

**ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2011
EXAMINATION CATEGORY: TECHNICAL**

PAPER III: SUBJECT SPECIALIZATION PAPER FOR: MICROBIOLOGY

Date : October 30, 2011
Total Marks : 100
Examination Time : 2.5 Hours
Reading Time : 15 Minutes

INSTRUCTIONS

1. Write your Roll Number clearly on the answer booklet in the space provided.
2. The first 15 minutes is being provided to check the number of pages, printing errors, clarify doubts and to read the instructions. You are **NOT PERMITTED TO WRITE** during this time.
3. Use either **Blue** or **Black** ink pen or ball point pen for the written part and **Pencils** for the sketches and drawings.
4. All answers should be written on the Answer Booklet provided. Candidates are not allowed to write anything on the question paper.
5. This Question Booklet consists of **9 pages**. It is divided into two sections – namely SECTION A and SECTION B.
6. **SECTION A** consists of two parts. **Part I and Part II.**

Part I consists of 30 multiple choice questions carrying one (1) mark each and is **compulsory**. The answer of your choice should be clearly written **in whole** along with the question and option number on your answer booklet.

Part II consists of four (4) short answer questions of five (5) marks each and all questions are compulsory.
7. **SECTION B** consists of two **Case Studies**. Choose only **ONE** case study and answer the questions under your choice. Each case study carries fifty (50) marks in total.

SECTION A

PART A: MULTIPLE CHOICE QUESTIONS (30 marks)

Directions: In this part there are thirty multiple choice questions each carrying 1 mark. Each question is followed by four suggested answers. The answer of your choice should be clearly written **in whole** along with the question and option number on your answer booklet.

1. Which of the following does NOT describe one of Koch's Postulates?

1. Grow the agent in pure culture.
2. Isolate the same agent from a new victim
3. Isolate the suspected agent from a disease victim
4. Characterize the Gram staining characteristic of the isolated agent

2. The important class of chemicals that limit radical pH changes in the body, medications, food, and also bacterial media are referred to as

1. Enzymes
2. Bases
3. Buffers
4. Acids

3. Chromosomes are

1. Multiple units of genes in linear chains
2. A newly discovered very large eukaryote
3. A type of virus that attacks only prokaryotic cells
4. A type of organelle that secretes material

4. ATP

1. Is an important molecule for energy sources
2. Contains three high energy phosphate bonds
3. Is classified with other organic molecules that contain nucleotides
4. All of the above

5. Microorganisms are involved in

1. Production of medicinal products
2. Food production
3. Pollution cleanup
4. All of the above

6. Fungi, more than bacteria, are responsible for decomposition of plant materials because

1. They have fermentative metabolism
2. They can not tolerate high osmotic pressure
3. They can not tolerate low moisture condition
4. They prefer a neutral environment (PH7)

7. The plasmid responsible for conjugation is called a

1. Sex plasmid
2. Resistance plasmid
3. Virulent plasmid
4. Fertility plasmid

8. Viruses that infect bacteria are called

1. Virions
2. Viroids
3. Bacteriophages
4. Bactericides

9. A pili is

1. A form of storage granule within the cell
2. Is a long thin protein rod that is used for adhesion
3. Generally composed of sugars.
4. Always present on a cell that has the ability to form a capsule.

10. Bacteria can be said to have a NOSE because

1. They have a special structure on one end or side of the cell that contains a primitive "brain" to process odors
2. Their flagella have special detectors in them that help a bacterium move towards desirable chemicals and away from undesirable ones
3. The presence of a capsule blocks a bacteria's ability to detect chemicals
4. They are able to detect chemicals and to move towards desirable ones and away from harmful ones

11. AIDS can best be classed as a/an:

1. Pandemic
2. Epidemic
3. Endemic
4. Opportunistic infection

12. A DNA molecule does NOT contain the following

1. Uracil
2. Cytosine
3. Adenine
4. Thymine

13. Which of the following materials is NOT a bacterial storage granule?

1. Sulfur
2. Glycogen
3. Phosphorous
4. Ribosome

14. A catalyst is:

1. A type of DNA that carries the genetic code.
2. Chemically modified by the chemical reaction it controls.
3. Something that increases the speed of a chemical reaction.
4. Something that decreases the speed of a chemical reaction.

