

CUET(UG) Solved Paper 2024

National Testing Agency

BIOLOGY

[This includes Questions pertaining to Domain Specific Subject only]

Time Allowed: 45 Mins.

Maximum Marks: 200

General Instructions :

- (i) This paper consists of 50 MCQs, attempt any 40 out of 50 .
- (ii) Correct answer or the most appropriate answer: Five marks (+5) .
- (iii) Any incorrect option marked will be given minus One mark (−1) .
- (iv) Unanswered/Marked for Review will be given No mark (0) .
- (v) If more than one option is found to be correct then Five marks (+5) will be awarded to only those who have marked any of the correct options.
- (vi) If all options are found to be correct then Five marks (+5) will be awarded to all those who have attempted the question.
- (vii) If none of the options is found correct or a Question is found to be wrong or a Question is dropped then all candidates who have appeared will be given five marks (+5).
- (viii) Calculator / any electronic gadgets are not permitted.

1. Analogous structures are a result of:

- (1) Convergent evolution
- (2) Divergent evolution
- (3) Parallel evolution
- (4) Retrogressive evolution

Ans. Option (1) is correct.

Explanation: Analogous structures are a result of convergent evolution. These structures have similar functions but do not share a common ancestral origin. An example of analogous structures is the wings of insects, birds and bats. While they serve the same purpose of flight, they evolved independently in these groups.

2. Which of the following does not affect the Hardy-Weinberg equilibrium?

- (1) Natural selection (2) Genetic drift
- (3) Gene pool (4) Gene migration

Ans. Option (3) is correct.

Explanation: Five factors are known to affect Hardy-Weinberg equilibrium. These are gene migration or gene flow, genetic drift, mutation, genetic recombination and natural selection. The gene pool (total genes and their alleles in a population) remains a constant. This is called genetic equilibrium.

3. Which of the following primates was more like an ape?

- (1) *Homo erectus* (2) *Dryopithecus*
- (3) *Australopithecines* (4) *Ramapithecus*

Ans. Option (2) is correct.

Explanation: *Dryopithecus* was more like an ape compared to other primates. *Dryopithecus* is an extinct genus of hominoids (ape-like creatures) that lived approximately 12 to 9 million years ago during the Miocene epoch. It is considered to be closely related to the common ancestor of both humans and modern apes. Characteristics of *Dryopithecus* suggest it had a more ape-like anatomy, including features similar to those found in modern apes such as chimpanzees and gorillas, though it is not directly ancestral to any living species of apes or humans. They were hairy and walked like gorillas and chimpanzees.

4. Nucleosome is associated with molecules of histones:

- (1) Four (2) Nine
- (3) Two (4) Eight

Ans. Option (4) is correct.

Explanation: Each nucleosome core particle consists of an octamer of histone proteins around 147 base pairs of DNA are wrapped. The histone octamer consists of two molecules each of H2A, H2B, H3 and H4, total eight molecules of histones per nucleosome.

5. Select the observations drawn from the Human Genome Project which are correct.

- A. The Human Genome contains 3164.7 million bp
- B. The average gene consists of 3000 bases.
- C. Total number of genes is estimated at 30,000.
- D. The functions are unknown for over 50% of discovered genes.

E. Less than 2% of the genome codes for proteins
Choose the correct answer from the options given below:

- (1) (A), (B), (C) and (D) only
- (2) (A), (C), (D) and (E) only
- (3) (A), (C) and (E) only
- (4) (A), (B), (C), (D) and (E)

Ans. Option (4) is correct.

Explanation: The observations drawn from the Human Genome Project (HGP) have provided significant insights into the structure and function of the human genome. First, it was found that the human genome comprises approximately 3164.7 million base pairs (bp), detailing the complete genetic blueprint of human DNA. Secondly, the project estimated that there are around 30,000 genes encoded within this vast genome, each contributing to various biological functions. Furthermore, researchers discovered that less than 2% of the human genome codes for proteins, highlighting the prevalence of non-coding DNA regions that play roles in regulation and other genomic functions. Though the size of the gene varies but the average gene consists of 3000 bases. The total number of estimated genes are 30,000. The functions are unknown for over 50 per cent of discovered genes. These findings underscore the complexity and diversity of the human genome, while also emphasising the ongoing challenge of understanding the functions of many genes, as over half of them remain functionally uncharacterised despite their identification.

6. Match List-I with List-II:

List-I Placental mammals		List II Counterpart Marsupials	
A.	Anteater	I.	Spotted cuscus
B.	Bobcat	II.	Numbat
C.	Lemur	III.	Flying Phalanger
D.	Flying squirrel	IV.	Tasmanian tiger cat

Choose the correct answer from the options given below:

- (1) (A)-(II), (B)-(IV), (C) - (I), (D) - (III)
- (2) (A)-(II), (B)-(I), (C) - (IV), (D) - (II)
- (3) (A)-(IV), (B)-(I), (C) - (II), (D) - (III)
- (4) (A)-(IV), (B)-(I), (C) - (III), (D) - (II)

Ans. Option (1) is correct.

Explanation:

A.	Anteater (Australian marsupial)	II.	Numbat (Placental mammal)
B.	Bobcat (Australian marsupial)	IV.	Tasmanian tiger cat (Placental mammal)
C.	Lemur (Australian marsupial)	I.	Spotted cuscus (Placental mammal)
D.	Flying squirrel (Australian marsupial)	III.	Flying Phalanger (Placental mammal)

The given pairs show the convergent evolution of Australian marsupials and placental mammals that resemble with each other and live in the similar habitats of different continents. The Australian marsupials inhabited Australia before its separation. These two groups developed similar features due to the similar habitats.

