

Sri Lankan Biology Olympiad 2020



Instructions:

This paper contains two parts, **A** and **B**.

Part A: 40 multiple choice questions; Total Marks 40.

Part B: 20 correct incorrect answer questions; Total Marks 60.

Answer All Questions.

Time: Two (02) hours

Part A – Multiple Choice Questions

Mark the correct answer with an X on the answer sheet provided

- Which one of the following statements regarding enzymes is correct?
 - (1) Temperature only enhances colliding probability of active sites of the enzymes.
 - (2) In some enzymes beyond the optimum temperature active sites do not change.
 - (3) All enzymes function at the same pH range.
 - (4) pH alters chemical bonds involved in the formation of enzyme- substrate complex.
 - (5) In most enzymes, optimum pH range is 4-8.
- Which one of the following statements is correct regarding plasma membrane?
 - (1) Cholesterol molecules are present in all plasma membranes.
 - (2) Both sides of the plasma membrane have the same structural composition and function.
 - (3) Protein molecules embedded in plasma membrane act as enzymes and hormones.
 - (4) Only phospholipids molecules in the plasma membrane have hydrophobic and hydrophilic parts.
 - (5) Only phospholipids molecules can change their position in the plasma membrane.
- Which one of the following organelle combinations is involved in the formation of glycolipids?
 - (1) RER and SER
 - (2) SER and Golgi complex
 - (3) SER and Glyoxysomes
 - (4) Glyoxysomes and Golgi complex
 - (5) SER and lysosomes

4. Following are few events that take place in meiosis.
 - a. Pairing of homologous chromosomes at metaphase plate.
 - b. Crossing over takes place in some places of homologous chromosomes.
 - c. Two haploid cells are formed.
 - d. Chromosomes with chromatids move to opposite poles.
 - e. Centromere splits and chromatids are separated apart.

Which one of the following shows the correct sequence of the above events in meiosis?

- (1) b, a, d, e and c (2) b, d, a, e and c (3) b, a, d, c and e
 (4) b, a, c, d and e (5) a, b, e, d and c

5. Which of the following statements regarding photosystems is correct?
 - (1) PS I and PS II both absorb 680 nm wave lengths effectively.
 - (2) They are consisted of Chl-a and other accessory pigments only.
 - (3) They are present on thylakoid lamella and stroma of the chloroplast.
 - (4) Light harvesting complex contains primary electron acceptor.
 - (5) They act as electron donors as well as electron acceptors.

6. Which of the following statements is correct regarding cellular respiration?
 - (1) Oxidative phosphorylation occurs in all living cells in human body.
 - (2) Glyceraldehyde 3 phosphate is a common intermediate product formed when any respiratory substrate is used.
 - (3) ATP is not utilized in aerobic respiration.
 - (4) Pyruvate is converted to Acetyl Co-A in cytosol.
 - (5) The amount of ATP produced in plant cell is 32.

7. Darwin and Wallace proposed the theory of natural selection. The events that occur due to the influence of natural selection are as follows
 1. Well-adapted individuals produce more offspring than poorly adapted individuals.
 2. A change occurs in the environment.
 3. Gene frequencies within the population change.
 4. Poorly adapted individuals have decreased survival.

Which of the following indicates the correct sequence of the above events?

- (1) 2 → 4 → 1 → 3
 (2) 4 → 2 → 1 → 3
 (3) 4 → 1 → 2 → 3
 (4) 4 → 2 → 3 → 1
 (5) 2 → 4 → 3 → 1

8. A student collected an organism with differentiated organs. The presence of which of the following features would help to definitively identify this organism as a land plant?
 - (1) alternation of generations
 - (2) sporopollenin
 - (3) vascular tissues
 - (4) flagellated sperm
 - (5) embryos

