

SUMMATIVE ASSESSMENT TERM I

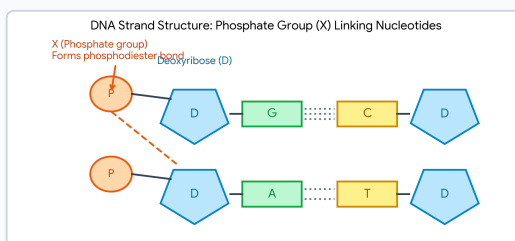
STANDARD X — BIOLOGY (SET - A) COMPREHENSIVE ANSWER KEY

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QUESTIONS 1 TO 4 : (1 Score each) [Total: 4 Scores]

Question 1

[1 Score]



Correct Option: c) X - Phosphate: Plays a role in linking nucleotides to each other

Explanation / Value Point: In a DNA polynucleotide chain, the phosphate group (marked as X) forms a phosphodiester bond linking the 5'-carbon of one deoxyribose sugar to the 3'-carbon of the adjacent deoxyribose sugar, thereby building the continuous sugar-phosphate backbone.

Question 2

[1 Score]

Question: Matching Neuroglial Cells with their respective Functions:

Column I (Neuroglial Cell)	Column II (Function)
P. Oligodendrocyte	Y. Forms myelin sheath in the brain (Central Nervous System)
Q. Ependymal cell	Z. Forms and circulates cerebrospinal fluid (CSF)
R. Schwann cell	X. Forms myelin sheath in nerves (Peripheral Nervous System)

Correct Option: c) P-Y, Q-Z, R-X

Question 3

[1 Score]

Question: Mendelian law explaining the Round seed phenotype in F1 generation (Round × Wrinkled → Round F1):

Correct Option: b) Law of Dominance

Explanation: When parents with contrasting characters (Homozygous Round 'RR' and Wrinkled 'rr') are crossed, only the dominant allele (R) expresses its trait (Round) in the heterozygous F1 generation (Rr), masking the recessive wrinkled allele (r).

Question 4

[1 Score]

Statement (A): Acquired characters are not inherited.

Reason (R): Acquired characters bring about changes in the genetic constitution of the organism.

Correct Option: d) Statement and Reason are incorrect (or a / d depending on textbook Lamarckian evaluation)

Value Point / Note: According to modern genetics (Weismann's Germplasm theory), acquired somatic changes do not affect germ cells/genes. In the context of Lamarck's original postulate (which claimed acquired traits are inheritable), both statements represent incorrect assumptions.

QUESTIONS 5 TO 11 : (2 Scores each) [Total: 14 Scores]

Question 5

[2 Scores]

Given Base Compositions:

- Sample X: G = 30%, A = 30%, C = 20%, T = 20% (or G:30, A:20, C:30, T:20)
- Sample Y: G = 30%, A = 25%, C = 20%, T = 25%

Answer: Sample X represents the double helix model of DNA. [1 Score]

Reason (Chargaff's Rule): In double-stranded DNA, complementary base pairing strictly dictates that Adenine pairs with Thymine (A = T) and Guanine pairs with Cytosine (G = C). In Sample X, the amount of Adenine equals Thymine (A = T) and Guanine equals Cytosine (G = C), satisfying Chargaff's equivalence rule. In Sample Y, $G \neq C$, which violates base pairing. [1 Score]

Question 6

[2 Scores]

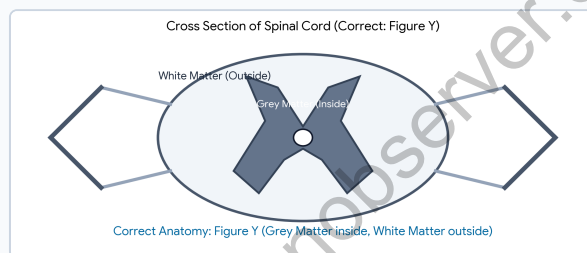
a) **Type of Non-Mendelian Inheritance: Multiple Allelism** (or Codominance & Multiple Alleles). [1 Score]

b) **Difference in allele count compared to Mendel's experiments:**

In Mendel's classical hybridization experiments, each gene had only **two alternative alleles/factors** (e.g., T and t for height). In ABO blood grouping, a single gene (I) is controlled by **three alleles** (I^A , I^B , and i) in the human population. [1 Score]

