is 15 [½]
  - Zygote ( $2n$ ) is formed through the process of syngamy when one male gamete ( $n$ ) fuses with an egg cell ( $n$ ) [1]
  - Thus, the number of chromosomes in zygote is 10 [½]

26. (a) Why does DNA replication occur within a replication fork and not in its entire length simultaneously? (b) "DNA replication is continuous and discontinuous on the two strands within the replication fork." Explain with the help of a schematic representation. [3]

**Sol.** (a) High amount of energy is required to break the hydrogen bond holding the two strands. Therefore, replication occurs in small opening of DNA strands called replication fork. [1]



The DNA dependent DNA polymerases catalyse polymerisation only in one direction, that is  $5' \rightarrow 3'$ . This creates some additional complications at the replication fork. Consequently, on one strand (the template with polarity  $3' \rightarrow 5'$ ), the replication is continuous, while on the other (the template with polarity  $5' \rightarrow 3'$ ), it is discontinuous. The discontinuously synthesised fragments are later joined by the enzyme DNA ligase. [2]

27. Explain the processing of heterogeneous nuclear RNA (hnRNA) into a fully functional mRNA in eukaryotes. Where does this processing occur in the cell? [3]

**Sol.** Processes involved in hnRNA processing include.

- Splicing**: During splicing, the introns present in hnRNA are removed and exons present in them are joined in a defined order. [1]

- (ii) **Capping:** During capping, an unusual nucleotide (methyl guanosine triphosphate) is added to the 5'-end of hnRNA. [1]
- (iii) **Tailing:** During tailing, adenylate residues (200-300) are added at the 3'-end in a template independent manner. [1]

After this whole processing hnRNA is now called mRNA which is transported out of the nucleus for translation. Processing of hnRNA occurs in nucleus of eukaryotic cells.

28. The world is facing accelerated rates of species extinction largely due to human activities. Explain any three human activities responsible for accelerated rates of species extinction. [3]

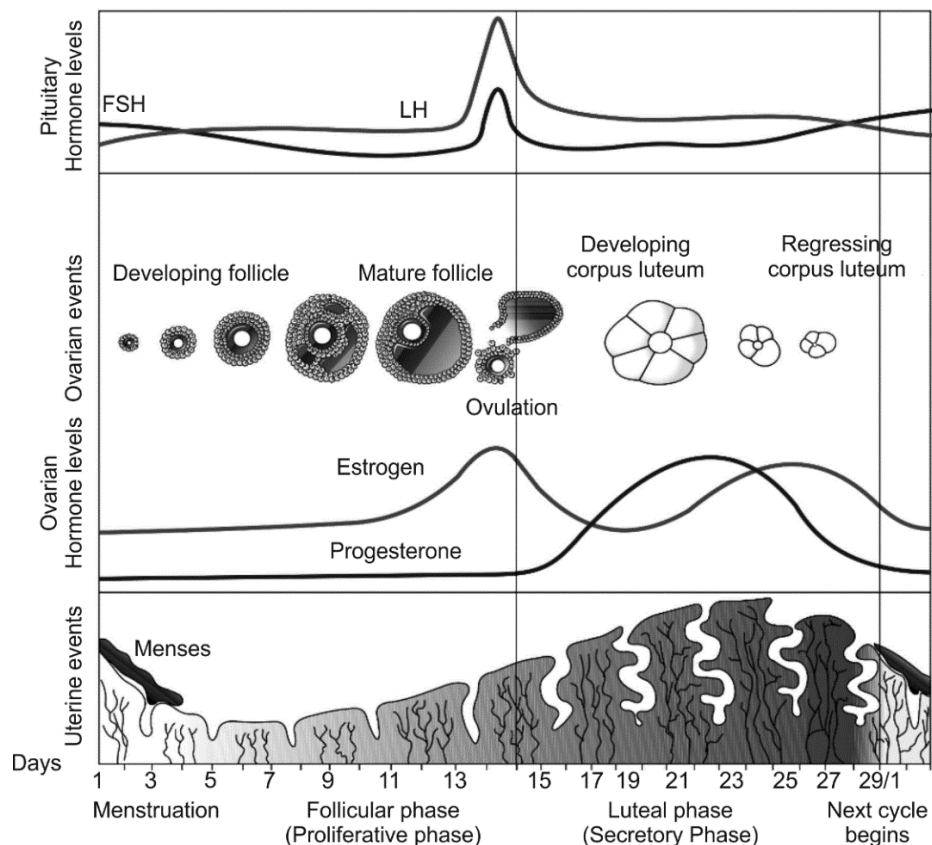
**Sol.** The human activities responsible for accelerated rate of species extinction are :

