

ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2018
EXAMINATION CATEGORY: TECHNICAL

PAPER III: SUBJECT SPECIALISATION PAPER FOR BIOTECHNOLOGY

Date	: 7 October 2018
Total Marks	: 100
Examination Time	: 150 minutes (2.5 hours)
Reading Time	: 15 Minutes (prior to examination time)

GENERAL INSTRUCTIONS:

1. Write your Registration Number clearly and correctly on the Answer Booklet.
2. The first 15 minutes is being provided to check the number of pages of Question Paper, printing errors, clarify doubts and to read the instructions. You are NOT permitted to write during this time.
3. This paper consists of **TWO SECTIONS**, namely SECTION A & SECTION B:
 - **SECTION A** has two parts: Part I - 30 Multiple Choice Questions
Part II - 4 Short Answer QuestionsAll questions under SECTION A are COMPULSORY.
 - **SECTION B** consists of two Case Studies. Choose only **ONE** case study and answer the questions of your choice.
4. All answers should be written on the Answer Booklet provided to you. Candidates are not allowed to write anything on the question paper. If required, ask for additional Answer Booklet.
5. All answers should be written with correct numbering of Section, Part and Question Number in the Answer Booklet provided to you. Note that any answer written without indicating the correct Section, Part and Question Number will NOT be evaluated and no marks will be awarded.
6. Begin each Section and Part in a fresh page of the Answer Booklet.
7. You are not permitted to tear off any sheet(s) of the Answer Booklet as well as the Question Paper.
8. Use of any other paper including paper for rough work is not permitted.
9. **You are required to hand over the Answer Booklet to the Invigilator before leaving the examination hall.**
10. This paper has **7 printed pages**, including this instruction page.

GOOD LUCK

SECTION A

PART I: Multiple Choice Questions (30 marks)

Choose the correct answer and write down the letter of your chosen answer in the Answer Booklet against the question number e.g. 31 (d). Each question carries ONE mark. Any double writing, smudgy answers or writing more than one choice shall not be evaluated.

1. Molecular Chaperone is
 - a) a specialized substructure of a cell with a specific structure and function surrounded by a membrane.
 - b) a mycelium or cell having two nuclei of different genotype.
 - c) a protein that is needed for assembly or proper folding of some other protein but which does not itself become a part of the molecule so produced.
 - d) a cell or organism having the gametic chromosome number.

2. In protein structure, the α -helix and β -pleated sheets are examples of
 - a) primary structure
 - b) secondary structure
 - c) tertiary structure
 - d) quaternary structure

3. The shortest of mitotic phase is
 - a) Telophase
 - b) Interphase
 - c) Metaphase
 - d) Anaphase

4. Reverse transcriptase is
 - a) RNA dependent RNA polymerase
 - b) DNA dependent RNA polymerase
 - c) DNA dependent DNA polymerase
 - d) RNA dependent DNA polymerase

5. Successive nucleotides are covalently linked through
 - a) Glycosidic bonds
 - b) Phosphodiester bonds
 - c) Hydrogen bonds
 - d) Nitrogen bonds

6. Protein helping in opening of DNA double helix in front of replication fork is
 - a) DNA gyrase
 - b) DNA Polymerase I
 - c) DNA ligase
 - d) DNA topoisomerase

7. The major classes of lipids, which are commonly present in Plasma membrane and other membranes are the following EXCEPT
- Phospholipids
 - Sialic Acid
 - Sterols
 - Glycolipids
8. In callus culture, roots can be induced by the supply of
- auxin and no cytokinin.
 - higher concentration of auxin and lower concentration of cytokinin.
 - higher concentration of cytokinin and lower concentration of auxin.
 - both auxin and cytokinin in equal proportions.
9. In double helix of DNA, the two DNA strands are
- coiled around a common axis
 - coiled around each other
 - coiled differently
 - colied over protein sheath
10. In tissue/bacterial culture glassware and nutrients are sterilized through
- Water bath at 100° C
 - Dry air oven at 100° C
 - Dehumidifer
 - Autoclave
11. When F₁ plants are crossed with the homozygous recessive plants, it is known as
- Test Cross
 - Recessive Cross
 - Criss-Cross
 - Para-cross
12. Nucleosides are
- Sugar + Phosphoric acid
 - Purine / Pyrimidine + Sugar + Phosphate
 - Purine / Pyrimidine + Phosphoric acid
 - Purine / Pyrimidine + Sugar
13. How many base pairs are present in one turn of DNA helix?
- 4
 - 8
 - 10
 - 9
14. Plasmids are vectors for gene cloning because they
- self replicate in bacterial cells.
 - replicate freely outside bacterial cells.

- c) can be multiplied in culture.
 - d) can be multiplied in laboratories using enzymes.
15. Distance between two successive nitrogenous bases or base pairs of DNA is
- a) 34 Å
 - b) 3.4 Å
 - c) 10 Å
 - d) 5 Å
16. DNA sequence is ATG. What would be the sequence of bases in anticodon of tRNA?
- a) ATG
 - b) AUG
 - c) UAC
 - d) TAC
17. Functional unit of gene that specifies synthesis of one polypeptide is
- a) Codon
 - b) Cistron
 - c) Recon
 - d) Muton
18. Haploid plant cultures are obtained from
- a) Leaves
 - b) Root tip
 - c) Pollen grain
 - d) Buds
19. A totipotent cell means
- a) an undifferentiated cell capable of developing into a system or entire plant.
 - b) an undifferentiated cell capable of developing into an organ.
 - c) an undifferentiated cell capable of developing into complete embryo.
 - d) a cell which lacks the capability differentiate into an organ or system.
20. Bacterial plasmid contains
- a) RNA
 - b) RNA + protein
 - c) DNA
 - d) Photosynthetic structures
21. A technique of using very small metal particles coated with desired gene in the gene transfer is called
- a) Electroporation
 - b) Microinjection
 - c) Liposome
 - d) Biolistics