7. Identify the incorrect statement/s:

- (A) Intestinal perforation and death may occur in severe cases of typhoid infection.
 - (B) Common cold is caused by Rhinoviruses.
 - (C) Lips and fingernails may turn grey to bluish colour in severe cases of pneumonia widal Test.
 - (D) Pneumonia is caused by *Salmonella*.
 - (E) Typhoid fever could be confirmed by Widal test.
- Choose the answer from the options given below
- (1) (A), (C) and (D) only
 - (2) (B) and (E) only
 - (3) (D) only
 - (4) (A) and (D) only

Ans. Option (3) is correct.

Explanation: The statements provided highlight various aspects of infectious diseases and diagnostic methods.

- Firstly, severe cases of typhoid fever can indeed lead to complications such as intestinal perforation, which can be life-threatening. This condition is caused by *Salmonella typhi* bacteria.
- Secondly, the common cold is predominantly caused by Rhinoviruses, among other viral agents, affecting the upper respiratory tract.
- Thirdly, pneumonia, a serious respiratory infection, can lead to severe oxygenation issues, resulting in a bluish discoloration of the lips and fingernails, known as cyanosis. However, pneumonia is commonly caused by bacteria like *Streptococcus pneumoniae*, not by *Salmonella*.
- Lastly, the Widal test is a valuable serological tool used to confirm the diagnosis of typhoid fever by detecting specific antibodies against *Salmonella typhi*.

8. Match List-I with List-II:

List-I Types of barriers		List-II Counterpart Marsupials	
A.	Cytokine barriers	I.	Mucus coating
B.	Physical barriers	II.	Tear from eyes
C.	Cellular barriers	III.	Phagocytosis
D.	Physiological barriers	IV.	Interferons

Choose the correct answer from the options given below:

- (1) (A)-(IV), (B) - (III), (C) - (I), (D)-(II)
- (2) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)
- (3) (A)-(II), (B) - (I), (C) - (IV), (D)-(III)
- (4) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)

Ans. Option (4) is correct.

Explanation:

- (A) Cytokine barriers - (IV) Interferons
 (B) Physical barriers - (I) Mucus coating
 (C) Cellular barriers - (III) Phagocytosis
 (D) Physiological barriers - (II) Tears from eyes
- Innate immunity includes non-specific defence against microbes. It includes physical, physiological, cellular and cytokine carrier.
 - Interferons produced by virus-infected cells represent the cytokine barriers.
 - Physical barriers prevent the entry of microbes. Example includes mucus coating of several organ tracts. Certain leukocytes such as neutrophils and monocytes are cellular barriers as they phagocytose microbes. Physiological barriers are exemplified by tears from the eyes.

9. Smack is chemically:

- (1) Diacetyl morphine
- (2) Cocaine
- (3) Benzodiazepine
- (4) Amphetamine

Ans. Option (1) is correct.

Explanation: "Smack" is a colloquial term for heroin, which is chemically known as diacetyl morphine. Heroin is an opioid drug derived from morphine and its chemical structure includes two acetyl groups attached to the morphine molecule, hence the name diacetyl morphine. Heroin is a highly addictive substance and is classified as a Schedule I controlled substance due to its potential for abuse and severe health risks.

10. Antibodies are secreted by:

- (1) T-Cells
- (2) B-Cells
- (3) α -Cells
- (4) β -Cells

Ans. Option (2) is correct.

Explanation: Antibodies are indeed secreted by B-cells. B-cells, also known as B lymphocytes, a type of white blood cell that plays a central role in the adaptive immune response. When activated by encountering a specific antigen (a molecule that triggers an immune response), B-cells differentiate into plasma cells. Plasma cells are specialised B-cells that produce and secrete antibodies (also known as immunoglobulins) into the bloodstream and extracellular fluid.

11. In sewage treatment, flocs are:

- (1) the solids that settle during sedimentation.
- (2) the supernatant that is formed above the primary sludge.
- (3) the masses of bacteria associated with fungal filaments.
- (4) the bacteria which grow anaerobically and are also called anaerobic sludge digesters.

Ans. Option (3) is correct.

Explanation: Flocs in sewage treatment refer to clusters of suspended particles, including essential bacteria, that aggregate with fungal filaments to form a mesh-like structure within sludge. These flocs play a crucial role in wastewater treatment by aiding in the removal of organic matter and other impurities. The fungal filaments help create a network that traps particles effectively when the sewage enters the secondary tank, facilitating increased aerobic decomposition processes.

12. Match List-I with List-II:

List-I Products		List-II Organisms	
A.	Statin	I.	<i>Streptococcus</i>
B.	Clot buster	II.	<i>Trichoderma</i>
C.	Swiss cheese	III.	<i>Monascus</i>
D.	Cyclosporin-A	IV.	<i>Propionibacterium</i>

Choose the correct answer from the options given below:

- (1) (A)-(II), (B)-(I), (C) - (IV), (D) - (III)
- (2) (A)-(III), (B)-(I), (C) - (IV), (D) - (II)
- (3) (A)-(III), (B)-(IV), (C)-(II), (D) - (I)
- (4) (A)-(II), (B) - (III), (C) - (I), (D)-(IV)

Ans. Option (2) is correct.

Explanation: (A) Statin - (III) *Monascus*
 (B) Clot buster - (I) *Streptococcus*
 (C) Swiss cheese - (IV) *Propionibacterium*
 (D) Cyclosporin-A - (II) *Trichoderma*

Microbes obtain many products for human welfare. Statin produced by the yeast *Monascus purpureus* is used as blood-cholesterol lowering agents. Streptokinase produced by the bacterium *Streptococcus* is modified by genetic engineering to remove clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack. Swiss cheese is famous for its large holes that are due to production of a large amount of CO₂ by a bacterium named *Propionibacterium sharmanii*. Cyclosporin A is obtained from fungus *Trichoderma polysporum* and is used as an immunosuppressive agent in organ-transplant patients.

