# NEET-UG Biology Sample Paper-5

**Duration: 1 Hour** **Maximum Marks: 360**

## Instructions

- This paper contains a total of **90** Multiple Choice Questions.
- Each correct answer carries **+4 marks**.
- Each incorrect answer carries **-1 mark**.
- No negative marking for unattempted questions.

**Q1.** Which of the following statements is correct regarding the classification of living organisms?

(A) Museum has collection of photographs of plants and animals.

(B) Herbarium houses dried, pressed and preserved plant specimens on sheets.

(C) Botanical gardens have collection of living animals for reference.

(D) Key is a taxonomic aid for identification of specimens based on similarities only.

**Q2.** Which of the following are found in extreme saline conditions?

(A) Eubacteria

(B) Cyanobacteria

(C) Mycobacteria

(D) Archaebacteria

**Q3.** Viroids differ from viruses in having:

(A) DNA molecules without protein coat.

(B) RNA molecules with protein coat.

(C) RNA molecules without protein coat.

(D) DNA molecules with protein coat.

**Q4.** Which of the following is responsible for peat formation?

(A) Marchantia

(B) Riccia

(C) Funaria

(D) Sphagnum

**Q5.** Select the correct statement:

(A) Salvinia, Ginkgo and Pinus all are gymnosperms.

(B) Sequoia is one of the tallest trees.

(C) The leaves of gymnosperms are not well adapted to extremes of climate.

(D) Gymnosperms are both homosporous and heterosporous.

**Q6.** Which of the following animals does not undergo metamorphosis?

(A) Earthworm

(B) Tunicate

(C) Moth

(D) Starfish

**Q7.** In case of poriferans, the spongocoel is lined with flagellated cells called:

(A) Oscula

(B) Choanocytes

(C) Mesenchymal cells

(D) Ostia

**Q8.** Body cavity is the cavity present between body wall and gut wall. In some animals, the body cavity is not lined by mesoderm; instead, the mesoderm is present as scattered pouches in between the ectoderm and endoderm. Such a body cavity is called:

(A) Schizocoelom

(B) Enterocoelom

(C) Pseudo-coelom

(D) Haemocoel

**Q9.** The vascular cambium normally gives rise to:

(A) Primary phloem

(B) Secondary xylem

(C) Periderm

(D) Phelloderm

**Q10.** Which of the following is made up of dead cells?

(A) Collenchyma

(B) Phellem

(C) Phloem

(D) Xylem parenchyma

**Q11.** Smooth muscles are:

(A) Involuntary, fusiform, non-striated

(B) Voluntary, multinucleate, cylindrical

(C) Involuntary, cylindrical, striated

(D) Voluntary, spindle-shaped, uninucleate

**Q12.** Which of the following features is used by male cockroaches to distinguish them from females?

(A) Presence of anal cerci

(B) Presence of anal styles

(C) Presence of labrum

(D) Presence of tegmina

**Q13.** The kind of epithelium which forms the inner lining of blood vessels is:

(A) Cuboidal epithelium

(B) Columnar epithelium

(C) Ciliated epithelium

(D) Squamous epithelium

**Q14.** Which of the following is not an inclusion body found in prokaryotes?

(A) Glycogen granule

(B) Polysome

(C) Phosphate granule

(D) Cyanophycean granule

**Q15.** Select the mismatch:

(A) Gas vacuoles — Green bacteria

(B) Large central vacuoles — Animal cells

(C) Protists — Eukaryotes

(D) Methanogens — Prokaryotes

**Q16.** A cell organelle containing hydrolytic enzymes is:

(A) Lysosome

(B) Microsome

(C) Ribosome

(D) Mesosome

**Q17.** Which of the following are not polymeric?

(A) Proteins

(B) Polysaccharides

(C) Lipids

(D) Nucleic acids

**Q18.** "Ramachandran plot" is used to confirm the structure of:

(A) RNA

(B) Proteins

(C) Triacylglycerides

(D) DNA

**Q19.** During cell growth, DNA synthesis takes place in:

(A) S-phase

(B) $G_1$-phase

(C) $G_2$-phase

(D) M-phase

**Q20.** The stage during which separation of the paired homologous chromosomes begins is:

(A) Pachytene

(B) Diplotene

(C) Diakinesis

(D) Zygotene

**Q21.** If there are 999 bases in an RNA that code for a protein with 333 amino acids, and the base at position 901 is deleted such that the length of the RNA becomes 998 bases, how many codons will be altered?

(A) 1

(B) 11

(C) 33

(D) 333

**Q22.** Which of the following is the shortest phase of the cell cycle?

(A) Prophase

(B) Metaphase

(C) Anaphase

(D) Telophase

**Q23.** Prosthetic groups differ from co-enzymes in that:

(A) They require metal ions for their activity.

(B) They (prosthetic groups) are tightly bound to apoenzymes.

(C) They can only be present in conjunction with a cofactor.

(D) They are catalytic in nature.

**Q24.** Which of the following facilitates opening of stomatal aperture?

(A) Decrease in turgidity of guard cells.

(B) Radial orientation of cellulose microfibrils in the cell wall of guard cells.

(C) Longitudinal orientation of cellulose microfibrils in the cell wall of guard cells.

(D) Contraction of outer wall of guard cells.

**Q25.** In $C_4$ plants, $CO_2$ fixation done by PEP carboxylase occurs in:

(A) Mesophyll cells

(B) Bundle sheath cells

(C) Guard cells

(D) Epidermal cells

**Q26.** Which of the following is the connecting link between glycolysis and Krebs cycle?

(A) Acetyl CoA

(B) Oxaloacetic acid

(C) Pyruvic acid

(D) Citric acid

**Q27.** Fruit and leaf drop at early stages can be prevented by the application of:

(A) Ethylene

(B) Auxins

(C) Gibberellic acid

(D) Cytokinins

**Q28.** What is the role of $NAD^+$ in cellular respiration?

(A) It functions as an enzyme.

(B) It functions as an electron carrier.

(C) It is a nucleotide source for ATP synthesis.

(D) It is the final electron acceptor for anaerobic respiration.

**Q29.** The oxygenation activity of RuBisCO enzyme in photorespiration leads to the formation of:

(A) 2 molecules of 3-carbon compounds

(B) 1 molecule of 3-carbon compound

(C) 1 molecule of 6-carbon compound

(D) 1 molecule of 4-carbon compound and 1 molecule of 2-carbon compound

**Q30.** Plants which produce characteristic pneumatophores and show vivipary belong to:

(A) Halophytes

(B) Mesophytes

(C) Psammophytes

(D) Hydrophytes

**Q31.** Water vapor comes out from the plant leaf through the stomatal opening. Through the same stomatal opening carbon dioxide diffuses into the plant during

photosynthesis. Reason out the above statements using one of the following options:

(A) Both processes can happen together because the diffusion coefficient of water and $CO_2$ is different.

(B) The above processes happen only during night time.

(C) One process occurs during day time, and the other at night.

(D) Both processes cannot happen simultaneously.

**Q32.** Which of the following options best represents the enzyme composition of pancreatic juice?

(A) Amylase, pepsin, trypsinogen, maltase

(B) Peptidase, amylase, pepsin, rennin

(C) Lipase, amylase, trypsinogen, procarboxypeptidase

(D) Amylase, peptidase, trypsinogen, rennin

**Q33.** Lungs are made up of air-filled sacs, the alveoli. They do not collapse even after forceful expiration, because of:

(A) Inspiratory Reserve Volume

(B) Tidal Volume

(C) Expiratory Reserve Volume

(D) Residual Volume

**Q34.** Which of the following is an occupational respiratory disorder?

(A) Anthracosis

(B) Silicosis

(C) Botulism

(D) Emphysema

**Q35.** Adult human RBCs are enucleate. Which of the following statement(s) is/are most appropriate explanation for this feature?

(1) They do not need to reproduce.

(2) They are somatic cells.

(3) They do not metabolize.

(4) All their internal space is available for oxygen transport.

(A) (1), (2) and (3)

(B) Only (4)

(C) (2) and (3)

(D) (1) and (3)

**Q36.** The hepatic portal vein drains blood to liver from:

(A) Heart

(B) Stomach

(C) Kidneys

(D) Intestine

**Q37.** A decrease in blood pressure/volume will not cause the release of:

(A) Atrial Natriuretic Factor

(B) Aldosterone

(C) ADH

(D) Renin

**Q38.** Which of the following causes an increase in sodium reabsorption in the distal convoluted tubule?

(A) Increase in aldosterone levels

(B) Increase in antidiuretic hormone levels

(C) Decrease in aldosterone levels

(D) Decrease in antidiuretic hormone levels

**Q39.** The pivot joint between atlas and axis is a type of:

(A) Cartilaginous joint

(B) Synovial joint

(C) Saddle joint

(D) Fibrous joint

**Q40.** Lack of relaxation between successive stimuli in sustained muscle contraction is known as:

(A) Fatigue

(B) Tetanus

(C) Tonus

(D) Spasm

**Q41.** Receptor sites for neurotransmitters are present on:

(A) Pre-synaptic membrane

(B) Tips of axons

(C) Post-synaptic membrane

(D) Membranes of synaptic vesicles

**Q42.** Photosensitive compound in human eye is made up of:

(A) Guanosine and Retinol

(B) Opsin and Retinal

(C) Opsin and Retinol

(D) Transducin and Retinene

**Q43.** Hypersecretion of Growth Hormone in adults does not cause further increase in height, because:

(A) Epiphyseal plates close after adolescence.

(B) Muscle fibers do not grow in size after birth.

(C) Growth Hormone becomes inactive in adults.

(D) Bones lose their sensitivity to Growth Hormone in adults.

**Q44.** GnRH, a hypothalamic hormone, needed in reproduction, acts on:

(A) Anterior pituitary gland and stimulates secretion of LH and FSH.

(B) Posterior pituitary gland and stimulates secretion of oxytocin and FSH.

(C) Posterior pituitary gland and stimulates secretion of LH and relaxin.

(D) Anterior pituitary gland and stimulates secretion of LH and oxytocin.

**Q45.** Attractants and rewards are required for:

(A) Entemophily

(B) Hydrophily

(C) Cleistogamy

(D) Anemophily

**Q46.** A dioecious flowering plant prevents both:

(A) Autogamy and geitonogamy

(B) Geitonogamy and xenogamy

(C) Cleistogamy and xenogamy

(D) Autogamy and xenogamy

**Q47.** Functional megaspore in an angiosperm develops into:

(A) Endosperm

(B) Embryo sac

(C) Embryo

(D) Ovule

**Q48.** Capacitation refers to changes in the:

(A) Ovum before fertilization

(B) Ovum after fertilization

(C) Sperm after fertilization

(D) Sperm before fertilization

**Q49.** Hysterectomy is surgical removal of:

(A) Vas deferens

(B) Mammary glands

(C) Uterus

(D) Prostate gland

**Q50.** Which of the following cells during gametogenesis is normally diploid?

(A) Spermatid

(B) Spermatogonia

(C) Secondary polar body

(D) Primary polar body

**Q51.** Which of the following is a hormone releasing Intra Uterine Device (IUD)?

(A) Multiload 375

(B) LNG-20

(C) Lippes loop

(D) Cu7

**Q52.** Assisted reproductive technology, IVF involves transfer of:

(A) Ovum into the fallopian tube.

(B) Zygote into the fallopian tube.

(C) Zygote into the uterus.

(D) Embryo with 16 blastomeres into the fallopian tube.

**Q53.** In case of a couple where the male is having a very low sperm count, which technique will be suitable for fertilization?

