

**Part A (50%)**

1. Gram stain is a key step in bacterial identification strategies in microbiology laboratories. Suppose you carried out the Gram stain on a culture of Gram-negative cells but forgot to add the safranin in the last step. What would you see when you examine the stained cells under the microscope? Explain. (10%)
2. How is gene expression measured using genomics tools that allow us to examine the transcripts and proteins present in a cell under certain conditions? (10%)
3. Define the following terms: (20%, 4% of each term)  
(1) Random mutagenesis (2) Site-directed mutagenesis (3) Fusion proteins  
(4) Antimetabolites (5) Primer walking
4. Describe alcoholic, lactic acid, mixed acid, and butanediol fermentations. How do mixed acid fermenters and butanediol fermenters differ? (10%)

**Part B (50%)**

1. What is the parasporal body? (2%) In *Bacillus thuringiensis*, please describe its parasporal body function and the mechanism which are capable of application in the agricultural field. (3%)
2. The physiology of actinomycete has switched from actively growing vegetative cells into special cell types (a) **hyphae** (b) **spore** (please chose one, 2%) and produce certain compounds. Those compounds are often called (c) **primary metabolite** (d) **secondary metabolite** (please chose one, 2%). Actinomycete can produce the (e) **endospore** (f) **exospore** (please chose one, 1%) to environments.
3. Generally describe the function of CRISPR/Cas system in the bacteria and archaea (5%)
4. What is the reverse transcriptase and its function used in Retroviruses (6%)
5. What is the fomite in vehicle transmission? (2%) What is the metal bioleaching in the mining of the valuable metals (2%)
6. Describe the following term (a) Methanogens (b) Methanotroph (c) Methylotroph (6%)
7. What is the biofilm (2%)? Why the SARS is disappeared (2%)?
8. What is the role and function for B cells and T cells in the immune system? (6%)
9. What is the function for the super-antigen in the immune activity? (2%) What is the function for the B-cell activation? (2%)
10. Please describe the term of probiotics (2%) and bioremediation (3%).

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