- 13.** The beetle used as a biocontrol agent for aphids and mosquitoes is

(1) *Trichoderma* (2) Dragonflies
 (3) Ladybird (4) Silver fish

Ans. Option (3) is correct.

Explanation: The beetle used as a biocontrol agent for aphids and mosquitoes is the Ladybird beetle, also known as the Ladybug (in North America) or Ladybird (in Europe). These beetles are known for their voracious appetite for aphids, which are common pests in agriculture, as well as for mosquitoes and other small insects.

- 14.** Downstream processing method involves:

(1) Identification (2) Amplification
 (3) Fermentation (4) Purification

Ans. Option (4) is correct.

Explanation: After the biosynthetic stage, proteins or products undergo downstream processing, which involves separating and purifying them before marketing. This critical phase ensures the product meets quality standards through formulation with preservatives and rigorous clinical trials akin to drug development. Each product undergoes tailored downstream processing and stringent quality control testing to ensure safety and efficacy, customised to its specific requirements before market release.

- 15.** Which of the following is not the correctly matched pair of organism and its respective cell wall degrading enzyme?

(1) Fungi-Chitinase (2) Algae-Methylase
 (3) Plant cells-Cellulase (4) Bacteria-Lysozyme

Ans. Option (2) is correct.

Explanation: Algae have cellulosic cell walls. Their cells walls are digested by cellulase enzyme. Methylase enzymes are involved in DNA methylation processes rather than breaking down cell walls, which is typically done by enzymes like cellulase or chitinase in other organisms.

- 16.** Arrange the following steps involved in transformation of bacteria in a sequence from initiation to end:

(A) Incubation of rDNA with bacterial cell on ice.
 (B) Treatment with divalent cations.
 (C) Heat shock treatment.
 (D) Selection on antibiotic containing agar plate.
 (E) Placed them again on ice.

Choose the correct answer from the options given below:

(1) (A), (B), (D), (C), (E) (2) (B); (A), (C), (E), (D)
 (3) (B), (C), (D), (A), (E) (4) (A), (C), (B), (D), (E)

Ans. Option (2) is correct.

Explanation: DNA, being hydrophilic, cannot naturally cross cell membranes. To enable bacteria to uptake DNA, they are first rendered 'competent' through treatment with specific divalent cations like calcium. This treatment enhances DNA entry into bacterial cells through pores in their cell walls. Following this, recombinant DNA is introduced by incubating the cells with it on ice, subjecting them briefly to heat shock at 42°C and then returning them to ice. This process facilitates bacterial uptake of recombinant DNA. Subsequently, transformed cells are plated on agar with antibiotics. Only those cells that successfully incorporate and express the antibiotic resistance gene from the recombinant DNA survive and form colonies, allowing for selection of transformed cells.

- 17.** Which of the following statements are incorrect?

(A) Fragments of DNA can be separated by ELISA.
 (B) Transformation is a procedure through which a piece of DNA is introduced in a host bacterium.
 (C) Recombinant DNA technology does not involve isolation of a desired DNA fragment.
 (D) DNA ligases are used for stitching DNA fragments into a vector.

Choose the answer from the options given below:

(1) (A) and (C) only (2) (A) and (B) only
 (3) (B) and (C) only (4) (A), (C) and (D) only

Ans. Option (1) is correct.

Explanation: (A) Fragments of DNA cannot be separated by ELISA. ELISA, or Enzyme-Linked Immunosorbent Assay, is primarily used for detecting proteins, antibodies and hormones, not for separating DNA fragments. DNA fragments are typically separated using techniques such as gel electrophoresis, which exploits the differential migration of DNA molecules based on size.

(B) Transformation is a procedure through which a piece of DNA is introduced into a host bacterium. This process is fundamental in molecular biology for introducing foreign DNA, such as recombinant DNA, into bacterial cells, enabling them to express new traits or proteins.

(C) Recombinant DNA technology involves the isolation of a desired DNA fragment. Contrary to the statement, recombinant DNA technology involves isolating specific DNA segments from various sources. These segments are then combined or inserted into vectors, forming recombinant DNA molecules for further experimentation or application.

(D) DNA ligases are crucial enzymes used to join or "stitch" DNA fragments into vectors. DNA ligases catalyze the formation of phosphodiester bonds between adjacent DNA strands, effectively sealing gaps or nicks in the DNA backbone.

18. Which of the following statements are true?

- (A) Milk obtained from 'Rosie' is nutritionally more balanced for human babies than natural human milk.
- (B) Biopiracy refers to the use of bioresources without proper authorisation from MNCs.
- (C) GEAC is the decisive body for safety and validity of GMOs and GM research respectively.
- (D) Transgenic animals help us to understand the contribution of genes in the development of disease.

Choose the correct answer from the options given below:

- (1) (A) and (C) only (2) (B) and (C) only
- (3) (A) and (D) only (4) (C) and (D) only

Ans. Option (2) is correct.

Explanation: A. In 1997, Rosie, the first transgenic cow, produced milk enriched with human alpha-lactalbumin, containing 2.4 grams per litre. This milk was nutritionally balanced for human babies compared to natural cow milk.

B. Biopiracy refers to the unauthorised use of biological resources by multinational companies and other organisations without proper compensation or permission from the countries and communities where those resources are found.

and other organisations without proper compensation or permission from the countries and communities where those resources are found.

C. GEAC (Genetic Engineering Appraisal Committee) is an organisation responsible for evaluating the safety and validity of genetically modified (GM) research and the introduction of GM organisms for public use.

D. Transgenic animals are created to enhance our understanding of the genetic basis of diseases. They serve as models for human diseases, facilitating research into new treatments and therapies.

