MHT CET Biology Sample Paper 15

Biology (PCB Group)

Duration: 90 Minutes **Maximum Marks: 100**

Instructions

- This paper contains **100** Multiple Choice Questions covering the full MHT CET Biology syllabus, grouped into five Parts: **A** – Class 11 Foundation (Q1–Q20), **B** – Reproduction (Q21–Q40), **C** – Genetics & Evolution (Q41–Q60), **D** – Biotechnology & Human Welfare (Q61–Q80), **E** – Ecology & Environment (Q81–Q100).
- Each correct answer carries **+1 mark**. Wrong and unattempted answers carry **0 marks** (no negative marking).
- Approximately 80% of questions are from the Class 12 Maharashtra Board syllabus and 20% from Class 11.
- Only **one** option is correct. Use of calculators or electronic gadgets is prohibited.

Part A: Class 11 Foundation (Diversity, Cell, Physiology)

Q1. The taxonomic category that contains genera with common origin and shares many characters in common is:

(A) Order

(B) Family

(C) Class

(D) Division

Q2. In the five-kingdom classification proposed by R. H. Whittaker, the kingdom that includes prokaryotic organisms is:

(A) Protista

(B) Fungi

(C) Monera

(D) Plantae

Q3. The mode of nutrition in *Cuscuta* (dodder), which lacks chlorophyll, is:

(A) Autotrophic

(B) Saprophytic

(C) Total parasitic

(D) Symbiotic

Q4. In bryophytes, the dominant photosynthetic phase is the:

(A) Sporophyte

(B) Gametophyte

(C) Protonema only

(D) Capsule

Q5. Double fertilisation is a unique feature of:

(A) Pteridophytes

(B) Gymnosperms

(C) Angiosperms

(D) Bryophytes

Q6. The water vascular system, used for locomotion and food capture, is characteristic of:

(A) Annelida

(B) Arthropoda

(C) Mollusca

(D) Echinodermata

Q7. In Aves (birds), the bones are pneumatic (air-filled), which is an adaptation for:

(A) Endothermy

(B) Flight (reduces body weight)

(C) Egg-laying

(D) Diving

Q8. The cell organelle responsible for ATP synthesis through oxidative phosphorylation is:

(A) Ribosome

(B) Lysosome

(C) Mitochondrion

(D) Golgi apparatus

Q9. The fluid-mosaic model of the plasma membrane was proposed by:

(A) Robert Hooke

(B) Singer and Nicolson

(C) Schleiden and Schwann

(D) Robert Brown

Q10. During mitotic anaphase, the structures that move toward opposite poles are:

(A) Bivalents

(B) Sister chromatids

(C) Homologous chromosomes

(D) Tetrads

Q11. In a C_4 plant, the primary CO_2 fixation occurs in the:

(A) Mesophyll cells (via PEP carboxylase)

(B) Bundle sheath cells (via RuBisCO)

(C) Guard cells

(D) Phloem cells

Q12. The respiratory quotient (R.Q.) for carbohydrates is:

(A) Less than 1

(B) Equal to 1

(C) Greater than 1

(D) Zero

Q13. Translocation of organic solutes in the phloem of plants is best explained by:

(A) Cohesion-tension theory

(B) Root pressure theory

(C) Munch's mass-flow hypothesis

(D) Capillarity

Q14. Apical dominance in plants is mainly due to:

(A) Cytokinins produced in roots

(B) Auxins produced at the shoot apex

(C) Ethylene

(D) Abscisic acid

Q15. The enzyme responsible for the breakdown of starch into maltose in the human mouth is:

(A) Pepsin

(B) Trypsin

(C) Salivary amylase (ptyalin)

(D) Lipase

Q16. During inspiration, the volume of the thoracic cavity:

(A) Decreases as the diaphragm relaxes

(B) Increases as the diaphragm contracts and the intercostal muscles lift the rib cage

(C) Remains unchanged

(D) First decreases, then increases

Q17. The universal donor blood group in the ABO system is:

(A) A

(B) B

(C) AB

(D) O (Rh negative)

Q18. The functional and structural unit of the kidney is the:

(A) Glomerulus

(B) Nephron

(C) Bowman's capsule

(D) Loop of Henle

Q19. The hormone that lowers blood glucose concentration is:

(A) Glucagon

(B) Cortisol

(C) Insulin

(D) Adrenaline

Q20. The sliding-filament theory of muscle contraction was proposed by:

(A) Watson and Crick

(B) Huxley and Hanson

(C) Singer and Nicolson

(D) Beadle and Tatum

Part B: Reproduction

Q21. In *Hydra*, the most common mode of asexual reproduction is:

(A) Fission

(B) Budding

(C) Fragmentation

(D) Sporulation

Q22. The juvenile phase in plants and animals is characterised by:

(A) Active reproduction

(B) Active growth and maturation before sexual maturity is reached

(C) Senescence

(D) Hibernation

Q23. The wall of the pollen grain consists of an outer hard *exine* made up of:

(A) Cellulose

(B) Suberin

(C) Sporopollenin

(D) Lignin

Q24. In an angiosperm embryo sac, the egg apparatus consists of:

(A) One egg cell and two synergids

(B) Two polar nuclei and one egg cell

(C) Three antipodal cells

(D) One egg cell and one synergid

Q25. The fusion of one male gamete with the secondary nucleus to form the triploid primary endosperm nucleus is called:

(A) Syngamy

(B) Triple fusion

(C) Porogamy

(D) Chalazogamy

Q26. Apomixis in plants refers to:

(A) Vegetative reproduction by stem cuttings

(B) Formation of seeds without fertilisation

(C) Fertilisation involving two male gametes

(D) Formation of fruit without seed

Q27. In the typical structure of an anatropous ovule, the micropyle and the chalaza are:

(A) Close together at the same end

(B) At opposite ends, with the ovule erect

(C) At right angles to each other

(D) Fused into a single opening

Q28. The edible part of a coconut (Cocos nucifera) is:

(A) Mesocarp

(B) Endocarp

(C) Cellular endosperm

(D) Liquid (free-nuclear) endosperm and the embryo

Q29. Spermatogenesis in human males begins at puberty under the influence of:

(A) Insulin

(B) Gonadotropin-releasing hormone (GnRH) leading to FSH and LH secretion

(C) Cortisol

(D) Calcitonin

Q30. The acrosome of a human spermatozoon contains:

(A) Energy-rich mitochondria

(B) Lysosomal enzymes (notably hyaluronidase) that digest the egg coats

(C) DNA only

(D) Cellulose

Q31. In the human female, the secondary oocyte completes meiosis II only:

(A) Before ovulation

(B) At the time of ovulation

(C) After fertilisation by the sperm

(D) During menstruation

Q32. The corpus luteum secretes mainly:

(A) Oestrogen only

(B) Progesterone (and some oestrogen)

(C) LH

(D) Prolactin

Q33. The chorionic villi of the placenta are formed by:

(A) Maternal blood vessels

(B) Endometrium alone

(C) Trophoblast cells of the embryo, plus mesodermal tissue

(D) Yolk sac alone

Q34. In the human menstrual cycle, the LH surge typically occurs around:

(A) Day 1

(B) Day 14 (just before ovulation)

(C) Day 28

(D) Day 7

Q35. The fetal membrane that gives rise to the umbilical cord is the:

(A) Amnion alone

(B) Allantois and umbilical mesoderm

(C) Yolk sac alone

(D) Chorion alone

Q36. Lactational amenorrhoea is a natural method of contraception that depends on:

(A) Full breast-feeding suppressing ovulation in the first six months postpartum

(B) Hormonal pills

(C) IUD insertion

(D) Tubectomy

Q37. Copper-T is a/an:

(A) Hormonal contraceptive

(B) Intra-uterine device that releases copper ions toxic to sperm

(C) Barrier method

(D) Surgical sterilisation

Q38. Medical Termination of Pregnancy (MTP) is considered relatively safe (under qualified medical supervision) up to:

(A) 4 weeks

(B) 12 weeks (first trimester)

(C) 24 weeks

(D) 36 weeks

Q39. Amniocentesis is a prenatal diagnostic test that is sometimes misused for:

(A) Detection of cancer

(B) Sex determination of the foetus and selective abortion (legally banned for this purpose)

(C) Treatment of infertility

(D) Vaccination

Q40. In assisted reproductive technology, ZIFT stands for:

(A) Zona Intra Fallopian Transfer

(B) Zygote Intra Fallopian Transfer

(C) Zoonotic Internal Fertilisation Test

(D) Zygote In-vitro Fertilisation Technique

Part C: Genetics & Evolution

Q41. Mendel's law of segregation states that:

(A) Alleles assort independently

(B) Two alleles for a character separate during gamete formation and end up in different gametes

