

**ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2021
EXAMINATION CATEGORY: TECHNICAL**

PAPER III: SUBJECT SPECIALISATION PAPER FOR MICROBIOLOGY

Date	: October 31, 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 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. The methods of strain improvement is
 - a) Protoplast fusion
 - b) Recombinant DNA technique
 - c) Genetic recombination
 - d) All of the above

2. First genetically engineered and biotechnologically produced vaccine was against
 - a) AIDS
 - b) Small pox
 - c) Herpes simplex
 - d) Hepatitis B

3. Which of the following cytochrome is observed in bacteria and can react with molecular oxygen?
 - a) Cyt b
 - b) Cyt c
 - c) Cyt d
 - d) Cyt o

4. Community acquired atypical pneumonia can be caused by which one of the following organisms?
 - a) Legionella pneumophila
 - b) Staphylococcus aureus
 - c) Klebsiella pneumonia
 - d) Mycoplasma pneumonia

5. The technique involved in comparing the DNA components of two samples is known as
 - a) Monoclonal antibody techniques
 - b) Genetic finger printing
 - c) Recombinant DNA technology
 - d) Polymerase chain reaction

6. The bases Adenine and Thymine are paired with
 - a) Double hydrogen bonds
 - b) Single hydrogen bonds
 - c) Triple hydrogen bonds
 - d) Both b) and c)

7. Salmonella typhi is causative organism of
 - a) Undulant fever
 - b) Remittent fever
 - c) Dengue fever
 - d) Enteric fever

8. Virulent factor in pneumococcus is
 - a) Cell wall
 - b) Capsule
 - c) Mesosomes
 - d) Endotoxins

9. The most important energy-yielding reaction for an aerobic organism is
 - a) Glycolysis
 - b) EMP
 - c) KDPG
 - d) both b) and c)

10. Differential staining of bacteria spore is related to
 - a) Albert's staining
 - b) Lugol's staining
 - c) Moller's staining
 - d) Indian ink preparation

11. Nagler's reaction detects
 - a) Coagulase
 - b) Hyaluronidase
 - c) Lecithinase
 - d) None of the above

12. L-Lysine is produced from
 - a) *Corynebacterium glutamicum*
 - b) *Clostridium botulinum*
 - c) *Mycobacterium* sps
 - d) *Pseudomonas*

13. *Treponema pallidum* can be best identified using
 - a) Fluorescence microscope
 - b) Bright field microscope
 - c) Dark field microscope
 - d) Fluorescence microscope

14. Which of the following is a neutral stain?
 - a) Picric acid
 - b) Giemsa
 - c) Neutral red
 - d) Malachite green

15. Multiple antibiotic resistance is mediated by
 - a) Episome
 - b) Plasmid
 - c) Colplasmid
 - d) both b) and c)

16. Which one of the following organisms requires tryptophan for growth?
- H.influenza
 - Vibrio
 - Gonococci
 - S.typhi
17. Plasmids are ideal vectors for gene cloning as they
- can be multiplied by culturing.
 - can be multiplied in the laboratory using enzymes.
 - can replicate freely outside the bacterial cell.
 - are self-replicating within the bacterial cell.
18. The enzyme required for DNA from RNA template is
- RNA polymerase
 - Reverse transcriptase
 - DNA polymerase
 - Terminal transferase
19. The gene transfer occurs by
- Transformation
 - Transduction
 - Conjugation
 - Cell fusion
20. The antibody that is first formed after infection is
- IgG
 - IgM
 - IgD
 - IgE
21. Which of the following contains structures composed of N-acetylmuramic acid and N-acetylglucosamine?
- Mycoplasmas
 - Amoeba
 - E.coli
 - Spheroplast
22. Which one of the following statements regarding gram staining is wrong?
- Mycobacterium tuberculosis* stains blue because of the thick lipid layer.
 - Streptococcus pyogenes* stains blue because of a thick peptidoglycan layer.
 - Escherichia coli* stains pink because of a thin peptidoglycan layer.
 - Mycoplasma pneumoniae* is not visible in the Gram's stain because it has no cell wall.
23. Which bacterial components is least likely to contain useful antigens?
- Cell wall
 - Flagella
 - Ribosomes
 - Capsule

24. The association of endotoxin in gram-negative bacteria is due to the presence of
- Steroids
 - Peptidoglycan
 - Lipopolysaccharides
 - Polypeptide
25. The prokaryotic cell membrane
- contains metabolic enzymes.
 - is selectively permeable.
 - regulates the entry and exit of materials.
 - contains proteins and phospholipids.
26. Cytochromes are
- Oxygen acceptors
 - ATP acceptors
 - Electron acceptors
 - Protein acceptors
27. Attenuation means
- killing of the bacteria (microorganism)
 - inactivation of bacteria
 - activating the bacteria
 - both a) and b)
28. The properties which is common to Gram positive and negative cell walls are
- equal susceptibility to hydrolysis by lysozyme.
 - peptide crosslinks between polysaccharides.
 - rigid peptoglycon activity.
 - greater resistance to drying than vegetative cell.
29. Drug resistance in bacteria is mainly determined by factor
- F
 - R
 - Col
 - Lysogenic factor
30. The major immunoglobulin present in the human serum is
- IgG
 - IgA
 - IgE
 - IgG

PART II – Short Answer Questions [20 marks]

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

1. Define serial dilution and its objectives. What is the dilution factor if you add 0.2 mL of a stock solution to 3.8 mL of diluent?
2. What is IMViC test? Explain its procedures for *Escherichia coli*.
3. What are the types of Staining Techniques used in Microbiology?
4. What are the different types of bacterial culture media? State its classification, types and uses with examples.

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

A 65-year-old dairy farmer and his family develops a severe headache, muscle ache, neck stiffness, possibly after eating contaminated food. He has no papilledema. A lumbar puncture is performed, and a Gram stain of the CSF obtained shows many short, gram-positive rods.

Question 1

Based on the clinical findings presented, what is the most likely causative agent and the condition of the case above? Define outbreak and state reasons for investigating the outbreak. (20 marks)

Question 2

What is hypothesis generation and explain how it can be done. What are the ways by which you can evaluate your hypothesis. (20 marks)

Question 3

As a Microbiologist, the main goal of outbreak investigation is to minimize the public health impact of disease outbreaks. When investigating, an outbreak approach to investigation should be very systematic. What would be some of the steps you would take to investigate the outbreak? (10 marks)

CASE II

A non-lactose fermenting microorganism on MacConkey was isolated from the sputum of a 75-year-old man admitted in a medical ward. The man has a previous history of admission in hospital and received various antibiotics during the visits. The direct microscopy of the sputum showed 15WBS/HPF and more than 10 epithelial cells/HPF. Subsequent antimicrobial susceptibility result showed that the isolate was highly resistant to most of the antibiotic prescribed by the physician.

Question 1

What are the components of MacConkey agar that supports the growth of different microorganism?
(20 marks)

Question 2

What is Minimum Inhibitory Concentration (MIC) and what are the types of test carried out to determine MIC? How would you interpret the Antimicrobial susceptibility test results? (20 marks)

Question 3

Name two non-lactose and lactose fermentative bacteria. What are the two main pathways through which AMR is achieved? (10 marks)

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