9. Nematodes
- (1) have longitudinal and circular muscle layers in the body wall.
 - (2) most of them live in the marine environment.
 - (3) are microscopic.
 - (4) do not have circulatory system.
 - (5) are bisexual animals.
10. Which of the following classes contain the organisms that show only internal fertilization?
- (1) Chondrichthyes, Osteichthyes and Mammalia
 - (2) Amphibia, Mammalia and Reptilia
 - (3) Chondrichthyes, Osteichthyes and Reptilia
 - (4) Chondrichthyes, Reptilia and Mammalia
 - (5) Osteichthyes, Reptilia and Amphibia
11. Select the correct statement regarding the hormones associated with the reproduction of man.
- (1) FSH stimulates Leydig cells to produce testosterone.
 - (2) Inhibin produced by Sertoli cells inhibits LH production.
 - (3) Testosterone produced by Sertoli cells inhibits LH.
 - (4) LH secreted by anterior pituitary stimulates the production of testosterone.
 - (5) Inhibin inhibits the production of GnRH by hypothalamus.
12. Which of the following could be seen in a cross section of a human ovary when observed under the compound light microscope?
- (1) Germinal epithelium as the outer most layer of each follicle
 - (2) Medulla containing developing follicles
 - (3) Mature ovum
 - (4) 2nd polar body
 - (5) Corpus albicans
13. Odontoid process is seen in the
- | | | |
|-------------------------|--------------------|--------------|
| (1) temporal bone. | (2) axis vertebra. | (3) sternum. |
| (4) thoracic vertebrae. | (5) mandible. | |
14. Which of the following can be seen in a cross section of the human brain taken perpendicular to the vertical axis of the body across pons Varolii?
- | | | |
|---------------|-----------------------|----------------|
| (1) Thalamus | (2) Cerebrum | (3) Cerebellum |
| (4) Mid brain | (5) Medulla oblongata | |
15. Which of the following statements regarding the action potential of a neuron is correct?
- (1) Any change in the membrane potential generates an action potential.
 - (2) Depolarization occurs due to inflow of K^+ in to the neuron.
 - (3) Sodium channels open during the repolarization phase.
 - (4) During the hyperpolarization phase, potassium channels are closed.
 - (5) Action potential is generated due to inflow of Na^+ at one location of the axon.
16. Which of the following respiratory pigments has a storage function?
- | | | |
|-----------------|-------------------|-------------------|
| (1) Haemoglobin | (2) Haemoerythrin | (3) Chlorocruorin |
| (4) Haemocyanin | (5) Myoglobin | |

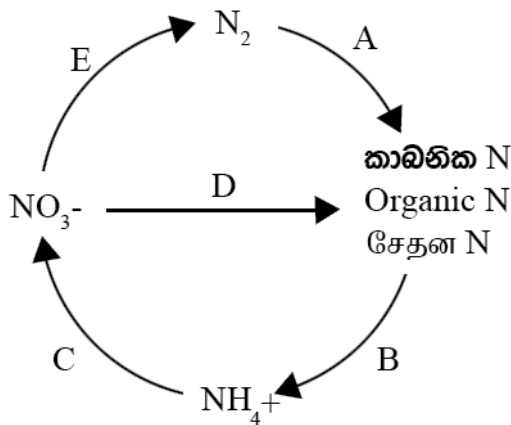
17. A person lost the control of voluntary muscle contraction due to a stroke. This stroke has most probably occurred in the
- (1) cerebrum.
 - (2) thalamus.
 - (3) hypothalamus.
 - (4) mid brain.
 - (5) medulla oblongata.
18. Select the correct statement regarding the human heart.
- (1) Its outermost layer is called serous pericardium.
 - (2) Endocardium consists of cuboidal epithelial cells
 - (3) Myocardium is continuous with the lining of blood vessels.
 - (4) Myocardium is thicker in the lower area than in the upper area
 - (5) Tricuspid valve is present in the left side of the heart.
19. Which of the following statements regarding the stomach of man is incorrect?
- (1) It functions as a storage organ.
 - (2) It has an absorptive function.
 - (3) It has an endocrine function.
 - (4) It is involved in defense.
 - (5) Pepsin is secreted by its chief cells.
20. A specific function of the human liver is
- (1) storage of bile.
 - (2) secretion of interferon.
 - (3) formation of red blood cells.
 - (4) storage of Vitamin B12.
 - (5) formation of fibrin.
21. Select the correct statement regarding the disorders of the human respiratory system.
- (1) Tuberculosis is caused due to dust particles in the air.
 - (2) Asthma is caused due to blocking of bronchioles by dust particles.
 - (3) Lung cancer may occur due to stopping of the action of cilia in the respiratory tract.
 - (4) Natural killer cells present in the lung tissue help to control asbestosis by destroying inhaled asbestos fibres.
 - (5) T cells present in the lung tissue help to control silicosis by ingesting inhaled silica particles.
22. Which of the following “respiratory pigment-main circulatory system of the animals having that pigment” combination is incorrect?
- (1) Haemoglobin – Double circulatory system
 - (2) Haemoglobin – Single circulatory system
 - (3) Haemocyanin – Closed circulatory system
 - (4) Haemoerythrin – Closed circulatory system
 - (5) Chlorocruorin – Closed circulatory system
23. Select the correct statement regarding the immune system of animals.
- (1) Phagocytic cells are involved in adaptive immunity of man.
 - (2) Sebaceous glands contribute to innate immunity of man.
 - (3) T lymphocytes are involved in acquired immunity of mollusks.
 - (4) B lymphocytes are involved in inflammatory response of animals.
 - (5) Histamine is mainly produced by neutrophils present in the connective tissues of man.

