# NEET-UG Biology Sample Paper-14

**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 taxonomic categories includes all the others listed in a standard hierarchy?

(A) Family

(B) Order

(C) Genus

(D) Species

**Q2.** In the binomial nomenclature system developed by Carolus Linnaeus, the first word and the second word represent respectively:

(A) Genus and Species

(B) Species and Genus

(C) Kingdom and Family

(D) Class and Order

**Q3.** Which organelle is known as the 'Powerhouse of the cell' due to its role in ATP production?

(A) Ribosome

(B) Golgi apparatus

(C) Mitochondrion

(D) Lysosome

**Q4.** The fluid mosaic model of the plasma membrane suggests that:

(A) Proteins are fixed in a bilayer of phospholipids

(B) Lipids are sandwiched between two layers of protein

(C) Proteins are embedded in a quasi-fluid lipid bilayer

(D) The membrane is a solid structure of carbohydrates

**Q5.** During which phase of the cell cycle does DNA replication occur?

(A) $G_1$ phase

(B) $G_2$ phase

(C) S phase

(D) M phase

**Q6.** The term 'Synapsis' refers to the pairing of:

(A) Non-homologous chromosomes

(B) Homologous chromosomes

(C) Sister chromatids

(D) Acentric chromosomes

**Q7.** Which of the following tissues provides mechanical support to the growing parts of a plant such as a young stem?

(A) Sclerenchyma

(B) Parenchyma

(C) Collenchyma

(D) Xylem vessels

**Q8.** The 'Bundle sheath cells' in $C_4$ plants are characterized by:

(A) Thin walls and no chloroplasts

(B) Large size, thick walls, and many chloroplasts

(C) Small size and high intercellular spaces

(D) Presence of Casparian strips

(E) Presence of Casparian strips

**Q9.** In a typical flower, the basal swollen part of the pistil is the:

(A) Stigma

(B) Style

(C) Ovary

(D) Thalamus

**Q10.** The process of transformation of a spermatid into a spermatozoon is called:

(A) Spermatogenesis

(B) Spermiogenesis

(C) Spermiation

(D) Spermatocytogenesis

**Q11.** Which hormone is primarily responsible for the maintenance of the endometrium during pregnancy?

(A) Estrogen

(B) Progesterone

(C) LH

(D) FSH

**Q12.** A person with blood group O can receive blood from a person with:

(A) Group A only

(B) Group B only

(C) Group AB only

(D) Group O only

**Q13.** The functional unit of the human kidney is the:

(A) Neuron

(B) Nephron

(C) Nephridia

(D) Ureter

**Q14.** Which of the following is a structural and functional unit between the developing embryo and the maternal body?

(A) Umbilical cord

(B) Placenta

(C) Amnion

(D) Yolk sac

**Q15.** The exchange of segments between non-sister chromatids of homologous chromosomes is called:

(A) Transformation

(B) Translocation

(C) Crossing over

(D) Linkage

**Q16.** The term 'Protoplasm' was coined by which of the following scientists?

(A) Robert Hooke

(B) Purkinje

(C) Schwann

(D) Robert Brown

**Q17.** Which of the following cell organelles is responsible for the synthesis of lipids and steroidal hormones in animal cells?

(A) Rough Endoplasmic Reticulum

(B) Smooth Endoplasmic Reticulum

(C) Golgi apparatus

(D) Lysosomes

**Q18.** The process of osmosis involves the movement of water molecules from a:

(A) Region of lower concentration of solvent to higher concentration

(B) Region of higher concentration of solvent to lower concentration

(C) Region of lower concentration of solute to higher concentration

(D) Both (B) and (C)

**Q19.** Which of the following elements is a structural component of the chlorophyll molecule?

(A) Magnesium

(B) Iron

(C) Manganese

(D) Calcium

**Q20.** During aerobic respiration, the final electron acceptor in the electron transport chain is:

(A) Cytochrome c

(B) Oxygen

(C) Water

(D) NADP+

**Q21.** The opening and closing of stomata is primarily regulated by the turgidity of:

(A) Epidermal cells

(B) Guard cells

(C) Mesophyll cells

(D) Lenticels

**Q22.** Which of the following is considered the 'Primary $CO_2$ acceptor' in $C_3$ plants?

(A) PEP (Phosphoenolpyruvate)

(B) PGA (Phosphoglyceric acid)

(C) RuBP (Ribulose 1,5-bisphosphate)

(D) OAA (Oxaloacetic acid)

**Q23.** The 'Vital Capacity' of the human lung is the sum of:

(A) $IRV + ERV + TV$

(B) $IRV + ERV + TV + RV$

(C) $IRV + TV$

(D) $TV + RV$

**Q24.** The 'Pacemaker' of the human heart is the:

(A) AV node

(B) SA node

(C) Bundle of His

(D) Purkinje fibers

**Q25.** Which enzyme is responsible for the digestion of proteins in the highly acidic environment of the stomach?

(A) Trypsin

(B) Amylase

(C) Pepsin

(D) Lipase

**Q26.** The sliding filament theory explains the mechanism of:

(A) Nerve impulse conduction

(B) Muscle contraction

(C) Blood clotting

(D) DNA replication

**Q27.** The space between the two neurons where information is transmitted is called the:

(A) Axon

(B) Dendrite

(C) Synapse

(D) Myelin sheath

**Q28.** Which part of the human brain is primarily responsible for maintaining posture and equilibrium?

(A) Cerebrum

(B) Cerebellum

(C) Medulla oblongata

(D) Hypothalamus

**Q29.** In Mendel's experiments, the $F_2$ phenotypic ratio of a dihybrid cross was:

(A) 3 : 1

(B) 1 : 2 : 1

(C) 9 : 3 : 3 : 1

(D) 1 : 1 : 1 : 1

**Q30.** The genetic material in most viruses that infect plants is:

(A) Double stranded DNA

(B) Single stranded RNA

(C) Double stranded RNA

(D) Single stranded DNA

**Q31.** The 'Theory of Natural Selection' was proposed by:

(A) Jean-Baptiste Lamarck

(B) Charles Darwin

(C) Hugo de Vries

(D) Gregor Mendel

**Q32.** The process of 'Transcription' involves the synthesis of:

(A) DNA from RNA

(B) RNA from DNA

(C) Protein from RNA

(D) RNA from Protein

**Q33.** Which of the following is an example of an autosomal recessive disorder?

(A) Haemophilia

(B) Colour blindness

(C) Sickle cell anaemia

(D) Turner's syndrome

**Q34.** The 'Miller-Urey experiment' provided evidence for the:

(A) Theory of biogenesis

(B) Chemical evolution of life

(C) Theory of panspermia

(D) Theory of spontaneous generation

**Q35.** Restriction endonucleases are enzymes that:

(A) Join DNA fragments

(B) Cut DNA at specific sequences

(C) Synthesize RNA from DNA

(D) Degrade cellular proteins

**Q36.** The first human hormone produced by recombinant DNA technology is:

(A) Estrogen

(B) Thyroxine

(C) Insulin

(D) Glucagon

**Q37.** In ecological succession, the first species to colonize a bare area are called:

(A) Climax species

(B) Pioneer species

(C) Seral species

(D) Endemic species

**Q38.** The relationship between an orchid growing on a mango tree branch is an example of:

(A) Mutualism

(B) Parasitism

(C) Commensalism

(D) Amensalism

**Q39.** Which of the following is a 'Hotspot' of biodiversity in India?

(A) Gangetic Plain

(B) Western Ghats

(C) Thar Desert

(D) Aravali Hills

**Q40.** The 'Montreal Protocol' was signed to control the emission of:

(A) Greenhouse gases

(B) Ozone depleting substances

(C) Toxic waste

(D) Nuclear radiation

**Q41.** Which of the following is the most common and essential mineral element for the process of nitrogen fixation in legumes?

(A) Molybdenum

(B) Copper

(C) Zinc

(D) Boron

**Q42.** The term 'Linkage' was first used by T.H. Morgan to describe the physical association of genes on:

(A) Different chromosomes

(B) The same chromosome

(C) Sister chromatids

(D) Mitochondria

**Q43.** In human females, the process of oogenesis is initiated during:

(A) Puberty

(B) Embryonic development

(C) Menarche

(D) Fertilization

**Q44.** The enzyme 'Nitrogenase', which is essential for biological nitrogen fixation, is highly sensitive to:

(A) Molecular Hydrogen

(B) Molecular Oxygen

(C) Carbon dioxide

(D) Nitrogen gas

**Q45.** Which of the following is a 'Stop Codon' that signals the termination of polypeptide synthesis?

(A) AUG

(B) GUG

(C) UAA

(D) UUU

**Q46.** The technique used to amplify a specific segment of DNA in vitro is called:

(A) Gel electrophoresis

(B) Polymerase Chain Reaction (PCR)

(C) Southern Blotting

(D) DNA Fingerprinting

**Q47.** Which of the following is an example of an 'In-situ' conservation strategy?

(A) Botanical Garden

(B) National Park

(C) Zoological Park

(D) Cryopreservation

**Q48.** The 'Double Fertilization' is a characteristic feature of which group of plants?

(A) Bryophytes

(B) Pteridophytes

(C) Gymnosperms

(D) Angiosperms

**Q49.** Which of the following is a gaseous plant hormone that promotes fruit ripening?

(A) Auxin

(B) Gibberellin

(C) Ethylene

(D) Abscisic acid

**Q50.** The primary reason for the 'Greenhouse Effect' on Earth is the:

(A) Depletion of the ozone layer

(B) Absorption of infrared radiation by $CO_2$ and $CH_4$

(C) Melting of polar ice caps

(D) Increase in ultraviolet radiation

**Q51.** Which antibody is primarily present in Colostrum, providing passive immunity to the newborn?

(A) IgG

(B) IgE

(C) IgA

(D) IgM

**Q52.** The 'Law of Segregation' states that alleles of a gene:

(A) Blend together in the $F_1$ generation

(B) Segregate during gamete formation

(C) Are always inherited together

(D) Express themselves only in the homozygous state

**Q53.** The breakdown of complex organic matter into inorganic substances like $CO_2$, water, and nutrients by decomposers is called:

(A) Fragmentation

(B) Leaching

(C) Decomposition

(D) Humification

**Q54.** Which cell organelle is primarily involved in the synthesis of proteins?

(A) Lysosome

(B) Vacuole

(C) Ribosome

(D) Peroxisome

**Q55.** The hormone 'Adrenaline' is secreted by which of the following glands?

(A) Thyroid

(B) Pancreas

(C) Adrenal Medulla

(D) Pituitary

**Q56.** Which of the following is a 'Vestigial Organ' in humans?

(A) Heart

(B) Kidney

(C) Vermiform Appendix

(D) Liver

**Q57.** The process of 'Crossing Over' occurs during which sub-stage of Prophase I?

(A) Leptotene

(B) Zygotene

(C) Pachytene

(D) Diplotene

**Q58.** Which of the following is the 'Universal Donor' blood group?

(A) A

(B) B

(C) AB

(D) O

**Q59.** The 'Amniocentesis' technique is used to detect:

(A) Heart defects

(B) Chromosomal abnormalities in the fetus

(C) Blood pressure of the mother

(D) Body temperature of the fetus

**Q60.** The 'S-shaped' growth curve is also known as:

(A) Exponential growth curve

(B) Geometric growth curve

(C) Sigmoid growth curve

(D) Arithmetic growth curve

**Q61.** Which of the following is a non-symbiotic nitrogen-fixing bacterium?

(A) Rhizobium

(B) Azotobacter

(C) Nitrosomonas

(D) Nitrobacter

**Q62.** The functional unit of the human nervous system is the:

(A) Nephron

(B) Neuron

(C) Alveoli

(D) Osteocyte

**Q63.** Which of the following causes 'Bancroftian Filariasis'?

(A) Ascaris lumbricoides

(B) Wuchereria bancrofti

(C) Plasmodium vivax

(D) Entamoeba histolytica

**Q64.** The site of photosynthesis in a plant cell is the:

(A) Mitochondrion

(B) Chloroplast

(C) Endoplasmic Reticulum

(D) Nucleus

**Q65.** Which of the following describes the 'Innate Immunity'?

(A) Pathogen-specific

(B) Acquired after birth

(C) Non-specific defense present from birth

(D) Memory-based

**Q66.** Which of the following is the primary function of the 'Corpus Luteum' in the human ovary?

(A) Secretion of FSH

(B) Secretion of Progesterone

(C) Facilitating Ovulation

(D) Production of HCG

**Q67.** The 'Lock and Key' hypothesis of enzyme action was proposed by:

(A) Emil Fischer

(B) Daniel Koshland

(C) Louis Pasteur

(D) Alexander Fleming

**Q68.** In a food chain, the energy flow is always:

(A) Bidirectional

(B) Multidirectional

(C) Unidirectional

(D) Circular

**Q69.** Which of the following is a nitrogenous base found in RNA but not in DNA?

(A) Adenine

(B) Guanine

(C) Cytosine

(D) Uracil

**Q70.** The 'Quiescent Stage' ($G_0$) in the cell cycle refers to:

(A) Stage of cell death

(B) Exit of cell from the cell cycle

(C) Continuous cell division

(D) Synthesis of DNA

**Q71.** Which of the following describes 'Alleles'?

(A) Identical genes

(B) Slightly different forms of the same gene

(C) Genes located on different chromosomes

(D) Non-functional DNA segments

**Q72.** The 'Ozone Hole' is most prominent over which geographical region?

(A) Equator

(B) Arctic region

(C) Antarctica

(D) Tropical rain forests

**Q73.** Which of the following is a 'Polysaccharide'?

(A) Glucose

(B) Sucrose

(C) Cellulose

(D) Fructose

**Q74.** The 'Vital Force Theory' related to the synthesis of organic compounds was disproved by:

(A) Berzelius

(B) Friedrich Wöhler

(C) Lavoisier

(D) Pasteur

**Q75.** Which of the following is the 'Structural and functional unit of the liver'?

(A) Nephron

(B) Hepatic lobule

(C) Alveolus

(D) Hepatocyte

**Q76.** The process of 'Gutattion' in plants occurs through:

(A) Stomata

(B) Lenticels

(C) Hydathodes

(D) Cuticle

**Q77.** Which of the following is a 'Mendelian Disorder'?

(A) Down's syndrome

(B) Phenylketonuria

(C) Turner's syndrome

(D) Klinefelter's syndrome

**Q78.** The 'Ti-plasmid' used in plant biotechnology is obtained from:

(A) *Escherichia coli*

(B) *Agrobacterium tumefaciens*

(C) *Bacillus thuringiensis*

(D) *Thermus aquaticus*

**Q79.** The relationship between the 'Clown fish' and 'Sea anemone' is an example of:

(A) Parasitism

(B) Commensalism

(C) Predation

(D) Competition

**Q80.** Which of the following is the most abundant protein in the whole of the biosphere?

(A) Collagen

(B) RuBisCO

(C) Insulin

(D) Hemoglobin

**Q81.** The 'Inhibitory' neurotransmitter in the human brain is:

(A) Acetylcholine

(B) Glutamate

(C) GABA (Gamma-aminobutyric acid)

(D) Noradrenaline

**Q82.** The 'Endosymbiotic Theory' explains the origin of:

(A) Nucleus

(B) Ribosomes

(C) Mitochondria and Chloroplasts

(D) Lysosomes

**Q83.** Which of the following is the 'Phylloclade' an adaptation for?

(A) Aquatic life

(B) Xerophytic life

(C) Epiphytic life

(D) Parasitic life

**Q84.** The 'Restriction Enzymes' are also known as:

(A) Molecular glue

(B) Molecular scissors

(C) Molecular vehicles

(D) Molecular probes

**Q85.** Which of the following is a 'Primary Pollutant'?

(A) Ozone

(B) PAN (Peroxyacetyl nitrate)

(C) Sulfur dioxide ($SO_2$)

(D) Smog

**Q86.** The 'Phloem' in plants is responsible for the transport of:

(A) Water

(B) Minerals

(C) Food (Sucrose)

(D) Oxygen

**Q87.** The 'Bohr Effect' refers to the influence of which gas on the affinity of hemoglobin for oxygen?

(A) $N_2$

(B) $CO$

(C) $CO_2$

(D) $H_2$

**Q88.** Which of the following is the 'Karyotype' of a person with Turner's Syndrome?

(A) 47, XXY

(B) 45, XO

(C) 47, XY+21

(D) 47, XYY

**Q89.** The 'Link reaction' in aerobic respiration connects:

(A) Glycolysis and ETC

(B) Glycolysis and Krebs cycle

(C) Krebs cycle and ETC

(D) Photolysis and Calvin cycle

**Q90.** Which of the following is a 'Laticiferous' tissue product?

(A) Resin

(B) Rubber

(C) Tannin

(D) Mucilage

## Detailed Solutions

**Q1.**

### Solution

**Concept:**

Taxonomic hierarchy represents the arrangement of various categories in descending order. The hierarchy follows: $Kingdom \rightarrow Phylum/Division \rightarrow Class \rightarrow Order \rightarrow Family \rightarrow Genus \rightarrow Species$. As we move up the hierarchy, the group becomes broader and includes more organisms.

**Solution:**

1. In the given options: Family, Order, Genus, and Species. 2. According to the hierarchy, Species is the lowest and most specific category. 3. Multiple related Genera are grouped into a Family. 4. Multiple related Families are grouped into an Order. 5. Therefore, the Order is the highest category among the choices provided. 6. Being higher in the hierarchy, the category 'Order' includes all the families, genera, and species that fall under it.

**Final Answer:** Order is the category that includes the others listed.

**Answer: (B)**

**Q2.**

### Solution

**Concept:**

Binomial nomenclature is a formal system of naming species of living things by giving each a name composed of two parts. This system was popularized by Carolus Linnaeus. The rules state that the name must be in Latin or latinized, and consists of a generic name and a specific epithet.

**Solution:**

1. The first part of the binomial name identifies the genus to which the species belongs. 2. The second part identifies the specific species within that genus. 3. For example, in *Homo sapiens*, *Homo* is the genus and *sapiens* is the specific epithet. 4. The genus name always starts with a capital letter, while the species name starts with a lowercase letter. 5. Therefore, the first and second words represent the Genus and Species respectively.

**Final Answer:** The first word represents the Genus and the second represents the Species.

**Answer: (A)**

## Q3.

### Solution

**Concept:**

Mitochondria are membrane-bound cell organelles that generate most of the chemical energy needed to power the cell's biochemical reactions. This energy is stored in a small molecule called adenosine triphosphate (ATP).

**Solution:**

1. Ribosomes are sites of protein synthesis, not energy production. 2. The Golgi apparatus is involved in packaging and secretion of proteins. 3. Lysosomes contain digestive enzymes to break down waste. 4. Mitochondria contain the machinery for aerobic respiration (Krebs cycle and Electron Transport Chain). 5. Because they produce ATP, which is the "energy currency" of the cell, they are termed the 'Powerhouse of the cell'.

**Final Answer:** Mitochondrion is known as the powerhouse of the cell.

**Answer: (C)**

## Q4.

### Solution

**Concept:**

The Fluid Mosaic Model describes the cell membrane as a tapestry of several types of molecules (phospholipids, cholesterols, and proteins) that are constantly moving. This movement helps the cell membrane maintain its role as a barrier between the inside and outside of the cell environments.

**Solution:**

1. The main fabric of the membrane is composed of an amphipathic phospholipid bilayer. 2. Proteins are not in a fixed position; they "float" in or on the fluid lipid bilayer. 3. The "quasi-fluid" nature of the lipids allows for lateral movement of proteins within the bilayer. 4. This model was proposed by SJ Singer and GL Nicolson in 1972. 5. It rejects the idea of a solid or static sandwich structure of proteins and lipids.

**Final Answer:** The model suggests proteins are embedded in a quasi-fluid lipid bilayer.

**Answer: (C)**

## Q5.

### Solution

**Concept:**

The cell cycle is an ordered series of events involving cell growth and cell division that produces two new daughter cells. It is divided into Interphase ($G_1$, S, $G_2$) and the Mitotic phase (M phase).

**Solution:**

1. $G_1$ phase (Gap 1) is a period of intense metabolic activity and cell growth. 2. S phase (Synthesis phase) is the specific period during which DNA is replicated, doubling the amount of DNA per cell while keeping the chromosome number the same. 3. $G_2$ phase (Gap 2) involves further growth and preparation for mitosis. 4. M phase is where the actual nuclear and cytoplasmic division occurs. 5. Therefore, DNA replication is strictly assigned to the S phase.

**Final Answer:** DNA replication occurs during the S phase of the cell cycle.

**Answer: (C)**

## Q6.

### Solution

**Concept:**

Synapsis is a key event that occurs during the Zygotene stage of Prophase I in Meiosis. It involves the highly specific longitudinal pairing of homologous chromosomes. This pairing is mediated by a proteinaceous structure known as the synaptonemal complex, which stabilizes the association between the two chromosomes.

**Solution:**

1. Homologous chromosomes are pairs of chromosomes (one from each parent) that are similar in length, gene position, and centromere location. 2. During the early stages of Meiosis I, these homologous pairs find each other and align. 3. The process of this physical pairing is called Synapsis. 4. Non-homologous chromosomes do not pair in this manner under normal biological conditions. 5. Sister chromatids are identical copies of a single chromosome and are held together at the centromere, but their association is not referred to as synapsis. 6. Therefore, synapsis specifically describes the union of homologous chromosomes.

**Final Answer:** Synapsis refers to the pairing of homologous chromosomes.

**Answer: (B)**

## Q7.

### Solution

**Concept:**

Collenchyma is a simple living mechanical tissue found in the peripheral regions of stems and leaves. It is characterized by cells that have localized thickenings of cellulose, hemicellulose, and pectin at their corners. It provides both mechanical strength and flexibility to young, growing plant organs.

**Solution:**

1. Parenchyma is primarily involved in storage and photosynthesis; it is not a specialized mechanical tissue. 2. Sclerenchyma consists of dead cells with thick lignified walls and provides rigid support to mature, non-growing plant parts. 3. Collenchyma is unique because it is living at maturity and can expand, making it ideal for supporting growing regions like the petiole or young dicot stems. 4. Xylem vessels are primarily responsible for water conduction, though they do provide structural support to the plant as a whole. 5. In the context of "growing parts," collenchyma is the correct functional tissue.

**Final Answer:** Collenchyma provides mechanical support to the growing parts of a plant.

**Answer: (C)**

## Q8.

### Solution

**Concept:**

$C_4$ plants have a specialized leaf anatomy called Kranz anatomy. This involves two types of photosynthetic cells: Mesophyll cells and Bundle sheath cells. This arrangement allows the plant to minimize photorespiration and efficiently fix $CO_2$ even at high temperatures.

**Solution:**

1. Bundle sheath cells are arranged in a wreath-like manner around the vascular bundles. 2. They are characterized by having very thick walls that are impervious to gaseous exchange. 3. They contain a large number of chloroplasts, which are often agranal (lacking grana) in certain $C_4$ species. 4. These cells lack intercellular spaces to maintain a high concentration of $CO_2$ for the enzyme RuBisCO. 5. Casparian strips are a feature of the endodermis in roots, not the bundle sheath of $C_4$ leaves.

**Final Answer:** Bundle sheath cells are large, have thick walls, and contain many chloroplasts.

**Answer: (B)**

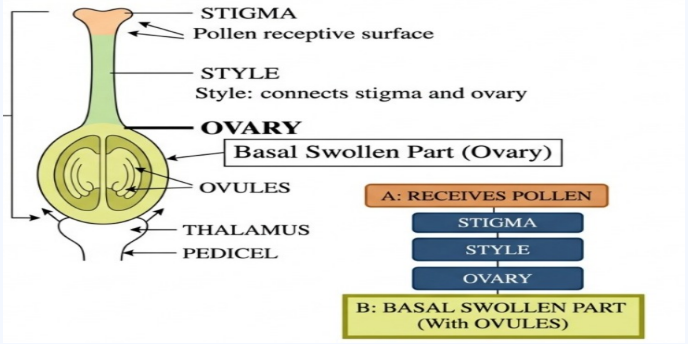
## Q9.