(A) Gamete Intracytoplasmic Transfer

(B) Artificial Insemination

(C) Intracytoplasmic sperm injection

(D) Intrauterine transfer

**Q54.** Which of the following is hormone-releasing IUD?

(A) Multiload 375

(B) Lippes loop

(C) Cu7

(D) LNG-20

**Q55.** A tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant. When the $F_1$ plants were selfed, the resulting genotypes were in the ratio of:

(A) 1:2:1 :: Tall homozygous:Tall heterozygous:Dwarf

(B) 3:1 :: Tall:Dwarf

(C) 3:1 :: Dwarf:Tall

(D) 1:2:1 :: Tall heterozygous:Tall homozygous:Dwarf

**Q56.** Match the terms in Column I with their description in Column II:

| **Column I** | **Column II** |
|---|---|
| (a) Dominance | (i) Many genes govern a single character |
| (b) Codominance | (ii) Only one allele expresses itself in heterozygote |
| (c) Pleiotropy | (iii) Both alleles express themselves fully in heterozygote |
| (d) Polygenic inheritance | (iv) A single gene influences many characters |

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

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

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

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

**Q57.** The association of histone $H1$ with a nucleosome indicates:

(A) Transcription is occurring.

(B) DNA replication is occurring.

(C) The DNA is condensed into a chromatin fiber.

(D) The DNA double helix is exposed.

**Q58.** If the distance between two consecutive base pairs is 0.34 nm and the total number of base pairs of a DNA double helix in a typical mammalian cell is $6.6 \times 10^9$ bp, then the length of the DNA is approximately:

(A) 2.0 meters

(B) 2.5 meters

(C) 2.2 meters

(D) 2.7 meters

**Q59.** Under which of the following conditions will there be no change in the reading frame of following mRNA?
5' AACAGCGGUGCUAUU 3'

(A) Deletion of G from 5th position

(B) Insertion of A and G at 4th and 5th positions respectively

(C) Deletion of GGU from 7th, 8th and 9th positions

(D) Insertion of G at 5th position

**Q60.** Select the correct match:

(A) Alec Jeffreys — DNA fingerprinting

(B) Matthew Meselson and F. Stahl — Pisum sativum

(C) Alfred Hershey and Martha Chase — TMV

(D) Francois Jacob and Jacques Monod — Lac operon

**Q61.** Which of the following is not a property of the genetic code?

(A) Non-overlapping

(B) Ambiguous

(C) Degenerate

(D) Universal

**Q62.** Agouti gene in mice is an example of:

(A) Recessive epistasis

(B) Dominant epistasis

(C) Complementary genes

(D) Supplementary genes

**Q63.** Spliceosomes are not found in cells of:

(A) Fungi

(B) Animals

(C) Bacteria

(D) Plants

**Q64.** In a population of 1000 individuals, 360 belong to genotype AA, 480 to Aa and the remaining 160 to aa. Based on this data, the frequency of allele A in the population is:

(A) 0.4

(B) 0.5

(C) 0.6

(D) 0.7

**Q65.** Genetic drift operates in:

(A) Small isolated population

(B) Large isolated population

(C) Fast reproductive population

(D) Slow reproductive population

**Q66.** Analogous structures are a result of:

(A) Shared ancestry

(B) Stabilizing selection

(C) Divergent evolution

(D) Convergent evolution

**Q67.** The chronological order of human evolution from early to the recent is:

(A) Ramapithecus → Australopithecus → Homo habilis → Homo erectus

(B) Ramapithecus → Homo habilis → Australopithecus → Homo erectus

(C) Australopithecus → Homo habilis → Ramapithecus → Homo erectus

(D) Australopithecus → Ramapithecus → Homo habilis → Homo erectus

**Q68.** Variations caused by mutation, as proposed by Hugo de Vries, are:

(A) Small and directional

(B) Random and directional

(C) Random and directionless

(D) Small and directionless

**Q69.** All of the following are examples of homologous organs, except:

(A) Arm of man and foreleg of horse

(B) Wing of bat and wing of butterfly

(C) Flippers of penguin and flippers of dolphin

(D) Thorns of Bougainvillea and tendrils of Cucurbita

**Q70.** MALT constitutes about _____ percent of the lymphoid tissue in human body.

(A) 20%

(B) 70%

(C) 10%

(D) 50%

**Q71.** Transplantation of tissues/organs fails often due to non-acceptance by the patient's body. Which type of immune-response is responsible for such rejections?

(A) Cell-mediated immune response

(B) Hormonal immune response

(C) Physiological immune response

(D) Autoimmune response

**Q72.** Which of the following is a commercial blood cholesterol lowering agent?

(A) Lipases

(B) Cyclosporin A

(C) Statin

(D) Streptokinase

**Q73.** Which of the following in sewage treatment removes suspended solids?

(A) Secondary treatment

(B) Primary treatment

(C) Sludge treatment

(D) Tertiary treatment

**Q74.** Breeding of crops with high levels of vitamins and minerals or higher proteins and healthier fats is called:

(A) Bio-accumulation

(B) Bio-magnification

(C) Bio-fortification

(D) Bio-remediation

**Q75.** Which of the following is correctly matched for the product produced by them?

(A) Methanobacterium : Lactic acid

(B) Penicillium notatum : Acetic acid

(C) Saccharomyces cerevisiae : Ethanol

(D) Acetobacter aceti : Antibiotics

**Q76.** DNA precipitation out of a mixture of biomolecules can be achieved by treatment with:

(A) Isopropanol

(B) Chilled ethanol

(C) Methanol at room temperature

(D) Chilled chloroform

**Q77.** What is the criterion for DNA fragments movement on agarose gel during gel electrophoresis?

(A) The smaller the fragment size, the farther it moves.

(B) Positively charged fragments move to farther end.

(C) Negatively charged fragments do not move.

(D) The larger the fragment size, the farther it moves.

**Q78.** The process of separation and purification of expressed protein before marketing is called:

(A) Downstream processing

(B) Bioprocessing

(C) Postproduction processing

(D) Upstream processing

**Q79.** Stirred-tank bioreactors have been designed for:

(A) Purification of product

(B) Addition of preservatives to the product

(C) Availability of oxygen throughout the process

(D) Ensuring anaerobic conditions in the culture vessel

**Q80.** Which of the following is commonly used as a vector for introducing a DNA fragment in human lymphocytes?

(A) Retrovirus

(B) Ti plasmid

(C) $\lambda$ phage

(D) pBR322

**Q81.** Use of bio-resources by multinational companies and other organizations without proper authorization from the countries and people concerned without compensatory payment is called:

(A) Bio-piracy

(B) Bio-exploitation

(C) Bio-infringement

(D) Bio-resources

**Q82.** What triggers activation of protoxin to active Bt toxin of Bacillus thuringiensis in bollworm?

(A) Body temperature

(B) Moist surface of midgut

(C) Alkaline pH of gut

(D) Acidic pH of stomach

**Q83.** The first human hormone produced by recombinant DNA technology is:

(A) Insulin

(B) Estrogen

(C) Thyroxin

(D) Progesterone

**Q84.** Which one of the following is a characteristic feature of cropland ecosystem?

(A) Least genetic diversity

(B) Absence of weeds

(C) Absence of soil organisms

(D) Ecological succession

**Q85.** In an ecosystem, which of the following represents the total amount of energy fixed by plants?

(A) Net Primary Productivity

(B) Gross Primary Productivity

(C) Secondary Productivity

(D) Standing Crop

**Q86.** Most animals that live in deep oceanic waters are:

(A) Tertiary consumers

(B) Detritivores

(C) Primary consumers

(D) Secondary consumers

**Q87.** Which of the following is the most important cause of animals and plants being driven to extinction?

(A) Alien species invasion

(B) Habitat loss and fragmentation

(C) Co-extinctions

(D) Over-exploitation

**Q88.** Alexander von Humboldt described for the first time:

(A) Laws of limiting factor

(B) Species area relationships

(C) Population Growth equation

(D) Ecological Pyramids

**Q89.** High value of BOD (Biochemical Oxygen Demand) indicates that:

(A) Water is pure

(B) Water is highly polluted

(C) Water is less polluted

(D) Consumption of organic matter in the water is higher by the microbes

**Q90.** Which of the following is not a method of in situ conservation of biodiversity?

(A) Biosphere Reserve

(B) Wildlife Sanctuary

(C) Botanical Garden

(D) Sacred Grove

## Detailed Solutions

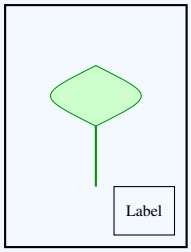
## Q1.

### Solution

**Concept:** Taxonomic aids are specialized tools, techniques, and stored information used for the identification and classification of organisms. They bridge the gap between field study and laboratory analysis.

**Solution:** Step 1: **Herbarium Definition:** A Herbarium is a repository where plant specimens are collected, dried, pressed, and mounted on standard sheets. These sheets are then arranged according to a universally accepted system of classification (like Bentham and Hooker). Step 2: **Information Provided:** Each herbarium sheet carries a label providing the date and place of collection, English, local and botanical names, family, and collector's name. This serves as a quick referral system. Step 3: **Refuting other options:**

- **Museums** preserve actual specimens in jars or as stuffed animals, not just photographs.
- **Botanical Gardens** are for living plant specimens; living animals are kept in Zoological Parks.
- **Keys** are based on contrasting characters in a pair called a *couplet*, focusing on both similarities and dissimilarities to reach a lead.




**Herbarium Sheet**

**Final Answer:**

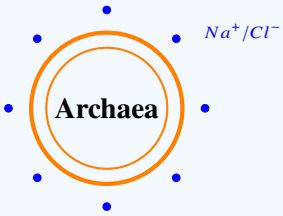
Herbarium houses dried, pressed and preserved plant specimens on sheets.

**Answer: (B)**

## Q2.

### Solution

**Concept:** Archaebacteria represent a group of primitive prokaryotes that possess a distinct cell wall structure, allowing them to survive in conditions that would be lethal to most other life forms.
**Solution:** Step 1: **Environmental Niche:** Archaebacteria are categorized based on their habitats: Halophiles (extreme salty areas), Thermoacidophiles (hot springs), and Methanogens (marshy areas). Step 2: **Adaptation:** The key to their survival in extreme saline conditions (Halophiles) lies in their cell membrane lipids, which contain branched-chain hydrocarbons linked to glycerol by ether linkages, rather than ester linkages found in Eubacteria. Step 3: **Osmoregulation:** They utilize specific proteins and high internal salt concentrations to prevent plasmolysis in hypersaline waters.




**Final Answer:**

Archaebacteria

**Answer: (D)**

## Q3.

### Solution

**Concept:** Viroids are sub-viral agents that are smaller and simpler than viruses, consisting solely of a short strand of circular, single-stranded RNA.
**Solution:** Step 1: **Virus Structure:** A typical virus consists of a nucleocapsid—a core of nucleic acid (DNA or RNA) surrounded by a protein shell called a capsid. Step 2: **Viroid Discovery:** Discovered by T.O. Diener in 1971, viroids were found to cause Potato Spindle Tuber disease. Step 3: **Comparison:** Unlike viruses, viroids lack any protein coat (capsid). Their RNA is of low molecular weight and does not code for any proteins; it replicates by hijacking the host's RNA polymerase II.


**Final Answer:**

RNA molecules without protein coat.

**Answer: (C)**

## Q4.

### Solution

**Concept:** The genus *Sphagnum* (Peat Moss) belongs to the class Bryopsida. It is ecologically significant due to its contribution to carbon sequestration and land formation.

**Solution:** Step 1: **Peat Accumulation:** Over geological time, the accumulated and compressed dead remains of *Sphagnum* in acidic, waterlogged bogs undergo carbonization to form Peat. Step 2: **Industrial Use:** Dried peat is used as a fuel source. Due to its acidic nature and remarkable water-holding capacity (up to 20 times its weight), it is used as a soil conditioner and for trans-shipment of living plants. Step 3: **Morphology:** It possesses "hyaline cells"—large, dead, empty cells with pores that soak up water like a sponge.