24. Which of the following “animal-its main nitrogenous waste” combination is correct?
- (1) Shark - ammonia (2) Tadpole – urea
 (3) Carp – ammonia (4) Toad – uric acid
 (5) Land snail – urea
25. Primary structure of dicot root can be differentiated from the primary structure of monocot root, because in dicot roots
- (1) endodermis is located inner to pericycle.
 (2) core of parenchyma cells is located at the middle.
 (3) contain more vascular bundles.
 (4) pericycle becomes meristematic.
 (5) endodermis blocks cortical apoplast from vascular apoplast.
26. A plant exhibits chlorosis especially in the older and more mature leaves. This is probably due to a deficiency of
- (1) N and Mg.
 (2) O and N.
 (3) S and Ca.
 (4) P and S.
 (5) H and Mg.
27. After double fertilization in Angiosperms, what would be the genotypes of the embryos and endosperm nuclei?
- (1) embryo Y endosperm XY
 (2) embryo XY endosperm XY
 (3) embryo XY endosperm XYY
 (4) embryo XY endosperm XXY
 (5) embryo XX endosperm XXY
28. What color of light would be most effective in promoting stomatal opening?
- (1) red
 (2) far-red
 (3) blue
 (4) red followed by far-red
 (5) far-red followed by blue
29. Which of the following is not a common defense against bacteria and fungi?
- (1) Lignin formation
 (2) Formation of abscission layer
 (3) A waxy covering
 (4) Formation of cell wall degrading enzymes
 (5) Presence of salt glands
30. Water potential
- (1) is the difference between the solute potential and the pressure potential.
 (2) is zero or negative
 (3) occurs due to the movement of water through a membrane.
 (4) determines the direction of water movement between cells.
 (5) is defined as 1.0 MPa for pure water without applying any pressure.