- (i) **Habitat loss and fragmentation :** This is the most important cause driving animals and plants extinction. When large habitats are broken up due to various human activities, mammals and birds requiring large territories and certain animals with migratory habits are badly affected. [1]
- (ii) **Over-exploitation by Humans :** Humans have always depend on nature for food and shelter, but when 'need' turns to 'greed' it leads to over-exploitation of natural resources. [1]
- (iii) **Alien species invasion :** When alien species are introduced by humans unintentionally or deliberately for whatever purpose, some of them turn invasive and cause decline or extinction of indigenous species. [1]

### 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. In a human female, the reproductive phase starts on the onset of puberty and ceases around middle age of the female. Study the graph given below regarding menstrual cycle and answer the questions that follow :



- (a) Name the hormones and their source organ, which are responsible for menstrual cycle at puberty. [1]
- (b) For successful pregnancy, at what phase of the menstrual cycle an early embryo (upto 3 blastomeres) should be Implanted in the Uterus (IUT) of a human female who has opted for Assisted Reproductive Technology (ART)? Support your answer with a reason. [1]
- (c) Name the hormone and its source organ responsible for the events occurring during proliferative phase of menstrual cycle. Explain the event. [2]

OR

In a normal human female, why does menstruation only occur if the released ovum is not fertilised? Explain. [2]

- Sol.** (a) The hormones which are responsible for menstrual cycle at puberty are: [1]
- GnRH produced from hypothalamus
  - FSH and LH produced from anterior pituitary
  - Estrogen and progesterone produced from ovaries
- (b) For successful pregnancy in a female who has opted for Assisted Reproductive Technology (ART), an embryo (upto 3 blastomeres) should be implanted in the uterus of a human female at **luteal phase** of the menstrual cycle. This is due to the fact that during luteal phase, the corpus luteum secretes large amount of progesterone which is essential for maintenance of the endometrium. Such an endometrium is necessary for implantation of the fertilised ovum and other events of pregnancy. [1]
- (c) The oestrogen secreted by growing ovarian follicles is responsible for the events occurring during proliferative phase of menstrual cycle. During proliferative phase of menstrual cycle, the endometrium of uterus regenerates through proliferation. [2]

OR

In a normal human female, menstruation only occurs if the released ovum is not fertilised.

This is because corpus luteum starts to degenerate due to decrease in levels of LH during luteal phase.

As the level of gonadotropin LH falls, it leads to decrease in levels of progesterone. Since progesterone plays important role in maintenance of endometrium, the endometrial lining disintegrates and sheds off, leading to menstruation. [2]

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

“Mosquitoes are drastically affecting the human health in almost all the developing tropical countries. Different species of mosquitoes cause very fatal diseases so much so that many humans loose their life and if they survive, are unable to put in productive hours to sustain their life. With the result the health index of the country goes down.”