15. The oxygen in the air is lethal to

1. Obligate thermophiles
2. Photosynthetic microbes
3. Microaerophilic microbes
4. Obligate anaerobes

16. When deer and elk are moved from one area to another several hundred miles away, they frequently die even though there is sufficient grass and water for them. Why does this happen?

1. These animals depend upon the microbes in their gut to digest the grasses they eat, but different grasses in different places can't be used by their gut microbes, so the animals starve.
2. All of these animals carry latent pathogens which the stress of moving activate, leading to disease and death.
3. The new areas contain pathogens that these animals are not immune to so they succumb rapidly to them.
4. The nutrient content of the grasses from one area can not meet the needs of the animals born and raised in another region with different grass species.

17. The following is a DNA sequence of the template strand of a gene AGGCTACGA

Based on the above sequence, identify the following nucleic acid sequences that are derived from this sequence.

1. AGGCTACGA
2. AGGCUACGA
3. UCCGAUGCU
4. TCCGATGCT

18. You have been performing experiments with two strains of bacteria that you isolated from the same environment. In a medium designed to cultivate oligotrophs (bacteria adapted to a nutrient-poor habitat), you have measured the doubling time of each species separately and report that species 1 doubles every 68 minutes and species 2 every 105 minutes. You go on to perform an experiment where you mix and grow the two strains together in the same oligotrophic broth. Starting with 5×10^6 cells/ml for each isolate (a total of 10^7 cells/ml), you incubate the mixed culture for 3 hours at which point you determine that both species have increased in number and that the total cell concentration (both strains summed) is 1.08×10^8 cells/ml. From this you conclude

1. The mixed culture has grown in a manner that is consistent with your estimates based on growth rates for the isolated strains
2. The mixed culture, while clearly showing growth, did not increase as rapidly as you estimated based on growth rates for the isolated strains, suggesting that one or both of the strains, when grown together, have a decreased generation time
3. This question is entirely too complicated for me to answer
4. I have decided not to become a microbiologist

19. One of our nonspecific defense mechanisms is the ACID in the stomach. Yet we get intestinal illnesses. Why?

1. Most of the intestinal pathogens are naturally resistant to acid conditions
2. Because pathogens are protected in large pieces of food
3. Intestinal pathogens enter first through breaks in the skin and are subsequently carried by the blood to the intestine
4. The natural flora in the bowel mutates to produce pathogenic varieties that attack the intestines

20. A NOSOCOMIAL infection is

1. An infection that one catches from an animal

2. An infection that one gets from drinking contaminated water
3. An infection that one gets from an insect bite; i.e., Lyme disease from the tick
4. An infection that a hospital patient picks up at the hospital from the personnel or materials used in the hospital

21. VIRULENCE refers to

1. The number of people in a population who are infected by a certain pathogen
2. The degree or intensity of pathogenicity
3. A pathogen that has lost its ability to produce a disease
4. Pathogens that are spread through the soil

22. The name of the enzyme that destroys red blood cells is

1. Endolysin
2. DNase
3. Hemolysin
4. Lipase

23. Which of these descriptions is NOT a characteristic of AGAR?

1. An excellent food material for many different microbes
2. Melts only at 100°C
3. Toxic to many microbes
4. E. Solidifies at 45°C

24. MAST CELLS are involved in

1. Destroying cancer cells
2. Attacking virus infected cells
3. Immune cell differentiation
4. Allergies

25. Death from AIDS is caused (the actual agent[s]) by

1. Massive growth of the HIV
2. Opportunistic infections
3. Herpes infections
4. Tapeworms

26. Which of the following is NOT a reason for using microorganisms to study metabolism?

1. Microorganisms are rather boring and don't do many interesting things except cause diseases
2. Microorganisms are generally inexpensive to grow and work with

3. Microorganisms are often used to produce commercial products
4. Microorganisms have a metabolism that is always similar to that of higher plants and animals

27. the most common source(s) of *SALMONELLOSIS* infections is/are

1. Fish
2. Human, particularly babies
3. House hold pets like, cats & dogs
4. Domestic animals like chickens, turkeys, & cattle