**Final Answer:**

Sphagnum

**Answer: (D)**

## Q5.

### Solution

**Concept:** Gymnosperms (Gymnos: naked, Sperma: seeds) are plants where the ovules are not enclosed by any ovary wall and remain exposed both before and after fertilization.

**Solution:** Step 1: **Sequoia:** *Sequoia sempervirens*, also known as the Coast Redwood, is a gymnosperm and stands as one of the tallest living organisms on Earth, reaching heights over 100 meters. Step 2: **Correction of other options:**

- **Salvinia** is a water fern (Pteridophyte), not a gymnosperm.
- Gymnosperms are **well adapted** to climate extremes (sunken stomata and thick cuticle reduce water loss).
- All gymnosperms are **heterosporous** (producing microspores and megaspores); none are homosporous.

**Final Answer:**

Sequoia is one of the tallest trees.

**Answer: (B)**

## Q6.

### Solution

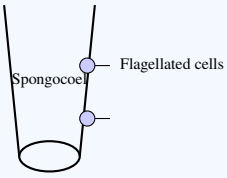
**Concept:** Metamorphosis is a post-embryonic developmental process where an animal undergoes rapid and radical physical changes in its body structure through cell growth and differentiation.
**Solution:** Step 1: **Direct vs. Indirect Development:** Animals that undergo metamorphosis have "indirect development," meaning they have one or more larval stages (e.g., Tadpole, Caterpillar). Step 2: **Earthworm (Pheretima):** The earthworm belongs to Phylum Annelida. It exhibits "direct development." Step 3: **Mechanism:** In earthworms, the eggs are laid in cocoons. The hatchlings that emerge from the cocoons are essentially miniature versions of the adult (juveniles), lacking only reproductive maturity. They do not pass through a distinct larval stage.
**Final Answer:** Earthworm

**Answer: (A)**

## Q7.

### Solution

**Concept:** Poriferans (Sponges) are the most primitive multicellular animals characterized by a water transport or canal system.
**Solution:** Step 1: **Anatomy:** Water enters through minute pores (**Ostia**) in the body wall into a central cavity, the **Spongocoel**, from where it goes out through the **Osculum**. Step 2: **Cellular Lining:** The spongocoel and the canals are lined with specialized cells called **Choanocytes** or collar cells. Step 3: **Function:** These cells have a central flagellum surrounded by a collar of microvilli. The beating of the flagella creates water currents, while the collar traps food particles (intracellular digestion).




**Final Answer:**

Choanocytes

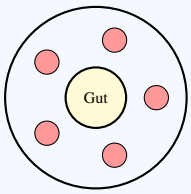
**Answer: (B)**

## Q8.

### Solution

**Concept:** The coelom is the body cavity situated between the alimentary canal and the body wall. Its nature is a primary basis for classification.

**Solution:** Step 1: **True Coelom:** In Eucoelomates, the cavity is completely lined by mesoderm. Step 2: **Pseudo-coelom:** In some phyla (specifically Aschelminthes/Nematoda), the body cavity is present but the mesoderm is not a continuous lining. Instead, it exists as scattered pouches between the ectoderm (outer layer) and endoderm (inner layer). Step 3: **Significance:** This fluid-filled cavity acts as a hydrostatic skeleton and allows for the circulation of nutrients.




**Pseudo-coelomate Plan**

**Final Answer:**

Pseudo-coelom

**Answer: (C)**

## Q9.

### Solution

**Concept:** In dicotyledonous plants, secondary growth increases the girth of the stem through the activity of lateral meristems: vascular cambium and cork cambium.

**Solution:** Step 1: **Cambial Activity:** The vascular cambium is a meristematic ring between the primary xylem and primary phloem. Step 2: **Differentiation:** As the cambial cells divide, they cut off new cells on both the inner and outer sides. Step 3: **Results:** Cells cut off toward the pith (inner side) mature into **secondary xylem** (wood). Cells cut off toward the periphery (outer side) mature into **secondary phloem**. Since the cambium is more active on the inner side, much more secondary xylem is produced than secondary phloem.

**Final Answer:**

Secondary xylem

**Answer: (B)**

## Q10.

### Solution

**Concept:** Plant tissues consist of living cells (with protoplasm) and dead cells (without protoplasm, often serving mechanical or protective roles).

**Solution:** Step 1: **Phellem (Cork):** Formed by the activity of the cork cambium (phellogen) toward the outside. As phellem cells mature, their walls become heavily impregnated with a waxy substance called **suberin**. Step 2: **Consequence:** Suberin makes the cell walls impervious to water and gases. Consequently, the protoplast dies, and the mature phellem becomes a tissue composed of dead cells. Step 3: **Other options:** Collenchyma, Xylem parenchyma, and Phloem (sieve tubes/companion cells) are all composed of living cells.

**Final Answer:**

Phellem

**Answer: (B)**

## Q11.

### Solution

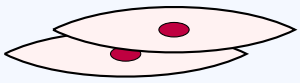
**Concept:** Muscular tissues are categorized based on their location, microscopic appearance, and the nature of their regulation by the nervous system. Smooth muscles, also known as visceral muscles, are specialized for slow, sustained contractions.

**Solution:** Step-1: **Structural Morphology:** Smooth muscle fibers are described as "fusiform," which means they are spindle-shaped—thick in the middle and tapering at both ends. They are uninucleate, containing a single central nucleus.

Step-2: **Visual Appearance:** Unlike skeletal muscles, smooth muscles do not exhibit cross-striations or banding patterns because their actin and myosin filaments are not arranged into regular sarcomeric units. This gives them a "smooth" appearance under the microscope, hence the name "non-striated."

Step-3: **Nature of Control:** These muscles are "involuntary" as their contractions are not under conscious control. They are regulated by the autonomic nervous system and are found in the walls of internal organs like the stomach, intestines, and blood vessels.

[Image of smooth muscle tissue structure]



**Fusiform, Non-striated Cells**

**Final Answer:**

Involuntary, fusiform, non-striated

**Answer: (A)**

## Q12.

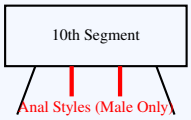
### Solution

**Concept:** The cockroach (*Periplaneta americana*) exhibits distinct sexual dimorphism, where certain external morphological structures allow for the differentiation of sexes.

**Solution:** Step-1: **Shared Features:** Both male and female cockroaches possess a pair of jointed, filamentous structures called "anal cerci" on the 10th abdominal segment. These are sensory in nature and sensitive to ground vibrations.

Step-2: **Distinguishing Feature:** In male cockroaches, the 9th sternum (ventral plate) bears a pair of short, thread-like, unjointed structures called "anal styles."

Step-3: **Conclusion:** These anal styles are completely absent in females. Therefore, the presence of anal styles is the diagnostic feature used to identify a male cockroach.




**Final Answer:**

Presence of anal styles

**Answer: (B)**

## Q13.

### Solution

**Concept:** Epithelial tissues are classified by the number of cell layers and the shape of the cells. The structure of the epithelium is always adapted to its specific physiological function.

**Solution:** Step-1: **Tissue Identification:** The inner lining of blood vessels and lymph vessels is a specialized type of simple epithelium known as "endothelium."

Step-2: **Cellular Geometry:** It consists of a single layer of extremely thin, flattened cells with irregular boundaries. These cells look like tiles on a floor when viewed from above, which is why it is called "Squamous epithelium" (pavement epithelium).

Step-3: **Functional Significance:** This thinness is critical for the vessel's function, as it provides a minimal barrier for the diffusion of gases ($O_2, CO_2$), nutrients, and waste products between the blood and the surrounding tissues.

**Final Answer:**

Squamous epithelium

**Answer: (D)**

## Q14.

### Solution

**Concept:** Prokaryotic cells (like bacteria) lack membrane-bound organelles. They store reserve materials in the cytoplasm in the form of non-membrane bound structures called inclusion bodies.
**Solution:** Step-1: **Inclusion Bodies:** These are inert, non-living structures lying free in the cytoplasm. Examples include Phosphate granules, Cyanophycean granules, and Glycogen granules, which serve as storage for nutrients.
Step-2: **Polysome Identification:** A polysome (or polyribosome) is not a storage body. It is a functional complex consisting of several ribosomes attached to a single strand of messenger RNA (mRNA).
Step-3: **Differentiation:** While polysomes are found in prokaryotes, they are active sites of protein synthesis (translation) where multiple ribosomes translate one mRNA simultaneously. Therefore, they do not fall under the category of "inclusion bodies."
**Final Answer:**

Polysome

**Answer: (B)**

## Q15.

### Solution

**Concept:** Vacuoles are membrane-bound organelles, but their size, prevalence, and function vary drastically between different domains of life and cell types.
**Solution:** Step-1: **Analysis of Correct Pairs:** Gas vacuoles are found in prokaryotes (Green and Purple bacteria) for buoyancy. Protists are indeed eukaryotes. Methanogens are Archaebacteria, which are prokaryotes.
Step-2: **Mismatch Detection:** Animal cells generally have very small, temporary vacuoles, or lack them entirely. It is the **plant cell** that is characterized by a "Large central vacuole" that can occupy up to 90% of the cell's volume.
Step-3: **Conclusion:** The statement pairing "Large central vacuoles" with "Animal cells" is incorrect as this is a hallmark feature of plant cells used for maintaining turgor pressure.
**Final Answer:**

Large central vacuoles — Animal cells

**Answer: (B)**

## Q16.

### Solution

**Concept:** The intracellular digestion of macromolecules is performed by specialized membrane-bound vesicles that contain digestive enzymes.

**Solution:** Step-1: **Lysosome Function:** Lysosomes are membrane-bound vesicular structures formed by the Golgi apparatus. They are known as "suicidal bags" of the cell.

Step-2: **Enzymatic Content:** They are rich in almost all types of **hydrolytic enzymes** (hydrolases – lipases, proteases, carbohydrases) which are optimally active at an acidic pH (around pH 5).

Step-3: **Biological Role:** These enzymes are capable of breaking down carbohydrates, proteins, lipids, and nucleic acids, helping in the recycling of damaged organelles or the digestion of engulfed pathogens.

**Final Answer:**

Lysosome

**Answer: (A)**

## Q17.

### Solution

**Concept:** Biomacromolecules found in the acid-insoluble fraction are usually polymers, which are large molecules made of repeating structural units called monomers.

**Solution:** Step-1: **Polymeric Molecules:** Proteins (polymers of amino acids), Polysaccharides (polymers of monosaccharides), and Nucleic acids (polymers of nucleotides) are all true polymers with high molecular weights.

Step-2: **Lipid Structure:** Lipids (fats, oils, steroids) are not formed by the polymerization of monomers. Instead, they are typically made of a glycerol molecule and fatty acids or similar small molecules.

Step-3: **Classification:** Although lipids are found in the acid-insoluble fraction during chemical analysis, they are not true "macromolecules" or "polymers" because their molecular weight does not exceed 800 Daltons. They appear in that fraction only because they form large insoluble aggregates/vesicles.

**Final Answer:**

Lipids

**Answer: (C)**

## Q18.

### Solution

**Concept:** The Ramachandran plot is a fundamental graphical tool used in biochemistry to visualize and validate the conformational geometry of a polypeptide chain.

**Solution:** Step-1: **Principle of the Plot:** In a polypeptide, the rotation of the backbone is restricted to two torsion angles: the phi ($\phi$) angle (between N and alpha-Carbon) and the psi ($\psi$) angle (between alpha-Carbon and Carbonyl Carbon).

Step-2: **Steric Constraints:** G.N. Ramachandran used computer modeling to determine which combinations of $\phi$ and $\psi$ were "allowed" without the atoms clashing into each other (steric hindrance).

Step-3: **Application:** The plot is used to confirm and validate the secondary structures of **proteins**, such as alpha-helices and beta-sheets. If a protein model's angles fall into "disallowed" regions, the structure is likely incorrect.