### Solution

**Concept:**

The gynoecium or pistil is the female reproductive part of the flower. A typical pistil consists of three distinct regions: the stigma (receptive surface for pollen), the style (elongated tube), and the ovary (the basal portion).

**Fig. 1:** Structure of a Flower Pistil




**Solution:**

1. The stigma is the topmost part where pollen grains land. 2. The style is the slender stalk that connects the stigma to the ovary. 3. The ovary is the basal, swollen, and hollow part of the pistil that contains ovules. 4. The thalamus (or receptacle) is the thickened part of a stem from which the flower organs grow; it is not part of the pistil itself, though the pistil sits upon it. 5. Therefore, the specific region requested is the ovary.

**Final Answer:** The basal swollen part of the pistil is the ovary.

**Answer: (C)**

## Q10.

### Solution

**Concept:**

Spermatogenesis is the overall process of sperm production in the testes. It involves several stages: Spermatocytogenesis (mitosis/meiosis), Spermiogenesis (transformation), and Spermiation (release).

**Solution:**

1. Spermatogenesis refers to the entire sequence from spermatogonia to mature spermatozoa. 2. Spermatocytogenesis is the initial phase where spermatogonia divide to form primary spermatocytes. 3. Spermiogenesis is the specific differentiation process where spherical, non-motile spermatids are transformed into elongated, motile spermatozoa (sperm). 4. Spermiation is the process by which mature spermatozoa are released from the Sertoli cells into the lumen of the seminiferous tubules. 5. Thus, the transformation of spermatids is correctly termed spermiogenesis.

**Final Answer:** The transformation of a spermatid into a spermatozoon is called spermiogenesis.

**Answer: (B)**

## Q11.

### Solution

**Concept:**

The menstrual cycle is regulated by a complex interplay of pituitary hormones (LH and FSH) and ovarian hormones (Estrogen and Progesterone). Following ovulation, the ruptured Graafian follicle transforms into the corpus luteum, which acts as a temporary endocrine gland.

**Solution:**

1. The corpus luteum secretes large amounts of progesterone. 2. Progesterone is essential for the maintenance of the endometrium, which is the inner lining of the uterus. 3. A thick, vascularized endometrium is necessary for the successful implantation of a fertilized ovum and the subsequent maintenance of pregnancy. 4. In the absence of fertilization, the corpus luteum degenerates, progesterone levels fall, and the endometrium disintegrates, leading to menstruation. 5. While estrogen also helps in the proliferation of the endometrium, progesterone is the primary "pregnancy hormone" responsible for its maintenance.

**Final Answer:** Progesterone is primarily responsible for the maintenance of the endometrium.

**Answer: (B)**

## Q12.

### Solution

**Concept:**

The ABO blood group system is based on the presence or absence of specific antigens (A and B) on the surface of red blood cells and antibodies in the plasma. Blood group O is characterized by the absence of both A and B antigens on the red blood cells, but the presence of both anti-A and anti-B antibodies in the plasma.

**Solution:**

1. Because a person with blood group O has anti-A and anti-B antibodies, their immune system will attack any red blood cells carrying A or B antigens. 2. Blood group A has A antigens, group B has B antigens, and group AB has both. Therefore, these cannot be received by an O-type individual. 3. Blood group O has no A or B antigens on the RBCs, so it does not trigger a reaction from the anti-A or anti-B antibodies. 4. Consequently, a person with blood group O can only receive blood from another person with blood group O.

**Final Answer:** A person with blood group O can receive blood from a person with group O only.

**Answer: (D)**

## Q13.

### Solution

**Concept:**

The human excretory system consists of a pair of kidneys, ureters, a urinary bladder, and a urethra. Each organ has a specific role, but the actual process of filtration and urine formation occurs within microscopic structures within the kidney.

**Solution:**

1. A neuron is the structural and functional unit of the nervous system, responsible for transmitting electrical impulses. 2. Nephridia are excretory organs found in certain invertebrates like earthworms. 3. The ureter is a tube that carries urine from the kidney to the bladder. 4. The nephron is a complex tubular structure within the kidney. Each kidney contains approximately one million nephrons. 5. The nephron performs the functions of ultrafiltration, selective reabsorption, and tubular secretion, making it the fundamental functional unit of the kidney.

**Final Answer:** The functional unit of the human kidney is the nephron.

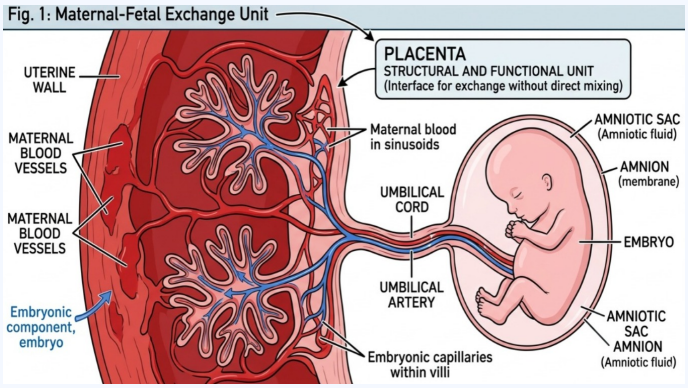
**Answer: (B)**

## Q14.

### Solution

**Concept:**

During embryonic development, certain tissues are formed to facilitate the exchange of nutrients, gases, and waste between the mother and the fetus. This connection is essential because the fetal and maternal blood supplies never mix directly.




**Solution:**

1. The chorionic villi (from the embryo) and the uterine tissue (from the mother) become interdigitated with each other to form the placenta. 2. The placenta is the organic connection that acts as a structural and functional unit between the developing embryo and the maternal body. 3. The umbilical cord is a tube that connects the fetus to the placenta, but the placenta itself is the interface unit. 4. The amnion is a membrane that surrounds the embryo and contains amniotic fluid for protection. 5. The yolk sac is involved in early blood cell formation and nutrient transport in some species, but the primary interface in humans is the placenta.

**Final Answer:** The placenta is the structural and functional unit between the embryo and the maternal body.

**Answer: (B)**

## Q15.

### Solution

**Concept:**

Variation in offspring is largely due to the shuffling of genetic material during meiosis. One of the primary mechanisms for this is the physical exchange of chromosome parts during Prophase I.

**Solution:**

1. During the pachytene stage of meiosis I, homologous chromosomes pair up. 2. Crossing over occurs, which is the enzymatic process (involving recombinase) where segments of DNA are exchanged. 3. This exchange happens between the non-sister chromatids of the homologous pair. 4. Transformation is the uptake of foreign DNA by a cell. 5. Translocation is a mutation where a segment of a chromosome breaks off and attaches to a non-homologous chromosome. 6. Linkage is the tendency of genes located close together on the same chromosome to be inherited together.

**Final Answer:** The exchange of segments between non-sister chromatids is called crossing over.

**Answer: (C)**

## Q16.

### Solution

**Concept:**

The study of cell history reveals the contributions of various scientists to our understanding of the living substance. Protoplasm is defined as the living part of a cell that is surrounded by a plasma membrane. It includes the cytoplasm and the nucleus.

**Solution:**

1. Robert Hooke (1665) discovered the cell but actually observed the dead cell walls of cork. 2. Robert Brown (1831) discovered and named the nucleus. 3. J.E. Purkinje (1839) coined the term 'Protoplasm' for the fluid substance of the cell. 4. Schleiden and Schwann (1838-39) formulated the Cell Theory. 5. Therefore, Purkinje is the scientist associated with the term protoplasm.

**Final Answer:** The term 'Protoplasm' was coined by Purkinje.

**Answer: (B)**

## Q17.

### Solution

**Concept:**

The Endoplasmic Reticulum (ER) is an extensive network of membrane-bound tubules and sacs. It is divided into two types based on the presence or absence of ribosomes: Rough ER (RER) and Smooth ER (SER).

**Solution:**

1. RER is studded with ribosomes and is primarily involved in protein synthesis and secretion. 2. SER lacks ribosomes. Its functions include the synthesis of lipids, including phospholipids and cholesterol. 3. In animal cells, lipid-like steroidal hormones (such as testosterone and estrogen) are synthesized in the SER. 4. Golgi apparatus is involved in modification and packaging, while lysosomes are involved in intracellular digestion. 5. Thus, for lipid and steroid hormone synthesis, the Smooth Endoplasmic Reticulum is the site.

**Final Answer:** Smooth Endoplasmic Reticulum is responsible for the synthesis of lipids and steroidal hormones.

**Answer: (B)**

## Q18.

### Solution

**Concept:**

Osmosis is a specific type of diffusion that refers to the movement of water across a semi-permeable membrane. It is driven by the concentration gradient of the solvent (water) or the solute.

**Solution:**

1. Water always moves from a region where it is more concentrated (high water potential) to a region where it is less concentrated (low water potential). 2. A region of higher solvent (water) concentration is equivalent to a region of lower solute concentration. 3. Conversely, water moves toward a region of higher solute concentration (lower water potential). 4. Option (B) states "higher concentration of solvent to lower," which is correct. 5. Option (C) states "lower concentration of solute to higher," which is also correct. 6. Therefore, both descriptions accurately represent the process of osmosis.

**Final Answer:** Osmosis involves movement from higher solvent/lower solute concentration to lower solvent/higher solute concentration.

**Answer: (D)**

## Q19.

### Solution

**Concept:**

Chlorophyll is the green pigment found in the thylakoid membranes of chloroplasts, essential for photosynthesis. It has a complex ring structure called a porphyrin ring, similar to the heme group in hemoglobin but with a different central atom.

**Solution:**

1. The central core of the chlorophyll molecule consists of a single atom of Magnesium ($Mg$). 2. This magnesium atom is coordinated to four nitrogen atoms of the pyrrole rings. 3. Iron is a component of cytochromes and ferredoxin but not chlorophyll. 4. Manganese is essential for the photolysis of water (oxygen-evolving complex). 5. Calcium is involved in cell wall structure (calcium pectate) and membrane permeability.

**Final Answer:** Magnesium is the structural component of the chlorophyll molecule.

**Answer: (A)**

## Q20.

### Solution

**Concept:**

The Electron Transport Chain (ETC) is the final stage of aerobic respiration located in the inner mitochondrial membrane. It consists of a series of redox reactions where electrons are passed from one carrier to another.

**Solution:**

1. Electrons from $NADH$ and $FADH_2$ are passed through complex I-IV. 2. At the end of the chain (Complex IV), the electrons have lost much of their energy. 3. These electrons are finally accepted by molecular oxygen ($O_2$). 4. Oxygen also picks up protons ($H^+$) from the matrix to form water ($H_2O$). 5. Without oxygen to act as the final acceptor, the entire chain would halt, stopping ATP production via oxidative phosphorylation.

**Final Answer:** The final electron acceptor in the electron transport chain is oxygen.

**Answer: (B)**

## Q21.

### Solution

**Concept:**

The opening and closing of stomata is a turgor-operated mechanism. Stomata are tiny pores found on the epidermis of leaves, each surrounded by two specialized kidney-shaped (in dicots) or dumb-bell shaped (in monocots) cells known as guard cells. The movement of water in and out of these cells changes their shape, thereby opening or closing the stomatal aperture.

**Solution:**

1. Guard cells possess chloroplasts and have differentially thickened walls; the inner wall facing the pore is thick and elastic, while the outer wall is thin. 2. When water enters the guard cells (endosmosis), they become turgid. The thin outer walls bulge outward, pulling the thick inner walls apart, which opens the stomatal pore. 3. When the guard cells lose water (exosmosis), they become flaccid. The elastic inner walls regain their original shape, causing the pore to close. 4. This turgidity is primarily regulated by the accumulation of potassium ions ($K^+$) and malate, which lowers the water potential inside the guard cells. 5. Other cells mentioned, like mesophyll or epidermal cells, do not directly control the pore aperture, though they may supply the water.