- (a) Name the form in which *Plasmodium* gains entry into (i) human body (ii) the female *Anopheles* body. [1]
- (b) Why do the symptoms of malaria not appear in a person immediately after being bitten by an infected female *Anopheles*? Give one reason. [2]
- Explain when and how do the symptoms of the disease would appear. [2]

OR

- (b) Explain the events which occur within a female *Anopheles* mosquito after it has sucked blood from a malaria patient [2]
- (c) Name a species of mosquito other than female *Anopheles* and the disease, for which it carries the pathogen. [1]

**Sol.** (a) (i) Sporozoites [½×2]  
(ii) Gametocytes

(b) The symptoms of malaria do not appear immediately after the infection due to the absence of toxic substance hemozoin in the blood of a person.

The parasites initially multiply within the liver cells and then attack the red blood cells resulting in their rupture to release hemozoin, which is responsible for the chill and high fever recurring every three to four days. [2]

**OR**

(b) When a female *Anopheles* mosquito bites an infected person, *Plasmodium* which is the causative agent of malaria enters the mosquito's body as gametocytes. These gametocytes undergo further development and gametogenesis. Then, fertilisation of gametes takes place in the mosquito's gut. After fertilisation, the parasite multiply within mosquito's body to form sporozoites that are stored in their salivary glands. When these mosquitoes bite a human, the sporozoites are introduced into his/her body. [2]

(c) *Aedes* mosquito is the vector for disease such as dengue and chikungunya. [1]

**Or**

*Culex* mosquito is the vector for disease filariasis/elephantiasis.

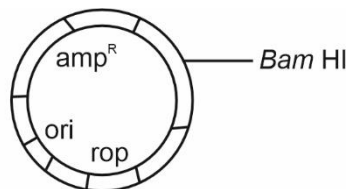
### SECTION-E

31. (a) (i) Draw a schematic diagram of the cloning vector pBR322 and label (1) Bam HI site (2) gene for ampicillin resistance (3) 'ori' (4) 'rop' gene.
- (ii) State the role of 'rop' gene
- (iii) A cloning vector does not have a selectable marker. How will it affect the process of cloning?
- (iv) Why is insertional inactivation preferred over the use of selectable markers in cloning vectors? [5]

**OR**

- (b) (i) Name the nematode (scientific name) that infects the roots of tobacco plant and reduces its yield.
- (ii) Name the vector that is used to introduce nematode-specific genes into the host plant (tobacco).
- (iii) How do sense and anti-sense RNAs function?
- (iv) Why could parasite not survive in a transgenic tobacco plant? [5]

**Sol.** (a) (i)



Schematic diagram of the cloning vector pBR322

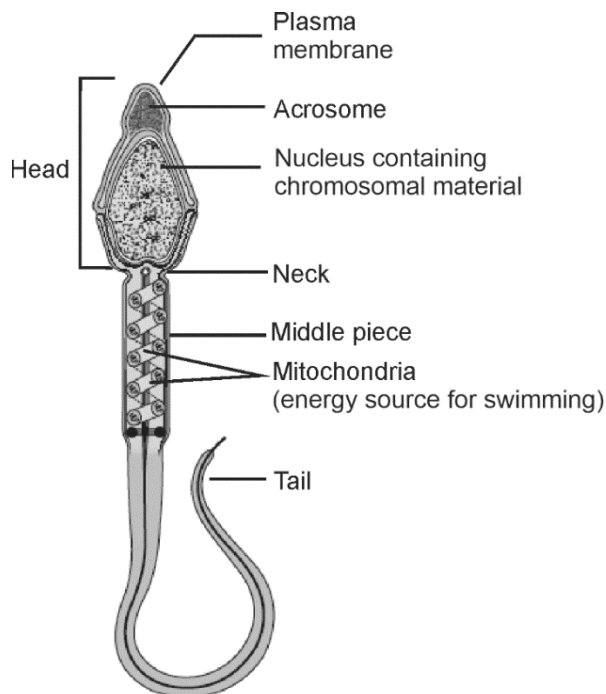
- (ii) **Role of 'rop' gene:** 'rop' codes for the proteins involved in the replication of the plasmid. [1]
- (iii) In the absence of a selectable marker, the cloning vector would not be able to identify and eliminate the non-transformants and selectively permitting the growth of the transformants. [1]
- (iv) Insertional inactivation helps to differentiate recombinants from non-recombinants on the basis of their ability to produce colour in the presence chromogenic substrate while selection through selectable marker requires simultaneous plating on two plates having different antibiotics, which is a cumbersome procedure. Therefore, insertional inactivation is preferred over the use of selectable markers in cloning vectors. [2]