19. Match List-I with List -II :

List-I Transgene		List-II Used for Products	
A.	α -1-antitrypsin	I.	<i>Meloidogyne incognitia</i>
B.	<i>cryI</i> Ac	II.	Corn borer
C.	Antisense RNA	III.	Treat emphysema
D.	<i>cryII</i> Ab	IV.	Cotton bollworms

Choose the correct answer from the options given below :

- (1) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
- (2) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
- (3) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)
- (4) (A)-(I), (B)-(IV), (C)-(III), (D)-(II)

Ans. Option (1) is correct.

Explanation:

List-I Transgene		List-II Used for Products	
A.	α -1-antitrypsin	III.	Treat emphysema
B.	<i>cryI</i> Ac	IV.	Cotton bollworms
C.	Antisense RNA	I.	<i>Meloidogyne incognitia</i>
D.	<i>cryII</i> Ab	II.	Corn borer

Genetically modified organisms are produced by recombinant DNA technology for several purposes. Transgenic animals that carry gene for human protein (α -1-antitrypsin) obtain the protein used to treat emphysema. The Bt toxin genes from *Bacillus thuringiensis* code for proteins that control the pests. The Bt toxin encoded by the genes *cryI*Ac and *cryII*Ab control the cotton bollworms, that of *cryI*Ab controls corn borer. The transgenic crops that carry *Meloidogyne incognitia* are resistant to this nematode. The introduced gene produces both sense and antisense RNA which then form the dsRNA to begin RNA interference.

20. Expand "GEAC":

- (1) Genetic and Environmental Advisory Committee
- (2) Gene Establishment Approval Committee
- (3) Genetic Engineering Appraisal Committee
- (4) Genetic Engineering Approval Committee

Ans. Option (3) is correct.

Explanation: GEAC (Genetic Engineering Appraisal Committee) is an organisation responsible for evaluating the safety and validity of genetically modified (GM) research and the introduction of GM organisms for public use.

21. When an insect feeds on the Bt plant, the insect dies due to the conversion of inactive protein to active protein in :

- (1) Alkaline pH of the gut.
- (2) Acidic pH of the gut.
- (3) Acidic pH of saliva.
- (4) Alkaline pH of saliva.

Ans. Option (1) is correct.

Explanation: When an insect feeds on the Bt plant, the insect dies due to the conversion of inactive protein (protoxin) to active protein (toxin) in its gut. This activation process occurs due to the alkaline pH in the insect's gut, which cleaves the protoxin and releases the active toxin. The toxin, produced by the bacterium *Bacillus thuringiensis* (Bt), targets specific receptors in the insect gut, disrupting cell membranes and leading to cell lysis and ultimately causing the insect's death.

22. Match List-I with List-II:

List-I Interspecies Relationships		List-II Features	
A.	Commensalism	I.	One species is benefitted at the expense of the other
B.	Mutualism	II.	One species is harmed and the other is unaffected
C.	Amensalism	III.	Both the species are benefitted
D.	Parasitism	IV.	One species benefits and other remains unaffected

Choose the correct answer from the options given below:

- (1) (A)-(I), (B) - (II), (C) - (III), (D) - (IV)
- (2) (A)-(IV), (B)-(III), (C) - (II), (D) - (I)
- (3) (A)-(II), (B)-(I), (C) - (III), (D)-(IV)
- (4) (A)-(III), (B) - (IV), (C) - (I), (D) - (II)

Ans. Option (2) is correct.

Explanation: Ecological interactions are beneficial, harmful and/or neutral to one or both the interacting species. The interaction where one species is benefitted and the other is neither benefitted nor harmed is called commensalism. In amensalism, one species is harmed whereas, the other is unaffected. Mutualism confers benefits on both the interacting species. Parasitism is the interaction in which parasite is benefitted while the host is harmed.

23. In a country, at any time, the population has the same number of youngs and mature ones. What type of growth does it reflect?

- (1) Expanding
- (2) Declining
- (3) Stable
- (4) S-shaped

Ans. Option (3) is correct.

Explanation: The statement reflects stable growth in the population. This means that, over time, the population maintains a relatively constant size with an equal number of young (juveniles) and mature individuals. This equilibrium indicates that birth rates are roughly balanced by death rates, resulting in a stable population structure.

24. Two closely related species can co-exist indefinitely and violate the Gause's 'Competitive Exclusion Principle' by:

- (1) eliminating the inferior species.
- (2) resource partitioning.
- (3) interacting with each other symbiotically.
- (4) changing the area of grazing.

Ans. Option (2) is correct.

Explanation: Two closely related species can co-exist indefinitely and violate Gause's 'Competitive Exclusion Principle' by resource partitioning. This strategy allows species to divide available resources, such as food or habitat, in a way that reduces direct competition. Each species evolves to specialise in different niches within the same ecosystem, thus minimising competition and enabling their long-term co-existence.

25. The process of mineralisation by microorganisms holds in the release of:

- (1) inorganic nutrients from detritus and formation of humus.
- (2) organic nutrients from humus.
- (3) inorganic nutrients from humus.
- (4) organic and inorganic nutrients from detritus.

Ans. Option (3) is correct.

Explanation: The process of decomposition by microbes includes fragmentation, leaching, catabolism, humification and mineralisation. The humus is formed by humification. Humus is then degraded by some microbes to release the inorganic nutrients. It is called mineralisation. During mineralisation, organic compounds are broken down into simpler inorganic forms, such as ammonium, nitrate, phosphate and various ions. These inorganic nutrients are then released into the soil, where they can be absorbed by plants for growth.

26. In which ecosystem is the biomass of primary consumers greater than producers ?

- (1) Forests (2) Grassland
(3) Desert (4) Sea

Ans. Option (4) is correct.