**Final Answer:** The opening and closing of stomata is regulated by the turgidity of guard cells.

**Answer: (B)**

## Q22.

### Solution

**Concept:**

The Calvin cycle (or $C_3$ pathway) is the process by which carbon dioxide is fixed into organic compounds. It occurs in the stroma of chloroplasts. The first step of the cycle is carboxylation, where $CO_2$ is fixed into a stable intermediate.

**Solution:**

1. In $C_3$ plants, the primary $CO_2$ acceptor is a 5-carbon sugar called Ribulose 1,5-bisphosphate (RuBP). 2. The enzyme RuBisCO catalyzes the reaction between $CO_2$ and RuBP. 3. This reaction produces an unstable 6-carbon intermediate that immediately breaks down into two molecules of 3-phosphoglyceric acid (PGA), a 3-carbon compound (hence the name $C_3$ pathway). 4. PEP (Phosphoenolpyruvate) is the primary acceptor in $C_4$ plants, not $C_3$ plants. 5. OAA (Oxaloacetic acid) is the first stable product in $C_4$ plants.

**Final Answer:** The primary $CO_2$ acceptor in $C_3$ plants is RuBP.

**Answer: (C)**

## Q23.

### Solution

**Concept:**

Lung volumes and capacities are used to assess pulmonary function. Vital Capacity (VC) is the maximum volume of air a person can breathe out after a forced inspiration or the maximum volume of air a person can breathe in after a forced expiration.

**Solution:**

1. Tidal Volume (TV) is the volume of air inspired or expired during normal respiration. 2. Inspiratory Reserve Volume (IRV) is the additional volume of air a person can inspire by a forcible inspiration. 3. Expiratory Reserve Volume (ERV) is the additional volume of air a person can expire by a forcible expiration. 4. Residual Volume (RV) is the volume of air remaining in the lungs even after a forcible expiration. 5. Vital Capacity includes all the air that can be voluntarily moved in and out of the lungs. Therefore, $VC = IRV + ERV + TV$. 6. If Residual Volume is added to Vital Capacity, it becomes Total Lung Capacity (TLC).

**Final Answer:** Vital Capacity is the sum of $IRV + ERV + TV$.

**Answer: (A)**

## Q24.

### Solution

**Concept:**

The human heart is myogenic, meaning the heartbeat is initiated by specialized muscular tissue rather than external nerve impulses. The conductive system of the heart ensures that the chambers contract in a coordinated sequence.

**Solution:**

1. The Sino-atrial node (SA node) is a small mass of specialized cardiac muscle fibers located in the upper right corner of the right atrium. 2. It has the ability to generate action potentials spontaneously at a rate of 70 to 75 per minute without any external stimuli. 3. These impulses initiate the rhythmic contractile activity of the heart. 4. For this reason, the SA node is called the 'Pacemaker'. 5. The AV node receives the impulse from the SA node and delays it slightly before passing it to the Bundle of His and Purkinje fibers.

**Final Answer:** The 'Pacemaker' of the human heart is the SA node.

**Answer: (B)**

## Q25.

### Solution

**Concept:**

Digestion involves the mechanical and chemical breakdown of food. In the stomach, food is mixed with gastric juice, which contains hydrochloric acid ($HCl$), mucus, and proenzymes. The $HCl$ creates an acidic environment with a $pH$ of approximately 1.8.

**Solution:**

1. Pepsinogen is an inactive proenzyme secreted by the chief cells of the stomach. 2. Upon exposure to $HCl$, pepsinogen is converted into the active proteolytic enzyme called Pepsin. 3. Pepsin converts proteins into proteoses and peptones (peptides). 4. Trypsin is also a protein-digesting enzyme, but it works in the alkaline environment of the small intestine. 5. Amylase digests carbohydrates, and Lipase digests fats. 6. Therefore, the enzyme specific to the acidic conditions of the stomach for protein digestion is pepsin.

**Final Answer:** Pepsin is responsible for protein digestion in the stomach.

**Answer: (C)**

## Q26.

### Solution

**Concept:**

The sliding filament theory is the most widely accepted model for muscle contraction. It was proposed independently by Andrew Huxley and Rolf Niedergerke, and Hugh Huxley and Jean Hanson in 1954. It describes how muscles shorten to produce force without the actual shortening of the individual protein filaments.

**Solution:**

1. Muscle fibers contain myofibrils, which are composed of two types of myofilaments: thick filaments (Myosin) and thin filaments (Actin). 2. According to this theory, contraction occurs when the thin actin filaments slide over the thick myosin filaments. 3. This sliding is powered by the hydrolysis of ATP and the formation of cross-bridges between the myosin heads and actin binding sites. 4. As the actin filaments slide toward the center of the sarcomere (the H-zone), the I-bands shorten and the Z-lines are pulled closer together, resulting in the overall shortening (contraction) of the muscle fiber. 5. Crucially, the length of the A-band (myosin filament) remains constant during this process.

**Final Answer:** The sliding filament theory explains the mechanism of muscle contraction.

**Answer: (B)**

## Q27.

### Solution

**Concept:**

Neurons are the basic units of the nervous system. They do not physically touch each other; instead, they communicate across a specialized junction. This ensures that the signal remains controlled and can be modulated.

**Solution:**

1. An axon is the long fiber that carries the impulse away from the cell body. 2. Dendrites are the branch-like structures that receive signals from other neurons. 3. The synapse is the functional junction between the axon terminal of a pre-synaptic neuron and the dendrite or cell body of a post-synaptic neuron. 4. When an impulse reaches the axon terminal, it triggers the release of chemical messengers called neurotransmitters into the synaptic cleft (the narrow gap). 5. These chemicals bind to receptors on the next neuron, initiating a new electrical impulse. 6. Myelin sheath is an insulating layer around the axon that speeds up impulse conduction but is not the junction itself.

**Final Answer:** The space between two neurons where information is transmitted is called the synapse.

**Answer: (C)**

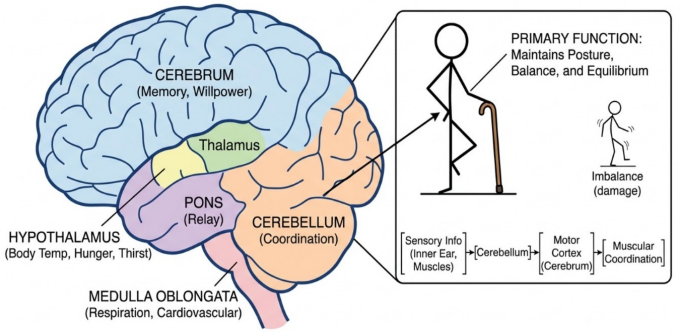
## Q28.

### Solution

**Concept:**

The human brain is divided into the forebrain, midbrain, and hindbrain. Each region has specific regulatory roles. The hindbrain includes the pons, cerebellum, and medulla oblongata.

Solution Figure 1: Role of Cerebellum in Maintaining Equilibrium




**Solution:**

1. The cerebrum (forebrain) is the seat of intelligence, memory, and voluntary motor control. 2. The cerebellum (hindbrain) is primarily responsible for the coordination of complex muscular movements. 3. It plays a critical role in maintaining body posture, balance, and equilibrium by integrating sensory information from the inner ear and muscles. 4. The medulla oblongata controls involuntary functions like respiration and cardiovascular reflexes. 5. The hypothalamus regulates body temperature, hunger, and thirst. 6. Therefore, the cerebellum is the "balancing center" of the brain.

**Final Answer:** The cerebellum is primarily responsible for maintaining posture and equilibrium.

**Answer: (B)**

## Q29.

### Solution

**Concept:**

A dihybrid cross involves the study of the inheritance of two pairs of contrasting traits simultaneously. Mendel used this to formulate the Law of Independent Assortment, which states that the alleles of two different genes get sorted into gametes independently of one another.

**Solution:**

1. In his classic dihybrid cross (e.g., Round-Yellow seeds vs. Wrinkled-Green seeds), the $F_1$ generation produced all Round-Yellow offspring ($RrYy$). 2. When the $F_1$ plants were self-pollinated, the $F_2$ generation showed four different phenotypes. 3. The resulting ratio was 9 (dominant for both traits) : 3 (dominant for first, recessive for second) : 3 (recessive for first, dominant for second) : 1 (recessive for both). 4. The 3 : 1 ratio is characteristic of a monohyrbid cross phenotypic ratio. 5. The 1 : 2 : 1 ratio is the genotypic ratio of a monohybrid cross. 6. The 1 : 1 : 1 : 1 ratio is the result of a dihybrid test cross.

**Final Answer:** The $F_2$ phenotypic ratio of a dihybrid cross is 9 : 3 : 3 : 1.

**Answer: (C)**

## Q30.

### Solution

**Concept:**

Viruses are obligate intracellular parasites consisting of a genetic core (DNA or RNA) surrounded by a protein coat (capsid). While animals are mostly infected by double-stranded DNA or single-stranded RNA viruses, plant viruses follow a specific trend.

**Solution:**

1. Most plant-infecting viruses have RNA as their genetic material. 2. Specifically, the majority of these viruses, such as the Tobacco Mosaic Virus (TMV), possess single-stranded RNA (ssRNA). 3. Bacteriophages (viruses that infect bacteria) usually have double-stranded DNA. 4. Animal viruses can have either single or double-stranded RNA or double-stranded DNA. 5. Although there are exceptions (like the Cauliflower Mosaic Virus which has dsDNA), for the purpose of a general NEET-level biology question, plant viruses are characterized by ssRNA.

**Final Answer:** The genetic material in most plant-infecting viruses is single stranded RNA.

**Answer: (B)**

## Q31.

### Solution

**Concept:**

The theory of evolution explains how life forms have changed over generations. Several theories were proposed in the 19th century to explain the mechanism behind these changes, focusing on how traits are passed on or why certain species survive while others perish.

**Solution:**

1. Jean-Baptiste Lamarck proposed the "Theory of Inheritance of Acquired Characters," suggesting that organisms pass on traits acquired through use and disuse during their lifetime. 2. Charles Darwin, in his 1859 book *On the Origin of Species*, proposed the "Theory of Natural Selection." He argued that individuals with favorable variations are more likely to survive and reproduce ("Survival of the Fittest"). 3. Hugo de Vries proposed the "Mutation Theory" based on his work with evening primrose, suggesting that evolution occurs through sudden, large changes (saltation). 4. Gregor Mendel is the "Father of Genetics" and worked on the laws of inheritance, but did not propose a theory of selection. 5. Therefore, the specific theory of Natural Selection is attributed to Charles Darwin.

**Final Answer:** The 'Theory of Natural Selection' was proposed by Charles Darwin.

**Answer: (B)**

## Q32.

### Solution

**Concept:**

The Central Dogma of Molecular Biology describes the flow of genetic information within a biological system. It follows the path: $DNA \rightarrow RNA \rightarrow Protein$. Each step has a specific name depending on the template and the product.

**Solution:**

1. Replication is the process of making a copy of DNA from a DNA template. 2. Transcription is the process of copying genetic information from one strand of DNA into RNA (specifically mRNA). This is catalyzed by the enzyme RNA polymerase. 3. Translation is the process of synthesizing proteins from an RNA template at the ribosome. 4. Reverse Transcription is the synthesis of DNA from an RNA template, typically seen in retroviruses. 5. Therefore, transcription specifically refers to the synthesis of RNA from DNA.

**Final Answer:** The process of 'Transcription' involves the synthesis of RNA from DNA.

**Answer: (B)**

## Q33.

### Solution

**Concept:**

Genetic disorders are classified based on their inheritance patterns. Autosomal disorders involve genes located on non-sex chromosomes (autosomes), and recessive disorders require two copies of the mutant gene (one from each parent) for the trait to be expressed.