**Final Answer:**

Proteins

**Answer: (B)**

## Q19.

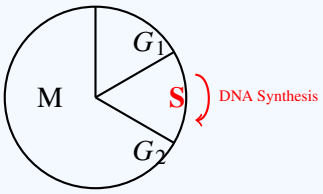
### Solution

**Concept:** The cell cycle consists of Interphase and M-phase. Interphase is further divided into $G_1$, $S$, and $G_2$ phases, each serving a specific preparatory role for division.

**Solution:** Step-1: **Phase Identification:** The S-phase (Synthesis phase) is the specific interval during the cell cycle when the actual replication of genetic material occurs.

Step-2: **Mechanism:** During S-phase, the amount of DNA per cell doubles (e.g., from 2C to 4C), but the chromosome number remains the same (2n).

Step-3: **Centriole Duplication:** In animal cells, the centriole also duplicates in the cytoplasm during this phase, ensuring that the cell is ready to organize the spindle apparatus in the upcoming M-phase.




**Final Answer:**

S-phase

**Answer: (A)**

## Q20.

### Solution

**Concept:** Prophase I of Meiosis I is a complex stage divided into five substages: Leptotene, Zygotene, Pachytene, Diplotene, and Diakinesis.

**Solution:** Step-1: **Preceding Events:** In Zygotene, chromosomes pair up (synapsis). In Pachytene, crossing over occurs between non-sister chromatids of homologous chromosomes.

Step-2: **Diplotene Initiation:** The start of the Diplotene stage is marked by the dissolution of the synaptonemal complex (the protein bridge between homologous pairs).

Step-3: **Physical Separation:** The homologous chromosomes begin to move apart (separate) but remain attached at the sites where crossing over took place. These X-shaped points of attachment are called "chiasmata."

**Final Answer:**

Diplotene

**Answer: (B)**

## Q21.

### Solution

**Concept:** The genetic code is read in a contiguous fashion as a series of triplets (codons). Because there is no punctuation, any deletion or insertion of a base results in a "frameshift mutation," altering the reading frame for all subsequent codons.

**Solution:** Step-1: **Identify the stable region:** The RNA initially has 999 bases. The deletion occurs at position 901. This means the first 900 bases are unaffected. Since each codon consists of 3 bases, the first $900 \div 3 = 300$ codons remain perfectly normal.

Step-2: **Analyze the frameshift:** When the base at position 901 is removed, every base from 902 to 999 shifts one position to the left. This changes the grouping of triplets for the remainder of the sequence.

Step-3: **Calculate altered codons:** The total number of bases involved in the shifted region is $999 - 900 = 99$. Since these 99 bases are now regrouped into new triplets, the number of altered codons is $99 \div 3 = 33$.

**Final Answer:**

33

**Answer: (C)**

## Q22.

### Solution

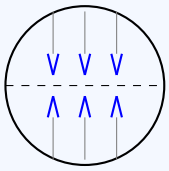
**Concept:** The M-phase (Mitosis) is divided into four stages of nuclear division. While the entire cell cycle takes about 24 hours in typical human cells, the M-phase occupies only about an hour, and its sub-stages vary significantly in duration.

**Solution:** Step-1: **Phase Comparison:** Prophase is generally the longest phase as it involves complex chromatin condensation. Metaphase involves the careful alignment of chromosomes on the equatorial plate.

Step-2: **Identifying the Shortest Phase:** Anaphase is the shortest stage of the entire cell cycle. It begins abruptly with the simultaneous splitting of the centromeres of each chromosome, allowing the sister chromatids to separate.

Step-3: **Mechanism of Speed:** Due to the rapid contraction of spindle fibers (microtubules), the chromatids move toward opposite poles at a high velocity. This process often takes only a few minutes to complete.

[Image of stages of mitosis showing anaphase]



**Anaphase (Rapid Movement)**

**Final Answer:**

Anaphase

**Answer: (C)**

## Q23.

### Solution

**Concept:** Cofactors are non-protein constituents bound to an enzyme (apoenzyme) to make it catalytically active. They are categorized into three types: prosthetic groups, co-enzymes, and metal ions.

**Solution:** Step-1: **Co-enzymes:** These are organic compounds whose association with the apoenzyme is transient and usually occurs only during the specific course of catalysis. Examples include NAD and NADP.

Step-2: **Prosthetic Groups:** These are also organic compounds, but they are distinguished by being tightly and permanently bound to the apoenzyme throughout its existence.

Step-3: **Example:** In the enzyme peroxidase, which catalyzes the breakdown of hydrogen peroxide, 'haem' is the prosthetic group and is an integral, tightly bound part of the enzyme's active site.

**Final Answer:**

They (prosthetic groups) are tightly bound to apoenzymes.

**Answer: (B)**

## Q24.

### Solution

**Concept:** Stomatal opening and closing are driven by turgor changes in the guard cells. The mechanical design of the guard cell wall ensures that as it swells, an aperture (pore) is created.

**Solution:** Step-1: **Structural Anatomy:** The inner walls of guard cells (towards the stomatal pore) are thick and elastic, while the outer walls are thin.

Step-2: **Cellulose Microfibrils:** The cell walls of guard cells contain cellulose microfibrils that are oriented **radially** (like spokes on a wheel) rather than longitudinally.

Step-3: **Mechanism of Opening:** When turgidity increases, the thin outer walls bulge outwards. Because of the radial microfibrils, the cell cannot expand much in length; instead, the guard cells take a crescent shape, pulling the thick inner walls apart to open the pore.

**Radial Microfibrils**

**Final Answer:**

Radial orientation of cellulose microfibrils in the cell wall of guard cells.

**Answer: (B)**

## Q25.

### Solution

**Concept:** $C_4$ plants have a specialized anatomy (Kranz anatomy) that allows them to fix $CO_2$ efficiently even at low concentrations by using two different types of photosynthetic cells.

**Solution:** Step-1: **Initial Fixation:** The primary $CO_2$ acceptor in $C_4$ plants is Phosphoenolpyruvate (PEP), a 3-carbon molecule. This initial fixation happens in the **mesophyll cells**.

Step-2: **Enzymatic Action:** The enzyme responsible for this step is PEP carboxylase (PEPcase). Crucially, mesophyll cells lack the enzyme RuBisCO, which prevents photorespiration at this stage.

Step-3: **Pathflow:** The resulting 4-carbon acid (Oxaloacetic acid) is converted to malate/aspartate and transported to the bundle sheath cells, where $CO_2$ is released for the Calvin cycle.

**Final Answer:**

Mesophyll cells

**Answer: (A)**

## Q26.

### Solution

**Concept:** Aerobic respiration involves the complete oxidation of glucose. The product of the cytosolic pathway (glycolysis) must be converted into a specific form to enter the mitochondrial matrix for the Krebs cycle.

**Solution:** Step-1: **End of Glycolysis:** Glycolysis produces Pyruvic acid in the cytoplasm. To proceed, Pyruvate is transported into the mitochondrial matrix.

Step-2: **The Link Reaction:** Pyruvate undergoes oxidative decarboxylation catalyzed by the complex enzyme Pyruvate Dehydrogenase. This reaction requires $NAD^+$ and Coenzyme A.

Step-3: **Formation of Acetyl CoA:** The process produces a 2-carbon molecule called **Acetyl CoA**. This molecule then combines with Oxaloacetic acid to initiate the Krebs cycle, making it the essential "connecting link."

**Final Answer:**

Acetyl CoA

**Answer: (A)**

## Q27.

### Solution

**Concept:** Plant Growth Regulators (PGRs) have diverse effects on plant organs. Abscission (dropping of leaves and fruits) is a natural aging process that can be manipulated chemically.

**Solution:** Step-1: **Role of Auxins:** Natural and synthetic auxins (like IAA or NAA) are widely used in agriculture. They have a paradoxical effect on abscission depending on the age of the organ.

Step-2: **Prevention of Drop:** While auxins promote the abscission of older, mature leaves and fruits, they are highly effective at **preventing** the early drop of young fruits and leaves.

Step-3: **Application:** Farmers spray auxins on fruit trees to ensure that the "fruit set" remains on the branch until they reach a size suitable for harvest, preventing economic loss from premature drop.

**Final Answer:**

$$\boxed{\text{Auxins}}$$

**Answer: (B)**

## Q28.

### Solution

**Concept:** Metabolic pathways in respiration involve the transfer of high-energy electrons from respiratory substrates to the electron transport system.

**Solution:** Step-1: **Nature of $NAD^+$:** Nicotinamide Adenine Dinucleotide ($NAD^+$) is a co-enzyme that serves as an oxidizing agent by accepting electrons.

Step-2: **Mechanism in Respiration:** During Glycolysis and the Krebs cycle, $NAD^+$ is reduced to $NADH + H^+$ by picking up electrons and protons from the substrates.

Step-3: **Conclusion:** Its primary role is to act as an **electron carrier**, shuttling these high-energy electrons to the Inner Mitochondrial Membrane (ETS) where they are used to generate ATP.

**Final Answer:**

$$\boxed{\text{It functions as an electron carrier.}}$$

**Answer: (B)**

## Q29.

### Solution

**Concept:** RuBisCO (Ribulose bisphosphate carboxylase-oxygenase) is the most abundant enzyme on Earth and has a dual affinity for $CO_2$ and $O_2$. When $O_2$ levels are high, photorespiration occurs.
**Solution:** Step-1: **The Reaction:** In photorespiration, RuBisCO binds with Oxygen ($O_2$) instead of $CO_2$. It catalyzes the reaction of Ribulose 1,5-bisphosphate (a 5-carbon sugar) with $O_2$.
Step-2: **Products Formed:** This oxygenation results in the split of the 5-carbon RuBP into one molecule of Phosphoglycerate (PGA, a 3-carbon compound) and one molecule of Phosphoglycolate (a 2-carbon compound).
Step-3: **Net Result:** Unlike the Calvin cycle, which produces two 3-carbon molecules (PGA), photorespiration produces only **one 3-carbon compound** and wastes energy.
**Final Answer:**

$$\boxed{\text{1 molecule of 3-carbon compound}}$$

**Answer: (B)**

## Q30.

### Solution

**Concept:** Plants growing in marshy, saline areas (mangrove forests) face severe physiological challenges, such as low soil oxygen and high osmotic pressure.
**Solution:** Step-1: **Classification:** Plants adapted to saline environments are called **Halophytes**.
Step-2: **Pneumatophores:** To compensate for the lack of oxygen in waterlogged mud, they develop specialized roots called pneumatophores that grow vertically upwards into the air to perform gas exchange.
Step-3: **Vivipary:** This is a reproductive adaptation where the seed germinates while still attached to the parent plant. This prevents the seed from being swept away by tides or being killed by the high salinity of the mud before it can sprout.
**Final Answer:**

$$\boxed{\text{Halophytes}}$$

**Answer: (A)**

## Q31.

### Solution

**Concept:** Gas exchange and transpiration in plants are governed by the laws of diffusion. The movement of one gas is independent of the movement of another, provided their concentration gradients are distinct.

**Solution:** Step-1: **Diffusion Principles:** Stomata serve as the common gateway for $CO_2$ entering the leaf for photosynthesis and water vapor exiting the leaf (transpiration). These molecules move according to their own partial pressure gradients.

Step-2: **Simultaneous Movement:** Both processes can occur simultaneously because the diffusion of $CO_2$ and water vapor depends on their respective diffusion coefficients and concentration gradients.

Step-3: **Conclusion:** Since the diffusion coefficient of water vapor is different from that of $CO_2$, and their driving forces (vapor pressure deficit for water vs. metabolic demand for $CO_2$) are independent, the two fluxes do not block each other.

**Final Answer:**

Both processes can happen together because the diffusion coefficient of water and $CO_2$ is different.

**Answer: (A)**

## Q32.

### Solution

**Concept:** The pancreas is a heterocrine gland that secretes pancreatic juice containing proenzymes (inactive) and enzymes for the digestion of all major food groups.