Explanation: In marine ecosystems, the pyramid of biomass is often inverted due to the structure of the food web. Phytoplankton, which are the primary producers, are indeed small organisms, whereas organisms higher up in the food chain, such as carnivorous fish, tend to be larger in size. This results in a situation where the total biomass of fishes (including carnivores) far exceeds that of phytoplankton.

Specifically, the biomass of phytoplankton is smaller compared to zooplankton and the biomass of zooplankton is generally lesser than that of primary carnivores, such as small fish. This gradual increase in biomass from producers to top carnivores leads to an inverted pyramid of biomass in marine ecosystems. This structure reflects the energy dynamics and efficiency of biomass transfer through different trophic levels in the oceanic food web.

27. Choose the correct statements with respect to decomposition from the following:

- (A) Decomposition is an anaerobic process.
(B) Decomposition rate of detritus depends upon the chemical nature of it.
(C) Water-soluble organic nutrients go into the soil and get precipitated in the process of leaching.
(D) Humification follows mineralisation.

Choose the correct answer from the options given below:

- (1) (B) and (D) only (2) (A) and (C) only
(3) (B) and (C) only (4) (A) and (D) only

Ans. Option (1) is correct.

Explanation: (B) is correct because, the rate of decomposition of detritus (organic matter) is influenced by its chemical composition, such as the amount of lignin, cellulose and other organic compounds present.

(D) is correct because humification is the process that follows mineralisation during decomposition. It involves the transformation of organic matter into humus, which is a stable, dark organic material that enriches soil fertility. The correct sequence of steps in the process of decomposition is fragmentation, leaching, catabolism, humification and mineralisation.

28. Match List-I with List-II:

List-I Concepts		List-II Explanation	
A.	Standing state	I.	Available biomass for the consumption of heterotrophs
B.	Secondary productivity	II.	Rate of formation of organic matter by consumers
C.	Standing crop	III.	Mass of living matter in a trophic level at a given time
D.	Net primary productivity	IV.	Amount of mineral nutrients in the soil at a given time

Choose the correct answer from the options given below:

- (1) (A)-(IV), (B)-(III), (C)-(II), (D) - (I)
(2) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
(3) (A)-(IV), (B) - (II), (C) - (III), (D) - (I)
(4) (A)-(I), (B)-(IV), (C)-(II), (D)-(III)

Ans. Option (3) is correct.

Explanation: The amount of nutrients, such as carbon, nitrogen, phosphorus, calcium, etc., present in the soil at any given time, is referred to as the standing state. Each trophic level has a certain mass of living material at a particular time called as the standing crop. Net primary productivity is the biomass, or the energy left after utilisation of producers. Secondary productivity is the rate of assimilation of food energy by the consumers.

Read the passage carefully and give the answer to thinnest at five questions:

India was amongst the first countries in the world to initiate action plans and programmes at a National level to attain total reproductive health as a social goal. These programmes called 'family planning' were initiated in 1951 and were periodically assessed over the past decades. Approved programmes covering wider reproduction-related areas are currently in operation. Creating awareness among the people about various reproduction-related aspects and providing facilities and support for building up a reproductively healthy society are the major tasks under these programmes.

29. Which of the following is not a Sexually Transmitted Disease ?

- (1) Chlamydia (2) Filariasis
(3) Genital herpes (4) Trichomoniasis

Ans. Option (2) is correct.

Explanation: Filariasis, caused by parasitic worms spread through mosquito bites, is not classified as a Sexually Transmitted Disease (STD). In contrast, diseases like Chlamydia, Genital herpes and Trichomoniasis are transmitted through sexual contact. This distinction is crucial in public health efforts targeting prevention and treatment strategies for sexually transmitted infections versus vector-borne diseases like Filariasis.

30. Which of the following statements is incorrect with respect to Medical Termination of Pregnancy ?

- (1) They are considered safe during the first trimester.
(2) It is legalised in India from 1971.
(3) MTPs can be performed even after 24 weeks, but with the opinion of 2 registered medical practitioners on specific grounds.
(4) About 20% of the total number of conceived pregnancies undergo MTP in a year globally.

Ans. Option (3) is correct.

Explanation: MTPs can be performed even after 24 weeks but with the opinion of 2 registered medical practitioners on specific grounds. This statement is incorrect because according to the Medical Termination of Pregnancy Act in India, MTP beyond 24 weeks of gestation is prohibited except when there is a risk to the life of the pregnant woman or grave injury to her physical or mental health, or if there is substantial risk that the child, if born, would suffer from serious physical or mental abnormalities. In such cases, the opinion of two registered medical practitioners is required, along with approval from a Medical Board.

31. Match List-I with List-II:

List-I Various Assisted Reproductive Technologies		List-II Process Involved	
A.	ZIFT	I.	Formation of embryo <i>in vitro</i> by injecting sperm directly into ovum
B.	ICSI	II.	Transferring of embryo with more than 8 blastomeres into the uterus
C.	IUI	III.	Transferring of fertilised egg up to 8 blastomeres into fallopian tube
D.	IUT	IV.	Transfer of semen from a healthy donor into the uterus artificially

Choose the correct answer from the options given below:

- (1) (A)-(III), (B) (I), (C)-(II), (D)-(IV)
(2) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
(3) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
(4) (A)-(IV), (B)-(III), (C)-(I) (D)-(II)

Ans. Option (2) is correct.

Explanation:

List-I Various Assisted Reproductive Technologies		List-II Process Involved	
A.	ZIFT	III.	Transferring of fertilised egg up to 8 blastomeres into fallopian tube.
B.	ICSI	I.	Formation of the embryo <i>in vitro</i> by injecting sperm directly into the ovum.
C.	IUI	IV.	Transfer of semen from a healthy donor into the uterus artificially.
D.	IUT	II.	Transferring of embryo with more than 8 blastomeres into the uterus.