**Solution:**

1. Haemophilia and Colour blindness are X-linked recessive disorders; they are carried on the sex chromosomes. 2. Turner's syndrome is a chromosomal disorder caused by the absence of one of the X chromosomes (45, XO), not a single-gene recessive trait. 3. Sickle cell anaemia is an autosomal recessive disorder caused by a point mutation in the beta-globin chain of hemoglobin. 4. In this condition, the substitution of Glutamic acid by Valine at the sixth position causes the red blood cells to become sickle-shaped under low oxygen tension. 5. Since it is autosomal, both males and females are equally likely to inherit it if both parents are carriers.

**Final Answer:** Sickle cell anaemia is an example of an autosomal recessive disorder.

**Answer: (C)**

## Q34.

### Solution

**Concept:**

The origin of life on Earth is explained by the Oparin-Haldane hypothesis, which suggests that life arose from non-living organic molecules through a series of chemical reactions. This is known as "Chemical Evolution."

**Solution:**

1. S.L. Miller and H.C. Urey created a laboratory setup in 1953 that simulated the conditions of the primitive Earth's atmosphere ($CH_4, NH_3, H_2$, and water vapor). 2. They used electric discharges to simulate lightning and maintained a temperature of nearly 800°C. 3. After a week, they observed the formation of various amino acids, which are the building blocks of proteins. 4. This experiment provided the first experimental evidence that organic molecules could be formed from inorganic precursors under prebiotic conditions. 5. This directly supported the theory of chemical evolution rather than panspermia (life from outer space) or spontaneous generation (life from rotting matter).

**Final Answer:** The 'Miller-Urey experiment' provided evidence for the chemical evolution of life.

**Answer: (B)**

## Q35.

### Solution

**Concept:**

Restriction endonucleases, often called "molecular scissors," are fundamental tools in biotechnology and recombinant DNA technology. They are naturally found in bacteria as a defense mechanism against bacteriophages.

**Solution:**

1. These enzymes do not join DNA; that is the job of DNA Ligase. 2. They do not synthesize RNA; that is the job of RNA Polymerase. 3. Restriction endonucleases function by inspecting the length of a DNA sequence. Once they find a specific recognition sequence (usually a palindromic sequence), they bind to the DNA and cut each of the two strands at specific points in their sugar-phosphate backbones. 4. For example, the enzyme EcoRI recognizes the sequence 5'-GAATTC-3' and cuts between G and A. 5. This precision allows scientists to isolate specific genes for further study or for insertion into vectors.

**Final Answer:** Restriction endonucleases are enzymes that cut DNA at specific sequences.

**Answer: (B)**

## Q36.

### Solution

**Concept:**

Recombinant DNA technology allows for the large-scale production of human proteins in microbial hosts. The first major success in this field was the production of human insulin, which previously had to be extracted from the pancreases of slaughtered cattle and pigs, often causing allergic reactions.

**Solution:**

1. Human insulin consists of two short polypeptide chains: Chain A and Chain B, linked together by disulphide bridges. 2. In 1983, an American company called Eli Lilly prepared two DNA sequences corresponding to the A and B chains of human insulin. 3. These sequences were introduced into plasmids of *E. coli* to produce insulin chains separately. 4. The chains were then extracted and combined by creating disulphide bonds to form "Humulin." 5. While estrogen, thyroxine, and glucagon can be synthesized or regulated, insulin was the pioneering hormone produced using this specific genetic engineering technique.

**Final Answer:** The first human hormone produced by recombinant DNA technology is insulin.

**Answer: (C)**

## Q37.

### Solution

**Concept:**

Ecological succession is the process of change in the species structure of an ecological community over time. It begins with a relatively empty area and ends with a stable, complex community called the climax community.

**Solution:**

1. Primary succession occurs in areas where no living organisms ever existed (like bare rock or a new volcanic island). 2. The first species that invade these bare areas are known as pioneer species. 3. On bare rock, lichens are usually the pioneer species. They secrete acids to dissolve the rock, helping in soil formation (weathering). 4. The intermediate stages of succession are called seral stages or seral communities. 5. Endemic species are those restricted to a specific geographical area and are not related to the stages of succession.

**Final Answer:** The first species to colonize a bare area are called pioneer species.

**Answer: (B)**

## Q38.

### Solution

**Concept:**

Population interactions describe how individuals of different species interact within a community. These interactions are classified as positive (+), negative (−), or neutral (0) depending on whether they benefit, harm, or have no effect on the participants.

**Solution:**

1. Mutualism (+/+) involves benefits for both species. 2. Parasitism (+/−) involves one species benefiting at the expense of the other (host). 3. Commensalism (+/0) is an interaction where one species benefits while the other is neither helped nor harmed. 4. An orchid growing as an epiphyte on a mango branch gets a place to live and access to sunlight (benefit). 5. The mango tree does not derive any benefit from the orchid, nor is it harmed (neutral). 6. Amensalism (0/−) is where one species is harmed while the other is unaffected.

**Final Answer:** An orchid on a mango tree is an example of commensalism.

**Answer: (C)**

## Q39.

### Solution

**Concept:**

Biodiversity hotspots are regions with very high levels of species richness and high degree of endemism (species found nowhere else). To be qualified as a hotspot, a region must also be under significant threat of habitat loss.

**Solution:**

1. Globally, there are 34 biodiversity hotspots. Three of these cover parts of India: the Western Ghats and Sri Lanka, the Indo-Burma region, and the Himalayas. 2. The Western Ghats are exceptionally rich in amphibian species and tropical evergreen forests. 3. While the Gangetic Plain and Thar Desert have unique ecosystems, they do not meet the specific criteria of "Hotspot" status compared to the high endemism of the Western Ghats. 4. The Aravali Hills are an ecologically sensitive zone but are not categorized as one of the major global biodiversity hotspots.

**Final Answer:** The Western Ghats is a recognized biodiversity hotspot in India.

**Answer: (B)**

## Q40.

### Solution

**Concept:**

International efforts are required to tackle global environmental issues. The atmosphere's ozone layer protects the Earth from harmful ultraviolet (UV) radiation, and its depletion was linked to specific man-made chemicals.

**Solution:**

1. The Montreal Protocol is an international treaty signed in Montreal, Canada, in 1987 (effective in 1989). 2. Its primary goal is to protect the ozone layer by phasing out the production and consumption of ozone-depleting substances (ODS), primarily Chlorofluorocarbons (CFCs). 3. Greenhouse gases (like $CO_2$ and methane) are addressed by the Kyoto Protocol and the Paris Agreement. 4. Toxic waste and nuclear radiation are governed by different conventions (like the Basel Convention for hazardous waste).

**Final Answer:** The 'Montreal Protocol' was signed to control the emission of ozone depleting substances.

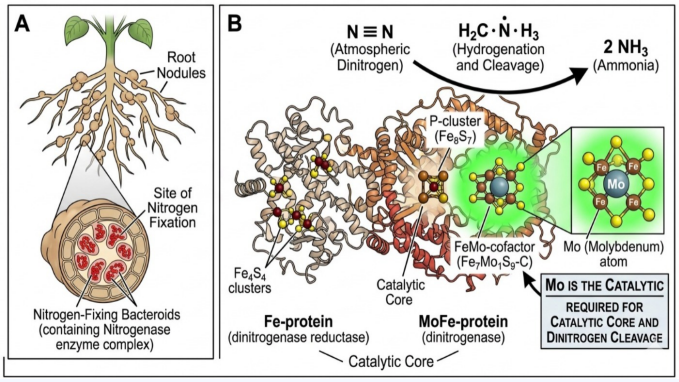
**Answer: (B)**

## Q41.

### Solution

**Concept:**

Nitrogen fixation is the process by which atmospheric nitrogen ($N_2$) is converted into ammonia ($NH_3$). This biological process requires specific enzymes and micronutrients to function correctly within the root nodules of leguminous plants.




**Solution:**

1. The key enzyme for this process is Nitrogenase. 2. Nitrogenase is a metallo-protein that contains iron ($Fe$) and molybdenum ($Mo$). 3. Molybdenum is specifically required as a cofactor for the enzyme's catalytic activity. 4. Zinc, copper, and boron are essential micronutrients for plants, but they do not play a direct structural or catalytic role in the nitrogenase enzyme complex. 5. Therefore, Molybdenum is the essential mineral for nitrogen fixation.

**Final Answer:** Molybdenum is the mineral element essential for nitrogen fixation.

**Answer: (A)**

## Q42.

### Solution

**Concept:**

Linkage refers to the tendency of genes that are located close to each other on the same chromosome to be inherited together during meiosis. This concept challenged Mendel's Law of Independent Assortment.

**Solution:**

1. T.H. Morgan performed several dihybrid crosses in *Drosophila melanogaster* to study genes that were sex-linked. 2. He observed that when two genes in a dihybrid cross were situated on the same chromosome, the proportion of parental gene combinations was much higher than the non-parental (recombinant) type. 3. He coined the term 'Linkage' to describe this physical association of genes on the same chromosome. 4. 'Recombination' was the term used to describe the generation of non-parental gene combinations. 5. Therefore, linkage strictly involves genes on the same chromosome.

**Final Answer:** Linkage describes the physical association of genes on the same chromosome.

**Answer: (B)**

## Q43.

### Solution

**Concept:**

Gametogenesis in humans differs significantly between males and females. While spermatogenesis starts at puberty and continues throughout life, oogenesis follows a much more complex and interrupted timeline.

**Solution:**

1. Oogenesis is initiated during the embryonic development stage when a couple of million gamete mother cells (oogonia) are formed within each fetal ovary. 2. No more oogonia are formed or added after birth. 3. These cells start division and enter Prophase I of the meiotic division and get temporarily arrested at that stage, called primary oocytes. 4. Puberty and menarche mark the resumption of this process for individual oocytes each month, but the initiation of the process itself occurred before birth.

**Final Answer:** Oogenesis is initiated during embryonic development.

**Answer: (B)**

## Q44.

### Solution

**Concept:**

Biological nitrogen fixation is an anaerobic process. The enzyme Nitrogenase is the catalyst for this reaction, but it functions only under very specific environmental conditions within the nodules.

**Solution:**

1. Nitrogenase is highly sensitive to molecular oxygen ($O_2$). 2. Exposure to oxygen permanently inactivates the enzyme. 3. To protect this enzyme from oxygen, legumes produce a specialized pigment called leg-hemoglobin (oxygen scavenger). 4. Leg-hemoglobin binds to oxygen and keeps its concentration low within the nodule, allowing the nitrogenase enzyme to work in an anaerobic environment. 5. While nitrogen gas is the substrate and hydrogen is a byproduct, oxygen is the specific inhibitory substance.

**Final Answer:** Nitrogenase is highly sensitive to molecular oxygen.

**Answer: (B)**

## Q45.

### Solution

**Concept:**

The genetic code consists of 64 codons. Out of these, 61 codons code for amino acids, while 3 codons do not code for any amino acids and serve as termination signals during protein synthesis (translation).

**Solution:**

1. AUG is the start codon (initiation codon) and also codes for the amino acid Methionine. 2. GUG can sometimes act as an initiator codon but normally codes for Valine. 3. UAA, UAG, and UGA are the three 'Stop Codons' or 'Nonsense Codons'. 4. When the ribosome encounters one of these codons on the mRNA, the process of translation stops, and the newly synthesized polypeptide chain is released. 5. UUU codes for the amino acid Phenylalanine.

**Final Answer:** UAA is a stop codon that signals the termination of polypeptide synthesis.

**Answer: (C)**

## Q46.

### Solution

**Concept:**

Polymerase Chain Reaction (PCR) is a molecular biology technique used to generate millions of copies of a specific DNA sequence. It was developed by Kary Mullis in 1983. The process is based on thermal cycling, which involves cycles of repeated heating and cooling for DNA melting and enzymatic replication of the DNA.

**Solution:**

1. Gel electrophoresis is a technique used to separate DNA fragments based on their size; it does not amplify DNA. 2. Southern Blotting is used to detect a specific DNA sequence in blood or tissue samples using a probe. 3. DNA Fingerprinting is a method used to identify individuals based on their unique DNA patterns. 4. PCR involves three main steps: Denaturation (separation of DNA strands at high temperature), Annealing (binding of primers to the single strands), and Extension (synthesis of new DNA strands using Taq polymerase). 5. Because it allows for the exponential amplification of a specific segment of DNA starting from a very small sample, it is the correct answer.