OR

- (b) (i) The nematode '*Meloidogyne incognita*' infects the roots of tobacco plant and reduces its yield. [1]  
(ii) '*Agrobacterium*' is the vector that is used to introduce nematode-specific genes into the host plant (tobacco). [1]  
(iii) Sense and anti-sense RNA being complementary to each other form a double stranded RNA (dsRNA) that initiates RNAi and thus silences the specific mRNA of the nematode. [1]  
(iv) The parasite could not survive in a transgenic tobacco plant because the specific mRNA of the nematode got silenced. [2]
32. (a) (i) Draw a diagram of a human sperm. Label any four parts and write their functions. [4]  
(ii) In a human female, probability of an ovum to get fertilized by more than one sperm is impossible. Give reason. [1]

OR

- (b) (i) With the help of labelled diagram **only**, show the different stages of embryo development in dicot plant. [4]  
(ii) Endosperm development precedes embryo development. Justify. [1]
- Sol.** (a) (i) [4]

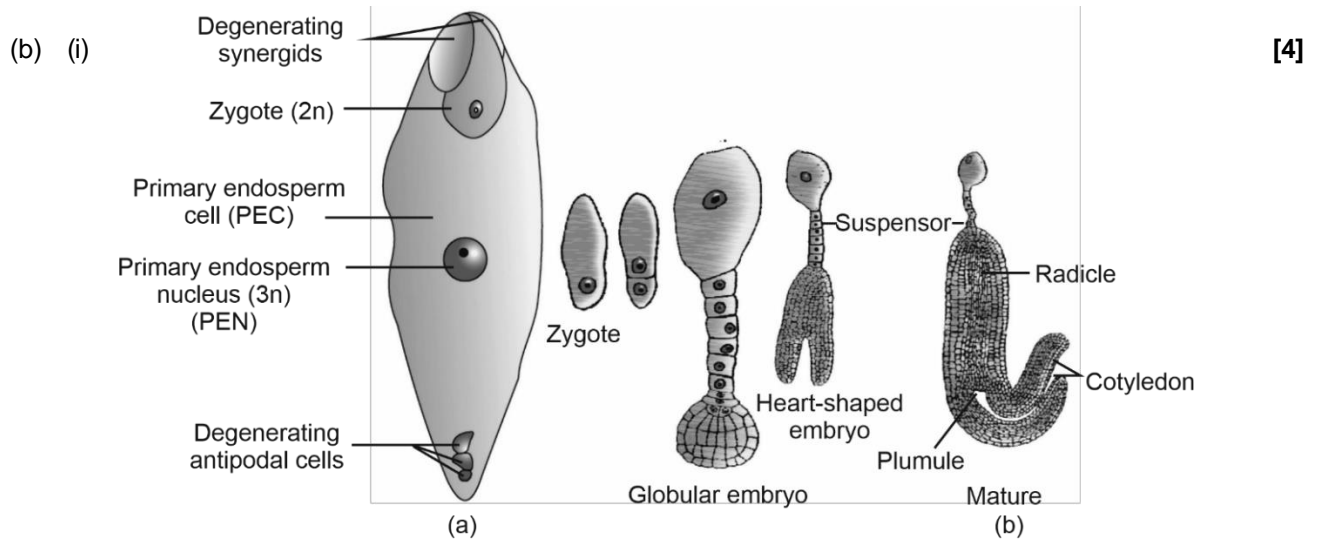


Any four labellings.