After IVF, the zygote or early embryos with upto 8 blastomeres is transferred into the fallopian tube. This is called ZIFT-zygote intra fallopian transfer.

- When the embryos with more than 8 blastomeres is implanted into the uterus, it is called IUT – intra uterine transfer. ZIFT and IUT are done to complete the further development of the embryo.
- Intra cytoplasmic sperm injection (ICSI) is specialised procedure to form an embryo in the laboratory in which a sperm is directly injected into the ovum.
- In Artificial Insemination (AI) technique, the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus of female. The introduction of semen into uterus is called IUI – intra-uterine insemination.

32. Which of the following methods of contraception is not meant for females ?

- (1) IUDs
(2) Lactational amenorrhea
(3) Vasectomy
(4) Condoms

Ans. Option (3) is correct.

Explanation: In vasectomy, a small part of the vas deferens is removed or tied up through a small incision on the scrotum. It is a surgical method for males only. For women, contraceptive methods include oral contraceptives (birth control pills), intrauterine devices (IUDs), contraceptive implants, hormonal patches, vaginal rings and barrier methods like diaphragms and female condoms.

- 33.** 'Saheli' – an oral contraceptive pill, also known as the, 'Once a week' pill, was developed by:

(1) AIIMS (2) CORI
(3) NORI (4) NIPGR

Ans. Option (3) is correct.

Explanation: "Saheli" is a non-steroidal oral contraceptive pill developed by the Central Drug Research Institute (CDRI) in India. It was developed by a team of scientists led by Dr. Pramod K. Gupta at CDRI. Saheli works by inhibiting ovulation and is known for its long-acting effects, providing contraceptive protection for up to a week after a single dose. It is an important contraceptive option for women in India and other countries where it is available.

Read the passage carefully and give the answers to the next five questions:

Does the number of species in a community really matter to the functioning of the ecosystem? This is a question for which ecologists have not been able to give a definitive answer. For many decades, ecologists believed that communities with more species, generally, tend to be mainly stable than those with less species. According to the International Union for Conservation of Nature (IUCN) (2004), the total number of plant and animal species described so far is more than 1.5 million.

- 34.** Which of the following is not a characteristic of a stable biological community?

(1) It must be resistant to invasions by alien species.
(2) It should not show too much variation in productivity from year to year.
(3) All the species are equally important in a stable community and absence of any one leads to its instability.
(4) It is resilient to occasional disturbances, whether natural or man-made.

Ans. Option (3) is correct.

Explanation: In reality, stable biological communities often exhibit redundancy and resilience,

where the loss of some species may have minimal impact on the overall stability of the community. The concept of all species being equally important contradicts ecological principles of functional redundancy and ecosystem resilience.

- 35.** In 'rivet popper hypothesis' the "rivet signifies:

(1) Key species (2) Endemic species
(3) Community (4) Species

Ans. Option (1) is correct.

Explanation: The rivet popper hypothesis, proposed by ecologist Paul Ehrlich and biologist E.O. Wilson, suggests that species in an ecosystem can be likened to rivets in an airplane's wing. Each species plays a crucial role and the removal of key species (like removing rivets from a wing) can lead to the collapse or instability of the entire system. Therefore, in this hypothesis, 'rivet' symbolizes a key species whose presence is critical for the stability and functioning of the ecosystem.

- 36.** The scientist who proved that species richness directly correlates with the stability of a community was

(1) Paul Ehrlich (2) David Tilman
(3) Robert May (4) Edward Wilson

Ans. Option (2) is correct.

Explanation: David Tilman, an ecologist known for his research on biodiversity and ecosystem stability, contributed significantly to understanding the relationship between species richness and community stability. His experiments and models demonstrated how biodiversity enhances ecosystem productivity and resilience, supporting the idea that diverse ecosystems are more stable over time.

- 37.** Among the vertebrates, which of the following is the most species-rich group?

(1) Reptiles (2) Fishes
(3) Insects (4) Mammals

Ans. Option (2) is correct.

Explanation: Fishes constitute the largest group of vertebrates in terms of species diversity. They contribute around 50% of the total species of vertebrates. They are found in diverse aquatic environments worldwide, ranging from freshwater rivers and lakes to oceans. This immense diversity of fish species makes them the most species-rich group among vertebrates.

38. The following are the various hypothesis proposed in explaining the greatest biological diversity in tropics except :

- (1) Temperate regions are subjected to glaciations, but tropical latitudes have remained relatively undisturbed.
- (2) Tropical environments have more humidity/moisture which helps the diversity to flourish.
- (3) Tropical environments are less seasonal and more constant.
- (4) There is more solar energy available in the tropics which contributes to higher productivity and hence biodiversity.

Ans. Option (2) is correct.

Explanation: Ecologists and evolutionary biologists have proposed several hypothesis to explain the greater biological diversity in tropical environments:

(a) Speciation in the tropics benefits from extended periods of stability compared to temperate regions, which were frequently affected by glaciations. This long period of evolutionary stability allows for greater species diversification.

(b) Tropical environments experience less seasonal variation and are more predictable compared to temperate regions. This stability promotes niche specialisation among species, leading to a higher diversity of species.

(c) The tropics receive more solar energy, which enhances productivity and supports more complex food webs. This increased productivity indirectly contributes to greater biodiversity by providing more ecological niches and resources for species diversification.

39. Cells present in the mature pollen grains are:

- (1) Central cell and generative cell
- (2) Antipodal cell and vegetative cell
- (3) Vegetative cell and generative cell
- (4) Filiform cell and micropylar cell

Ans. Option (3) is correct.

Explanation: In mature pollen grains, there are typically two cells:

1. Vegetative cell: This cell is involved in providing nutrients and support to the pollen grain.

2. Generative cell: This cell is responsible for dividing to form sperm cells during fertilisation. These cells play crucial roles in the reproduction of flowering plants.

