

**Part A (50%)**

1. What are DNA gyrase, DNA ligase, DNA polymerase III, and DNA polymerase I? Describe their functions in DNA replication. (10%)
2. Define the following terms: (A) carboxysomes, (B) poly-3-hydroxyalkanoate, (C) magnetosomes, (D) siderophores, (E) D-value. (10%)
3. Describe how fatty acids and unsaturated fatty acids are made? (5%)
4. Describe the pathways for triacylglycerol and phospholipid synthesis. Of what importance are phosphatidic acid and CDP-diacylglycerol? (10%)
5. Microbial products can be classified as primary and secondary metabolites. Which of the following are secondary metabolites: (A) pyruvate, (B) a secreted amylase, (C) an antibiotic, (D) leucine (E) organic acids. Explain your answer. (5%)
6. Choosing one of the following tests from (A) to (E) to answer Questions (1) to (5), single choice:  
(A) Catalase test, (B) Dextrose fermentation test, (C) Hydrogen sulfide test, (D) Cytochrome oxidase test, (E) Litmus milk test. (10 %)

**Questions:**

- (1) To separate and identify *Shigella dysenteriae* from *Proteus* and *Salmonella*.
- (2) To differentiate Enterobacteriaceae from other Gram-negative bacilli.
- (3) Differentiation of *Staphylococcus aureus* and *Streptococci*.
- (4) To separate yeast *Candida* from *Torulopsis*.
- (5) Differentiation between *Vibrio* and *Pseudomonads* species.

**Part B (50%)**

1. A bacterial pathogen is isolate from a patient. To identify the pathogen, we could use biochemical tests, molecular testing, and immunoassays. Please describe why these methods could be applied for bacterial identification. (9%)
2. To promote a more efficient immune response, antigens in vaccines can be mixed with an adjuvant. (1) Why adjuvant can enhance the rate and degree of immunization? (3%) (2) Please list 2 potential adjuvants. (4%)
3. Why introduce fragments of pathogen DNA directly into the host cells can trigger immunization? (3%)
4. DGGE (Denaturing gradient gel electrophoresis) is commonly used to assess bacterial diversity. Please describe the principles of this method. (3%)
5. There are many types of microbial interactions. Please explain the types below and give an example for each type (1) mutualism (2) parasitism (3) amensalism (9 %)
6. Immunity refers to the general ability of a host to resist infection or disease. Based on the mechanisms, this can be categorized as "innate and nonspecific immunity" and "adaptive and specific immunity". (1) Please describe each immunity type in details (4%) (2) Give 2 cell types for each immunity. (4%)
7. Please fit correct answers (A-E) to the questions below. Each question may have more than one answer. (5%)  
(A) Double-stranded DNA virus (B) Single-stranded DNA virus (C) Double-stranded RNA virus (D) Plus-strand RNA virus (E) Minus-strand RNA virus

**Questions:**

- (1) Which virus must carry RNA-dependent RNA polymerase in the virions?
  - (2) Which viral genome serves directly as mRNA molecules?
  - (3) HIV virus
  - (4) Hepatitis B virus
  - (5) Virus contain reverse transcriptase in their life cycles
8. Please define the following terms. (1) rhizobia (2) enterotoxin (3) phylogenetic tree (6%)