

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

PAPER III: SUBJECT SPECIALISATION PAPER FOR MICROBIOLOGY

Date	: February 27, 2021
Total Marks	: 100
Writing Time	: 150 minutes (2.5 hours)
Reading Time	: 15 Minutes (prior to writing time)

GENERAL INSTRUCTIONS:

1. Write your Registration Number clearly and correctly on the Answer Booklet.
2. The first 15 minutes is to check the number of pages of the 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 Questions
All 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 Section, Part and Question Number will NOT be evaluated and no marks will be awarded.
6. Begin each Section and Part on 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 must 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. For the examination of microbial cells, we require the use of
 - a) high-power microscope.
 - b) low-power microscope.
 - c) high-power microscope at a magnification of about 1,000 diameters.
 - d) low-power microscope at a magnification of about 1,000 diameters.

2. Lipopolysaccharide in cell walls is a characteristic of
 - a) Gram-positive bacteria
 - b) Gram-negative bacteria
 - c) Fungi
 - d) Algae

3. Which microorganism(s) among the following perform photosynthesis by utilizing light?
 - a) Cyanobacteria
 - b) Fungi
 - c) Viruses
 - d) Cyanobacteria, Fungi and Viruses

4. Growth of microbes in a solid media is identified by the formation of
 - a) Pellicle at the top of media
 - b) Colonies
 - c) Sediment at the bottom
 - d) Turbidity

5. Drug resistance in bacteria is mainly determined by which of the following factor?
 - a) F
 - b) R
 - c) Col
 - d) Lysogenic factor

6. The DNA molecule of microorganisms is made up of base pairs of
 - a) Guanine-cytosine
 - b) Adenine-thymine
 - c) Adenine-cytosine
 - d) Guanine-cytosine and adenine-thymine

7. Who is the Father of microbiology?
 - a) Louis Pasteur
 - b) Joseph Lister
 - c) A.V. Leeuwenhock
 - d) Robert Koch

8. Which among the following are the most important agents for carbon dioxide fixation?
- Bacteria
 - Fungi
 - Algae
 - protozoa
9. Cellulose is degraded to cellobiose by which of the following enzymes?
- Cellulose
 - beta-glucosidase
 - hexokinase
 - cellulose dehydrogenase
10. Fresh air contains approximately _____ percent of carbon dioxide by volume.
- 0.01
 - 2
 - 5
 - 0.03
11. In carbon cycle, the flow of energy is
- Bidirectional
 - Linear
 - Cyclic
 - Irreversible
12. Cysteine breaks down in presence of cysteine desulfurase to give
- Oxaloacetic acid
 - Sulphuric acid
 - Pyruvic acid
 - Glyoxalate
13. Which one of the following processes is performed by Thiobacillus thiooxidans?
- Converting sulphur to sulphates
 - Converting sulphur to sulphides
 - Converting sulphur to sulphites
 - Converting organic sulphur to inorganic sulphur
14. Sulphates are reduced to hydrogen sulphide by
- Desulfotomaculum sp.
 - Thiobacillus thiooxidans
 - Photosynthetic sulfur bacteria
 - Rhodospirillum
15. The reduction of sulphates and sulphites to hydrogen sulphide is done by which of the following group of bacteria?
- aerobic sulfate-reducing bacteria
 - photosynthetic sulphur bacteria
 - anaerobic sulphate-reducing bacteria
 - heterotrophic bacteria