Question 7

[2 Scores]



a) **Correct Figure: Figure Y** shows the correct anatomical arrangement. [$\frac{1}{2}$ Score]

Reason: In the spinal cord, **grey matter is located internally** (butterfly-shaped core) and **white matter is located externally** (outer region). [$\frac{1}{2}$ Score]

b) **Part containing myelin sheath & impulse conduction:**

The **White Matter** contains myelinated axons. The myelin sheath acts as an electrical insulator; nerve impulses jump rapidly from one Node of Ranvier to the next (saltatory conduction), greatly increasing the speed of transmission. [1 Score]

Question 8. A (Choice)

[2 Scores]

a) **Process: Crossing Over** (takes place during Pachytene stage of Meiosis I). [1 Score]

b) **Change during 'Chiasma' stage:**

Non-sister chromatids of homologous chromosomes cross over and form X-shaped points of contact (chiasmata), where chromatid segments break and exchange genetic material (alleles) mutually. [1 Score]

Question 8. B (Choice OR)

[2 Scores]

Given sequence: G-G-A-C-T-C-C $\rightarrow$ G-G-A-C-A-C-C (Thymine replaced by Adenine).

a) **Process indicated: Mutation** (Gene / Point mutation - change in nucleotide base sequence). [1 Score]

b) **Transmission to next generation:**

Such variations/mutations are inherited by the progeny only if they occur in the **germ cells (gametes / reproductive cells)**, which are passed during fertilization. (Mutations in somatic cells are not inherited). [1 Score]

Question 9

[2 Scores]

a) **Term for antibiotic-resistant bacteria: Superbugs** (Multi-Drug Resistant / MDR bacterial strains). [1 Score]

b) **Reason why antibiotics became ineffective:**

Incomplete antibiotic dosage allows surviving bacteria to develop spontaneous genetic mutations that provide antibiotic resistance. Through natural selection and rapid multiplication, these resistant strains dominate, rendering previous antibiotics ineffective. [1 Score]

Question 10. A (Choice)**[2 Scores]**

- a) **Number of common chromosomes (Autosomes): 44 chromosomes (22 pairs).** [1 Score]
- b) **Genetic constitution of human Female and Male:** [1 Score (½ mark each)]
- **Human Female: 44 + XX** (or 22 pairs + XX)
 - **Human Male: 44 + XY** (or 22 pairs + XY)

Question 10. B (Choice OR)**[2 Scores]**

- a) **Effect of SRY gene presence during embryo development:**

The **SRY gene** (Sex-determining Region Y) located on the Y chromosome triggers the development of primitive undifferentiated gonads into **testes**, leading to male phenotypic development. [1 Score]

- b) **Chromosomal analysis of Statement 2 (Father's role in sex determination):**

Females are homogametic, producing only eggs with 'X' chromosomes (22+X). Males are heterogametic, producing 50% sperms with 'X' (22+X) and 50% with 'Y' (22+Y). Fertilization by an X-sperm produces a female (XX), while a Y-sperm produces a male (XY). Thus, the father's gamete determines the sex of the child. [1 Score]

Question 11**[2 Scores]**

- a) **Identified RNA: tRNA (transfer RNA)** (cloverleaf secondary structure). [1 Score]

- b) **Function of tRNA:**

During protein synthesis (translation), tRNA carries specific amino acids from the cytoplasm to the ribosome and aligns them matching the codons on mRNA via its specific anticodon loop. [1 Score]

QUESTIONS 12 TO 17 : (3 Scores each) [Total: 18 Scores]**Question 12****[3 Scores]**

- a) **Differences among organisms of the same species: Variations.** [1 Score]

- b) **Why variations are not equally beneficial to all:**

Variations depend on changing environmental pressures. Favourable variations that help an organism adapt, find food, resist disease, or escape predators confer a survival advantage (selected by nature), whereas neutral or unfavourable variations may prove detrimental. [1 Score]