31. Which one of the following statements is correct?
- (1) There are 23 different chromosomes in the human male.
 - (2) Y chromosome in human is longer than X chromosome.
 - (3) In some cases, one allele expresses its phenotypic character.
 - (4) Most X linked recessive disorders are common in females.
 - (5) X chromosomes carry only sex related characters.
32. Which one of the following statements is correct?
- (1) Gene frequencies in a population normally fluctuate with time.
 - (2) In an isolated population, homozygotes decrease whereas heterozygotes increase.
 - (3) Heterosis increases in inbreeding population.
 - (4) Hardy Weinberg equilibrium is a common state in natural populations.
 - (5) Fertile offspring could never be obtained in interspecific breeding.
33. Select correct combinations
- (1) Red Green colour blindness – Pleiotropy
 - (2) ABO blood group – Polygenes
 - (3) Plumage colour of house fowl – recessive epistasis
 - (4) Cystic fibrosis – Pleiotropy
 - (5) Flower colour of *Mirabilis* – Co-dominance
34. Which one of the following is correct?
- (1) The tightly packed chromatin is called euchromatin.
 - (2) Scaffold of chromatin is made up of RNA.
 - (3) Domains of bacterial chromosomes are supercoiled.
 - (4) Histone proteins are present only in the nucleosomes.
 - (5) Dark stained areas of chromatin are called Euchromatin.
35. The following are some events that take place in DNA replication
- A- Ligase forms phosphodiester bonds.
 - B- SSB proteins binds to template strands.
 - C- Polymerase I acts on the primers.
 - D- Polymerase III incorporates nucleotides in the growing strand
 - E- Primer binds to template strand
- Which of the following responses indicates the correct sequence of events that take place in DNA replication?
- (1) E,B,D,A,C
 - (2) B,E,D,C,A
 - (3) B,E,C,D,A
 - (4) B,E,D,A,C
 - (5) E,B,D,C,A
36. Select the incorrect statement regarding GMOs/LMOs.
- (1) GMOs can occur naturally.
 - (2) GMOs may show horizontal gene transfer.
 - (3) Cartagena protocol is for GMOs that affect the biodiversity.
 - (4) Biosafety framework is not legalized yet in Sri Lanka.
 - (5) Production of GMOs is against the natural selection.

37. Which of the following is true regarding detritivores?
- (1) They recycle chemical elements directly to primary consumers.
 - (2) They synthesize organic molecules that are used by primary producers.
 - (3) They convert organic materials from all trophic levels to inorganic compounds.
 - (4) They secrete enzymes that convert organic molecules of detritus into CO₂ and H₂O.
 - (5) Some species are autotrophic, while others are heterotrophic.
38. Which of the following combination represents a community in a particular ecosystem?
- (1) *Drypetes sepiaria*, *Manilkara hexandra*, *Diospyros ebenum*
 - (2) Caribou, Reindeer, brown bear
 - (3) Purple faced langur, Sri Lanka Yellow eared bulbul, Sri Lanka slender loris
 - (4) *Phyllanthus emblica*, *Spinifex littoreus*, *Imperata cylindrica*
 - (5) Antelope, lion, prairie dog
39. Which of the following statements is true regarding microorganisms living in the human body?
- (1) Internal tissues of healthy humans contain few microorganisms.
 - (2) *E. coli* living in large intestine is harmless.
 - (3) Probiotics are opportunistic pathogens.
 - (4) Some microorganisms produce protein endotoxins.
 - (5) Intestine of the Human foetus contains bacteria.

40. This question is based on following diagram on the Nitrogen cycle



Select the response with correct “microorganism – function” combination.

| | <i>Nitrosomonas</i> | <i>Pseudomonas</i> | <i>Nitrobacter</i> | <i>Azotobacter</i> | <i>Agaricus</i> |
|-----|---------------------|--------------------|--------------------|--------------------|-----------------|
| (1) | C | E | D | A | B |
| (2) | C | E | C | A | B |
| (3) | B | C | C | A | D |
| (4) | C | D | C | A | B |
| (5) | A | D | E | C | E |

Part B – Correct Incorrect answer Questions

Mark the correct answer on the answer sheet provided. Use only the symbols \checkmark or X.