(C) Dominant alleles always mask recessive ones in F_2

(D) Genes are linked on the same chromosome

Q42. In a Mendelian dihybrid cross between $RrYy \times RrYy$, the phenotypic ratio in F_2 is:

(A) 3 : 1

(B) 1 : 2 : 1

(C) 9 : 3 : 3 : 1

(D) 1 : 1 : 1 : 1

Q43. Incomplete dominance is best illustrated in:

(A) Pea plants (Pisum sativum)

(B) Snapdragon (Antirrhinum / 4 o'clock plant) flower colour

(C) Garden peas seed shape

(D) Drosophila eye colour

Q44. In humans, the ABO blood group system shows:

(A) Sex-linkage

(B) Multiple allelism with codominance between I^A and I^B

(C) Polygenic inheritance with no codominance

(D) Linkage only

Q45. Colour blindness in humans is:

(A) Autosomal dominant

(B) X-linked recessive

(C) Y-linked

(D) Mitochondrial

Q46. Down syndrome is caused by:

(A) Monosomy of chromosome 21

(B) Trisomy of chromosome 21

(C) Trisomy of chromosome 18

(D) Deletion of chromosome 5

Q47. The double-helical model of DNA was proposed by:

(A) Meselson and Stahl

(B) Watson and Crick

(C) Hershey and Chase

(D) Beadle and Tatum

Q48. Meselson and Stahl's experiment with *E. coli* grown in ^{15}N medium proved that DNA replication is:

(A) Conservative

(B) Semi-conservative

(C) Dispersive

(D) Random

Q49. The enzyme that joins Okazaki fragments on the lagging strand during DNA replication is:

(A) DNA polymerase I

(B) DNA helicase

(C) DNA ligase

(D) Topoisomerase

Q50. In transcription, the strand of DNA that serves as a template for synthesis of RNA is the:

(A) Coding strand

(B) Antisense (template) strand, read in $3' \rightarrow 5'$ direction

(C) Both strands simultaneously

(D) Neither, transcription uses protein only

Q51. Splicing of introns from heterogeneous nuclear RNA (hnRNA) occurs in:

(A) Cytoplasm

(B) Nucleus (spliceosome)

(C) Mitochondria only

(D) Ribosomes

Q52. In the genetic code, the start codon in eukaryotes that codes for methionine is:

(A) UAA

(B) UAG

(C) AUG

(D) UGA

Q53. The Human Genome Project was officially declared complete (essentially complete) in the year:

(A) 1990

(B) 2003

(C) 1953

(D) 2010

Q54. The pioneer of evolutionary theory by natural selection was:

(A) Lamarck

(B) Charles Darwin

(C) Hugo de Vries

(D) Mendel

Q55. The Hardy–Weinberg principle holds under all of the following conditions EXCEPT:

(A) Large population

(B) Random mating

(C) No mutation, migration, or selection

(D) Strong genetic drift

Q56. The presence of homologous structures (e.g., human arm, whale flipper, bird wing) is best evidence for:

(A) Convergent evolution

(B) Divergent evolution from a common ancestor

(C) Parallel evolution

(D) Spontaneous generation

Q57. Industrial melanism in the peppered moth (*Biston betularia*) is a classical example of:

(A) Genetic drift

(B) Natural selection driven by environmental change

(C) Mutation pressure alone

(D) Founder effect

Q58. Darwin's finches of the Galapagos Islands illustrate:

(A) Convergent evolution

(B) Coevolution

(C) Adaptive radiation

(D) Inheritance of acquired characters

Q59. The earliest hominid to walk upright on two legs (bipedal) is believed to be:

(A) *Homo sapiens*

(B) *Australopithecus*

(C) *Ramapithecus*

(D) *Dryopithecus*

Q60. The Miller–Urey experiment demonstrated:

(A) The structure of DNA

(B) That simple organic molecules (including amino acids) could form abiotically under conditions believed to resemble early Earth

(C) That life arose by spontaneous generation in modern conditions

(D) The mechanism of natural selection

Part D: Biotechnology & Human Welfare

Q61. Malaria is caused by:

(A) Trypanosoma

(B) Plasmodium, transmitted by the female Anopheles mosquito

(C) Leishmania

(D) Entamoeba

Q62. The causative agent of AIDS is:

(A) HSV virus

(B) HIV (a retrovirus that targets helper T cells)

(C) HPV

(D) Influenza virus

Q63. Cell-mediated immunity is provided mainly by:

(A) B-lymphocytes

(B) T-lymphocytes

(C) Mast cells

(D) Erythrocytes

Q64. The reaction occurring during transformation of harmful substances by liver enzymes is part of:

(A) Cellular respiration

(B) Innate barriers; immunity

(C) Drug metabolism and detoxification

(D) Excretion of urea only

Q65. Heroin is a derivative of:

(A) Cannabis

(B) Coca plant

(C) Opium poppy (Papaver somniferum) – it is a diacetyl derivative of morphine

(D) Tobacco

Q66. Inbreeding depression in cattle can be relieved by:

(A) Continuous self-mating

(B) Out-crossing or out-breeding

(C) Mass selection

(D) No remedy is available

Q67. Apiculture refers to the rearing of:

(A) Silkworms

(B) Honeybees

(C) Fish

(D) Lac insects

Q68. Tissue culture techniques used to produce a large number of genetically identical plantlets from a small parental plant tissue rely on:

(A) Sexual reproduction

(B) Totipotency of plant cells

(C) Mutation pressure

(D) Polyploidy

Q69. Curdling of milk into curd is caused mainly by:

(A) *Saccharomyces cerevisiae*

(B) *Lactobacillus* species (LAB) producing lactic acid

(C) *Aspergillus niger*

(D) *Penicillium chrysogenum*

Q70. In an anaerobic sewage-treatment digester, the dominant micro-organisms producing biogas are:

(A) Algae

(B) Methanogenic archaea (e.g., *Methanobacterium*)

(C) Yeasts

(D) Cyanobacteria

Q71. Penicillin, the first widely used antibiotic, was isolated by Alexander Fleming from:

(A) *Bacillus subtilis*

(B) *Penicillium notatum*

(C) *E. coli*

(D) *Streptomyces griseus*

Q72. Bt cotton is engineered to express a gene from:

(A) *Bacillus thuringiensis*, producing a crystal (Cry) protein toxic to boll-worm larvae

(B) *E. coli*

(C) *Agrobacterium tumefaciens* (the vector, not the toxin source)

(D) Tobacco mosaic virus

Q73. Recombinant DNA technology requires three essential tools, NOT including:

(A) Restriction enzymes (molecular scissors)

(B) Vectors (plasmids, phages)

(C) Suitable host cells

(D) Photosynthetic enzymes

Q74. The restriction enzyme EcoRI cuts the DNA sequence:

(A) GAATTC, between G and A on both strands (producing sticky ends)

(B) AAGCTT

(C) GGATCC

(D) TGGCCA

Q75. In a polymerase chain reaction (PCR), the heat-stable enzyme used for DNA synthesis is:

(A) DNA ligase

(B) RNase H

(C) *Taq* polymerase from *Thermus aquaticus*

(D) Reverse transcriptase

Q76. In gel electrophoresis of DNA fragments, the fragments move toward the:

(A) Anode (positive electrode) – because DNA is negatively charged

(B) Cathode (negative electrode)

(C) Both electrodes equally

(D) Neither – the gel prevents movement

Q77. The first transgenic human insulin produced by recombinant DNA technology was marketed by Eli Lilly under the name:

(A) Humatrope

(B) Humulin

(C) Glargine

(D) Lispro

Q78. Bt toxin produced in transgenic plants is in an **inactive** pro-toxin form, becoming active only when:

(A) Exposed to UV light

(B) It enters the alkaline midgut of insect larvae where it is solubilised and cleaved into the active form

(C) Exposed to acid (such as in the human stomach)

(D) Heated above 60 °C

Q79. Gene therapy was first attempted (1990) on a four-year-old girl with:

(A) Sickle-cell anaemia

(B) Severe combined immunodeficiency (SCID) due to adenosine deaminase (ADA) deficiency

(C) Cystic fibrosis

(D) Phenylketonuria

Q80. The basmati rice patent issue and the neem patent issue raised the concern of:

(A) Stem-cell research

(B) Biopiracy of traditional biological resources and knowledge

(C) Reproductive cloning

(D) Forensic DNA fingerprinting

Part E: Ecology & Environment

Q81. An assemblage of individuals of the same species living in a defined geographical area at a given time is called a/an:

(A) Community

(B) Population

(C) Ecosystem

(D) Biome

Q82. The most common type of population growth curve in nature, under finite resources, is:

(A) Exponential (J-shaped) indefinitely

(B) Logistic (sigmoid, S-shaped) due to carrying capacity

(C) Linear

(D) Bell-shaped

Q83. In an interaction between two species where one is benefited and the other is neither benefited nor harmed, the relationship is called:

(A) Mutualism

(B) Commensalism

(C) Parasitism

(D) Predation

Q84. The lichen relationship between an alga and a fungus is an example of:

(A) Predation

(B) Mutualism

(C) Parasitism

(D) Amensalism

Q85. In an aquatic ecosystem, the primary productivity is mainly contributed by:

(A) Decomposers

(B) Phytoplankton

(C) Zooplankton

(D) Fish

Q86. In the standard energy-flow pyramid in an ecosystem, energy:

(A) Increases as it moves up trophic levels

(B) Decreases as it moves up trophic levels (approximately 10% transfer at each step, the 10% law)

(C) Remains constant

(D) Is recycled in a closed loop

Q87. Pyramid of biomass in an aquatic ecosystem (e.g., pond) is often:

(A) Upright

(B) Inverted, because producers (phytoplankton) have lower standing biomass than consumers at any instant

(C) Linear

(D) Always rectangular

Q88. The major reservoir for nitrogen on Earth is:

(A) Atmosphere (about 78%)

(B) Ocean only

(C) Lithosphere only

(D) Living biomass

Q89. Primary ecological succession on bare rock typically begins with:

(A) Mosses and grasses

(B) Lichens (pioneer community)

(C) Shrubs

(D) Hardwood trees

Q90. The phenomenon in which producers are eaten by consumers and producers' energy is irretrievably lost as heat to surroundings is described by:

(A) First law of thermodynamics only

(B) Second law of thermodynamics

(C) Hardy–Weinberg principle

(D) Allen's rule

Q91. The total number of species in a given area at a given time is referred to as:

(A) Genetic diversity

(B) Species diversity

(C) Ecosystem diversity

(D) Population diversity

Q92. A 'biodiversity hot spot' is characterised by:

(A) High endemism and very high habitat loss

(B) Low endemism but high biomass

(C) No habitat loss

(D) Only marine areas

Q93. Which of the following is NOT an Indian biodiversity hot spot?

(A) Western Ghats and Sri Lanka

(B) Indo-Burma

(C) Himalaya

(D) Sahara Desert

Q94. *Ex-situ* conservation of biodiversity includes:

(A) National parks and sanctuaries

(B) Zoological parks, botanical gardens, gene banks, seed banks and cryopreservation

(C) Biosphere reserves

(D) Sacred groves

Q95. The Red Data Book is maintained by the:

(A) World Health Organisation

(B) International Union for Conservation of Nature (IUCN)

(C) World Bank

(D) UN General Assembly

Q96. The Convention on Biological Diversity (CBD) was signed at the Earth Summit held in:

(A) Stockholm, 1972

(B) Rio de Janeiro, 1992

(C) Johannesburg, 2002

(D) Kyoto, 1997

Q97. In a lake, the deficiency of dissolved oxygen brought about by an excess of nutrients (such as nitrates and phosphates from fertilisers) leading to algal blooms and fish kill is termed:

(A) Eutrophication

(B) Acidification

(C) Salination

(D) Thermal pollution

Q98. Biological magnification of DDT in food chains was a key concern raised in Rachel Carson's book:

(A) The Origin of Species

(B) Silent Spring

(C) One Earth, One Family

(D) The Selfish Gene

Q99. The chlorofluorocarbons (CFCs) deplete the ozone layer by releasing, on UV exposure, free radicals of:

(A) Carbon

(B) Chlorine

(C) Nitrogen

(D) Hydrogen

Q100. The major greenhouse gas emitted in greatest quantity by human activities (mainly fossil-fuel combustion) is:

(A) Methane

(B) Carbon dioxide

(C) Nitrous oxide

(D) Ozone

Detailed Solutions

Q1.

Solution

Concept — Taxonomic Hierarchy: The standard sequence (descending) is Kingdom → Phylum/Division → Class → Order → Family → Genus → Species. A *family* groups together related genera that share a common ancestral origin.

Tip: Mnemonic: "King Philip Came Over For Good Soup". **Final Answer:** Family ⇒ B

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Five-Kingdom Classification: Whittaker (1969) classified all organisms into Monera, Protista, Fungi, Plantae and Animalia. Only *Monera* contains prokaryotes (bacteria and cyanobacteria). The other four are eukaryotic.

Tip: Two basic criteria he used: cell structure (pro/eukaryotic) and mode of nutrition. **Final Answer:** Monera ⇒ C

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Modes of Nutrition: *Cuscuta* (dodder) lacks chlorophyll, lacks roots, and obtains all its water, minerals and food through haustoria embedded in the host plant. It depends entirely on the host – hence **total parasite**.

Tip: Contrast with partial parasites like *Loranthus* and *Viscum* which photosynthesise but tap host water. **Final Answer:** Total parasitic ⇒ C

Answer: (C) Go Back to Q3

Q4.

Solution

Concept — Bryophyte Life Cycle: Bryophytes show heteromorphic alternation of generations in which the *haploid gametophyte* is the dominant, free-living, photosynthetic phase. The diploid sporophyte is reduced and depends on the gameto-

phyte.

Tip: "Mosses are gametophyte-dominant" is the AIIMS/NEET-level one-liner. **Final Answer:** Gametophyte $\Rightarrow$ B

Answer: (B) Go Back to Q4

Q5.

Solution

Concept — Double Fertilisation: A unique feature of angiosperms. One male gamete fuses with the egg to form the zygote (syngamy, $n+n=2n$). The other male gamete fuses with the two polar nuclei (secondary nucleus) to give the triploid primary endosperm nucleus (triple fusion). Together = double fertilisation.

Tip: Discovered by S. G. Nawaschin (1898) in *Lilium* and *Fritillaria*. **Final Answer:** Angiosperms $\Rightarrow$ C

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Echinoderm Water Vascular System: A network of fluid-filled canals (madreporite $\rightarrow$ stone canal $\rightarrow$ ring canal $\rightarrow$ radial canals $\rightarrow$ tube feet) used for locomotion, food capture and respiration in starfish, sea urchins, etc.

Tip: Only Echinodermata has a water vascular system. **Final Answer:** Echinodermata $\Rightarrow$ D

Answer: (D) Go Back to Q6

Q7.

Solution

Concept — Pneumatic Bones in Birds: Long bones of Aves contain air-filled cavities (pneumatic spaces) connected to the lung air sacs. This drastically reduces the bird's body weight, an essential adaptation for sustained flight.

Tip: Other flight adaptations: fused bones, keeled sternum, feathers, four-chambered heart, high metabolic rate. **Final Answer:** Flight $\Rightarrow$ B

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — Mitochondria as Powerhouse: Oxidative phosphorylation (ETC + ATP synthase) occurs on the inner mitochondrial membrane; ATP is synthesised in large quantity. Hence mitochondria are called the powerhouse of the cell.

Tip: 38 ATP per glucose in eukaryotes (theoretical max), of which ≈ 34 come from the mitochondrion. **Final Answer:** Mitochondrion $\Rightarrow$ C

Answer: (C) Go Back to Q8

Q9.

Solution

Concept — Fluid Mosaic Model: Singer and Nicolson (1972) proposed that the membrane is a lipid bilayer with proteins floating in it like icebergs, with lateral fluidity. Replaced the older "sandwich" model of Danielli and Davson.

Tip: Two main lipid components: phospholipids and cholesterol; cholesterol stabilises fluidity at varying temperatures. **Final Answer:** Singer and Nicolson $\Rightarrow$ B

Answer: (B) Go Back to Q9

Q10.

Solution

Concept — Mitotic Anaphase: The centromeres split and the two sister chromatids of each chromosome separate, pulled by the spindle fibres toward opposite poles. Each chromatid is now an independent chromosome.

Tip: Bivalents/tetrads are meiotic structures (prophase I). **Final Answer:** Sister chromatids $\Rightarrow$ B

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — C_4 Pathway (Hatch–Slack): In C_4 plants (maize, sugarcane), the first CO_2 fixation is in the mesophyll cells via *PEP carboxylase*, producing oxaloacetate (a 4-C compound). The 4-C acid is transported to the bundle sheath, where it releases CO_2 for the Calvin cycle.

Tip: Kranz anatomy (mesophyll + bundle sheath) is the structural hallmark of C_4

plants. **Final Answer:** Mesophyll via PEP carboxylase $\Rightarrow$ A

Answer: (A) Go Back to Q11

Q12.

Solution

Concept — Respiratory Quotient: $RQ = \dfrac{\text{Volume of } CO_2 \text{ produced}}{\text{Volume of } O_2 \text{ used}}$. For carbohydrates: $C_6H_{12}O_6 + 6\,O_2 \rightarrow 6\,CO_2 + 6\,H_2O$, so $RQ = 6/6 = 1$.