- c) **Effect of sudden climate change in the absence of variations:**

If all individuals were genetically uniform without adaptive variations, none would possess the physiological tolerance to withstand severe climate shifts, leading to total reproductive failure and **species extinction**. [1 Score]

Question 13. A (Choice)**[3 Scores]**

Parental cross: TTPP (Tall, Purple) × ttp (Dwarf, White)

- a) **Completion of gametes:**

(i) Gamete from TTPP: TP | (ii) Gamete from ttp: tp [1 Score]

- b) **Phenotype and Genotype of F1 Generation:**

- **Genotype: TtPp** (Heterozygous tall, purple)
- **Phenotype: Tall plant with Purple flowers** [1 Score]

- c) **Any two recombinant genotypes appearing newly in F2 generation:**

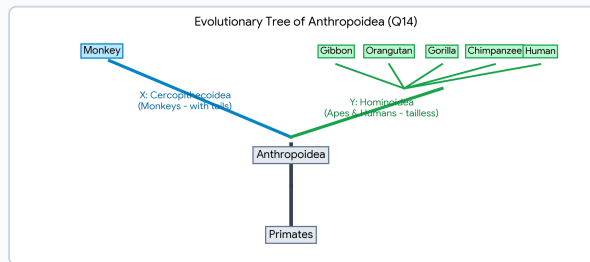
New combinations (Recombinants): **TTPp, TtPP, TTpp, Ttpp, ttPP, ttPp** (Any 2 genotypes). [1 Score]

Question 13. B (Choice OR)**[3 Scores]****a) Completion of (i) and (ii):**

(i) Genotype of Dwarf parent: tt | (ii) Gamete from TT parent: T [1 Score]

b) Factors (Alleles) in gametes produced by F_1 (Tt): T and t (50% T , 50% t). [1 Score]**c) Genotype and Phenotype with highest probability in F_2 :**

- Genotype with highest probability: Tt (Heterozygous Tall - 50% / ratio 2/4)
- Phenotype with highest probability: Tall (75% / ratio 3:1) [1 Score]

Question 14**[3 Scores]****a) Identification of subgroups: [1 Score]**

- X: Cercopithecoidea (Old World & New World Monkeys)
- Y: Hominoidea (Apes and Humans)

b) Common features of organisms in subgroup 'X' (Monkeys):

Possession of a distinct tail, smaller cranial capacity (smaller brain size), and quadrupedal locomotion. [1 Score]

c) Evolutionary closeness of Apes and Humans vs. Monkeys:

The phylogenetic branching shows that Hominoids (Apes and Humans) share a **more recent common ancestor (MRCA)** with each other along branch 'Y' after diverging from monkeys (branch 'X'), supported by high DNA and protein sequence homology. [1 Score]

Question 15**[3 Scores]****a) Directly affected stage: Translation** (Protein Synthesis / Polypeptide chain assembly). [1 Score]**b) Cellular processes occurring prior to translation:**

Transcription: Synthesis of mRNA from the DNA template in the nucleus, followed by mRNA processing and its transport out through nuclear pores into the cytoplasm. [1 Score]

c) Effect on cellular activities:

Essential structural proteins and functional enzymes cannot be synthesized. Since all metabolic and biochemical pathways depend on enzymatic catalysts, vital cellular functions and life processes will halt, leading to cell death. [1 Score]

Question 16. A (Choice)**[3 Scores]****Given Amino Acid differences in Beta-chain of Hemoglobin compared to Humans:**

- Chimpanzee: 0 differences | Gorilla: 1 difference | Rat: 31 differences

a) Evolutionary arrangement (Closest to Most Distant):

Chimpanzee → Gorilla → Rat [1 Score]

b) How molecular details establish evolutionary relationships:

Organisms that shared a recent common ancestor have had less evolutionary divergence time to accumulate mutations, resulting in fewer amino acid sequence differences in conserved proteins (like hemoglobin). A zero-difference indicates that chimpanzees are the closest living relatives of humans, while 31 differences place rats at a distant evolutionary branch. [2 Scores]