1. Indicate whether each of the following statements regarding allosteric regulation of enzymes is correct (\checkmark) or incorrect (X).
 - (1) Allosteric activator always binds to active sites.
 - (2) Cooperativity is a kind of allosteric activator.
 - (3) When an inhibitor attaches to the regulatory sites, it stabilizes the active form of the enzyme.
 - (4) Temperature does not affect allosteric regulation.
 - (5) Allosteric inhibitors are reversible non-competitive inhibitors.
2. Indicate whether each of the following statements regarding protein is correct (\checkmark) or incorrect (X).
 - (1) All proteins get modified in the cell.
 - (2) Myoglobin undergoes primary, secondary and tertiary levels in sequence during its formation.
 - (3) Haemoglobin contains both α helix and β pleated sheets.
 - (4) 3D structure of proteins is maintained due to interactions between side chains and R group of amino acids.
 - (5) Some quaternary structures consist of only one polypeptide chain.
3. Indicate whether each of the following statements regarding photosynthesis is correct (\checkmark) or incorrect (X).
 - (1) Reductase enzyme is involved in the light independent reaction
 - (2) Rubisco is normally absent in mesophyll cells.
 - (3) Both carboxylation and decarboxylation occur in bundle sheath cells of C4 plants.
 - (4) 2 phosphoglycolate is formed in both C3 and C4 plants.
 - (5) CO₂ and O₂ are competitive substrates for Rubisco.
4. Indicate whether each of the following statements regarding evolution of biodiversity is correct (\checkmark) or incorrect (X).
 - (1) RNA in protocells self-replicate and act as enzymes.
 - (2) Scientists do not have experimental evidence to prove that organic monomers can be formed by abiotic synthesis.
 - (3) First photosynthetic organisms were cyanobacteria.
 - (4) Fossils of the oldest known protists were similar to green algae.
 - (5) Cnidarians and molluscs first appeared before Cambrian period .
5. Indicate whether each of the following statements regarding Cnidaria is correct (\checkmark) or incorrect (X).
 - (1) They cannot locomote because they lack true muscle tissue.
 - (2) They are the simplest organisms with a complete alimentary canal.
 - (3) They all have two body forms: polyps and medusae.
 - (4) All of them are marine animals.
 - (5) They have tentacles with cnidocytes.