**Final Answer:** The technique used to amplify DNA in vitro is Polymerase Chain Reaction (PCR).

**Answer: (B)**

## Q47.

### Solution

**Concept:**

Conservation of biodiversity can be classified into two categories: In-situ (on-site) and Ex-situ (off-site). In-situ conservation involves protecting species in their natural habitats, where the entire ecosystem is preserved.

**Solution:**

1. Botanical Gardens and Zoological Parks are Ex-situ methods because the organisms are removed from their natural homes and kept in man-made environments. 2. Cryopreservation is an Ex-situ method where gametes or tissues are preserved at very low temperatures (usually in liquid nitrogen at $-196^{\circ}C$). 3. National Parks, Biosphere Reserves, and Wildlife Sanctuaries are In-situ methods. In these areas, the species are protected within their natural environment, allowing natural ecological and evolutionary processes to continue. 4. Therefore, a National Park is an example of In-situ conservation.

**Final Answer:** A National Park is an example of an In-situ conservation strategy.

**Answer: (B)**

## Q48.

### Solution

**Concept:**

Double fertilization is a unique and complex fertilization mechanism found in flowering plants. It involves the joining of a female gametophyte (megagametophyte, also called the embryo sac) with two male gametes (sperm).

**Solution:**

1. In Bryophytes, Pteridophytes, and Gymnosperms, fertilization typically involves a single fusion event between one male gamete and one egg. 2. In Angiosperms (flowering plants), the pollen tube releases two male gametes into the embryo sac. 3. One male gamete fuses with the egg cell to form a diploid zygote ($2n$); this is called Syngamy. 4. The second male gamete fuses with the two polar nuclei (or the secondary nucleus) to form a triploid Primary Endosperm Nucleus (PEN, $3n$); this is called Triple Fusion. 5. Together, these two events (Syngamy + Triple Fusion) constitute Double Fertilization.

**Final Answer:** Double Fertilization is a characteristic feature of Angiosperms.

**Answer: (D)**

## Q49.

### Solution

**Concept:**

Plant hormones (Phytohormones) are chemical signalers that regulate various aspects of plant growth and development. They can be growth promoters or growth inhibitors, and they exist in various chemical states.

**Solution:**

1. Auxins and Gibberellins are primarily growth promoters involved in cell elongation and stem growth; they are typically liquid/solute-based within the plant. 2. Abscisic acid (ABA) is a growth inhibitor often called the "stress hormone." 3. Ethylene is unique because it is the only gaseous plant hormone. 4. Ethylene plays a critical role in the ripening of fruits (like tomatoes and bananas) by increasing the respiration rate (climacteric rise) and breaking down complex sugars. 5. Therefore, Ethylene is the gaseous hormone responsible for fruit ripening.

**Final Answer:** Ethylene is the gaseous plant hormone that promotes fruit ripening.

**Answer: (C)**

## Q50.

### Solution

**Concept:**

The Greenhouse Effect is a natural process that warms the Earth's surface. When the Sun's energy reaches the Earth's atmosphere, some of it is reflected back to space and the rest is absorbed and re-radiated by greenhouse gases.

**Solution:**

1. The Earth's surface absorbs solar radiation and re-emits energy in the form of long-wavelength infrared radiation (heat). 2. Greenhouse gases, primarily Carbon dioxide ($CO_2$) and Methane ($CH_4$), absorb this outgoing infrared radiation instead of letting it escape into space. 3. This trapped heat is then radiated back toward the Earth's surface, causing the temperature to rise. 4. Ozone layer depletion is a separate issue related to UV radiation, not the primary cause of the greenhouse effect. 5. Melting of ice caps is a result of global warming (the enhanced greenhouse effect), not the cause of it.

**Final Answer:** The Greenhouse Effect is caused by the absorption of infrared radiation by $CO_2$ and $CH_4$.

**Answer: (B)**

## Q51.

### Solution

**Concept:**

Passive immunity is the transfer of active humoral immunity in the form of ready-made antibodies. This provides immediate protection but does not confer long-term memory. A natural example of this occurs during the early days of lactation.

**Solution:**

1. Colostrum is the yellowish fluid secreted by the mother during the initial days of lactation. 2. It is exceptionally rich in antibodies necessary to protect the newborn from environmental pathogens while its own immune system is still developing. 3. The specific class of antibody found in high concentrations in colostrum is IgA (Immunoglobulin A). 4. IgA is secretory and provides protection at mucosal surfaces. 5. IgG is the only antibody that can cross the placenta, while IgE is involved in allergic reactions and IgM is the first antibody produced during a primary immune response.

**Final Answer:** IgA is the antibody primarily present in Colostrum.

**Answer: (C)**

## Q52.

### Solution

**Concept:**

Gregor Mendel's Law of Segregation (The First Law of Inheritance) is based on the observation that even though a pair of alleles for a character stay together in an individual, they do not mix or blend.

**Solution:**

1. During the process of gametogenesis (meiosis), the two alleles of a gene pair separate or "segregate" from each other. 2. Each gamete receives only one of the two alleles. 3. This ensures that the offspring receives one allele from each parent, restoring the diploid state. 4. The law proves that factors (genes) are discrete units. 5. Blending was a pre-Mendelian theory that Mendel's work successfully debunked. 6. Homozygous expression is related to dominance/recessiveness, but segregation describes the mechanical separation of alleles into gametes.

**Final Answer:** The Law of Segregation states that alleles segregate during gamete formation.

**Answer: (B)**

## Q53.

### Solution

**Concept:**

Decomposition is a metabolic process that involves the step-by-step breakdown of detritus (dead plant remains and animal waste) into simpler molecules. It is a vital part of nutrient cycling in an ecosystem.

**Solution:**

1. Fragmentation is the process where detritivores (like earthworms) break detritus into smaller particles. 2. Leaching involves water-soluble inorganic nutrients moving down into the soil profile. 3. Decomposition is the overall biological process where fungi and bacteria convert organic matter into inorganic substances like $CO_2$, $H_2O$, and mineral nutrients. 4. Humification is a specific stage of decomposition that leads to the accumulation of a dark-colored, amorphous substance called humus. 5. Therefore, the definition provided in the question matches the broad process of decomposition.

**Final Answer:** The breakdown of complex organic matter into inorganic substances is called decomposition.

**Answer: (C)**

## Q54.

### Solution

**Concept:**

Cells contain specialized compartments called organelles to carry out life functions. Protein synthesis is a fundamental activity required for cell structure, enzymes, and signaling.

**Solution:**

1. Lysosomes are "suicide bags" containing hydrolytic enzymes for digestion. 2. Vacuoles are used for storage of water, sap, and waste products. 3. Ribosomes are the cellular machinery where the translation of mRNA into polypeptide chains occurs. They can be free in the cytoplasm or attached to the Rough Endoplasmic Reticulum. 4. Peroxisomes are involved in lipid metabolism and the chemical detoxification of hydrogen peroxide. 5. Because ribosomes are the direct site of amino acid assembly, they are the organelles involved in protein synthesis.

**Final Answer:** The ribosome is the cell organelle primarily involved in protein synthesis.

**Answer: (C)**

## Q55.

### Solution

**Concept:**

The endocrine system uses glands to secrete hormones into the bloodstream to maintain homeostasis or prepare the body for specific actions. Adrenaline (epinephrine) is a "fight or flight" hormone.

**Solution:**

1. The Thyroid gland secretes thyroxine to regulate metabolism. 2. The Pancreas secretes insulin and glucagon to regulate blood sugar. 3. The Adrenal gland has two parts: the outer cortex and the inner medulla. 4. The Adrenal Medulla secretes adrenaline and noradrenaline in response to stress or emergency situations. 5. These hormones increase heart rate, blood pressure, and alertness. 6. The Pituitary gland is the master gland that regulates other glands but does not secrete adrenaline.

**Final Answer:** Adrenaline is secreted by the Adrenal Medulla.

**Answer: (C)**

## Q56.

### Solution

**Concept:**

Vestigial organs are structures or organs that are present in an organism but have lost their original ancestral function through the process of evolution. Their presence provides strong evidence for common descent and evolutionary change.

**Solution:**

1. The heart, kidney, and liver are vital functional organs in humans, essential for circulation, excretion, and metabolism, respectively. 2. The vermiform appendix is a narrow, finger-like tubular projection that arises from the caecum. 3. In herbivorous ancestors, it was a large and functional organ used for the digestion of cellulose. 4. In modern humans, due to changes in diet and lifestyle, it no longer serves a digestive function and is considered vestigial. 5. Other examples in humans include the nictitating membrane (third eyelid), coccyx (tail bone), and wisdom teeth.

**Final Answer:** The vermiform appendix is a vestigial organ in humans.

**Answer: (C)**

## Q57.

### Solution

**Concept:**

Meiosis I is the reductional division where homologous chromosomes separate. Prophase I is the most prolonged and complex phase, divided into five sub-stages: Leptotene, Zygotene, Pachytene, Diplotene, and Diakinesis.

**Solution:**

1. Leptotene: Chromosomes become gradually visible under the light microscope. 2. Zygotene: Homologous chromosomes start pairing (synapsis). 3. Pachytene: The bivalent chromosomes (tetrads) become clearly visible. This is the stage where "Crossing Over" occurs, which is the exchange of genetic material between non-sister chromatids of homologous chromosomes. 4. Crossing over is an enzyme-mediated process involving the enzyme recombinase. 5. Diplotene: The synaptonemal complex dissolves, and chiasmata (X-shaped structures) become visible.

**Final Answer:** Crossing Over occurs during the Pachytene sub-stage.

**Answer: (C)**

## Q58.

### Solution

**Concept:**

The "Universal Donor" is a term used for a blood group that can be safely transfused into any recipient regardless of the recipient's blood group, as it lacks antigens that would trigger an immune response.

**Solution:**

1. Blood group A has A antigens and anti-B antibodies. 2. Blood group B has B antigens and anti-A antibodies. 3. Blood group AB has both A and B antigens and no antibodies; it is the "Universal Recipient." 4. Blood group O has neither A nor B antigens on the surface of the Red Blood Cells (RBCs). 5. Because it lacks these surface antigens, group O blood does not react with the antibodies present in the plasma of any other blood group. 6. Specifically, O-negative ($O^-$) is the true universal donor as it also lacks the Rh factor.

**Final Answer:** Blood group O is the universal donor.

**Answer: (D)**

## Q59.

### Solution

**Concept:**

Amniocentesis is a medical procedure used for prenatal diagnosis. It involves extracting a small amount of amniotic fluid, which contains fetal cells, from the amnion sac surrounding a developing fetus.

**Solution:**

1. The fetal cells present in the amniotic fluid are cultured and analyzed for chromosomal patterns (karyotyping). 2. This allows for the detection of genetic disorders and chromosomal abnormalities such as Down's syndrome, Turner's syndrome, or Klinefelter's syndrome. 3. It can also be used to determine the sex of the fetus, which has led to its legal restriction in some countries to prevent female foeticide. 4. It is not used to detect structural heart defects (usually done via ultrasound) or to monitor the mother's blood pressure.

**Final Answer:** Amniocentesis is used to detect chromosomal abnormalities in the fetus.

**Answer: (B)**

## Q60.

### Solution

**Concept:**

Biological growth in a limited environment usually follows a predictable pattern. While exponential growth occurs when resources are unlimited, most natural populations face competition and limited resources.

**Solution:**

1. When a population is introduced into a new habitat, it first shows a Lag phase (slow growth). 2. This is followed by a phase of acceleration and then deceleration. 3. Finally, the population reaches an asymptote when the population density reaches the "Carrying Capacity" ($K$) of the environment. 4. This type of growth is called Verhulst-Pearl Logistic Growth. 5. The plot of population density ($N$) in relation to time ($t$) results in a sigmoid or 'S-shaped' curve. 6. 'J-shaped' curves represent exponential or geometric growth without limiting factors.