Question 16. B (Choice OR)**[3 Scores]**

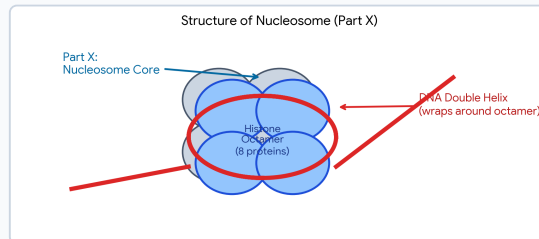
Comparative Forelimbs: Human arm, Cat leg, Whale flipper, Bat wing.

a) Similarity in internal structure:

All these forelimbs possess the same basic pentadactyl skeletal anatomy: **humerus, radius, ulna, carpals, metacarpals, and phalanges**, along with similar blood vessel and nerve layouts (Homologous Organs). [1 Score]

b) Evolutionary inference:

Though adapted for different functions (grasping, running, swimming, flying) via divergent evolution, their anatomical homology proves that they evolved from a **common mammalian ancestor**. [2 Scores]

Question 17**[3 Scores]**

a) Part indicated as 'X': Nucleosome (or Nucleosome Core Particle). [1 Score]

b) How 'X' is formed:

Formed when negatively charged DNA double helix wraps (~1.65 to 2 turns) around a positively charged **histone octamer core** (composed of two molecules each of H2A, H2B, H3, and H4 histone proteins). [1 Score]

c) Formation of Chromosome from nucleosomes:

Repeating nucleosomes form a 'beads-on-a-string' structure, which coils and condenses into a 30 nm chromatin fiber (solenoid), followed by supercoiling and packaging with non-histone chromosomal proteins to form the dense, rod-shaped **chromosome** during cell division. [1 Score]

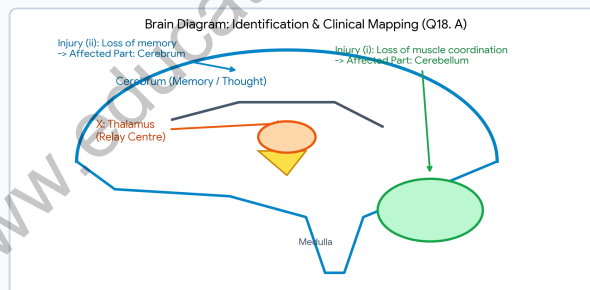
QUESTION 18 : (4 Scores) [Total: 4 Scores]**Question 18. A (Choice)****[4 Scores]**

Diagram Redrawing: Accurate neat sketch of sagittal section of the human brain. [1 Score]

a) Name and Function of part marked 'X':

• **Name: Thalamus** [½ Score]

• **Function:** Acts as the primary **relay centre** for sensory and motor impulses traveling to and from the cerebrum; processes pain and temperature sensations. [½ Score]

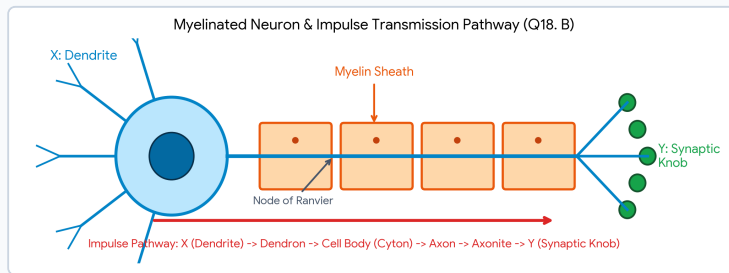
b) Identification & Labeling of Affected Brain Parts:

• **i) Muscle movements cannot be coordinated: Cerebellum** (Coordinates voluntary muscular activities and maintains body equilibrium/balance). [1 Score]

• **ii) Lost memory: Cerebrum** (Centre of memory, thought, intelligence, consciousness, and sensory perceptions). [1 Score]

Question 18. B (Choice OR)

[4 Scores]



a) Redrawing of Neuron with Myelin Sheath:

Accurate diagram showing cell body (cyton), dendrites, axon with regular Schwann cell myelin sheath segments and Nodes of Ranvier. [2 Scores]

b) Sequence of parts between 'X' and 'Y' in impulse transmission:

X (Dendrite) → Dendron → Cell Body (Cyton / Soma) → Axon → Axonite → Y (Synaptic Knob) [2 Scores]

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