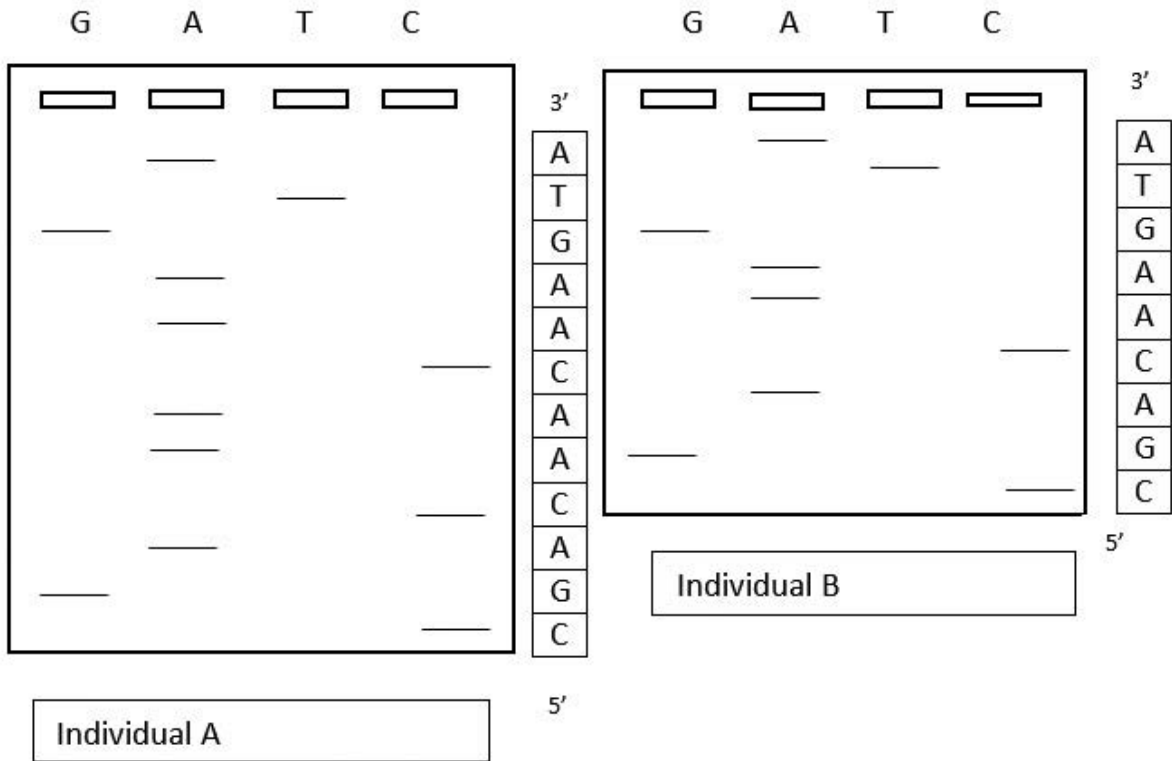
6. Indicate whether each of the following statements regarding receptors of man is correct (\checkmark) or incorrect (X).
- (1) Pacinian corpuscles are mechanoreceptors.
 - (2) Ruffini corpuscles detect cold.
 - (3) Olfactory receptors bear cilia.
 - (4) Sensory receptors are always connected to the nervous system.
 - (5) Pain receptors are special nerve endings.
7. Indicate whether each of the following statements regarding embryonic development of man is correct (\checkmark) or incorrect (X).
- (1) Trophoblast can secrete enzymes.
 - (2) Trophoblast can secrete hormones.
 - (3) Implantation occurs at the blastocyst stage.
 - (4) Morula gets nourishment from the uterine wall.
 - (5) Amnion is associated with the development of the urinary bladder.
8. Indicate whether each of the following statements regarding the skeletal system of man is correct (\checkmark) or incorrect (X).
- (1) Three pairs of ribs do not articulate with the sternum.
 - (2) Sternum articulates with clavicles.
 - (3) Coccyx articulates with sacrum.
 - (4) Largest vertebrae are the thoracic vertebrae.
 - (5) Two pairs of articular facets are present in a lumbar vertebra.
9. Indicate whether each of the following statements regarding the functions of the distal convoluted tubule of the human kidney under normal conditions is correct (\checkmark) or incorrect (X).
- (1) It contributes to regulate blood pH level.
 - (2) It contributes to regulate blood volume.
 - (3) It contributes to regulate blood pressure.
 - (4) Major portion of the glomerular filtrate is reabsorbed in it.
 - (5) It secretes ammonia.
10. Indicate whether each of the following statements regarding the digestive system of man is correct (\checkmark) or incorrect (X).
- (1) Caecum is a part of colon.
 - (2) Vitamin D is produced in the colon of man.
 - (3) Nucleic acids are digested to nitrogenous bases by nucleases.
 - (4) Absorption of glucose in the small intestine requires energy.
 - (5) Absorption of water in the small intestine requires energy.
11. Indicate whether each of the following statements regarding some diseases of man is correct (\checkmark) or incorrect (X).
- (1) Type II diabetes mellitus occurs due to attacking of β cells of pancreas by cytotoxic T lymphocytes.
 - (2) When cytotoxic T cells attack the axon membrane, multiple sclerosis occurs.
 - (3) When antibodies attack the tissues surrounding joints, multiple sclerosis occurs.
 - (4) Many autoimmune diseases occur in men than in women.
 - (5) Rheumatoid arthritis may occur due to genetic factors.