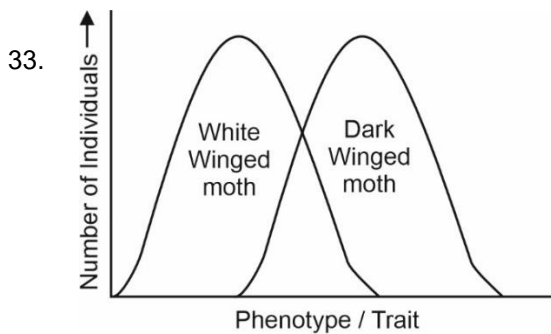
Functions of different parts of a sperm:

- (1) Acrosome – It is filled with enzymes that help in fertilisation of the ovum.
  - (2) Nucleus – The sperm head contains an elongated haploid nucleus which contains the chromosomal material to regulate hereditary functions.
  - (3) Middle piece – It possesses numerous mitochondria, which produce energy for the movement of tail.
  - (4) Tail – It facilitates sperm motility which is essential for fertilisation.
- (ii) In a human female, the probability of an ovum to get fertilized by more than one sperm is impossible as when a sperm comes in contact with the zona pellucida layer of the ovum, it induces changes in the membrane that block the entry of additional sperms. [1]

OR



- (ii) The primary endosperm cell divides repeatedly and forms a triploid endosperm tissue. The cells of this tissue are filled with reserve food materials and are used for the nutrition of the developing embryo. [1]



- (a) Natural selection operates in different ways in nature.
- (i) Identify the type of natural selection depicted in the graph above. [1]
- (ii) In England after industrialisation, the population of dark-winged moths were more favoured than white winged moth. Explain. [2]
- (iii) Anthropogenic action can enhance the rate of evolution. Explain with the help of an example. [2]

OR

- (b) (i) Why did Hershey and Chase use  $^{35}\text{S}$  and  $^{32}\text{P}$  in their experiment? Explain. [1]
- (ii) State the importance of (1) blending and (2) centrifugation in their experiment. [2]
- (iii) Write the conclusion they arrived at the end of their experiment. [2]

- Sol.** (a) (i) The given graph depicts the disruptive selection. [1]
- (ii) In England, during post-industrialisation period, the tree trunks became dark due to industrial smoke and soot. Under this condition, the white-winged moths could not camouflage themselves and therefore, did not survive due to predators (birds). [1]
- On the contrary, it was difficult for predators (birds) to find dark-winged moths against the dark background of tree trunk. Hence, they were favoured more. [1]

(iii) Anthropogenic action can enhance the rate of evolution by natural selection as well as by artificial selection. **Example of natural selections are:** [1]

- (1) Excess use of herbicides, pesticides, etc. has only resulted in selection of resistant varieties in much lesser time scale.
- (2) Microbes against which we employ antibiotics or drugs against eukaryotic organisms/cell led to appearance of resistant organisms/cell in a time scale of months or year and not centuries.

**Example of artificial selection are:** [1]

- (I) Selected breeding of plants and animals for agriculture, horticulture, sport or security by humans.
- (II) Generation of different breeds of animals, such as dogs.

**OR**

(b) (i) Viruses grown in the presence of  $^{32}\text{P}$  contained radioactive DNA because DNA contains phosphorus but protein does not. Similarly, viruses grown on  $^{35}\text{S}$  contained radioactive protein because protein contain sulphur but DNA does not. [1]

(ii) Importance of blending and centrifugation are as follows -

- (1) Blending – The viral coats were removed from the bacteria by agitating them in a blender. [1]
- (2) Centrifugation – The virus particles were separated from the bacteria by spinning them in a centrifuge. [1]

(iii) Bacteria which was infected with viruses that had radioactive DNA were radioactive, indicating that DNA was the material that passed from the viruses to the bacteria. Bacteria that were infected with viruses that had radioactive proteins were not radioactive. Thus, they conclude that DNA is the genetic material that is passed from virus to bacteria. [2]