40. Match List-I with List-II:

List-I Structures		List-II Functions	
A.	Filiform apparatus	I.	Made up of sporopollenin
B.	Tapetum	II.	Attachment of ovule to the placenta
C.	Exine	III.	Guides pollen tube into the synergid
D.	Funicle	IV.	Nourishes the pollen grain

Choose the correct answer from the options given belows:

(1) (A)-(IV), (B)-(I), (C) - (II), (D) - (III)

(2) (A)-(III), (B)-(IV), (C) - (I), (D) - (II)

(3) (A)-(II), (B)-(I), (C) - (III), (D) - (IV)

(4) (A)-(I), (B)-(III), (C)-(IV), (D)-(II)

Ans. Option (2) is correct.

Explanation:

A.	Filiform apparatus	III.	Guides pollen tube into the synergid.
B.	Tapetum	IV.	Nourishes the pollen grain
C.	Exine	I.	Made up of sporopollenin
D.	Funicle	II.	Attachment of ovule to the placenta

The synergids of an embryo sac have special cellular thickenings at the micropylar tip called filiform apparatus that guides the pollen tubes into the synergid. Four wall layers, the epidermis, endothecium, middle layers and the tapetum surround the microsporangium. The innermost wall layer is the tapetum that nourishes the developing pollen grains. Exine is the hard outer layer of a pollen grain. It is made up of sporopollenin which is one of the most resistant organic materials known. The ovule or megasporangium of flowering plants is a small structure attached to the placenta by means of a stalk called funicle.

41. Primary Endosperm Nucleus is the product of:

- (1) Double fusion
- (2) Triple fusion
- (3) Parthenogenesis
- (4) Apomixis

Ans. Option (2) is correct.

Explanation: The primary endosperm nucleus is formed by the fusion of two polar nuclei during double fertilisation in flowering plants. This fusion occurs within the embryo sac, resulting in a triploid (3n) nucleus. This process is essential for the formation of endosperm, which serves as a nutritive tissue supporting the developing embryo in seeds.

42. In humans, mammary gland is divided into ___ lobes.

- (1) 10–12 (2) 5–30
(3) 30–35 (4) 15–20

Ans. Option (4) is correct.

Explanation: In humans, mammary glands are typically divided into 15–20 lobes. Each lobe contains clusters of alveoli (small sacs) that produce milk during lactation. These lobes are connected by ducts that carry milk to the nipple, where it can be expelled for breastfeeding. This anatomical structure allows for the production, storage and release of milk to nourish infants.

43. Sex in human embryo is determined by:

- (1) 'X' chromosome of egg
(2) 'X' or 'Y' chromosome of sperm
(3) Only Y chromosome of sperm
(4) Health of mother

Ans. Option (2) is correct.

Explanation: Sex in human embryos is determined by the combination of sex chromosomes from the sperm. Specifically:

- **Male embryo:** If the sperm carries a Y chromosome, the embryo will develop as male (XY).
- **Female embryo:** If the sperm carries an X chromosome, the embryo will develop as female (XX).

This determination occurs at the moment of fertilisation when the sperm cell with either an X or Y chromosome fertilises the egg cell (which always carries an X chromosome). This genetic combination sets the course for the development of primary and secondary sexual characteristics in the embryo.

44. Arrange the following stages of oogenesis in order of their occurrence.

- (A) Ovum (B) Oogonia
(C) Primary oocyte (D) Secondary oocyte

Choose the correct answer from the options given below:

- (1) (C) (B) (D) (A) (2) (B), (C) (D) (A)
(3) (D) (C) (A), (B) (4) (A), (D) (C) (B)

Ans. Option (2) is correct.

Explanation: Oogenesis, the process of forming a mature female gamete, begins during embryonic development when millions of gamete mother cells (oogonia) form within each fetal ovary. Oogonia starts division and enter into prophase-I of the meiotic division and get temporarily arrested at that stage, called primary oocytes. The process resumes after menarche and the completion of meiosis I just before the ovulation forms secondary oocyte. The secondary oocyte enters meiosis II after fertilisation and forms ovum and a secondary polar body.

45. Which of the following pair of contrasting traits was not studied by Mendel ?

- (1) Pink and white flowers
(2) Inflated and constricted pods
(3) Axial and terminal flowers
(4) Green and yellow pods

Ans. Option (1) is correct.

Explanation: Mendel did not study the contrasting trait of pink and white flowers in his experiments with pea plants. He chose seven genetic traits which were flower colour (purple vs. white), seed shape (round vs. wrinkled), seed colour (yellow vs. green), pod shape (inflated vs. constricted), pod colour (green vs. yellow), flower position (axial vs. terminal) and plant height (tall vs. short). These traits formed the basis of his experiments on inheritance and the establishment of fundamental laws of genetics.

46. Failure of chromatids to segregate during cell division cycle results in :

- (1) Polyploidy (2) Euploidy
(3) Aneuploidy (4) Autopolyploidy

Ans. Option (3) is correct.

Explanation: Failure of chromatids to segregate properly during the cell division cycle can result in aneuploidy. Aneuploidy refers to an abnormal number of chromosomes in a cell, which can occur due to errors in chromosome segregation during mitosis or meiosis. This condition can lead to genetic disorders and developmental abnormalities in organisms.

47. Select the correctly matched pair about sickle cell anaemia :

Genotype : Phenotype

- (A) $Hb^A Hb^A$: Diseased phenotype
 (B) $Hb^A Hb^S$: Diseased phenotype
 (C) $Hb^S Hb^S$: Diseased phenotype
 (D) $Hb^S Hb^A$: Carrier of disease

Choose the correct answer from the options given below:

- (1) (C) and (D) only (2) (A) and (C) only
 (3) (B), (C) and (D) only (4) (A), (B) and (C) only

Ans. Option (1) is correct.