Tip: Fats RQ ≈ 0.7; proteins ≈ 0.9; organic acids > 1. **Final Answer:** $1 \Rightarrow$ B

Answer: (B) Go Back to Q12

Q13.

Solution

Concept — Mass-Flow Hypothesis (Munch, 1930): Translocation in phloem is from *source* (where sugars are loaded) to *sink* (where sugars are used or stored). Active loading at the source raises osmotic pressure; water enters; the resulting hydrostatic pressure pushes the sap to the sink.

Tip: Cohesion-tension theory explains xylem transport (water), not phloem (sugars). **Final Answer:** Munch's mass-flow hypothesis $\Rightarrow$ C

Answer: (C) Go Back to Q13

Q14.

Solution

Concept — Apical Dominance: Auxin (IAA) produced by the shoot apex moves downward and inhibits the growth of lateral buds. Removing the shoot tip releases this inhibition and the laterals grow – this is why gardeners pinch off the tip to make bushy plants.

Tip: Cytokinins, in contrast, promote lateral bud growth. **Final Answer:** Auxin from the shoot apex $\Rightarrow$ B

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — Salivary Amylase (Ptyalin): Secreted by the salivary glands; it hydrolyses about 30% of dietary starch into maltose and dextrins in the mouth. Optimum pH ≈ 6.8.

Tip: Pepsin is in the stomach (protein); trypsin in the intestine (protein); lipase digests fat. **Final Answer:** Salivary amylase (ptyalin) $\Rightarrow$ C

Answer: (C) Go Back to Q15

Q16.

Solution

Concept — Inspiration Mechanics: The diaphragm *contracts and flattens*; the external intercostal muscles contract and lift the ribs upward and outward. Together they increase the thoracic volume, intra-pulmonary pressure drops below atmospheric, and air rushes in.

Tip: Expiration is largely passive: muscles relax, elastic recoil compresses the lungs. **Final Answer:** Volume increases as the diaphragm contracts $\Rightarrow$ B

Answer: (B) Go Back to Q16

Q17.

Solution

Concept — ABO Blood Groups and Universal Donor: Group O lacks both A and B antigens on RBCs; Rh-negative O lacks the D antigen as well. Such blood can be transfused into any ABO/Rh recipient without triggering an antigen-driven reaction.

Tip: Universal recipient = AB Rh+ (has all antigens, no antibodies to A, B or D). **Final Answer:** O (Rh negative) $\Rightarrow$ D

Answer: (D) Go Back to Q17

Q18.

Solution

Concept — Nephron: The structural and functional unit of the kidney. Each human kidney has $\approx 10^6$ nephrons. A nephron = Bowman's capsule + glomerulus + PCT + Loop of Henle + DCT + collecting duct.

Tip: Filtration occurs in the Malpighian body (glomerulus + capsule); selective

reabsorption in PCT and Loop of Henle; conditional reabsorption in DCT and CD. **Final Answer:** Nephron ⇒ B

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Insulin: Secreted by β-cells of the islets of Langerhans of the pancreas. It lowers blood glucose by promoting cellular uptake (especially in muscle and adipose tissue) and conversion of glucose to glycogen in the liver.

Tip: Glucagon (from α-cells) is the antagonist that raises blood glucose. **Final Answer:** Insulin ⇒ C

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Sliding-Filament Theory: Huxley and Hanson (1954) proposed that during muscle contraction the thin actin filaments slide over the thick myosin filaments. The lengths of the filaments themselves do not change; only the I-band and the H-zone shorten while the A-band stays constant.

Tip: ATP, Ca^{2+} and troponin-tropomyosin regulate the cross-bridge cycle. **Final Answer:** Huxley and Hanson ⇒ B

Answer: (B) Go Back to Q20

Q21.

Solution

Concept — Asexual Reproduction in *Hydra*: The commonest mode is exogenous *budding*: a small outgrowth on the parent body wall develops into a complete miniature *Hydra* and detaches.

Tip: *Hydra* can also reproduce sexually under stress (autumn). **Final Answer:** Budding ⇒ B

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — Juvenile Phase: The pre-reproductive period during which the organism grows and matures. Reproductive maturity follows; senescence marks the end of life.

Tip: In plants, the juvenile phase is also called the vegetative phase. **Final Answer:** Growth/maturation before reproduction $\Rightarrow$ B

Answer: (B) Go Back to Q22

Q23.

Solution

Concept — Pollen Wall Structure: The exine is composed of *sporopollenin*, one of the most resistant organic substances known. It can withstand high temperature, strong acids and alkalis – which is why fossil pollen survives for millions of years.

Tip: Germ pores in the exine are sporopollenin-free. **Final Answer:** Sporopollenin $\Rightarrow$ C

Answer: (C) Go Back to Q23

Q24.

Solution

Concept — Embryo Sac (Polygonum-type): 7-celled, 8-nucleate. The egg apparatus at the micropylar end has **one egg cell + two synergids**. The two polar nuclei sit in the central cell. The chalazal end has three antipodal cells.

Tip: Filiform apparatus is present in synergids; it guides the pollen tube to the embryo sac. **Final Answer:** One egg + two synergids $\Rightarrow$ A

Answer: (A) Go Back to Q24

Q25.

Solution

Concept — Triple Fusion: The second male gamete (n) fuses with the secondary nucleus (which is itself the diploid product of fusion of two haploid polar nuclei). This gives the *triploid* (3n) primary endosperm nucleus (PEN). The endosperm develops from the PEN.

Tip: Syngamy + Triple fusion = Double fertilisation. **Final Answer:** Triple fusion $\Rightarrow$ B

Answer: (B) Go Back to Q25

Q26.

Solution

Concept — Apomixis: An asexual mode of reproduction in which seeds are formed without fertilisation (without meiosis or syngamy in the typical sense). It produces genetically identical clonal seeds. Common in some grasses (e.g., *Asteraceae*, *Poaceae*).

Tip: Useful for hybrid-seed companies: an apomictic line preserves hybrid vigour indefinitely. **Final Answer:** Seeds without fertilisation $\Rightarrow$ B

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Anatropous Ovule: The most common ovule type ($\approx 80\%$). The ovule body is inverted such that the micropyle and the funicle lie close together, while the chalaza is at the opposite end. (Orthotropous = erect; campylotropous = curved.)

Tip: Easy mnemonic: "Ana-tropous = upside-down". **Final Answer:** Same end, inverted ovule $\Rightarrow$ A

Answer: (A) Go Back to Q27

Q28.

Solution

Concept — Coconut Endosperm: The coconut shows two-phase endosperm: an early *free-nuclear* (liquid, "coconut water") stage and a later *cellular* (white kernel, "coconut meat") stage. The embryo lies embedded in the kernel. Together they are the edible portion.

Tip: Mesocarp of a coconut is the fibrous coir; endocarp is the hard shell. **Final Answer:** Liquid & cellular endosperm + embryo $\Rightarrow$ D

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Hormonal Control of Spermatogenesis: The hypothalamus secretes GnRH which triggers the anterior pituitary to release FSH (acts on Sertoli cells → androgen-binding protein and spermatogenesis support) and LH (acts on Leydig cells → testosterone). Testosterone, in turn, drives the final maturation of sperms.

Tip: Inhibin from Sertoli cells provides negative feedback on FSH. **Final Answer:** GnRH → FSH and LH ⇒ B

Answer: (B) Go Back to Q29

Q30.

Solution

Concept — Acrosomal Reaction: The acrosome is a cap-like membrane-bound vesicle at the anterior end of the sperm head. It contains hydrolytic enzymes, principally hyaluronidase and acrosin, which digest the corona radiata and zona pellucida, allowing the sperm to penetrate the egg.

Tip: Once one sperm fuses with the oocyte plasma membrane, the cortical reaction prevents polyspermy. **Final Answer:** Lysosomal enzymes for egg coat digestion ⇒ B

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Meiosis II in Human Oogenesis: Oogenesis is arrested twice. The primary oocyte is arrested in prophase I from foetal life until ovulation. After the LH surge it completes meiosis I to yield the secondary oocyte, which immediately enters meiosis II and is arrested at metaphase II. Meiosis II is completed *only on fertilisation* – the sperm entry triggers the resumption.

Tip: The result is one ovum + the second polar body. **Final Answer:** After fertilisation ⇒ C

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Corpus Luteum: After ovulation, the empty Graafian follicle is converted into the corpus luteum by LH. It secretes mainly *progesterone* (and some

oestrogen), which prepares and maintains the endometrium for implantation. If pregnancy doesn't occur, it degenerates after 10–12 days into the corpus albicans.

Tip: In pregnancy, hCG from the implanting embryo rescues the corpus luteum, which keeps secreting progesterone until the placenta takes over. **Final Answer:** Progesterone (and some oestrogen) $\Rightarrow$ B

Answer: (B) Go Back to Q32

Q33.