**Final Answer:** The S-shaped growth curve is also known as the Sigmoid growth curve.

**Answer: (C)**

## Q61.

### Solution

**Concept:**

Nitrogen fixation can be symbiotic (occurring in association with a host plant) or non-symbiotic (free-living in the soil). Free-living nitrogen-fixing bacteria can fix atmospheric nitrogen independently of any plant relationship.

**Solution:**

1. Rhizobium is a well-known symbiotic bacterium that forms nodules on the roots of leguminous plants. 2. Nitrosomonas and Nitrobacter are nitrifying bacteria; they convert ammonia to nitrite and nitrite to nitrate, respectively, rather than fixing atmospheric nitrogen. 3. Azotobacter is a genus of free-living, aerobic, non-symbiotic nitrogen-fixing bacteria found in alkaline or neutral soils. 4. Other examples of non-symbiotic nitrogen fixers include Azospirillum and certain cyanobacteria like Nostoc and Anabaena when they are in their free-living state. 5. Therefore, Azotobacter fits the description of a non-symbiotic nitrogen fixer.

**Final Answer:** Azotobacter is a non-symbiotic nitrogen-fixing bacterium.

**Answer: (B)**

## Q62.

### Solution

**Concept:**

Living systems are organized into structural and functional units at every level. Just as the nephron is to the kidney, the nervous system has a specific cell type dedicated to the transmission and processing of information.

**Solution:**

1. The nephron is the functional unit of the kidney, responsible for filtration. 2. Alveoli are the structural units of the lungs where gas exchange occurs. 3. Osteocytes are mature bone cells. 4. The neuron (nerve cell) is the structural and functional unit of the nervous system. 5. Neurons are specialized to detect, receive, and transmit different kinds of stimuli via electrical impulses and chemical signals. 6. A typical neuron consists of a cell body (cyton), dendrites, and an axon.

**Final Answer:** The functional unit of the human nervous system is the neuron.

**Answer: (B)**

## Q63.

### Solution

**Concept:**

Filariasis, specifically Elephantiasis, is a chronic inflammation of the organs in which the parasites live for many years, usually the lymphatic vessels of the lower limbs. It is caused by helminthic parasites.

**Solution:**

1. Ascaris lumbricoides is an intestinal roundworm that causes Ascariasis. 2. Plasmodium vivax is a protozoan responsible for Malaria. 3. Entamoeba histolytica is a protozoan that causes Amoebic dysentery (Amoebiasis). 4. Wuchereria bancrofti (and W. malayi) are the filarial worms that cause Bancroftian Filariasis. 5. These worms are transmitted to humans through the bite of an infected female Culex mosquito. 6. The disease results in gross deformities of the legs and genital organs.

**Final Answer:** Wuchereria bancrofti causes Bancroftian Filariasis.

**Answer: (B)**

## Q64.

### Solution

**Concept:**

Photosynthesis is the process by which green plants and some other organisms use sunlight to synthesize nutrients from carbon dioxide and water. This process occurs in specialized double-membrane organelles.

**Solution:**

1. Mitochondria are the site of cellular respiration and ATP production. 2. The Nucleus contains genetic material and controls cellular activities. 3. The Endoplasmic Reticulum is involved in protein and lipid synthesis. 4. Chloroplasts are the organelles specifically responsible for photosynthesis. 5. They contain chlorophyll pigments that trap solar energy. 6. Within the chloroplast, the light reactions occur in the thylakoid membranes (grana), while the dark reactions (Calvin cycle) occur in the fluid stroma.

**Final Answer:** The site of photosynthesis in a plant cell is the chloroplast.

**Answer: (B)**

## Q65.

### Solution

**Concept:**

Immunity is the overall ability of the host to fight disease-causing organisms. It is categorized into two main types: Innate and Acquired.

**Solution:**

1. Acquired immunity is pathogen-specific and is characterized by memory. It is developed after birth upon exposure to pathogens. 2. Innate immunity is a non-specific type of defense that is present at the time of birth. 3. It consists of four types of barriers: Physical (skin, mucus), Physiological ($HCl$ in stomach, saliva), Cellular (WBCs like neutrophils and monocytes), and Cytokine (interferons). 4. Because it does not rely on previous exposure and is a general defense mechanism, it is "non-specific." 5. Memory-based defense is a hallmark of acquired immunity, not innate.

**Final Answer:** Innate immunity is a non-specific defense present from birth.

**Answer: (C)**

## Q66.

### Solution

**Concept:**

The Corpus Luteum is a temporary endocrine structure in the female ovary that is involved in the production of relatively high levels of progesterone and moderate levels of estradiol and inhibin A. It is formed from the remains of the ovarian follicle that has recently released a secondary oocyte during ovulation.

**Solution:**

1. FSH (Follicle-Stimulating Hormone) is secreted by the anterior pituitary, not the ovary. 2. After ovulation, the LH (Luteinizing Hormone) causes the ruptured follicle to transform into the Corpus Luteum. 3. The primary function of the Corpus Luteum is to secrete progesterone, which prepares the uterine lining (endometrium) for potential implantation of a fertilized egg. 4. If fertilization does not occur, the Corpus Luteum degenerates, leading to a drop in progesterone and the start of menstruation. 5. HCG (Human Chorionic Gonadotropin) is produced by the placenta after implantation, not by the Corpus Luteum.

**Final Answer:** The primary function of the Corpus Luteum is the secretion of Progesterone.

**Answer: (B)**

## Q67.

### Solution

**Concept:**

The 'Lock and Key' hypothesis is a model for enzyme-substrate interaction. It suggests that the enzyme and the substrate possess specific complementary geometric shapes that fit exactly into one another, much like a key fits into a specific lock.

**Solution:**

1. Emil Fischer proposed the 'Lock and Key' model in 1894 to explain the high specificity of enzymes. 2. Daniel Koshland later proposed the 'Induced Fit' theory, suggesting that the enzyme's active site changes shape slightly to fit the substrate. 3. Louis Pasteur is known for his work on fermentation and pasteurization. 4. Alexander Fleming discovered penicillin. 5. In Fischer's model, the active site is considered a rigid structure that only accepts a specific substrate.

**Final Answer:** The 'Lock and Key' hypothesis was proposed by Emil Fischer.

**Answer: (A)**

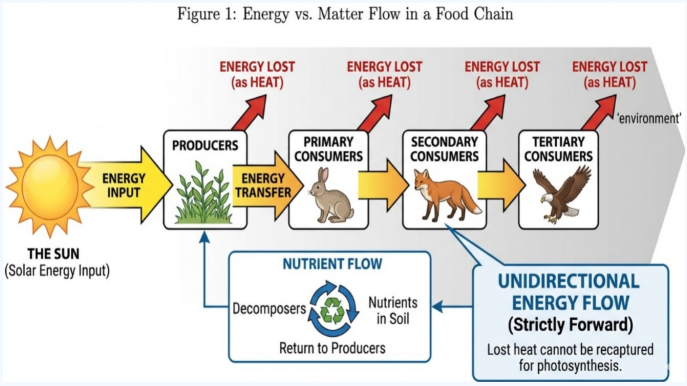
## Q68.

### Solution

**Concept:**

Energy flow in an ecosystem describes the transfer of energy from one trophic level to the next. According to the laws of thermodynamics, energy is lost as heat at each transfer, meaning it cannot be recycled back to the previous level.

Figure 1: Energy vs. Matter Flow in a Food Chain




**Solution:**

1. The primary source of energy is the Sun. 2. Producers (plants) capture solar energy and convert it into chemical energy. 3. This energy is passed to primary consumers, then secondary consumers, and so on. 4. Energy always moves from the lower trophic level to the higher trophic level. 5. Because energy lost as heat to the environment can never be recaptured by the producers for photosynthesis, the flow is strictly unidirectional. 6. Matter (nutrients), on the other hand, flows in a circular or cyclic manner through biogeochemical cycles.

**Final Answer:** In a food chain, the energy flow is always unidirectional.

**Answer: (C)**

## Q69.

### Solution

**Concept:**

Nucleic acids (DNA and RNA) are composed of nucleotides, which consist of a sugar, a phosphate group, and a nitrogenous base. There are two types of bases: purines (Adenine and Guanine) and pyrimidines (Cytosine, Thymine, and Uracil).

**Solution:**

1. Adenine ($A$), Guanine ($G$), and Cytosine ($C$) are found in both DNA and RNA. 2. In DNA, the fourth base is Thymine ($T$), which pairs with Adenine. 3. In RNA, Thymine is absent and is replaced by Uracil ($U$). 4. Therefore, Uracil is the nitrogenous base unique to RNA. 5. This difference is one of the key structural distinctions between the two types of genetic material.

**Final Answer:** Uracil is the nitrogenous base found in RNA but not in DNA.

**Answer: (D)**

## Q70.

### Solution

**Concept:**

The cell cycle is tightly regulated. Not all cells divide continuously; some exit the cycle and enter a non-dividing, inactive state depending on the organism's needs or environmental conditions.

**Solution:**

1. Some cells in the adult animal do not appear to exhibit division (e.g., heart cells) and many other cells divide only occasionally. 2. These cells that do not divide further exit the $G_1$ phase to enter an inactive stage called the Quiescent Stage ($G_0$) of the cell cycle. 3. Cells in this stage remain metabolically active but no longer proliferate unless called on to do so depending on the requirement of the organism. 4. It is not a stage of cell death, nor is it a stage of DNA synthesis (which happens in S phase).

**Final Answer:** The $G_0$ stage refers to the exit of the cell from the cell cycle.

**Answer: (B)**

## Q71.

### Solution

**Concept:**

Genes are the units of inheritance, but they often exist in multiple versions. An allele is one of two or more alternative forms of a gene that arise by mutation and are found at the same place (locus) on a chromosome.

**Solution:**

1. In a diploid organism, a gene pair consists of two alleles. 2. These alleles may be identical (homozygous) or different (heterozygous). 3. For example, in Mendel's pea plants, the gene for height has two alleles: 'T' (tall) and 't' (dwarf). 4. Alleles are "slightly different forms of the same gene" because they code for the same trait but may result in different expressions of that trait. 5. They are located at the same locus on homologous chromosomes.

**Final Answer:** Alleles are slightly different forms of the same gene.

**Answer: (B)**

## Q72.

### Solution

**Concept:**

The ozone layer in the stratosphere protects Earth from harmful UV radiation. Ozone depletion is caused by the release of chlorofluorocarbons (CFCs). While depletion occurs globally, atmospheric and climatic conditions cause it to be most severe in a specific polar region.

**Solution:**

1. During the winter in the Southern Hemisphere, a polar vortex forms over Antarctica, trapping cold air. 2. Polar Stratospheric Clouds (PSCs) form, providing a surface for chemical reactions that release chlorine from CFCs. 3. When sunlight returns in the spring, this chlorine rapidly destroys ozone molecules. 4. This results in a massive, seasonal thinning of the ozone layer known as the 'Ozone Hole'. 5. While the Arctic also experiences depletion, the Antarctic hole is significantly larger and more persistent.

**Final Answer:** The 'Ozone Hole' is most prominent over Antarctica.

**Answer: (C)**

## Q73.

### Solution

**Concept:**

Carbohydrates are classified based on the number of sugar units they contain. Monosaccharides are single units, Disaccharides have two units, and Polysaccharides are long chains (polymers) of monosaccharide units.

**Solution:**

1. Glucose and Fructose are monosaccharides (simple sugars). 2. Sucrose is a disaccharide composed of glucose and fructose. 3. Cellulose is a complex carbohydrate and a structural polysaccharide found in the cell walls of plants. 4. It is a polymer of $\beta$-D-glucose units linked by $\beta$-1,4-glycosidic bonds. 5. Glycogen and Starch are other common examples of storage polysaccharides.

