

Sri Lankan Biology Olympiad 2021 (2022 January) Examination



Instructions:

This paper contains two parts, A and B.

Part A: 20 multiple choice questions with one answer; Total Marks 100.

Part B: 10 multiple choice questions with more than one answer; Total Marks 100.

Answer All Questions Time 1 hour

Part A – Multiple choice questions. In questions 1-40, select only one response which is correct or most appropriate.

- Which one of the following statements is correct regarding subcellular components?
 - All are membrane-bound structures.
 - They are always present in the cytosol.
 - All subcellular components are organelles.
 - The size of some subcellular components is greater than $0.2 \mu\text{m}$.
 - They are present only in eukaryotic cells.
- Which one of the following statements is correct regarding allosteric regulation?
 - All enzymes that show allosteric regulation are made up of two or more sub-units.
 - Allosteric activators can bind to the active sites of the enzyme.
 - Cooperativity increases the catalytic activity of the enzyme.
 - Cascade of enzymes is involved in all metabolic pathways.
 - Allosteric regulation is absent in prokaryotes.

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3. Molecules that can be seen in the Calvin cycle of C₃ plants are as follows.

- a) 3 phosphoglycerate
- b) RuBP
- c) 1,3 bis phosphoglycerate
- d) Glyceraldehyde 3 phosphate

The correct sequence of the above molecules present in the Calvin cycle is

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

4. Select the correct response regarding the evolution of biological diversity.

- (1) Atmospheric conditions in the early earth facilitated the biotic synthesis of small organic molecules.
- (2) Proteins in early protocells catalyzed biochemical reactions.
- (3) Protocells contained RNA capable of self-replicating.
- (4) The first atmosphere did not contain oxides.
- (5) Biological and chemical observations and experiments have provided evidence for the appearance of first living cells.

5. In addition to biological definition, there are morphological, ecological and phylogenetic definitions for species. Based on these, a species can more accurately be defined as,

- (1) a group of organisms with unique morphological features and distinct from other groups.
- (2) a group of organisms which cannot interbreed and produce fertile offspring.
- (3) a group of organisms living in a particular ecosystem.
- (4) a group of organisms that share a common ancestor in a phylogenetic tree.
- (5) a group of organisms with the same genetic composition.

6. Compared with the meristematic region in the stem apex, root apex meristematic region

- (1) contain cells in Anaphase II of cell division.
- (2) contain cells that are protected by diploid tissues.
- (3) does not produce lateral buds.
- (4) contain cells that do not have chloroplasts.
- (5) shows only primary growth.

7. Which of the following leads to the closing of stomata?

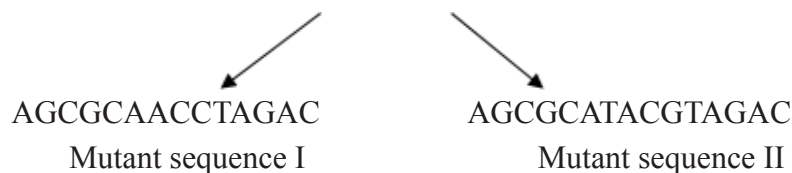
- (1) Heavy winds
- (2) Decrease in CO₂ concentration in substomatal cavity
- (3) Accumulation of K⁺ in guard cells
- (4) Production of ABA in xylem tissue
- (5) High photosynthetic activity of the chloroplast in guard cells

8. Which of the following statements is correct regarding the gametophytes of flowering plants?
- (1) They are unicellular.
 - (2) They are developed within the ovary.
 - (3) Their nuclei are covered by a thick wall.
 - (4) They are produced after due to meiosis.
 - (5) Female gametophyte contains more nuclei compared with male gametophyte.
9. Due to a drug that inhibits secretion of aldosterone,
- (1) K^+ concentration in urine will be increased.
 - (2) amount of urine discharged will be reduced.
 - (3) concentration of urea in urine will be increased.
 - (4) Na^+ concentration in urine will be increased.
 - (5) glucose concentration in urine will be increased.
10. Humoral immune response is a type of
- (1) innate immunity where memory T cells are produced.
 - (2) adaptive immunity where natural killer cells are produced.
 - (3) innate immunity where cytotoxic T cells are produced.
 - (4) acquired immunity where antimicrobial proteins are produced.
 - (5) adaptive immunity where antibodies are produced.
11. Which of the following 'cells and secretion' combination is correct?
- (1) Cells of the salivary glands – Glycoproteins
 - (2) Chief cells of the stomach – Pepsin
 - (3) Parietal cells of the stomach – Hydrochloric acid
 - (4) Epithelial cells of the small intestine – Lipase
 - (5) Hepatocytes – Nucleotidase
12. Some lung volumes and capacities of an adult person are as follows:
Vital capacity = 4800 mL; Tidal volume = 500 mL;
Expiratory Reserve Volume = 1500 mL
The inspiratory capacity of this person is
- (1) 2000 mL. (2) 2800 mL. (3) 3300 mL. (4) 3800 mL. (5) 4300 mL.
13. Which of the following receptors is located most deeply?
- (1) Olfactory receptor cells
 - (2) Meissner corpuscles
 - (3) Taste cells
 - (4) Merkel disks
 - (5) Pacinian corpuscle