Solution

Concept — Chorionic Villi: Finger-like outgrowths of the trophoblast (later trophoblast + extra-embryonic mesoderm) that interdigitate with the endometrium. They form the foetal half of the placenta and house foetal capillaries for nutrient/gas exchange.

Tip: Sample of villi (CVS) at 10–12 weeks can detect chromosomal disorders. **Final Answer:** Trophoblast + mesoderm of the embryo $\Rightarrow$ C

Answer: (C) Go Back to Q33

Q34.

Solution

Concept — LH Surge: A sharp peak in luteinising hormone in the middle of the 28-day cycle, around day 13–14. It triggers ovulation about 16–24 hours later. The surge is itself triggered by sustained high oestrogen produced by the maturing dominant follicle (positive feedback).

Tip: Home ovulation kits detect this LH peak in urine. **Final Answer:** Day 14 (around mid-cycle) $\Rightarrow$ B

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Umbilical Cord Origin: The allantois (an endodermal outgrowth from the hindgut) plus the surrounding extra-embryonic mesoderm contribute the blood vessels that become the umbilical artery and umbilical vein, forming the umbilical cord.

Tip: The amnion forms the protective fluid sac; the chorion forms the foetal side

of the placenta; the yolk sac is reduced in humans. **Final Answer:** Allantois + umbilical mesoderm ⇒ B

Answer: (B) Go Back to Q35

Q36.

Solution

Concept — Lactational Amenorrhoea: Intense, exclusive breastfeeding raises serum prolactin which suppresses GnRH and hence ovulation. Effective up to about 6 months postpartum if the woman is breastfeeding exclusively and is amenorrhoeic.

Tip: A useful natural method, but the suppression weakens once supplementary feeds begin. **Final Answer:** Exclusive breastfeeding ⇒ A

Answer: (A) Go Back to Q36

Q37.

Solution

Concept — Copper-T (Cu-T): An intrauterine device that releases copper ions. The copper ions are spermicidal and they also create a local inflammatory reaction in the uterus that prevents fertilisation and implantation.

Tip: LNG-IUDs (Mirena, Progestasert) release progestin instead of copper. **Final Answer:** IUD releasing copper ions toxic to sperm ⇒ B

Answer: (B) Go Back to Q37

Q38.

Solution

Concept — MTP Time Limits: The MTP Act (1971, amended 2021) allows termination on prescribed grounds up to 20 weeks with one doctor's opinion and up to 24 weeks (with two doctors' opinion) in specified categories. The *relatively safe* window, however, is the first trimester (up to 12 weeks).

Tip: Beyond 12 weeks the procedure is more complex and risk rises. **Final Answer:** 12 weeks (first trimester) ⇒ B

Answer: (B) Go Back to Q38

Q39.

Solution

Concept — Amniocentesis Misuse: A medical test that withdraws amniotic fluid for prenatal diagnosis of foetal disorders (e.g., chromosomal). When misused for foetal sex determination, it has fuelled female foeticide; the practice is banned by the PCPNDT Act, 1994.

Tip: Foetal karyotyping is the legitimate clinical use. **Final Answer:** Sex determination and selective abortion (banned) $\Rightarrow$ B

Answer: (B) Go Back to Q39

Q40.

Solution

Concept — ZIFT: *Zygote Intra Fallopian Transfer*. The egg is fertilised *in vitro*, and the resulting zygote (within 8 cells) is transferred into the woman's fallopian tube. Distinct from IVF-ET (transfer into the uterus) and GIFT (transfer of unfertilised gametes).

Tip: GIFT, ZIFT, IVF, ICSI are common ART acronyms tested in MHT CET. **Final Answer:** Zygote Intra Fallopian Transfer $\Rightarrow$ B

Answer: (B) Go Back to Q40

Q41.

Solution

Concept — Mendel's Law of Segregation: During gamete formation, the two alleles of a gene separate (segregate) from each other so that each gamete carries only one of the two alleles. This law explains the $3{:}1$ phenotypic and $1{:}2{:}1$ genotypic ratio in F_2 of a monohybrid cross.

Tip: Sometimes called the law of *purity of gametes* – gametes are never hybrid. **Final Answer:** Two alleles separate during gamete formation $\Rightarrow$ B

Answer: (B) Go Back to Q41

Q42.

Solution

Concept — Dihybrid Cross F_2 Ratio: For two independently assorting gene pairs, the F_2 phenotypic ratio is $9{:}3{:}3{:}1$ – 9 both dominant, 3 first dominant + second recessive, 3 first recessive + second dominant, 1 both recessive. (This was Mendel's experimental result with round/wrinkled and yellow/green peas.)

Tip: For three genes, the F_2 ratio is $27{:}9{:}9{:}9{:}3{:}3{:}3{:}1$. **Final Answer:** $9{:}3{:}3{:}1 \Rightarrow$ C

Answer: (C) Go Back to Q42

Q43.

Solution

Concept — Incomplete Dominance: The heterozygote shows a phenotype intermediate between the two homozygotes. Snapdragon: RR (red) $\times rr$ (white) $\rightarrow Rr$ (pink). F_2 ratio is $1{:}2{:}1$ phenotypically and genotypically.

Tip: Codominance (e.g., ABO blood groups) is different – both alleles are simultaneously expressed. **Final Answer:** Snapdragon flower colour $\Rightarrow$ B

Answer: (B) Go Back to Q43

Q44.

Solution

Concept — ABO System – Multiple Alleles and Codominance: Three alleles (I^A, I^B, i) govern the gene – multiple allelism. I^A and I^B are codominant (both expressed in AB heterozygotes); both are dominant over i.

Tip: Genotypes: AA or AO $\rightarrow$ A; BB or BO $\rightarrow$ B; AB $\rightarrow$ AB; OO $\rightarrow$ O. **Final Answer:** Multiple alleles + codominance $\Rightarrow$ B

Answer: (B) Go Back to Q44

Q45.

Solution

Concept — Colour Blindness: A defect of the cone pigment gene located on the X chromosome (mostly the red-green type). It is recessive: a male is affected if his single X carries the gene; a female is affected only if both her X's do. Hence colour blindness is much more common in men.

Tip: Other X-linked recessive diseases: haemophilia, Duchenne muscular dystrophy. **Final Answer:** X-linked recessive $\Rightarrow$ B

Answer: (B) Go Back to Q45

Q46.

Solution

Concept — Down Syndrome: An autosomal aneuploidy: trisomy of chromosome 21 (47, +21). Discovered by Langdon Down (1866). Features include mental retardation, characteristic facial features, broad palm with crease, and sometimes congenital heart defects.

Tip: Edwards syndrome = trisomy 18; Patau syndrome = trisomy 13. **Final Answer:** Trisomy of chromosome 21 $\Rightarrow$ B

Answer: (B) Go Back to Q46

Q47.

Solution

Concept — Watson–Crick Model (1953): Two antiparallel polynucleotide chains coiled around a common axis – a right-handed double helix. The bases pair specifically: A=T (2 H-bonds), G≡C (3 H-bonds). The diameter is 20 Å, the rise per base pair is 3.4 Å, and one complete turn covers 34 Å (10 base pairs).

Tip: Earned them the Nobel Prize in 1962, shared with Wilkins. **Final Answer:** Watson and Crick $\Rightarrow$ B

Answer: (B) Go Back to Q47

Q48.

Solution

Concept — Semi-Conservative DNA Replication: Meselson & Stahl (1958) used ^{15}N density labelling. After one round of replication in ^{14}N, all DNA was hybrid (one heavy + one light strand). After two rounds, half was hybrid and half was light – the classic pattern predicted by semi-conservative replication.

Tip: Conservative or dispersive models would have given a different density profile, which the experiment ruled out. **Final Answer:** Semi-conservative $\Rightarrow$ B

Answer: (B) Go Back to Q48

Q49.

Solution

Concept — DNA Ligase: Seals nicks between adjacent Okazaki fragments on the lagging strand by forming the missing phosphodiester bond using ATP (or NAD+). Without ligase, the lagging strand would remain fragmented.

Tip: Same ligase is the workhorse of recombinant DNA technology – it joins vector + insert. **Final Answer:** DNA ligase $\Rightarrow$ C

Answer: (C) Go Back to Q49

Q50.

Solution

Concept — Template Strand: RNA is synthesised in the $5' \rightarrow 3'$ direction. Therefore the DNA strand that is read by RNA polymerase must be in the $3' \rightarrow 5'$ direction – this is the *template* or *antisense* strand. The other strand (coding strand) has the same sequence as the mRNA (with T instead of U).