**Final Answer:** Cellulose is a polysaccharide.

**Answer: (C)**

## Q74.

### Solution

**Concept:**

The 'Vital Force Theory' was a long-held belief that organic compounds could only be produced by living organisms because they required a "mysterious vital force." This suggested that organic chemistry was fundamentally different from inorganic chemistry.

**Solution:**

1. Berzelius was a strong proponent of the Vital Force Theory. 2. In 1828, Friedrich Wöhler heated an inorganic compound, ammonium cyanate ($NH_4CNO$), and successfully synthesized urea ($NH_2CONH_2$), an organic compound found in urine. 3. This was the first time an organic compound was produced in a laboratory from inorganic precursors. 4. This experiment dealt a death blow to the Vital Force Theory and paved the way for modern organic synthesis.

**Final Answer:** The Vital Force Theory was disproved by Friedrich Wöhler.

**Answer: (B)**

## Q75.

### Solution

**Concept:**

The liver is the largest gland in the human body and performs numerous metabolic and secretory functions. Like other organs, it is organized into repeating units that contain all the necessary components for its function.

**Solution:**

1. The nephron is the unit of the kidney. 2. The alveolus is the unit of the lung. 3. Hepatocytes are the individual cells of the liver, but they are organized into a higher structural order. 4. The hepatic lobules are the structural and functional units of the liver. 5. Each lobule is a hexagonal structure consisting of plates of hepatocytes radiating from a central vein, covered by a thin connective tissue sheath called Glisson's capsule.

**Final Answer:** The hepatic lobule is the structural and functional unit of the liver.

**Answer: (B)**

## Q76.

### Solution

**Concept:**

Guttation is the loss of water in the form of liquid droplets from the margins or tips of leaves. It occurs when root pressure is high and transpiration is low, typically during the night or early morning in high humidity conditions.

**Solution:**

1. Stomata are involved in transpiration (loss of water as vapor), not guttation. 2. Lenticels are small openings in the bark of woody stems used for gas exchange. 3. Hydathodes are specialized structures (water stomata) located at the vein endings of leaves. 4. In guttation, water is pushed out of the xylem through these hydathodes due to positive root pressure. 5. Cuticle is a waxy layer that prevents water loss but can be a site for minor cuticular transpiration.

**Final Answer:** Guttation in plants occurs through hydathodes.

**Answer: (C)**

## Q77.

### Solution

**Concept:**

Genetic disorders are broadly grouped into two categories: Mendelian disorders and Chromosomal disorders. Mendelian disorders are mainly determined by alteration or mutation in a single gene and follow Mendelian principles of inheritance.

**Solution:**

1. Down's syndrome, Turner's syndrome, and Klinefelter's syndrome are chromosomal disorders caused by the presence or absence of an entire chromosome (aneuploidy). 2. Phenylketonuria (PKU) is an inborn error of metabolism inherited as an autosomal recessive trait. 3. It is caused by a mutation in the gene that codes for the enzyme phenylalanine hydroxylase. 4. Other Mendelian disorders include Haemophilia, Cystic fibrosis, Sickle-cell anaemia, and Thalassemia.

**Final Answer:** Phenylketonuria is a Mendelian disorder.

**Answer: (B)**

## Q78.

### Solution

**Concept:**

In plant biotechnology, specific bacteria act as "natural genetic engineers" by transferring their DNA into the plant genome. A plasmid from such bacteria is used as a vector to deliver desired genes into host plants.

**Solution:**

1. *Escherichia coli* is widely used in cloning but does not naturally infect plants with Ti-plasmids. 2. *Agrobacterium tumefaciens* is a pathogen of several dicot plants. It contains a "Tumor inducing" (Ti) plasmid. 3. The T-DNA part of the Ti-plasmid integrates into the plant's DNA, causing crown gall disease. 4. Scientists have modified this plasmid to be a non-pathogenic, efficient vector for plant transformation. 5. *Bacillus thuringiensis* is the source of Bt toxin, and *Thermus aquaticus* provides Taq polymerase.

**Final Answer:** The Ti-plasmid is obtained from *Agrobacterium tumefaciens*.

**Answer: (B)**

## Q79.

### Solution

**Concept:**

Commensalism is an interspecific interaction where one species benefits and the other is neither harmed nor benefited (+/0).

**Solution:**

1. The sea anemone has stinging tentacles that provide protection from predators. 2. The clown fish lives among the tentacles, gaining protection and sometimes scraps of food left by the anemone (Benefit). 3. The sea anemone does not appear to derive any specific benefit from the presence of the clown fish, nor is it harmed (Neutral). 4. Parasitism and Predation involve harm to one species, and Competition involves harm to both.

**Final Answer:** The relationship between clown fish and sea anemone is commensalism.

**Answer: (B)**

## Q80.

### Solution

**Concept:**

Proteins are the most diverse and abundant organic molecules in living organisms. Their abundance can be measured within specific tissues or globally across the entire biosphere.

**Solution:**

1. Collagen is the most abundant protein in the animal world, forming connective tissues. 2. RuBisCO (Ribulose bisphosphate carboxylase-oxygenase) is the enzyme responsible for $CO_2$ fixation in all photosynthetic plants. 3. Because plants and algae make up the vast majority of the Earth's biomass, RuBisCO is considered the most abundant protein in the whole of the biosphere. 4. Insulin and Hemoglobin are vital proteins but are found in much lower total quantities.

**Final Answer:** RuBisCO is the most abundant protein in the biosphere.

**Answer: (B)**

## Q81.

### Solution

**Concept:**

Neurotransmitters are chemical messengers that transmit signals across a synapse. They are classified as excitatory (increasing the likelihood of a neuron firing) or inhibitory (decreasing the likelihood).

**Solution:**

1. Acetylcholine and Glutamate are primarily excitatory neurotransmitters. Glutamate is the most common excitatory neurotransmitter in the vertebrate central nervous system. 2. GABA (Gamma-aminobutyric acid) is the chief inhibitory neurotransmitter in the mammalian central nervous system. 3. It acts by binding to specific receptors that allow the influx of chloride ions or efflux of potassium ions, hyperpolarizing the neuron and making it less likely to generate an action potential. 4. Noradrenaline generally has an excitatory effect, increasing heart rate and blood flow.

**Final Answer:** GABA is the primary inhibitory neurotransmitter in the brain.

**Answer: (C)**

## Q82.

### Solution

**Concept:**

The Endosymbiotic Theory, popularized by Lynn Margulis, explains how eukaryotic cells evolved from prokaryotic organisms. It suggests that certain organelles were once free-living bacteria.

**Solution:**

1. Mitochondria are believed to have evolved from aerobic alpha-proteobacteria. 2. Chloroplasts are believed to have evolved from photosynthetic cyanobacteria. 3. Evidence includes the fact that both organelles have their own circular DNA, 70S ribosomes (like prokaryotes), and a double membrane (the inner representing the original bacterial membrane). 4. Nuclei, ribosomes, and lysosomes are not explained by this theory; the nucleus is thought to have formed from the invagination of the plasma membrane.

**Final Answer:** The Endosymbiotic Theory explains the origin of Mitochondria and Chloroplasts.

**Answer: (C)**

## Q83.

### Solution

**Concept:**

Plants develop various morphological adaptations to survive in extreme environments. A phylloclade is a modified stem that performs the function of a leaf.

**Solution:**

1. In xerophytic plants (plants living in dry/desert conditions like *Opuntia*), leaves are often reduced to spines to minimize water loss through transpiration. 2. The stem becomes green, flattened, and fleshy to carry out photosynthesis and store water. 3. This modified photosynthetic stem is called a phylloclade. 4. It is a classic adaptation for xerophytic life, where water conservation is critical.

**Final Answer:** A phylloclade is an adaptation for xerophytic life.

**Answer: (B)**

## Q84.

### Solution

**Concept:** Restriction enzymes, or restriction endonucleases, are proteins that recognize specific DNA sequences and cleave the phosphodiester bonds of the DNA backbone. In genetic engineering, they are the fundamental tools used to isolate specific genes.

**Solution:** The term "Molecular scissors" is used because these enzymes precisely cut DNA molecules at specific points, similar to how scissors cut paper. While DNA ligase acts as the "molecular glue" to join fragments and plasmids act as "molecular vehicles" (vectors) to transport DNA, restriction enzymes are responsible for the initial cutting.

**Final Answer:** Molecular scissors

**Answer: (B)**

## Q85.

### Solution

**Concept:**

Pollutants are classified based on how they enter the environment. Primary pollutants are emitted directly from a source, while secondary pollutants form in the atmosphere through chemical reactions.

**Solution:**

1. Sulfur dioxide ($SO_2$) is a primary pollutant because it is released directly from volcanic eruptions and the combustion of fossil fuels. 2. Ozone ($O_3$) in the troposphere is a secondary pollutant formed by the reaction of $NO_x$ and VOCs in the presence of sunlight. 3. PAN and Smog are also secondary pollutants/mixtures resulting from atmospheric reactions.

**Final Answer:** Sulfur dioxide is a primary pollutant.

**Answer: (C)**

## Q86.

### Solution

**Concept:** Phloem is a vascular tissue in plants responsible for the process of translocation. While xylem handles the movement of water and minerals from the roots, phloem distributes the organic nutrients synthesized during photosynthesis.

**Solution:** The products of photosynthesis, primarily sucrose, are transported through the phloem from the leaves (source) to various storage organs and growing parts of the plant (sink). This movement is bidirectional and requires metabolic energy in the form of ATP to load sucrose into the sieve tubes.

**Final Answer:** Food (Sucrose)

**Answer: (C)**

## Q87.

### Solution

**Concept:**

The Bohr Effect describes the physiological phenomenon where the presence of certain substances in the blood causes hemoglobin to release oxygen more readily.

**Solution:**

1. In tissues where metabolism is high, $CO_2$ levels increase. 2. This $CO_2$ reacts with water to form carbonic acid, which lowers the $pH$ (increases acidity). 3. The increased $CO_2$ and decreased $pH$ cause a rightward shift in the oxygen-dissociation curve. 4. This means hemoglobin's affinity for oxygen decreases, allowing oxygen to be unloaded into the tissues where it is needed.

**Final Answer:** The Bohr Effect refers to the influence of $CO_2$ on hemoglobin affinity.

**Answer: (C)**

## Q88.

### Solution

**Concept:** Turner's Syndrome is a chromosomal disorder caused by the absence of one of the X chromosomes in females. It is a type of aneuploidy, specifically monosomy, where the total chromosome count is 45 instead of the normal 46.

**Solution:** In a person with Turner's Syndrome, the sex chromosome composition is represented as 'XO', meaning there is only one functional X chromosome. Therefore, the karyotype is written as 45, XO. Options like 47, XXY and 47, XY+21 represent Klinefelter's Syndrome and Down Syndrome, respectively, which involve an extra chromosome (trisomy).

**Final Answer:** 45, XO

**Answer: (B)**

## Q89.

### Solution

**Concept:**

Cellular respiration occurs in stages. The link reaction (oxidative decarboxylation of pyruvate) serves as a bridge between the process in the cytoplasm and the process in the mitochondrial matrix.

**Solution:**

1. Glycolysis (cytoplasm) produces Pyruvate. 2. The link reaction converts Pyruvate into Acetyl CoA in the mitochondrial matrix. 3. Acetyl CoA then enters the Krebs cycle (matrix). 4. Therefore, the link reaction connects Glycolysis and the Krebs cycle.

**Final Answer:** The link reaction connects Glycolysis and the Krebs cycle.

**Answer: (B)**

## Q90.

### Solution

**Concept:**

Laticiferous tissues are specialized plant cells or ducts that contain "latex," a milky or clear fluid consisting of a complex mixture of substances.

**Solution:**

1. Resins are usually products of resin ducts (e.g., in Pine). 2. Rubber is obtained from the latex of the tree *Hevea brasiliensis*. The latex is secreted by laticiferous vessels in the bark. 3. Tannins and mucilage are secondary metabolites but are not the primary characteristic product of laticiferous tissue in the same way rubber is.

**Final Answer:** Rubber is a product of laticiferous tissue.

**Answer: (B)**

# Answer Key

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