16. Purple and green sulfur bacteria use _____ as the electron donor to reduce carbon dioxide.
- S^{2-}
 - SO_4^{2-}
 - H^2S
 - Organic acids
17. Which one of the following is non-sulfur purple bacteria?
- Rhodospirillum rubrum
 - Thiobacillus
 - Chromatium
 - Chlorobium
18. Which of the following techniques is used for identification and enumeration of algae, bacteria, protozoa?
- Microscopic examination
 - Submerged-slide technique
 - Membrane-filter technique
 - Enrichment-culture technique
19. Which one of the following techniques can be used to separate different-size fractions of the aquatic microbial community?
- Submerged-slide technique
 - Fluorescent antibody technique
 - Membrane-filter technique
 - By measuring biochemical activity
20. The portion of the growth curve in which the rapid growth of bacteria is observed is known as
- Lag phase
 - Logarithmic phase
 - Stationary phase
 - Decline phase
21. In the growth equation $n = 3.3 (\log_{10} N - \log_{10} N_0)$, n stands for
- Total population
 - Initial population
 - Number of generations
 - Growth constant
22. Lag phase is also known as
- period of initial adjustment.
 - transitional period.
 - generation time.
 - period of rapid growth.

23. The coliform group of bacteria includes all the _____ bacilli.
- aerobic
 - anaerobic
 - aerobic, non-sporulating
 - aerobic, gram-negative, non-sporulating
24. The image obtained in a compound microscope is
- Real
 - Virtual
 - Real inverted
 - Virtual inverted
25. Methane is formed due to the reduction of
- Nitrates
 - Sulfates
 - Carbon dioxide
 - Organic acids
26. Which one of the following is formed from the anaerobic oxidation of organic matter?
- NO₃
 - SO₄
 - H₂S
 - NH₂
27. Most bacteria require vitamins as the
- Growth factors
 - Sources of energy
 - Sources of carbon
 - Sources of electron donors
28. At the temperature 160°C for one hour, complete sterilization occurs in
- Autoclave
 - Hot air oven
 - Laminar flow
 - Incubator
29. Yeast extract is an excellent source of
- Vitamin A
 - Proteins
 - Vitamin B
 - Carbohydrates
30. Which one of the following is an example of anaerobic medium?
- Wilson blair medium
 - Mac conkey broth
 - Robertson's cooked meat medium
 - EMB agar

PART II – Short Answer Questions [20 marks]

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

1. What are the different types of classification of microorganisms based on their requirement for gaseous oxygen and explain briefly.
2. Why bacteria require staining before microscopic examination?
3. Why is gram stain one of the most important and widely used stains in bacteriology?
4. Why is 70% ethanol used as disinfectant?

SECTION B: CASE STUDY [50 marks]

Choose either Case I or Case II from this section. Each case study carries 50 marks. Mark for each sub-question is indicated in the brackets.

CASE I

The use of chemical pesticides and fertilisers in agriculture has seen a sharp increase in recent years in the neighboring Indian towns at an alarming level. The heavy use of these chemicals has already caused grave damage to health, ecosystems and ground water. It is therefore increasingly urgent that environmentally friendly methods of improving soil fertility and pests and disease control are used. The potential of biopesticides and biofertilisers for promoting sustainable agriculture has been known for many years.

- 1) Explain what is biopesticide, different types of biopesticides, and advantages and disadvantages of biopesticides? (20 marks)
- 2) The growth in agricultural production during the last three decades has been accompanied by a sharp increase in the use of chemical fertilisers, causing serious concern. Foremost among these concerns is the effect of excessive fertilizer (especially nitrogenous fertilisers) on the quality of soil and ground water. Explain what is biofertilizer, different types of biofertilizers, its importance, and component of biofertilizers used? (20 marks)
- 3) Explain biological control or biocontrol and different types of microorganisms used. (10 marks)

CASE II

Microorganisms are everywhere, and some are good for us while others are harmful. Bacteria, viruses, and other microorganisms that cause disease are called pathogens. To protect yourself and everyone from harmful bacteria and other pathogens during routine microbiological analysis, the use of aseptic technique is imperative.

- 1) Explain aseptic technique, what it is used for and cite examples. (20 marks)
- 2) You have followed laboratory standard operating procedure to analyze total microbial load in a sample. But after close examination of petri plates, there are contaminations. Explain the steps you would take to mitigate such problems in your laboratory. (20 marks)
- 3) Apart from general techniques, explain quality assurance and how it would be used to generate accurate and precise test results. (10 marks)

TASHI DELEK