Tip: Only one strand is used per gene; which one is template depends on the orientation of the gene. **Final Answer:** Antisense (template) strand $\Rightarrow$ B

Answer: (B) Go Back to Q50

Q51.

Solution

Concept — Spliceosome: Eukaryotic hnRNA contains introns (non-coding) and exons (coding). The spliceosome – a complex of small nuclear ribonucleoproteins (snRNPs U1, U2, U4, U5, U6) – excises introns and joins exons *inside the nucleus* before the mature mRNA is exported.

Tip: 5'-cap and poly-A tail are also added in the nucleus. **Final Answer:** Nucleus (spliceosome) $\Rightarrow$ B

Answer: (B) Go Back to Q51

Q52.

Solution

Concept — Start Codon: **AUG** codes for methionine in eukaryotes (and N-formylmethionine in prokaryotes). It also serves as the universal start codon. The three stop codons are UAA (ochre), UAG (amber), and UGA (opal).

Tip: Out of 64 codons: 1 start, 3 stop, 60 code for amino acids; degeneracy means most amino acids have multiple codons. **Final Answer:** AUG $\Rightarrow$ C

Answer: (C) Go Back to Q52

Q53.

Solution

Concept — Human Genome Project: Launched 1990, declared essentially complete in 2003 (the year that the consensus reference sequence was published). Sequenced about 3.2×10^9 base pairs spread across 23 chromosome pairs and identified $\approx 20{,}000$–$25{,}000$ protein-coding genes.

Tip: A finished, gap-filled human genome (T2T consortium) was published in 2022. **Final Answer:** 2003 $\Rightarrow$ B

Answer: (B) Go Back to Q53

Q54.

Solution

Concept — Darwin and Natural Selection: In his book *On the Origin of Species* (1859), Darwin proposed that evolution proceeds by natural selection of heritable variations – "descent with modification". Wallace independently came to the same idea; the joint Darwin–Wallace paper was read in 1858.

Tip: Lamarck (inheritance of acquired characters) and Hugo de Vries (mutation theory) are alternative/competing earlier theories. **Final Answer:** Charles Darwin $\Rightarrow$ B

Answer: (B) Go Back to Q54

Q55.

Solution

Concept — Hardy–Weinberg Assumptions: Allele frequencies remain constant only if (i) the population is very large; (ii) mating is random; (iii) no mutation, migration or selection occurs; and (iv) all individuals are equally fertile. *Strong genetic drift* violates the large-population requirement, so it is NOT among the Hardy–Weinberg conditions.

Tip: Genetic drift is significant in small populations and produces evolutionary change. **Final Answer:** Strong genetic drift (this violates HWE) $\Rightarrow$ D

Answer: (D) Go Back to Q55

Q56.

Solution

Concept — Homologous Structures and Divergent Evolution: Organs that share a common embryonic origin and basic anatomical plan but perform differ-

ent functions in different species. They evidence *divergent* evolution from a shared ancestor (adaptive radiation).

Tip: Analogous structures (wings of insect vs. bird) evidence *convergent* evolution from unrelated origins. **Final Answer:** Divergent evolution from common ancestor $\Rightarrow$ B

Answer: (B) Go Back to Q56

Q57.

Solution

Concept — Industrial Melanism: Before the Industrial Revolution in England, light-coloured peppered moths were camouflaged on lichen-covered tree trunks. Soot pollution killed the lichens, blackening the tree trunks. The dark (melanic) variant gained survival advantage. The frequency of the melanic morph rose dramatically – a textbook case of natural selection responding to a man-made environmental change.

Tip: When pollution was controlled, light forms made a comeback – demonstrating reversibility. **Final Answer:** Natural selection $\Rightarrow$ B

Answer: (B) Go Back to Q57

Q58.

Solution

Concept — Adaptive Radiation: The diversification of a single ancestral species into multiple new species occupying different ecological niches. Darwin's finches on the Galapagos – 13 species derived from a single ancestor with beaks adapted to different food sources – are the prototype example.

Tip: Marsupial diversification in Australia is another classical case. **Final Answer:** Adaptive radiation $\Rightarrow$ C

Answer: (C) Go Back to Q58

Q59.

Solution

Concept — Earliest Bipedal Hominid: *Australopithecus afarensis* (e.g., the famous Lucy fossil, ≈ 3.2 million years old, found in Ethiopia) is widely accepted as the earliest hominid for which bipedal locomotion is well-documented.

Tip: *Ramapithecus* and *Dryopithecus* are earlier hominoids; *Homo sapiens* appeared much later ($\approx$ 200,000 years ago). **Final Answer:** Australopithecus $\Rightarrow$ B

Answer: (B) Go Back to Q59

Q60.

Solution

Concept — Miller–Urey Experiment (1953): A sealed apparatus simulated the early Earth atmosphere – CH_4, NH_3, H_2 and water vapour – with electric sparks (lightning). After about a week, several amino acids (including alanine, glycine, and aspartic acid) were detected in the residue. Showed that abiotic synthesis of organic monomers is chemically plausible.

Tip: Supports Oparin–Haldane hypothesis of chemical evolution. **Final Answer:** Abiotic formation of organic molecules $\Rightarrow$ B

Answer: (B) Go Back to Q60

Q61.

Solution

Concept — Malaria Parasite: *Plasmodium* (P. vivax, P. falciparum, P. malariae, P. ovale, P. knowlesi) is the protozoan parasite. The vector is the female *Anopheles* mosquito, which transmits sporozoites through its bite. The exoerythrocytic phase occurs in liver hepatocytes; the erythrocytic phase causes recurring fevers.

Tip: Falciparum is the deadliest species; vivax is the most common in India. **Final Answer:** Plasmodium + female Anopheles $\Rightarrow$ B

Answer: (B) Go Back to Q61

Q62.

Solution

Concept — HIV and AIDS: HIV is a retrovirus (single-stranded RNA + reverse transcriptase). It infects helper T cells ($CD4^+$ T cells), macrophages and dendritic cells. Progressive depletion of $CD4^+$ T cells leads to immunodeficiency (AIDS).

Tip: Diagnosis: ELISA + Western blot, or HIV PCR. **Final Answer:** HIV $\Rightarrow$ B

Answer: (B) Go Back to Q62

Q63.

Solution

Concept — Cell-Mediated Immunity (CMI): Mediated by T-lymphocytes (mainly T_C cytotoxic T cells and T_H helper T cells), it deals with intracellular pathogens (viruses, intracellular bacteria) and tumour cells. B-cells, by contrast, drive humoral (antibody-mediated) immunity.

Tip: The thymus is the site of T-cell maturation. **Final Answer:** T-lymphocytes $\Rightarrow$ B

Answer: (B) Go Back to Q63

Q64.

Solution

Concept — Liver as Detoxifier: Hepatocytes contain a large amount of cytochrome P450 (smooth ER) and Phase II conjugation enzymes that biotransform drugs, alcohol, hormones and toxins into water-soluble forms for excretion. This is drug metabolism / detoxification.

Tip: Liver also produces urea (urea cycle) and bile. **Final Answer:** Drug metabolism and detoxification $\Rightarrow$ C

Answer: (C) Go Back to Q64

Q65.

Solution

Concept — Heroin: A semi-synthetic opioid – diacetylmorphine – derived from morphine, which itself is extracted from the opium poppy *Papaver somniferum*. Used illicitly (also called smack or junk). Highly addictive depressant of the CNS.

Tip: Cocaine $\rightarrow$ coca; cannabis $\rightarrow$ hemp; tobacco $\rightarrow$ nicotine – different drug sources. **Final Answer:** Opium poppy $\Rightarrow$ C

Answer: (C) Go Back to Q65

Q66.

Solution

Concept — Out-crossing: The mating of two animals of the same breed but with no common ancestry for 4–6 generations. It restores heterozygosity, recovers vigour, and overcomes inbreeding depression caused by accumulated deleterious

recessives.

Tip: Cross-breeding (two different breeds) and interspecific hybridisation are even broader strategies. **Final Answer:** Out-crossing / out-breeding $\Rightarrow$ B

Answer: (B) Go Back to Q66

Q67.

Solution

Concept — Apiculture: The maintenance of honeybee colonies in man-made hives for honey, beeswax and pollination services. *Apis mellifera* (Italian bee) is widely used in commercial apiculture.

Tip: Sericulture = silkworm; pisciculture = fish; aquaculture = aquatic species; lac culture = lac insects. **Final Answer:** Honeybees $\Rightarrow$ B

Answer: (B) Go Back to Q67

Q68.

Solution

Concept — Totipotency: A plant cell carries all the genetic information needed to give rise to a complete plant. By providing the correct nutrient medium and hormones (auxin + cytokinin), an explant can be induced to form a callus, then organs, and finally an entire plantlet. Demonstrated by F. C. Steward in carrot cells.