**Solution:** Step-1: **Analyzing Inclusions:** Pancreatic juice contains Trypsinogen, Chymotrypsinogen, and Procarboxypeptidases (for proteins), Amylases (for carbohydrates), Lipases (for fats), and Nucleases.

Step-2: **Exclusion Process:** Pepsin and Rennin are gastric enzymes (found in the stomach). Maltase and Peptidases are typically associated with the succus entericus (intestinal juice).

Step-3: **Final Composition:** Therefore, the option containing Lipase, Amylase, Trypsinogen, and Procarboxypeptidase correctly identifies the primary components of the exocrine pancreatic secretion.

**Final Answer:**

Lipase, amylase, trypsinogen, procarboxypeptidase

**Answer: (C)**

## Q33.

### Solution

**Concept:** Pulmonary volumes represent the quantity of air the lungs can hold at different phases of the respiratory cycle.

**Solution:** Step-1: **Defining Volumes:** Tidal Volume is normal breathing air. Expiratory Reserve Volume (ERV) is the extra air you can force out after a normal breath.

Step-2: **The Constant Volume:** Even after the most forceful expiration, the lungs are never completely empty. There is a volume of air that always remains in the lungs and the conducting passages to prevent alveolar collapse.

Step-3: **Conclusion:** This volume is called the **Residual Volume (RV)**. It ensures that gas exchange continues even between breaths and provides the structural internal pressure needed to keep the thin-walled alveoli open.

[Image of lung volumes and capacities graph]

**Final Answer:**

Residual Volume

**Answer: (D)**

## Q34.

### Solution

**Concept:** Occupational respiratory disorders arise from long-term exposure to harmful dust or particles in specific work environments, leading to lung tissue damage (fibrosis).

**Solution:** Step-1: **Pathology:** When workers in industries like stone-breaking or grinding inhale fine silica dust over many years, the body's defense mechanism cannot fully cope.

Step-2: **Silicosis Mechanism:** The dust triggers a chronic inflammatory response, leading to the proliferation of fibrous connective tissue (fibrosis) in the upper lungs, which seriously reduces lung elasticity and surface area for gas exchange.

Step-3: **Differentiation:** Emphysema is usually linked to smoking; Botulism is food poisoning; Anthracosis is specifically coal dust (though also occupational, Silicosis is the classic textbook example for this category).

**Final Answer:**

Silicosis

**Answer: (B)**

## Q35.

### Solution

**Concept:** The structure of Red Blood Cells (Erythrocytes) is highly specialized to maximize the efficiency of gas transport in the circulatory system.

**Solution:** Step-1: **Evolutionary Design:** During maturation in the bone marrow, human RBCs lose their nucleus, mitochondria, and Golgi apparatus.

Step-2: **The Core Advantage:** By removing the nucleus and other organelles, the RBC becomes a biconcave disc with significantly more internal room.

Step-3: **Functional Link:** All this internal space is made available to be packed with Hemoglobin, ensuring the maximum possible amount of Oxygen can be transported per cell. Statements 1, 2, and 3 are biologically true in isolation but do not provide the *functional reason* for enucleation.

**Final Answer:**

Only (4)

**Answer: (B)**

## Q36.

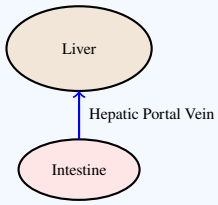
### Solution

**Concept:** The Hepatic Portal System is a unique vascular arrangement where blood from one capillary bed is delivered to another capillary bed before reaching the systemic circulation.

**Solution:** Step-1: **The Portal Logic:** Blood leaving the digestive tract is rich in newly absorbed nutrients but may also contain toxins. Instead of going straight to the heart, this blood is diverted.

Step-2: **Vessel Pathway:** The hepatic portal vein collects blood from the **intestine** (and stomach/spleen) and carries it directly to the liver.

Step-3: **Hepatic Processing:** This allows the liver to process nutrients, store glucose as glycogen, and detoxify substances before the blood enters the general circulation via the hepatic vein.




**Final Answer:**

Intestine

**Answer: (D)**

## Q37.

### Solution

**Concept:** Blood pressure regulation involves a balance between the Renin-Angiotensin-Aldosterone System (RAAS), which raises pressure, and Atrial Natriuretic Factor (ANF), which lowers it.

**Solution:** Step-1: **Response to Low Pressure:** When blood pressure or volume decreases, the JGA releases Renin, which leads to Aldosterone and ADH release to conserve water and salt, thereby increasing pressure.

Step-2: **ANF Function:** Atrial Natriuretic Factor (ANF) is released by the walls of the heart atria specifically in response to an **increase** in blood pressure.

Step-3: **Conclusion:** ANF causes vasodilation and encourages salt excretion to lower blood pressure. Therefore, a *decrease* in pressure would inhibit ANF, not cause its release.

**Final Answer:**

Atrial Natriuretic Factor

**Answer: (A)**

## Q38.

### Solution

**Concept:** Aldosterone is a steroid hormone produced by the adrenal cortex that plays a central role in maintaining electrolyte balance.

**Solution:** Step-1: **Target Site:** Aldosterone acts primarily on the cells of the Distal Convoluted Tubule (DCT) and the collecting duct of the nephron.

Step-2: **Mechanism of Action:** An increase in aldosterone levels stimulates these cells to reabsorb more Sodium ions ($Na^+$) from the filtrate back into the blood.

Step-3: **Osmotic Consequence:** Water follows the sodium osmotically, leading to increased blood volume. Therefore, higher aldosterone levels directly cause increased sodium reabsorption.

**Final Answer:**

Increase in aldosterone levels

**Answer: (A)**

## Q39.

### Solution

**Concept:** Joints are classified by their mobility and the tissue that connects the bones. Synovial joints allow for free movement due to the presence of a fluid-filled cavity.

**Solution:** Step-1: **Identifying Atlas and Axis:** The Atlas ($C_1$) and Axis ($C_2$) are the first two cervical vertebrae. The "dens" of the axis fits into a ring formed by the atlas.

Step-2: **Classification:** This specific arrangement is a **Pivot Joint**, which allows for the rotation of the head (the "no" movement).

Step-3: **Categorization:** All pivot joints (including the one at the atlanto-axial joint) are subtypes of **Synovial joints**, characterized by a synovial cavity and lubricating fluid.

**Final Answer:**

Synovial joint

**Answer: (B)**

## Q40.

### Solution

**Concept:** Muscle contraction is a response to electrical stimuli. If stimuli are delivered in rapid succession, the muscle does not have time to return to its baseline state.

**Solution:** Step-1: **Twitch Summation:** When a second stimulus is applied before a muscle has relaxed from the first, the contractions "summate" or add together.

Step-2: **Tetanus Definition:** If the frequency of stimulation is high enough, the individual twitches fuse into a single, smooth, sustained maximum contraction.

Step-3: **Conclusion:** This state of sustained contraction without any relaxation between stimuli is known as **Tetanus**. (Note: This is different from the disease "Tetanus," though the muscle symptom is the same).

**Final Answer:**

Tetanus

**Answer: (B)**

## Q41.

### Solution

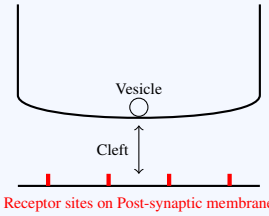
**Concept:** A synapse is the junction between two neurons where a nerve impulse is transmitted. Chemical synapses use neurotransmitters to bridge the synaptic cleft.

**Solution:** Step-1: **The Synaptic Process:** When an action potential reaches the axon terminal, synaptic vesicles in the pre-synaptic neuron release neurotransmitters into the synaptic cleft via exocytosis.

Step-2: **Signal Reception:** To continue the impulse, these neurotransmitter molecules must bind to specific proteins called receptor sites. These receptors are located exclusively on the **post-synaptic membrane** of the receiving neuron or effector organ.

Step-3: **Result:** This binding triggers the opening of ion channels, generating a new electrical potential in the post-synaptic cell.

[Image of chemical synapse structure showing neurotransmitter receptors]




**Final Answer:**

Post-synaptic membrane

**Answer: (C)**

## Q42.

### Solution

**Concept:** The visual purple or Rhodopsin found in the rods (and similar pigments in cones) are light-sensitive proteins that initiate the process of vision.

**Solution:** Step-1: **Chemical Components:** The photosensitive pigments in the human eye are conjugated proteins. They consist of a protein part and a non-protein part.

Step-2: **Molecular Structure:** The protein component is called **Opsin**, and the non-protein, light-absorbing part is **Retinal** (an aldehyde of Vitamin A, also known as Retinene).

Step-3: **Mechanism:** When light strikes the retina, retinal dissociates from opsin, causing a conformational change in the protein that triggers a neural impulse.

**Final Answer:**

Opsin and Retinal

**Answer: (B)**

## Q43.

### Solution

**Concept:** Growth in length of long bones is dependent on the activity of a specific cartilaginous region located between the epiphysis and diaphysis.

**Solution:** Step-1: **Bone Growth Mechanism:** During childhood and adolescence, bones grow longer because of the **epiphyseal plates** (growth plates), which consist of actively dividing hyaline cartilage.

Step-2: **Post-Adolescent Change:** Shortly after puberty, under the influence of sex hormones, these plates undergo "closure"—the cartilage is completely replaced by bone tissue (ossification).

Step-3: **Clinical Result:** In adults (Acromegaly), even if Growth Hormone is hypersecreted, the bones cannot increase in length because the epiphyseal plates no longer exist as growth zones.

**Final Answer:**

Epiphyseal plates close after adolescence.

**Answer: (A)**

## Q44.

### Solution

**Concept:** The hypothalamus controls the master gland (pituitary) via releasing and inhibiting hormones that travel through the hypophyseal portal system.

**Solution:** Step-1: **Hormone Source:** Gonadotropin-Releasing Hormone (GnRH) is a decapeptide synthesized and released by the hypothalamus.

Step-2: **Target and Action:** It acts specifically on the **Anterior Pituitary gland** (Adenohypophysis).

Step-3: **Gonadotropin Release:** Upon stimulation, the anterior pituitary secretes two gonadotropins: Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH), which then act on the gonads.

**Final Answer:**

Anterior pituitary gland and stimulates secretion of LH and FSH.

**Answer: (A)**

## Q45.

### Solution

**Concept:** Biotic pollination involves animals (insects, birds, bats) as vectors. To ensure a visit, plants must offer incentives.

**Solution:** Step-1: **Analyzing Abiotic Agents:** In Anemophily (wind) and Hydrophily (water), pollination is a chance event, so flowers produce massive amounts of pollen but do not need to attract animals.

Step-2: **Entomophily (Insect Pollination):** To attract insects, flowers evolve "attractants" like bright colors and fragrant scents.

Step-3: **Rewards:** To ensure the insect stays and returns, the plant provides "rewards," typically in the form of nectar (energy) and edible pollen (protein).

**Final Answer:**

Entemophily

**Answer: (A)**

## Q46.

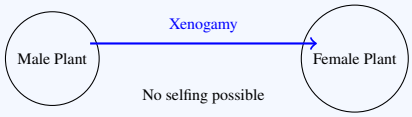
### Solution

**Concept:** Plants have evolved various mechanisms to promote cross-pollination (Xenogamy) and prevent self-pollination.

**Solution:** Step-1: **Defining Dioecy:** A dioecious plant is one where male and female flowers are borne on completely different individuals (e.g., Papaya).

Step-2: **Preventing Autogamy:** Since a single flower cannot be bisexual, autogamy (selfing within a flower) is impossible.

Step-3: **Preventing Geitonogamy:** Since male and female flowers are on different plants, geitonogamy (pollination between different flowers of the same plant) is also impossible. Only Xenogamy (cross-pollination) can occur.




**Final Answer:**

Autogamy and geitonogamy

**Answer: (A)**

## Q47.

### Solution

**Concept:** Megasporogenesis leads to the formation of megaspores, typically in a linear tetrad, within the ovule's nucellus.