22. Hybridoma Technology is used in the production of
- mRNA
 - Monoclonal serum
 - Monoclonal antibodies
 - Polyclonal antibodies
23. A set standards used to regulate own or community activity in relation to biological world is
- Biopotency
 - Biopiracy
 - Bioterrorism
 - Bioethics
24. Extranuclear genetic material is found in
- Plastid and nucleus
 - Mitochondria and plastids
 - Nucleus and cytoplasm
 - Mitochondria and nucleus
25. The molecular formulae of deoxyribose sugar and ribose sugar respectively are
- $C_5H_{10}O_4$ and $C_5H_{10}O_6$
 - $C_5H_{10}O_4$ and $C_5H_{10}O_5$
 - $C_5H_{10}O_5$ and $C_5H_{10}O_4$
 - $C_5H_{10}O_5$ and $C_6H_{10}O_4$
26. During DNA replication, the reunion or recoiling of separated DNA strand is prevented by
- Helix destabilizing protein
 - Single strand binding protein
 - Rep protein
 - Both (a) and (b)
27. Which of the following is NOT a tool of genetic engineering?
- Vectors
 - Enzymes
 - Foreign DNA
 - GMO
28. Glucose is degraded into pyruvate under anaerobic conditions. This process is called
- Oxidative decarboxylation
 - Kreb's cycle
 - Glycolysis
 - Redox reaction
29. Some individuals have a patch of blond hair in a head of brown hair. This could be due to
- Somatic Mutation
 - Point Mutation
 - Deletion Mutation
 - Gametic Mutation

30. All the following statements is true EXCEPT:

- Viruses that parasitize the bacterial cells are called phages.
- Asexual reproduction in bacteria occur by Conjugation.
- Plastids are absent in animal cell.
- Heterosis is the superiority of a heterozygote over both the concerned homozygotes in respect of one or more characters.

PART II – Short Answer Questions (20 marks)

This part has 4 Short Answer Questions. Answer ALL the questions. Each question carries 5 marks.

- What is a bioreactor? List down four types of bioreactors and one important uses of bioreactor. (2+2+1 marks)
 - What is a transcription unit? Is it same as gene, how? Name the enzyme for RNA synthesis? (2+2+1 marks)
 - List down the basic steps involved in the recombinant DNA technology. (5 marks)
 - What is the role of RNA in DNA Replication? Distinguish the roles of helicases and SSB proteins in DNA replication. (2+3 marks)
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SECTION B

Case Study

Choose either Case I OR Case II from this section. Each case study carries 50 marks.

Case I

Biotechnology involves the potential use of living organisms including the cells of animals, plants and microorganisms. It represents a fusion between biology and technology. Microorganisms play a major role in this field for millennia, since the discovery of fermentation and will continue to do so more extensively for the foreseeable future. In this context, answer the following questions.

- List and explain the reasons for the wide application of microorganisms in biotechnology processes? (6 marks)
- Name any 2 microorganisms used in the fermentation of milk to yoghurt (4 marks)
- Assume that you have been working on cloning the gene you study into a cloning vector and finally you have it. You increase the production of the recombinant DNA using *E. coli* as the host. When isolating the gene from your bacteria, what are mechanisms can you use to ensure that the gene you have isolated is what you are expecting? (10 marks)

4. Define the following terms with example: (5x2 marks)
 - a) Bio-pesticides
 - b) Cloning Vector
 - c) Antibody
 - d) Transgene
 - e) Pathogen
5. You have fallen sick and after a quick examination, the doctor wants to have you tested for West Nile Virus. West Nile is a RNA virus. What test or technique can be used to confirm whether or not you have West Nile? Explain the steps (10 marks)
6. Differentiate between EX VIVO and IN VIVO Gene Therapy. Mention the steps involved in EX VIVO Gene Therapy. (5+5 marks)

Case II

You work in a renowned Company, which deals with multiple applications of Biotechnology. Upon a special request, you were given the task to address some queries from the audiences consisting of agriculturists, students, food importers and government officials who have very little knowledge on the subject. Answer the following questions.

1. The Agriculturists wanted to know the possible benefits of "Terminator technology"? Or is it simply a means to exercise control over farmers' right to grow their own seed? (5 marks)
2. Explain what is direct gene transfer? What are the methods of direct gene transfer? (5 marks)
3. How would you explain the following: (5x2 marks)
 - a) In vitro fertilization
 - b) Law of independent assortment
 - c) Chemical composition of DNA
 - d) Frame shift Mutation
 - e) Gene therapy
4. How would you explain the difference between (a) auxotrophic mutation, (b) genetic recombination, and (c) recombinant DNA? (10 marks)
5. Your company had recently developed the Genetically Modified Soy, which has low level of saturated fatty acids and high oleic acid. One of the food importers is very much interested in importing such Soy into Bhutan for human consumption. Advise the importer as per the provisions of the Biosafety Act of Bhutan, 2015 on the import of GM Products? Also, explain on the primary purpose of conducting the safety assessment of GM food and principles on which the safety assessment is conducted. (5+5 marks)
6. Describe in detail two methods to introduce the foreign DNA into cells. (10 marks)

TASHI DELEK