Tip: Same principle underlies micropropagation (huge numbers of clonal plantlets), somatic embryogenesis and protoplast fusion. **Final Answer:** Totipotency $\Rightarrow$ B

Answer: (B) Go Back to Q68

Q69.

Solution

Concept — Curd Formation: *Lactobacillus* species (LAB – lactic acid bacteria, especially *L. acidophilus* and *L. bulgaricus*) ferment lactose in milk into lactic acid. The drop in pH coagulates the milk proteins (casein) into curd.

Tip: Yeasts (Saccharomyces) ferment sugar to ethanol – used in bread, beer, wine. **Final Answer:** Lactobacillus species $\Rightarrow$ B

Answer: (B) Go Back to Q69

Q70.

Solution

Concept — Methanogens in Biogas: The anaerobic digester is dominated by *methanogenic archaea* (*Methanobacterium*, *Methanococcus*, *Methanosarcina*), which convert the products of fermentation ($CO_2 + H_2$, formate, acetate) into methane (CH_4). Biogas is ≈ 55–$70\% CH_4 + 30$–$45\% CO_2$.

Tip: Cow dung is rich in methanogens, which is why it is the typical inoculum for rural biogas plants. **Final Answer:** Methanogenic archaea $\Rightarrow$ B

Answer: (B) Go Back to Q70

Q71.

Solution

Concept — Discovery of Penicillin: Alexander Fleming (1928) noticed that the mould *Penicillium notatum* on a culture plate had inhibited a surrounding zone of *Staphylococcus*. The active substance, isolated by Florey and Chain in the 1940s, was named penicillin – the first antibiotic. They received the 1945 Nobel Prize.

Tip: Today industrial production uses *P. chrysogenum*. **Final Answer:** Penicillium notatum $\Rightarrow$ B

Answer: (B) Go Back to Q71

Q72.

Solution

Concept — Bt Cotton: A transgenic crop carrying *cry* genes (e.g., cry1Ac, cry2Ab) from the soil bacterium *Bacillus thuringiensis*. The Cry protoxin, ingested by boll-worm larvae, is activated in the alkaline midgut, binds to gut epithelial receptors, and lyses the gut wall – killing the insect. Reduces pesticide use.

Tip: The same bacterium contributes the Bt brinjal (eggplant) cry gene. **Final Answer:** Bacillus thuringiensis $\Rightarrow$ A

Answer: (A) Go Back to Q72

Q73.

Solution

Concept — Tools of Recombinant DNA Technology: (i) Restriction enzymes (cutting); (ii) Vectors – plasmids, bacteriophages, cosmids, BACs (carrying); (iii) Suitable host cells (*E. coli*, yeast, animal cells); (iv) DNA ligase, polymerases, gel electrophoresis kit, etc. Photosynthetic enzymes are NOT part of the standard rDNA toolkit.

Tip: The three pillars are often summarised as "cut, paste, copy". **Final Answer:** Photosynthetic enzymes (not needed) $\Rightarrow$ D

Answer: (D) Go Back to Q73

Q74.

Solution

Concept — EcoRI Recognition: EcoRI (from *E. coli* strain RY13) recognises the palindromic hexanucleotide $5'$-GAATTC-$3'$ and cuts between G and A on both strands, leaving 4-nucleotide 5' overhangs (AATT) – called *sticky ends* because two such ends can re-anneal.

Tip: Other common enzymes: BamHI (GGATCC), HindIII (AAGCTT), SmaI (CCCGGG, blunt). **Final Answer:** GAATTC, sticky ends $\Rightarrow$ A

Answer: (A) Go Back to Q74

Q75.

Solution

Concept — Taq Polymerase: A heat-stable DNA polymerase isolated from *Thermus aquaticus*, a thermophilic bacterium of hot springs. It retains activity through repeated denaturation steps at 95°C, which makes the PCR thermal-cycler workflow possible.

Tip: Pfu polymerase (from Pyrococcus furiosus) has proof-reading and is used for high-fidelity PCR. **Final Answer:** Taq polymerase $\Rightarrow$ C

Answer: (C) Go Back to Q75

Q76.

Solution

Concept — Gel Electrophoresis: DNA is negatively charged due to its phosphate backbone. When an electric field is applied across an agarose gel, the DNA migrates from the well (loaded near the cathode) toward the positive electrode

(anode). Smaller fragments move faster.

Tip: EtBr or SYBR dye is used to visualise the bands under UV. **Final Answer:** Anode (positive electrode) $\Rightarrow$ A

Answer: (A) Go Back to Q76

Q77.

Solution

Concept — Humulin (1983): The first commercial therapeutic protein made by recombinant DNA technology, by Eli Lilly. The genes for the A and B chains of human insulin were inserted separately into *E. coli*; the two chains were then combined by disulphide bridges to give functional insulin.

Tip: Modern long-acting analogues include glargine and detemir. **Final Answer:** Humulin $\Rightarrow$ B

Answer: (B) Go Back to Q77

Q78.

Solution

Concept — Bt Toxin Activation: The crystalline protoxin produced by the bacterium (or expressed in transgenic plants) is inactive. In the larva's *alkaline* midgut (pH $\approx$ 9–10.5), the crystal dissolves and gut proteases cleave it into the active toxin, which then binds to gut epithelial receptors. Hence harmless to humans (acidic stomach).

Tip: This selectivity is why Bt is considered relatively safe – mammals lack both the alkaline gut pH and the receptor. **Final Answer:** Activated in alkaline larval midgut $\Rightarrow$ B

Answer: (B) Go Back to Q78

Q79.

Solution

Concept — First Gene Therapy: Ashanti DeSilva (1990, USA), a 4-year-old girl with ADA deficiency causing SCID, was the first patient given gene therapy. Lymphocytes were isolated, transduced ex vivo with a retroviral vector carrying the normal ADA gene, and re-infused. The therapy was supplementary to enzyme-replacement.

Tip: Permanent cure would require gene introduction into hematopoietic stem cells – now being attempted. **Final Answer:** ADA-deficient SCID $\Rightarrow$ B

Answer: (B) Go Back to Q79

Q80.

Solution

Concept — Biopiracy: The use, by industries or governments of one country, of bioresources or associated traditional knowledge from another country without authorisation or fair compensation. The basmati and neem patent issues mobilised India to invoke the Convention on Biological Diversity (CBD) and the TKDL (Traditional Knowledge Digital Library) defensive mechanism.

Tip: Turmeric patent was successfully revoked by India in the late 1990s. **Final Answer:** Biopiracy $\Rightarrow$ B

Answer: (B) Go Back to Q80

Q81.

Solution

Concept — Population: A group of individuals of the same species living in a defined area at a given time, capable of interbreeding. Several populations of different species = community; community + abiotic factors = ecosystem; many ecosystems with similar climate = biome.

Tip: Population attributes: density, natality, mortality, sex ratio, age distribution. **Final Answer:** Population $\Rightarrow$ B

Answer: (B) Go Back to Q81

Q82.

Solution

Concept — Logistic Growth: When resources are finite, exponential growth is gradually slowed by environmental resistance. The result is the sigmoid (S-shaped) Verhulst–Pearl logistic curve, with the population approaching the carrying capacity (K) asymptotically. $\frac{dN}{dt} = rN\frac{K-N}{K}$.

Tip: Real populations usually approximate logistic, with overshoot/oscillation around K. **Final Answer:** Logistic (sigmoid) $\Rightarrow$ B

Answer: (B) Go Back to Q82

Q83.

Solution

Concept — Commensalism: A relationship in which one species (commensal) benefits while the other (host) is neither helped nor harmed. Example: orchids growing on the branches of a mango tree; barnacles on a whale; sea anemone on a hermit crab's shell.

Tip: Mutualism = both gain; parasitism = host loses; predation = predator gains, prey is killed. **Final Answer:** Commensalism $\Rightarrow$ B

Answer: (B) Go Back to Q83

Q84.

Solution

Concept — Lichen Mutualism: A symbiotic association between a fungus (mycobiont, often Ascomycota) and an alga or cyanobacterium (phycobiont). The alga photosynthesises; the fungus provides physical support, water and minerals. Both partners benefit.

Tip: Lichens are extremely sensitive to air pollution and so serve as biological indicators of air quality. **Final Answer:** Mutualism $\Rightarrow$ B

Answer: (B) Go Back to Q84

Q85.

Solution

Concept — Aquatic Primary Productivity: Photosynthetic plankton (microscopic algae and cyanobacteria, collectively phytoplankton) are the main primary producers in open oceans and most freshwater bodies. Larger plants are restricted to shallow margins.

Tip: Net primary productivity (NPP) of the world's oceans, despite low standing biomass, is comparable to that of all terrestrial ecosystems put together. **Final Answer:** Phytoplankton $\Rightarrow$ B

Answer: (B) Go Back to Q85

Q86.