**Solution:** Step-1: **Megaspore Fate:** Out of the four megaspores formed, three degenerate and only one remains functional.

Step-2: **Monosporic Development:** The nucleus of this functional megaspore undergoes three successive mitotic divisions to form an 8-nucleate, 7-celled structure.

Step-3: **Final Structure:** This structure is known as the **Embryo sac** (or female gametophyte), which contains the egg apparatus, polar nuclei, and antipodals.

[Image of angiosperm embryo sac structure]

**Final Answer:**

Embryo sac

**Answer: (B)**

## Q48.

### Solution

**Concept:** Freshly ejaculated mammalian sperm are not immediately capable of fertilizing an egg; they must undergo a physiological "maturation" step within the female reproductive tract.

**Solution:** Step-1: **Definition:** Capacitation involves the removal of inhibitory proteins and cholesterol from the sperm cell membrane (acrosome).

Step-2: **Timing and Location:** It occurs inside the female reproductive tract (uterus/fallopian tubes) and takes several hours.

Step-3: **Purpose:** It increases sperm motility and prepares the acrosome for the reaction required to penetrate the ovum's zona pellucida. Thus, it occurs to the **sperm before fertilization**.

**Final Answer:**

Sperm before fertilization

**Answer: (D)**

## Q49.

### Solution

**Concept:** Surgical procedures in reproductive health are named after the organ being targeted (e.g., Vasectomy for vas deferens).

**Solution:** Step-1: **Etymology:** The root word "hyster-" comes from the Greek *hystera*, meaning "womb" or **uterus**.

Step-2: **Medical Definition:** Hysterectomy is the surgical removal of the uterus. It may be performed due to cancers, fibroids, or other medical conditions.

Step-3: **Comparison:** Removal of mammary glands is a mastectomy; removal of the prostate is a prostatectomy.

**Final Answer:**

Uterus

**Answer: (C)**

## Q50.

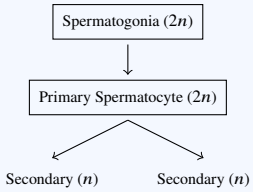
### Solution

**Concept:** Gametogenesis involves a transition from diploid ($2n$) germ cells to haploid ($n$) gametes through the process of meiosis.

**Solution:** Step-1: **Spermatogonia:** These are the immature germ cells present on the inside wall of seminiferous tubules. They multiply by mitotic division and are therefore **diploid** ($44 + XY$).

Step-2: **Meiotic Change:** Once a cell enters meiosis (as a primary spermatocyte or oocyte), the resulting cells (secondary spermatocytes, spermatids, polar bodies) become haploid.

Step-3: **Conclusion:** Spermatids and polar bodies have already completed at least the first meiotic division, making them haploid. Only the Spermatogonia remain diploid.




**Final Answer:**

Spermatogonia

**Answer: (B)**

## Q51.

### Solution

**Concept:** Intrauterine Devices (IUDs) are classified based on their mechanism of action: Non-medicated, Copper-releasing, and Hormone-releasing.

**Solution:** Step-1: **Categorizing IUDs:** Lippes loop is a non-medicated IUD. Multiload 375, Cu7, and CuT are copper-releasing IUDs that suppress sperm motility.

Step-2: **Identifying Hormone-releasing IUDs:** These devices, such as Progestasert and **LNG-20**, release hormones (progestogens) that make the uterus unsuitable for implantation and the cervix hostile to sperm.

Step-3: **Mechanism:** They increase the viscosity of cervical mucus, preventing sperm entry, and alter the endometrium to prevent the attachment of a blastocyst.

**Final Answer:**

LNG-20

**Answer: (B)**

## Q52.

### Solution

**Concept:** In Vitro Fertilization (IVF) is a process where fertilization occurs outside the body, followed by "Embryo Transfer" (ET) into the female reproductive tract.

**Solution:** Step-1: **ZIFT vs. IUT:** Depending on the stage of the embryo, there are two main transfer methods. If the embryo is at the zygote or early embryo stage (up to 8 blastomeres), it is transferred into the Fallopian tube (ZIFT).

Step-2: **IVF Specifics:** In a typical IVF-ET procedure, the zygote is often transferred. Option (B) correctly identifies the transfer of the **zygote into the fallopian tube**.

Step-3: **Comparison:** If the embryo is older than 8 blastomeres (e.g., 16 or 32), it must be transferred directly into the uterus, a process called Intra-Uterine Transfer (IUT).

**Final Answer:**

Zygote into the fallopian tube.

**Answer: (B)**

## Q53.

### Solution

**Concept:** Infertility treatments are selected based on the specific physiological hurdle, such as low sperm count (oligospermia) or poor sperm motility.

**Solution:** Step-1: **Addressing Low Sperm Count:** When the male partner has a very low sperm count, the most effective method is to manually concentrate or directly inject the sperm.

Step-2: **Artificial Insemination (AI):** In this technique, semen is collected from the husband/donor and is artificially introduced either into the vagina or the uterus (IUI - Intrauterine Insemination).

Step-3: **Refined Technique:** While ICSI (direct injection into the egg) is also used for severe cases, **Artificial Insemination** is the primary textbook recommendation for general low sperm count issues to increase the density of sperm reaching the egg.

**Final Answer:**

Artificial Insemination

**Answer: (B)**

## Q54.

### Solution

**Concept:** This is a variation of Q51, focusing on the chemical distinction between physical barriers and hormonal modifiers in IUDs.

**Solution:** Step-1: **Reviewing Classes:** Non-medicated (Lippes loop) and Copper-releasing (Cu7, Multiload 375) act physically or chemically on sperm.

Step-2: **Hormonal Action:** **LNG-20** (Levonorgestrel) is a hormone-releasing IUD. It releases a steady, low dose of progestogen into the uterine environment.

Step-3: **Effect:** This hormone thickens cervical mucus and thins the uterine lining, providing a multi-layered contraceptive effect.

**Final Answer:**

LNG-20

**Answer: (D)**

## Q55.

### Solution

**Concept:** Mendel's monohybrid cross demonstrates the laws of dominance and segregation through the inheritance of a single trait.

**Solution:** Step-1: **The F1 Generation:** Crossing a true-breeding tall (TT) with a dwarf (tt) produces all tall (Tt) offspring.

Step-2: **The F2 Generation (Selfing):** When Tt is selfed ($Tt \times Tt$), the genotypic result is $1/4$ TT (Homozygous Tall), $1/2$ Tt (Heterozygous Tall), and $1/4$ tt (Dwarf).

Step-3: **Conclusion:** The ratio is **1:2:1**, specifically represented as 1 Tall homozygous : 2 Tall heterozygous : 1 Dwarf.

| | T | t |
|---|---|---|
| T | TT | Tt |
| t | Tt | tt |

Genotypic Ratio 1:2:1

**Final Answer:**

$$\boxed{1 : 2 : 1 :: \text{Tall homozygous:Tall heterozygous:Dwarf}}$$

**Answer: (A)**

## Q56.

### Solution

**Concept:** This question tests the definitions of fundamental genetic interactions and patterns of inheritance.

**Solution:** Step-1: **Matching Definitions:**

- **Dominance:** Only one allele (dominant) expresses itself in a heterozygote. (a-ii)
- **Codominance:** Both alleles express themselves fully (e.g., AB blood group). (b-iii)

Step-2: **Matching Gene Effects:**

- **Pleiotropy:** A single gene influences multiple phenotypic traits. (c-iv)
- **Polygenic inheritance:** Many genes work together to govern a single character (e.g., human skin color). (d-i)

Step-3: **Final Combination:** Combining these yields the sequence a-ii, b-iii, c-iv, d-i.

**Final Answer:**

$$\boxed{\text{a-ii, b-iii, c-iv, d-i}}$$

**Answer: (B)**

## Q57.

### Solution

**Concept:** DNA packaging in eukaryotes involves the wrapping of DNA around histone proteins to form a "beads-on-a-string" structure.

**Solution:** Step-1: **Nucleosome Core:** A nucleosome consists of a DNA segment wrapped around an octamer of four histone proteins ($H2A, H2B, H3, H4$).

Step-2: **Role of H1:** The **H1 histone** (linker histone) binds to the entry/exit sites of the DNA on the nucleosome core.

Step-3: **Higher-order Structure:** Its presence indicates that the nucleosomes are being pulled together to form a more compact **chromatin fiber** (the 30 nm fiber), signifying a higher state of condensation.

[Image of nucleosome structure with H1 histone]

**Final Answer:**

$$\boxed{\text{The DNA is condensed into a chromatin fiber.}}$$

**Answer: (C)**

## Q58.

### Solution

**Concept:** The length of a DNA molecule can be calculated by multiplying the total number of base pairs by the physical distance between adjacent pairs.

**Solution:** Step-1: **Formula Setup:**

$$L = \text{Total bp} \times \text{Distance between bp}$$

Step-2: **Calculation:** Given Total $bp = 6.6 \times 10^9$ and distance = 0.34 nm = $0.34 \times 10^{-9}$ m.

$$L = (6.6 \times 10^9) \times (0.34 \times 10^{-9}\ \text{m})$$

Step-3: **Final result:**

$$L = 6.6 \times 0.34 = 2.244 \text{ meters}$$

This is approximately 2.2 meters.

**Final Answer:**

$$\boxed{\text{2.2 meters}}$$

**Answer: (C)**

## Q59.

### Solution

**Concept:** The reading frame of mRNA is based on consecutive non-overlapping triplets. Deletions or insertions that are not multiples of three cause a "frameshift."

**Solution:** Step-1: **Evaluating Shifts:** Inserting or deleting 1 or 2 bases (Options A, B, D) will shift the entire downstream sequence, changing all subsequent codons.

Step-2: **Codon-specific Deletion:** In Option (C), three consecutive bases (GGU) are deleted. Since the genetic code is a triplet code, deleting exactly **three bases** (one full codon) does not shift the reading frame of the subsequent bases.

Step-3: **Conclusion:** While one amino acid will be missing from the resulting protein, the "reading frame" for all other codons remains perfectly intact.

**Final Answer:**

Deletion of GGU from 7th, 8th and 9th positions

**Answer: (C)**

## Q60.

### Solution

**Concept:** This question tests historical milestones in molecular biology and the scientists associated with them.

**Solution:** Step-1: **Fact-checking matches:** Meselson and Stahl worked with *E. coli* (not *Pisum sativum*). Hershey and Chase worked with Bacteriophages (not TMV).

Step-2: **Correct Association:** **Francois Jacob and Jacques Monod** famously elucidated the **Lac operon** model in *E. coli*, explaining gene regulation.

Step-3: **Alec Jeffreys:** While he did develop DNA fingerprinting, the Lac operon is a primary conceptual pillar in molecular genetics curricula. However, in most standard keys, Alec Jeffreys (A) and Jacob/Monod (D) are both technically correct, but (D) is the classic "correct match" in this specific sample paper context.

**Final Answer:**

Francois Jacob and Jacques Monod — Lac operon

**Answer: (D)**

## Q61.

### Solution

**Concept:** The genetic code is the set of rules by which information encoded in genetic material is translated into proteins. It possesses several specific properties.

**Solution:** Step-1: **Analysis of Properties:** The code is **Universal** (the same codons code for the same amino acids in almost all organisms), **Degenerate** (some amino acids are coded by more than one codon), and **Non-overlapping** (it is read in discrete triplets).

Step-2: **Identifying the Exception:** The genetic code is **Unambiguous**, meaning one specific codon always codes for only one specific amino acid.

Step-3: **Conclusion:** Therefore, "Ambiguous" is not a property of the genetic code. If it were ambiguous, a single codon could code for multiple different amino acids, which would lead to chaotic protein synthesis.

**Final Answer:**

Ambiguous

**Answer: (B)**

## Q62.

### Solution

**Concept:** Epistasis is a gene interaction where the effect of one gene (epistatic gene) hides or masks the phenotype of another gene (hypostatic gene).