12. Indicate whether each of the following statements regarding regulation of breathing of man is correct (✓) or incorrect (X).
- (1) Negative feedback mechanism is involved in it.
 - (2) Pons Varolii is involved in it
 - (3) A pair of breathing control centres is located in medulla oblongata.
 - (4) Stretch receptors are present in lung tissues.
 - (5) When oxygen concentration of blood is slightly below the optimum level, breathing control centres are stimulated.
13. Indicate whether each of the following statements regarding the secondary tissues in a woody stem is correct (✓) or incorrect (X).
- (1) Elongated initials of vascular cambium produce vascular rays.
 - (2) Periderm is impermeable to water and gasses.
 - (3) Cork cambium breaks down after sometime and a new cork cambium is initiated from its outside.
 - (4) Lumens of Spring wood vessels are wider than those of Summer wood vessels.
 - (5) Softwoods lack xylem vessels.
14. Indicate whether each of the following statements regarding plant growth regulators is correct (✓) or incorrect (X).
- (1) Abscisic acid helps plants to respond to drought.
 - (2) All plant growth regulators are transported from the place of production to trigger responses in target cells.
 - (3) Auxins and ethylene produce antagonistic responses for leaf abscission.
 - (4) Cytokinins and Ethylene show similar responses towards leaf senescence.
 - (5) Ethylene inhibits stem elongation and promotes horizontal growth.
15. Indicate whether each of the following statements regarding transport in plants is correct (✓) or incorrect (X).
- (1) Weak bonding between water molecules and the walls of xylem vessels helps support the columns of water in the xylem.
 - (2) Rise of water in xylem requires energy.
 - (3) Water potential in leaf air spaces is lower than that in root cortical cells.
 - (4) Guttation can occur when root pressure exceeds transpiration pull.
 - (5) Casparian strip ensures that all water and dissolved substances pass through a cell membrane before entering the stele.
16. Indicate whether each of the following statements regarding gene cloning is correct (✓) or incorrect (X).
- (1) In some cases, genes in plasmid vector are removed.
 - (2) Ligase enzyme is never used in gene cloning.
 - (3) Number of copies of a DNA fragment can be obtained from this technique.
 - (4) Selectable markers are needed to check whether insert is in the recombinant molecule.
 - (5) Plasmid DNA can be cleaved using any restriction enzyme at the polycloning site of plasmid vector.

17. Indicate whether each of the following statements regarding Polymerase Chain Reaction (PCR) is correct (✓) or incorrect (X).

- (1) This technique can be used to get many copies of a gene.
- (2) DNA polymerase III is used for amplification of target DNA.
- (3) To see the amplified DNA, gel electrophoresis needs to be carried out.
- (4) During initial PCR cycles, shorter sequences than the target sequence are formed.
- (5) Annealing temperature is critical for binding primers to the template strand.

18. The figure below shows DNA sequence profile of two individuals (A and B). One individual has normal gene and the other has a defective gene.



Based on sequences given in the two gels of individual A and individual B, indicate whether each of the following statement is correct (✓) or incorrect (X).

- (1) Individual A shows a duplication of genes in a chromosome and individual B shows a deletion of a gene in a chromosome.
- (2) Individual A shows normal base sequence of a part of a gene whereas individual B shows a deletion of a part of a gene.
- (3) Both individuals show normal tertiary structure of the protein coded by the particular gene.
- (4) Individual A has at least two molecules of the same amino acids in the polypeptide chain from sequences given.
- (5) B individual has a polypeptide chain that lacks one amino acid in the polypeptide chain.

19. Indicate whether each of the following statements regarding global environmental issues is correct (✓) or incorrect (X).

- (1) CO₂, CO, NO₂ and SO₂ are greenhouse gases.
- (2) Depletion of the ozone layer contributes to global warming.
- (3) A large ozone hole can be seen in northern polar region.
- (4) Deforestation reduces the carbon sequestration capacity.
- (5) Black carbon is large carbon particles that can absorb heat.

20. Indicate whether each of the following statements regarding viruses is correct (✓) or incorrect (X).

- (1) They require living cells to replicate.
- (2) RNA viruses such as COVID-19 contains reverse transcriptase enzyme.
- (3) Lysogenic cycle of a bacteriophage involves lysis of the host cell.
- (4) The first step in infection of a host bacterial cell by a phage is penetration.
- (5) Enveloped viruses are roughly spherical in shape.