14. All cells given in one of the following responses have been present in a menopausal normal woman who did not have any sexual relationship. Select that response.
- (1) 1st polar body, ovum, primary oocyte
 - (2) 1st polar body, 2nd polar body, oogonium
 - (3) Primordial germ cell, oogonium, ovum
 - (4) Primordial germ cell, 1st polar body, secondary oocyte
 - (5) Oogonium, primary oocyte, 2nd polar body
15. A function of vitreous humor is
- (1) removing waste from the lens.
 - (2) refracting light rays.
 - (3) supplying nutrients to lens capsule.
 - (4) holding the lens in place.
 - (5) contributing to change the thickness of lens.
16. Select the incorrect statement.
- (1) Gene cannot be expressed when one allele is present in the gene.
 - (2) In the ABO blood grouping system, three alleles are present in that particular locus.
 - (3) Allele is an alternative form of a gene.
 - (4) Aa genotype represents the identical nucleotide sequences in the homologous chromosomes.
 - (5) As a result of interactions among alleles, sometimes one character is formed.
17. Which of one the following statement is correct?
- (1) Occurrence of mutations leads to changes in the gene pool.
 - (2) To maintain Hardy-Weinberg equilibrium, allele (gene) frequencies must be changed.
 - (3) Genetic variation of a population does not occur due to migration.
 - (4) Inbreeding helps to increase the heterozygotes in the population.
 - (5) Polyploidy doesn't help in genome doubling.

18. The diagram below shows the results of two types of gene mutations

Original sequence of the gene - AGCGCATAACCTAGAC



What types of gene mutations produce mutant sequences I and II?

- | Mutant sequence I | Mutant sequence II |
|-------------------|--------------------|
| (1) Insertion | Deletion |
| (2) Deletion | Deletion |
| (3) Deletion | Substitution |
| (4) Insertion | Substitution |
| (5) Deletion | Inversion |

19. Which of the following statements is correct regarding species diversity and conservation?

- (1) Migration will limit increase the breeding capability of animals.
- (2) It is estimated that about 30% of the species may face extinction within the next 30 years.
- (3) Giant tortoise of Seychelles is an example for an extinct species.
- (4) Endemic species is confined to a particular area or country, and not found growing anywhere else in the world.
- (5) Flagship species play a very important role in the stability and functioning of an ecosystem

20. These days booster vaccines are administered to vaccinated population that has completed a primary COVID-19 vaccination. Which of the following vaccines may not require a booster doze?

- (1) Influenza
- (2) Cholera
- (3) Measles
- (4) Hepatitis-B
- (5) Rabies

Part B: Multiple choice questions with more than one answer

Questions in this part contain more than one correct answer. Select the correct answers for each question. If more than the correct number of answers are selected, no marks will be given for that question.

- Select the correct statements regarding the nucleus.
 - All cells have a nucleus surrounded by nuclear membrane.
 - Nuclear lamina is present near the nuclear envelope.
 - Chromosomes in the nucleus are visible only in dividing cells.
 - Nucleoplasm doesn't contain RNA.
 - Nuclear pore has a simple structure
- Select the molecules that are formed in photosynthesis pathways.
 - Acetyl co A
 - NADP⁺
 - FAD
 - Oxaloacetate
 - RuBP
- Select the correct period - event combinations.
 - Paleozoic era - Appearance and dominance of amphibia
 - Proterozoic eon - Concentration of atmospheric oxygen began to increase.
 - Archaean eon - Oldest fossils of cells appeared.
 - Mesozoic era - Cone-bearing gymnosperms dominated.
 - Cenozoic era - Flowering plants appeared.
- In an electrocardiogram of man,
 - P wave represents sweeping of impulse from SA node over the atria.
 - QRS wave represents spread of impulse from SA node over the ventricles.
 - T wave represents auricular repolarization.
 - ventricular repolarization is not seen.
 - QRS wave represents ventricular depolarization.
- Correct pathways of carrying impulses from the central nervous system to effector organs are
 - efferent neuron → motor system → skeletal muscles.
 - efferent neuron → autonomic nervous system → glands.
 - afferent neuron → motor system → skeletal muscles.
 - afferent neuron → autonomic nervous system → smooth muscles.
 - efferent neuron → motor system → cardiac muscles.
- Select the correct responses regarding the changes that take place in a pregnant mother in each trimester.
 - High level of progesterone in blood – 1st trimester
 - Reduction of sensitivity of prolactin receptors in the uterus – 1st trimester
 - Deterioration of corpus luteum – 2nd trimester
 - Frequent urination – 2nd trimester
 - High level of prolactin in blood – 3rd trimester

[See page seven]

- 7 Gibberellins
- (1) regulate sex determination.
 - (2) stimulate stem elongation.
 - (3) stimulate fruit growth.
 - (4) regulate cell division.
 - (5) inhibit early seed germination.
8. Rhoeo (*Tradescantia*) epidermal peels were placed in sucrose solutions with different concentrations. Select correct the statements regarding this experiment.
- (1) Cells of the lower epidermis are observed under microscope.
 - (2) When sucrose concentration increases more cells become turgid.
 - (3) There is a linear relationship between concentration of solutions and percentage of plasmolysis.
 - (4) Turgid, flaccid and incipient plasmolyzed cells can be observed under a microscope.
 - (5) Solute potential of the tissue is calculated based on the solution that would give 50 % plasmolysis.
9. Select the correct statements regarding DNA replication.
- (1) Both leading and lagging strands run 5' to 3' direction.
 - (2) Topoisomerase attaches to unwind part of the DNA molecule.
 - (3) DNA polymerase I replaces the RNA primer with deoxyribonucleotides.
 - (4) DNA polymerase III add nucleotides to the 5' end of the primer
 - (5) The leading strand contains Okazaki fragments
10. 26th United Nations Climate Change conference (COP26) was held in Glasgow, Scotland in 2021 where world leaders discussed the means of reducing greenhouse gas emissions. If greenhouse gas emissions are not controlled which of the following impacts can be observed in our country?
- (1) Increase in the spread of dengue
 - (2) Increase in the risk of skin cancer
 - (3) Extinction of some species
 - (4) Increase in heavy metal concentration such as lead and mercury in drinking water
 - (5) Increase in the occurrence of landslides