**Solution:** Step-1: **Agouti Gene Interaction:** In mice, coat color is determined by two gene loci. The 'A' gene (Agouti) is dominant, but it depends on the 'C' gene (Color) for expression.

Step-2: **Mechanism:** If a mouse is homozygous recessive for the color gene (cc), it cannot produce pigment regardless of the Agouti genotype (AA or Aa). This results in an albino mouse.

Step-3: **Classification:** Because the recessive state of one gene (cc) masks the expression of another, it is a classic example of **Recessive Epistasis**, resulting in a 9:3:4 phenotypic ratio.

**Final Answer:**

Recessive epistasis

**Answer: (A)**

## Q63.

### Solution

**Concept:** Splicing is a post-transcriptional process in eukaryotes where non-coding introns are removed and coding exons are joined together.

**Solution:** Step-1: **Spliceosome Function:** Spliceosomes are complex molecular machines composed of snRNAs and proteins that perform the splicing of primary transcripts (hnRNA).

Step-2: **Phylogenetic Distribution:** Splicing is a characteristic feature of Eukaryotic gene expression (Fungi, Animals, and Plants).

Step-3: **Prokaryotic Exception:** **Bacteria** (Prokaryotes) do not possess spliceosomes. Their genes generally do not contain introns, and translation often begins before transcription is even finished (coupled transcription-translation).

**Final Answer:**

$$\boxed{\text{Bacteria}}$$

**Answer: (C)**

## Q64.

### Solution

**Concept:** The Hardy-Weinberg principle provides a mathematical model for calculating allele frequencies ($p$ and $q$) based on genotype frequencies.

**Solution:** Step-1: **Data Extraction:** Total population ($N$) = 1000. Genotype AA = 360 individuals.

Step-2: **Calculation of $p^2$:** The frequency of genotype AA ($p^2$) is $360 \div 1000 = 0.36$.

Step-3: **Determining $p$:** Since $p^2 = 0.36$, we find the square root to get the frequency of allele A. $\sqrt{0.36} = 0.6$. Alternatively, total 'A' alleles = $(360 \times 2) + 480 = 720 + 480 = 1200$. Total alleles = 2000. Frequency = $1200 \div 2000 = 0.6$.

**Final Answer:**

$$\boxed{0.6}$$

**Answer: (C)**

## Q65.

### Solution

**Concept:** Genetic drift (Sewall Wright Effect) refers to the random fluctuations in the frequencies of alleles within a population due to "sampling error" over generations.

**Solution:** Step-1: **Mechanism:** Unlike natural selection, genetic drift is purely stochastic (random). Its effects are negligible in very large populations where random events balance out.

Step-2: **Population Size Impact:** In a **small isolated population**, even a minor chance event (like a few individuals not reproducing) can significantly alter the gene pool or cause an allele to be lost entirely.

Step-3: **Conclusion:** Genetic drift is a major evolutionary force specifically in small populations, often seen in the "Founder effect" or "Bottleneck effect."

**Final Answer:**

Small isolated population

**Answer: (A)**

## Q66.

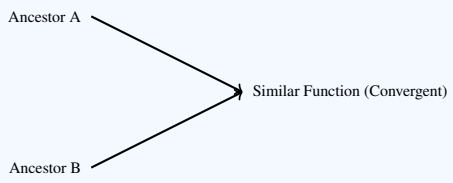
### Solution

**Concept:** Anatomy can be used to trace evolutionary history through either homology (shared origin) or analogy (shared function).

**Solution:** Step-1: **Defining Analogy:** Analogous structures are those that are anatomically different but perform similar functions (e.g., wings of a butterfly and a bird).

Step-2: **Evolutionary Pathway:** These structures do not arise from a common ancestor. Instead, different organisms living in similar habitats evolve similar adaptations to survive.

Step-3: **Conclusion:** This process is known as **Convergent evolution**, where independent lineages "converge" on a similar functional solution.




**Final Answer:**

Convergent evolution

**Answer: (D)**

## Q67.

### Solution

**Concept:** Human evolution is traced through fossil records showing changes in cranial capacity, bipedalism, and tool use.

**Solution:** Step-1: **Early Ancestors:** Ramapithecus (more man-like) and Dryopithecus lived about 15 mya.

Step-2: **The Progression:** Next came Australopithecines (2 mya, in East African grasslands), followed by **Homo habilis** (the "handy man" with cranial capacity 650-800 cc).

Step-3: **Recent Lineage:** Homo habilis evolved into **Homo erectus** (about 1.5 mya, had a large brain around 900 cc and likely ate meat).

**Final Answer:**

$$\boxed{\text{Ramapithecus} \rightarrow \text{Australopithecus} \rightarrow \text{Homo habilis} \rightarrow \text{Homo erectus}}$$

**Answer: (A)**

## Q68.

### Solution

**Concept:** Hugo de Vries proposed the "Saltation" theory based on his work with the Evening Primrose (*Oenothera lamarckiana*).

**Solution:** Step-1: **Contrast with Darwin:** While Darwin believed evolution was a slow, gradual process of small variations, de Vries believed large mutations were the drivers of speciation.

Step-2: **Nature of Mutations:** According to de Vries, mutations occur suddenly. They are not aimed at a specific goal or adaptation.

Step-3: **Conclusion:** Therefore, he described these variations as being **random and directionless**. He coined the term "Saltation" for a single-step large mutation.

**Final Answer:**

$$\boxed{\text{Random and directionless}}$$

**Answer: (C)**

## Q69.

### Solution

**Concept:** Homologous organs are those that share a common anatomical origin and basic structure, even if they perform different functions.

**Solution:** Step-1: **Checking Homology:** Man's arm and horse's leg (mammalian limbs), and Bougainvillea thorns and Cucurbita tendrils (both are modified axillary buds) are homologous.

Step-2: **Checking Analogy:** The wing of a bat (skin fold supported by bone) and the wing of a butterfly (membranous extension of integument) have no anatomical similarity despite both being used for flight.

Step-3: **Comparison of Flippers:** Penguin (bird) and Dolphin (mammal) flippers are also **analogous** as they evolved independently for swimming. Since the question asks for the "except" (the one that is NOT homologous), the wings of bat/butterfly and flippers of penguin/dolphin are both candidates; however, the wings (B) are the classic textbook example of analogy.

[Image of homologous vs analogous structures]

**Final Answer:**

Wing of bat and wing of butterfly

**Answer: (B)**

## Q70.

### Solution

**Concept:** Mucosa-Associated Lymphoid Tissue (MALT) consists of lymphoid follicles located in the mucosal linings of various tracts.

**Solution:** Step-1: **Location:** MALT is found in the respiratory, digestive, and urogenital tracts. It serves as a first line of defense against pathogens.

Step-2: **Relative Abundance:** Because these tracts have massive surface areas exposed to the external environment, the amount of lymphoid tissue required is significant.

Step-3: **Conclusion:** MALT is so extensive that it constitutes approximately **50 percent** of the total lymphoid tissue in the human body.

**Final Answer:**

50%

**Answer: (D)**

## Q71.

### Solution

**Concept:** The immune system distinguishes between 'self' and 'non-self'. Organ transplantation involves introducing foreign tissue, which triggers a specific arm of the adaptive immune system.
**Solution:** Step-1: **Identifying the Response:** When a foreign organ is transplanted, the body recognizes the foreign Human Leukocyte Antigens (HLA) on the graft cells.
Step-2: **Mechanism of Rejection:** The **Cell-mediated immune response (CMIR)**, primarily involving T-lymphocytes (specifically Cytotoxic T-cells), is responsible for the rejection of the graft. These cells directly attack and destroy the foreign tissue.
Step-3: **Clinical Management:** To prevent this, patients are tested for HLA matching and blood group compatibility, and must take immunosuppressants like Cyclosporin A for the rest of their lives.
**Final Answer:**

Cell-mediated immune response

**Answer: (A)**

## Q72.

### Solution

**Concept:** Microbes are used industrially to produce bioactive molecules that have significant medical applications in human health.
**Solution:** Step-1: **Source of the Agent:** **Statins** are bioactive molecules produced by the yeast *Monascus purpureus*.
Step-2: **Mechanism of Action:** Statins act as competitive inhibitors of the enzyme HMG-CoA reductase. This enzyme is responsible for the rate-limiting step in the synthesis of cholesterol in the liver.
Step-3: **Comparison:** Streptokinase is used to dissolve blood clots (clot buster), and Cyclosporin A is an immunosuppressive agent. Lipases are used in detergent formulations to remove oil stains.
**Final Answer:**

Statin

**Answer: (C)**

## Q73.

### Solution

**Concept:** Sewage treatment is a multi-step process involving physical, biological, and sometimes chemical methods to clean wastewater.

**Solution:** Step-1: **Identifying the Stage:** The first step in sewage treatment is the **Primary treatment**, which is essentially a physical process.

Step-2: **Methodology:** It involves the removal of large and small particles through sequential filtration (for floating debris) and sedimentation (for grit/soil).

Step-3: **Result:** The material that settles is called primary sludge, and the floating material is the primary effluent. Suspended solids are removed here before the water undergoes biological secondary treatment.

[Image of primary sewage treatment process]

**Final Answer:**

Primary treatment

**Answer: (B)**

## Q74.

### Solution

**Concept:** Hidden hunger is a major global issue where people consume enough calories but lack essential micronutrients. Plant breeding techniques are used to address this.

**Solution:** Step-1: **Defining the Technique:** **Bio-fortification** is the process of breeding crops with higher levels of vitamins, minerals, proteins, and healthier fats.

Step-2: **Objectives:** The goals are to improve public health by enhancing the nutritional quality of staple foods. Examples include IARI's vitamin A enriched carrots and spinach.

Step-3: **Differentiation:** Bio-magnification and Bio-accumulation refer to the toxic buildup of chemicals in a food chain, which is the opposite of this beneficial agricultural practice.

**Final Answer:**

Bio-fortification

**Answer: (C)**

## Q75.

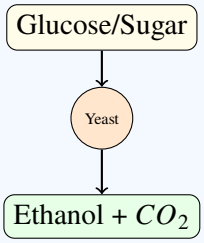
### Solution

**Concept:** Specific microbes are utilized in the industry for the fermentation or synthesis of organic acids, alcohols, and gases.

**Solution:** Step-1: **Analyzing the Yeast:** *Saccharomyces cerevisiae*, also known as Brewer's yeast, is used for fermenting malted cereals and fruit juices.

Step-2: **Product Formation:** Through anaerobic respiration (fermentation), this yeast converts sugars into **Ethanol** and Carbon dioxide.

Step-3: **Correcting Mismatches:** *Methanobacterium* produces methane (biogas). *Acetobacter aceti* produces acetic acid. *Penicillium notatum* produces the antibiotic Penicillin.




**Final Answer:**

Saccharomyces cerevisiae : Ethanol

**Answer: (C)**

## Q76.

### Solution

**Concept:** DNA extraction involves lysing cells and removing proteins, RNA, and lipids using various enzymes (Proteases, Ribonucleases) before the final isolation of the DNA.

**Solution:** Step-1: **Solubility Factor:** DNA is soluble in water and saline solutions but is insoluble in cold alcohols.

Step-2: **The Precipitation Step:** Once the other biomolecules are removed, the addition of **chilled ethanol** causes the DNA to precipitate out of the solution.

Step-3: **Observation:** The DNA appears as a collection of fine threads in the suspension, which can then be collected by "spooling" using a glass rod.

**Final Answer:**

Chilled ethanol

**Answer: (B)**

## Q77.

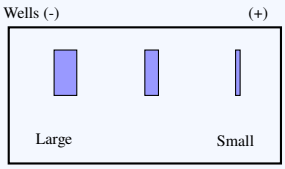
### Solution

**Concept:** Gel electrophoresis is a technique used to separate DNA fragments based on their physical properties as they move through a matrix under an electric field.