Explanation: Sickle-cell anemia is an autosomal recessive trait that can be inherited when both parents are carriers (heterozygous) for the gene. The disease is governed by a single pair of alleles, Hb^A and Hb^S . Only individuals homozygous for Hb^S ($Hb^S Hb^S$) exhibit the diseased phenotype. Heterozygous individuals ($Hb^A Hb^S$) typically appear unaffected but carry the disease, with a 50% chance of passing on the mutant gene to their offspring, thereby expressing the sickle-cell trait.

The defect arises from a substitution of glutamic acid (Glu) with valine (Val) at the sixth position of the beta globin chain of the hemoglobin molecule. This substitution occurs due to a single base change at the sixth codon of the beta globin gene, from GAG to GUG. The mutant hemoglobin molecule can polymerise under low oxygen conditions, leading to the characteristic change in red blood cell shape from a biconcave disc to an elongated, sickle-like structure.

48. Match List-I with List-II:

List-I Scientists		List-II Discover	
A.	Sutton and Boveri	I.	X-Body
B.	Sturtevant	II.	Chromosomal Theory of Inheritance
C.	Henking	III.	Transformation in bacteria
D.	Griffith	IV.	Genetic maps

Choose the correct answer from the options given below:

- (1) (A)-(II), (B)-(IV), (C) - (I), (D) - (III)
 (2) (A)-(II), (B) - (I), (C)-(IV), (D) - (III)
 (3) (A)-(I), (B) - (III), (C) - (II), (D) - (IV)
 (4) (A)-(IV), (B)-(I), (C) - (III), (D) - (II)

Ans. Option (1) is correct.

Explanation:

A.	Sutton and Boveri	II.	Chromosomal Theory of Inheritance
B.	Sturtevant	IV.	Genetic maps
C.	Henking	I.	X-Body
D.	Griffith	III.	Transformation in bacteria

Walter Sutton and Theodore Boveri gave the chromosomal theory of Inheritance that explains the parallel behaviour of chromosomes and genes and the chromosome movement during meiosis. Alfred Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and 'mapped' their position on the chromosome. Henking studied the presence of a specific nuclear structure all through spermatogenesis in a few insects and named it X-body. Frederick Griffith performed a series of experiments with *Streptococcus pneumoniae* and showed the presence of a transforming principle that transformed the living non-virulent strains of bacteria into virulent strains.

49. Which of the following statements are incorrect with respect to nucleotides?

- (A) Purines and pyrimidines are nitrogenous base.
 (B) Nucleotides are non-enzymatic molecules.
 (C) Phosphate group is linked to -OH of 5' C of a nucleoside through phosphoester linkage.
 (D) In RNA, every nucleotide residue has an additional 1-OH group present at 2' position in the ribose.
 (E) Thymine is an example of pyrimidine.

Choose the correct answer from the options given below:

- (1) (A), (B) and (E) only (2) (D) and (E) only
 (3) (B) and (D) only (4) (B) and (E) only

Ans. Option (3) is correct.

Explanation: (A) Purines and pyrimidines are nitrogenous bases.

• **Correct:** Purines (adenine and guanine) and pyrimidines (cytosine, thymine and uracil) are indeed nitrogenous bases.

(B) Nucleotides are non-enzymatic molecules.

• **Incorrect:** Nucleotides are enzymatic molecules because they participate in enzymatic reactions, such as DNA replication and RNA transcription.

(C) Phosphate group is linked to -OH of 5' C of nucleoside through phosphoester linkage.

- **Correct:** Nucleotides have a phosphate group linked to the 5' carbon of the sugar (ribose or deoxyribose) through a phosphoester linkage.

(D) In RNA, every nucleotide residue has an additional 1-OH group present at 2' position in the ribose.

- **Incorrect:** In RNA, the ribose sugar of nucleoside has a hydroxyl (-OH) group at the 2' position.

(E) Thymine is an example of pyrimidine.

- **Correct:** Thymine is a pyrimidine base in DNA, but in RNA, uracil replaces thymine.

50. Arrange the given steps of DNA fingerprinting in the sequence from initiation to end.

(A) Digestion of DNA by restriction endonuclease.

(B) Isolation of DNA.

(C) Hybridisation using labelled VNTR probe.

(D) Transferring (blotting) of separated DNA fragments to synthetic membrane.

Choose the correct answer from the options given below:

(1) (A), (B), (C), (D) (2) (A), (D), (C), (B)

(3) (B), (A), (D), (C) (4) (C), (A), (B), (D)

Ans. Option (3) is correct.

Explanation: • **Isolation of DNA (B):** The first step is to extract DNA from the sample, which could be from blood, saliva, or any other biological material.

- **Digestion of DNA by restriction endonuclease (A):** The extracted DNA is then treated with restriction enzymes (endonucleases) that cut the DNA at specific recognition sequences, producing fragments of varying lengths.

- **Transferring (blotting) of separated DNA fragments to synthetic membrane (D):** The fragmented DNA is transferred or blotted onto a synthetic membrane, such as a nitrocellulose or nylon membrane. This step allows the DNA fragments to be immobilised in a pattern that reflects their original distribution.

- **Hybridisation using labelled VNTR probe (C):** A labelled probe, which is complementary to the variable number tandem repeat (VNTR) sequences in the DNA, is then applied to the membrane. The probe binds specifically to its complementary sequences on the DNA fragments, forming DNA-probe hybrids.

By following these steps, DNA fingerprinting enables the identification of individuals based on their unique patterns of VNTRs, which vary among individuals except for identical twins. This technique has widespread applications in forensic science, paternity testing and genetic research.

□□□