Solution

Concept — Ten-Per-Cent Law (Lindeman): Only about 10% of the energy at one trophic level is transferred to the next; the rest is lost as heat (respiration), unassimilated waste, or used for the organism's own metabolism. Hence the energy pyramid is always upright and narrows steeply.

Tip: Pyramid of energy is the only pyramid that is always upright; biomass and number can be inverted in some ecosystems. **Final Answer:** Decreases (10% law) $\Rightarrow$ B

Answer: (B) Go Back to Q86

Q87.

Solution

Concept — Inverted Pyramid of Biomass: In aquatic ecosystems (e.g., a pond), the producers are tiny phytoplankton with a short life and rapid turnover. Their standing biomass at any instant is small, but they support a large biomass of consumers. Hence the biomass pyramid is inverted (small base, larger upper levels).

Tip: Pyramid of *numbers* can also be inverted, e.g., a single tree (one producer) supporting many insects, birds, etc. **Final Answer:** Inverted (in aquatic ecosystems) $\Rightarrow$ B

Answer: (B) Go Back to Q87

Q88.

Solution

Concept — Nitrogen Reservoir: The atmosphere is the largest reservoir of nitrogen, with about 78% by volume as N_2. However, this molecular nitrogen is inert and must be "fixed" (by lightning, industrial Haber process, or biological nitrogen fixation by *Rhizobium*, *Azotobacter*, cyanobacteria) into ammonia/nitrate before plants can use it.

Tip: Nitrogen cycle key steps: fixation $\rightarrow$ ammonification $\rightarrow$ nitrification $\rightarrow$ assimilation $\rightarrow$ denitrification. **Final Answer:** Atmosphere $\Rightarrow$ A

Answer: (A) Go Back to Q88

Q89.

Solution

Concept — Pioneer Community: On bare rock, the first colonisers (the pioneer community) are crustose lichens, which secrete acids that slowly weather the rock and accumulate soil. Once soil is built up, mosses replace lichens; later, herbs, shrubs and finally trees – forming a climax community.

Tip: Primary succession on a water body (hydrosere) starts with phytoplankton. **Final Answer:** Lichens $\Rightarrow$ B

Answer: (B) Go Back to Q89

Q90.

Solution

Concept — Second Law of Thermodynamics: In every energy transformation, some energy is dispersed as heat (the entropy of the universe increases). In an ecosystem, this is why the energy pyramid is always upright – only $\approx 10\%$ of consumed energy is incorporated as new biomass; the rest is lost as heat. The flow of energy through the biosphere is one-way (unlike the cyclic flow of matter).

Tip: The first law says energy is conserved; the second law explains why ecological efficiency is far less than 100%. **Final Answer:** Second law of thermodynamics $\Rightarrow$ B

Answer: (B) Go Back to Q90

Q91.

Solution

Concept — Three Levels of Biodiversity: (i) Genetic – variation within a species; (ii) Species – the variety of species in a given area; (iii) Ecosystem – the variety of habitats and ecological processes. The question describes the second of these.

Tip: Edward O. Wilson popularised the term "biodiversity". **Final Answer:** Species diversity $\Rightarrow$ B

Answer: (B) Go Back to Q91

Q92.

Solution

Concept — Biodiversity Hot Spot (Norman Myers, 1988): A region with very high species richness, a high level of endemism, AND severe threat of habitat loss (at least 70% of original habitat already lost). There are 36 hot spots globally; In-

dia has 4 (Western Ghats–Sri Lanka, Indo-Burma, Himalaya, Sundaland–Nicobar).

Tip: "Endemism" means species found nowhere else. **Final Answer:** High endemism + severe habitat loss $\Rightarrow$ A

Answer: (A) Go Back to Q92

Q93.

Solution

Concept — Indian Hot Spots: (i) Western Ghats and Sri Lanka; (ii) Indo-Burma; (iii) Himalaya; (iv) Sundaland (including Nicobar). The Sahara is a desert biome with low endemism – it is NOT a biodiversity hot spot.

Tip: Hot spots cover $\approx 2.3\%$ of Earth's land surface yet harbour about half of all plant species. **Final Answer:** Sahara Desert $\Rightarrow$ D

Answer: (D) Go Back to Q93

Q94.

Solution

Concept — *Ex-situ* Conservation: Conserving species *outside* their natural habitat. Includes zoos, botanical gardens, gene banks, seed banks, sperm/ovum banks, cryopreservation, and tissue culture banks. *In-situ* conservation, in contrast, is within natural habitats – biosphere reserves, national parks, sanctuaries and sacred groves.

Tip: Seed banks like the SVALBARD Global Seed Vault store seeds at -18°C as biological insurance. **Final Answer:** Zoos, gardens, gene banks, cryopreservation $\Rightarrow$ B

Answer: (B) Go Back to Q94

Q95.

Solution

Concept — Red Data Book: A document maintained by the IUCN (International Union for Conservation of Nature) that categorises species by extinction risk: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern.

Tip: The categories were formalised in 1994 and revised in 2001. **Final Answer:** IUCN $\Rightarrow$ B

Answer: (B) Go Back to Q95

Q96.

Solution

Concept — Earth Summit, 1992: The UN Conference on Environment and Development was held in Rio de Janeiro, Brazil. Major outcomes: Agenda 21, the UN Framework Convention on Climate Change (UNFCCC), and the Convention on Biological Diversity (CBD). India is a signatory to the CBD.

Tip: Stockholm 1972 was the earlier UN Conference on the Human Environment that gave birth to UNEP. **Final Answer:** Rio de Janeiro, 1992 $\Rightarrow$ B

Answer: (B) Go Back to Q96

Q97.

Solution

Concept — Eutrophication: Nutrient enrichment of water bodies, mainly by N and P fertiliser runoff, sewage and detergents. The result is algal blooms; on death of the algae, the decomposers consume the dissolved oxygen, resulting in fish kill and "dead zones".

Tip: Cultural (anthropogenic) eutrophication is the rapid form caused by human activity; natural eutrophication is geological in pace. **Final Answer:** Eutrophication $\Rightarrow$ A

Answer: (A) Go Back to Q97

Q98.

Solution

Concept — Silent Spring (1962): Rachel Carson's landmark book documented biomagnification of DDT and other persistent pesticides in food chains and its lethal effect on bird populations (especially raptors, whose egg-shells became thin). The book launched the modern environmental movement and eventually led to the US ban on DDT.

Tip: Biomagnification = increase in concentration of a non-degradable pollutant at successive trophic levels. **Final Answer:** Silent Spring $\Rightarrow$ B

Answer: (B) Go Back to Q98

Q99.

Solution

Concept — Ozone Depletion by CFCs: In the stratosphere, ultraviolet radiation cleaves the C–Cl bond of CFCs to release Cl radicals. Each Cl radical can catalytically destroy thousands of O_3 molecules: $Cl + O_3 \rightarrow ClO + O_2$, $ClO + O \rightarrow Cl + O_2$. This was the basis for the Montreal Protocol, 1987.

Tip: The Antarctic "ozone hole" over the South Pole is the most dramatic consequence. **Final Answer:** Chlorine free radicals $\Rightarrow$ B

Answer: (B) Go Back to Q99

Q100.

Solution

Concept — Greenhouse Gases: The major anthropogenic greenhouse gas, by both quantity and total radiative forcing, is carbon dioxide (CO_2) released by combustion of fossil fuels, deforestation and cement production. Other GHGs: methane (28$\times$ more potent than CO_2 per molecule, smaller in quantity), nitrous oxide, ozone, and CFCs.

Tip: The Kyoto Protocol (1997) and the Paris Agreement (2015) target greenhouse-gas emissions. **Final Answer:** Carbon dioxide $\Rightarrow$ B

Answer: (B) Go Back to Q100

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	C	4	B	5	C
6	D	7	B	8	C	9	B	10	B
11	A	12	B	13	C	14	B	15	C
16	B	17	D	18	B	19	C	20	B
21	B	22	B	23	C	24	A	25	B
26	B	27	A	28	D	29	B	30	B
31	C	32	B	33	C	34	B	35	B
36	A	37	B	38	B	39	B	40	B
41	B	42	C	43	B	44	B	45	B
46	B	47	B	48	B	49	C	50	B
51	B	52	C	53	B	54	B	55	D
56	B	57	B	58	C	59	B	60	B
61	B	62	B	63	B	64	C	65	C
66	B	67	B	68	B	69	B	70	B
71	B	72	A	73	D	74	A	75	C
76	A	77	B	78	B	79	B	80	B
81	B	82	B	83	B	84	B	85	B
86	B	87	B	88	A	89	B	90	B
91	B	92	A	93	D	94	B	95	B
96	B	97	A	98	B	99	B	100	B