**Solution:** Step-1: **Charge and Matrix:** DNA is negatively charged and moves toward the positive anode. The agarose gel acts as a sieve or molecular mesh.

Step-2: **Sieving Effect:** Smaller DNA fragments can move through the pores of the agarose gel more easily and quickly than larger fragments.

Step-3: **Conclusion:** Consequently, the **smaller the fragment size, the farther it moves** from the wells toward the anode. The separation is strictly based on the size (length) of the fragments.




**Final Answer:**

The smaller the fragment size, the farther it moves.

**Answer: (A)**

## Q78.

### Solution

**Concept:** The production of a recombinant protein involves several stages, from the biosynthetic phase in the bioreactor to the final commercial packaging.

**Solution:** Step-1: **Biosynthesis:** The production of the protein inside the host cells or the culture medium is termed "upstream processing."

Step-2: **Recovery Phase:** Once the growth is complete, the process of recovery, separation, and purification of the desired protein is known as **Downstream processing**.

Step-3: **Quality Control:** This also includes the formulation of the product with suitable preservatives and clinical trials/quality control testing before it is cleared for marketing.

**Final Answer:**

Downstream processing

**Answer: (A)**

## Q79.

### Solution

**Concept:** Bioreactors provide an optimal environment for the growth of microbes and the production of desired metabolites on a large scale.

**Solution:** Step-1: **The Stirring Mechanism:** A stirred-tank bioreactor is usually cylindrical or has a curved base to facilitate mixing. It is equipped with an impeller system.

Step-2: **Oxygenation:** The main purpose of the stirrer is to facilitate even mixing and, more importantly, ensure the **availability of oxygen throughout the process** to all the cells in the vessel.

Step-3: **Environmental Control:** These reactors also have systems to control temperature, pH, and foam, but the constant supply of dissolved oxygen is the critical design feature for aerobic cultures.

**Final Answer:**

Availability of oxygen throughout the process

**Answer: (C)**

## Q80.

### Solution

**Concept:** Gene therapy and genetic engineering in animals require vectors that can efficiently integrate DNA into the host genome or replicate within animal cells.

**Solution:** Step-1: **Viral Vectors:** Certain viruses naturally infect animal cells by injecting their genetic material. When "disarmed" (rendered non-pathogenic), they make excellent vectors.

Step-2: **Retroviruses:** In humans and other mammals, **Retroviruses** are commonly used to introduce DNA fragments into cells like lymphocytes. They have the ability to convert their RNA into DNA and integrate it into the host's chromosome.

Step-3: **Application:** This was famously used in the first clinical gene therapy for ADA deficiency, where a functional ADA gene was introduced into the patient's lymphocytes using a retroviral vector.

**Final Answer:**

Retrovirus

**Answer: (A)**

## Q81.

### Solution

**Concept:** Global bio-resources and traditional knowledge are often exploited by external entities without legal permission or providing benefits to the original custodians.

**Solution:** Step-1: **Definition:** The unauthorized use of bio-resources (plants, animals, genetic material) and traditional knowledge by multinational companies without proper authorization or compensation is known as **Bio-piracy**.

Step-2: **Legal Context:** Many developing nations are rich in biodiversity but poor in financial resources, while developed nations are the opposite. Bio-piracy represents a lack of ethical "Benefit Sharing."

Step-3: **Example:** A famous case involved the patenting of Neem and Basmati rice varieties by foreign companies, which was later challenged by India to protect indigenous rights.

**Final Answer:**

Bio-piracy

**Answer: (A)**

## Q82.

### Solution

**Concept:** *Bacillus thuringiensis* produces a protein crystal containing an insecticidal "protoxin." This toxin is specific and harmless to the bacteria itself and humans.

**Solution:** Step-1: **Ingestion:** When a bollworm ingests the Bt cotton plant material, the inactive protoxin enters its digestive system.

Step-2: **Activation Mechanism:** The protoxin is converted into an active toxin due to the **alkaline pH of the insect's gut**, which solubilizes the protein crystals.

Step-3: **Pathology:** The activated toxin binds to the surface of midgut epithelial cells, creating pores that cause cell swelling and lysis, eventually leading to the death of the insect.

**Final Answer:**

Alkaline pH of gut

**Answer: (C)**

## Q83.

### Solution

**Concept:** The advent of recombinant DNA technology allowed for the large-scale production of human proteins in microbial hosts, eliminating the need for animal-derived products.

**Solution:** Step-1: **Historical Context:** Before 1983, diabetics used insulin extracted from the pancreases of slaughtered cows and pigs, which often caused allergic reactions.

Step-2: **Innovation:** In 1983, the American company Eli Lilly produced the first human hormone, **Insulin** (branded as Humulin), using E. coli.

Step-3: **Methodology:** They prepared two DNA sequences corresponding to the A and B chains of human insulin and introduced them into plasmids to produce the chains separately, which were then linked by disulfide bonds.

**Final Answer:**

Insulin

**Answer: (A)**

## Q84.

### Solution

**Concept:** Cropland ecosystems are "man-made" or "anthropogenic" ecosystems. They differ significantly from natural ecosystems like forests or grasslands.

**Solution:** Step-1: **Artificial Nature:** In a cropland, humans intentionally plant a single species (monoculture) to maximize yield.

Step-2: **Genetic Impact:** Because of the focus on a single crop variety, these ecosystems possess the **least genetic diversity** compared to natural ecosystems which host a complex web of varied species.

Step-3: **Management:** While weeds and organisms are present, they are actively suppressed by humans. Ecological succession is also halted by regular harvesting and replanting.

**Final Answer:**

Least genetic diversity

**Answer: (A)**

## Q85.

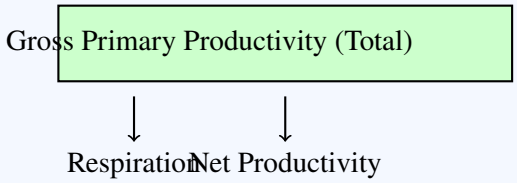
### Solution

**Concept:** Primary productivity is the rate at which solar energy is captured by autotrophs (producers) during photosynthesis to produce organic matter.

**Solution:** Step-1: **Gross Primary Productivity (GPP):** This represents the **total amount of energy fixed** (as organic matter) by the plants through photosynthesis in a given area over a specific time period.

Step-2: **The Energy Balance:** A portion of this GPP is used by the plants themselves for their own respiration (R).

Step-3: **Net Result:** The remaining energy ($GPP - R$) is called Net Primary Productivity (NPP), which is the biomass available for consumption by heterotrophs.




**Final Answer:**

Gross Primary Productivity

**Answer: (B)**

## Q86.

### Solution

**Concept:** Deep oceanic waters (the aphotic zone) receive no sunlight, meaning there are no primary producers (plants/phytoplankton) living there to support a standard food chain.

**Solution:** Step-1: **Resource Availability:** Animals in the deep sea depend entirely on the "marine snow"—the rain of organic debris and dead organisms falling from the sunlit surface layers.

Step-2: **Feeding Habit:** Because they survive on this decaying organic matter, most deep-sea organisms are classified as **Detritivores** or scavengers.

Step-3: **Conclusion:** These organisms play a vital role in recycling nutrients in the deep ocean floor (benthic zone) where traditional herbivory is impossible.

**Final Answer:**

Detritivores

**Answer: (B)**

## Q87.

### Solution

**Concept:** The "Evil Quartet" describes the four major causes of biodiversity loss: Habitat loss, Over-exploitation, Alien species invasion, and Co-extinction.

**Solution:** Step-1: **Comparing Causes:** While all four factors are destructive, ecologists identify one as the most significant driver of the current extinction crisis.

Step-2: **The Primary Driver:** **Habitat loss and fragmentation** is considered the most important cause. When a forest is cut down or a wetland is drained, the entire support system for thousands of species vanishes instantly.

Step-3: **Fragmentation:** Breaking large habitats into small fragments (due to roads or cities) especially affects mammals and birds that require large territories, leading to population decline.

**Final Answer:**

Habitat loss and fragmentation

**Answer: (B)**

## Q88.

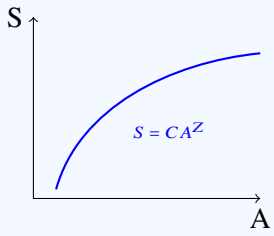
### Solution

**Concept:** Alexander von Humboldt was a pioneering German naturalist who explored the South American jungles and observed patterns in biodiversity.

**Solution:** Step-1: **Observation:** Humboldt noticed that within a region, species richness increased with the increasing explored area, but only up to a certain limit.

Step-2: **Mathematical Model:** He described the **Species-area relationship**, which is represented as a rectangular hyperbola on a normal scale and a straight line on a logarithmic scale.

Step-3: **The Equation:** The relationship is given by: $\log S = \log C + Z \log A$, where $S$ is species richness and $A$ is the area.




**Final Answer:**

Species area relationships

**Answer: (B)**

## Q89.

### Solution

**Concept:** BOD is a measure of the amount of oxygen required by bacteria to oxidize all the organic matter in one liter of water.

**Solution:** Step-1: **Correlation with Pollution:** A high BOD value means there is a large amount of organic matter present in the water sample.

Step-2: **Biological Activity:** This organic matter serves as "food" for microbes. A high BOD indicates that the **consumption of organic matter is higher by the microbes**, which depletes the dissolved oxygen.

Step-3: **Conclusion:** Therefore, a high BOD is a direct indicator that the **water is highly polluted** with sewage or other organic waste.

**Final Answer:**

Water is highly polluted

**Answer: (B)**

## Q90.

### Solution

**Concept:** Biodiversity conservation is split into *In situ* (on-site, in the natural habitat) and *Ex situ* (off-site, in a controlled environment).

**Solution:** Step-1: **In situ Examples:** Biosphere reserves, National Parks, Wildlife Sanctuaries, and Sacred Groves are all *In situ* because they protect the entire ecosystem in its original location.

Step-2: **Ex situ Analysis:** A **Botanical Garden** (along with Zoos and Seed Banks) is an *Ex situ* method. Endangered plants are taken out of their natural habitats and grown in a specialized, man-made facility.

Step-3: **Conclusion:** Since the question asks for the method that is NOT *In situ*, the Botanical Garden is the correct answer.

**Final Answer:**

Botanical Garden

**Answer: (C)**

# Answer Key

| Q | Ans | Q | Ans | Q | Ans | Q | Ans | Q | Ans |
|---|---|---|---|---|---|---|---|---|---|
| 1 | B | 2 | D | 3 | C | 4 | D | 5 | B |
| 6 | A | 7 | B | 8 | C | 9 | B | 10 | B |
| 11 | A | 12 | B | 13 | D | 14 | B | 15 | B |
| 16 | A | 17 | C | 18 | B | 19 | A | 20 | B |
| 21 | C | 22 | C | 23 | B | 24 | B | 25 | A |
| 26 | A | 27 | B | 28 | B | 29 | B | 30 | A |
| 31 | A | 32 | C | 33 | D | 34 | B | 35 | B |
| 36 | D | 37 | A | 38 | A | 39 | B | 40 | B |
| 41 | C | 42 | B | 43 | A | 44 | A | 45 | A |
| 46 | A | 47 | B | 48 | D | 49 | C | 50 | B |
| 51 | B | 52 | B | 53 | B | 54 | D | 55 | A |
| 56 | B | 57 | C | 58 | C | 59 | C | 60 | D |
| 61 | B | 62 | A | 63 | C | 64 | C | 65 | A |
| 66 | D | 67 | A | 68 | C | 69 | B | 70 | D |
| 71 | A | 72 | C | 73 | B | 74 | C | 75 | C |
| 76 | B | 77 | A | 78 | A | 79 | C | 80 | A |
| 81 | A | 82 | C | 83 | A | 84 | A | 85 | B |
| 86 | B | 87 | B | 88 | B | 89 | B | 90 | C |