28. Chose the best definition of an AQUIFER

1. A type of water-loving bacteria that is in activated sludge.
2. A type of water treatment facility.
3. A type of spring that flows all the time (without requiring a pump).
4. An underground water bearing layer of soil, sand or rock

29. Pasteurization preserves food by

1. Killing the pathogens and generally decreasing the total numbers of microbes in a food
2. By killing *Clostridium botulinum* spores
3. By drying out the food to the point where nothing can grow
4. By forming bacterial inhibiting chemicals in the heated foods

30. Organic acids, like vinegar and lactic acid, preserve foods by

1. By lowering the pH (making the food more acidic)
2. By raising the pH (making the food more alkaline)
3. Binding the free water so that microbes can't get enough to grow
4. By inducing the formation of inhibitory chemicals in the foods

PART B: WRITE SHORT ANSWERS (20 MARKS)

General direction: In this part there are four questions each carrying 5 marks. All the questions must be attempted.

1. You are given a test tube containing 10 ml of a solution with 8.4×10^7 cells/ml. You are to produce a solution that contains less than 100 cells/ml. What dilution must you perform in order to arrive at the desired result?

2. Explain the PCR (Polymerase Chain Reaction). List the steps in carrying it out; include all the components and special conditions, explaining why each one is used.

3. Describe what a virus is and tell how it is different from a bacterium or any other life form. Include a description of the general structure of all viruses, including their genetic material

4. Skin has some characteristics that make it a good nonspecific defense mechanism. Name them and tell how each works.

SECTION B (50 Marks)

General Direction: In this section there are two questions. Choose ANY one question and write your answer to the chosen question very carefully.

1. A civil servant was on tour to Southern Bhutan, during peak monsoon months, and his tour program mandated him to stay in villages to study their socio-economic problems. He had to sleep with villagers in their make shift accommodation without any protection from insects such as Mosquito. Everyday, rainfall becomes incessant and areas around the villages become clogged with stagnant pools of water. He completed tour and came back to office. After few days, he started developing intermittent headache, chills and fever. He consulted Physician, and narrated his travel in malaria endemic areas. A Physician ordered tests for malaria parasite. You happened to work in the Pathology lab as the microbiologist, and blood samples from the suspected malaria patient was referred to you. You performed standard tests for malaria parasites. From your training in the University, you know that malaria is caused by *Plasmodium* species

and transmitted by female mosquito and different malaria parasite species infect red blood cells with different pattern of infection. ***QA. List four major species of Plasmodium that cause malaria, and describe symptom on the red blood cells infected by these parasites? Which, out of four species, causes severe malaria? Do malaria parasite infected people remain asymptomatic? (25 marks)***

After examination of samples, you sent the lab report to the Physician indicating that samples have typical *P. falciparum* infection pattern. As usual, Physician prescribes normal anti malaria drug (e.g. chloroquine) to the sick civil servant. After few days, sadly, civil servant passed away. Post mortem blood sample was taken from the deceased patient and as part of your normal duty, you happened to examine the blood sample. To your surprise, you found heavy load of live *P. falciparum* even after administration of anti malaria drug. ***QB. What does this finding indicate? How are you going to test this evidence? (10 marks)***

Due to sad demise of able civil servant, Health Ministry orders area wide malaria vector control campaign. And you happened to be the part of the team to launch this campaign. ***QC: What vector are you targeting? What are your means to control the vector? What are other non-chemical methods to control malaria vectors? (15 marks)***

2. "Doctors in India aren't surprised that the Super Bug probably originated there. Drug control there is poor and common antibiotics have become ineffective in India. Some reasons may be because people can buy powerful antibiotics over the counter, leading to overuse. They also take small doses and discontinue treatment in order to save money. There are no current antibiotics, nor any in development, that can kill New Delhi Super Bug on their own."

QA. What do you think could allow some of the bacteria to live even in the presence of antibiotics? (Hint: Are all the bacteria in a population the same? How might they differ?) (20 marks)

QB. What are the biological, social, or cultural factors that may have influenced the increased resistance of this strain of bacteria to antibiotics? (20 marks)

QC. What measures could you think of to prevent overuse of antibiotics? (10 marks)