

※ 注意：請於試卷上「非選擇題作答區」依序作答，並應註明作答之部份及題號。

Part A (50%)

I. Terms and definitions (10 %)

(1) substrate-level phosphorylation (2) lysogeny (3) peptidoglycan (4) quorum sensing (5) ABC transporter

II. Comparison: please briefly describe the differences

between the following terms or cellular activities. (12 %)

(1) prokaryotic and eukaryotic flagella ( in terms of their structures and mechanisms of movement) (2) autotrophy and heterotrophy (3) fermentation and respiration (4) facultative anaerobes and aerotolerant anaerobes

III. As the temperature rises, there is an increase in the growth rate of microorganisms due to increasing rates of enzyme reactions; eventually a temperature becomes too high to maintain cellular functions. However, bacteria that have growth optima of 80~100°C have been found. How do we call this kind of bacteria? In what natural habitats might you find these conditions, and what types of adaptations would you envision for organisms living in those habitats? (8 %)

IV. Two-component system, a signal transduction system, is used to control many important cellular activities in prokaryotes. One of the well-studied two-component systems is involved in chemotaxis. Please describe how *E. coli* uses a two-component system to sense the attractant in the environment and then moves toward it. (10 %)

V. Multiple choice (10 % ). For each of the questions below, please select the best answers.

- (1) Which component is not found in a typical bacterial plasma membrane? (a) phospholipid (b) sterol (c) integral protein (d) all are found in bacterial plasma membrane
- (2) Which statement is incorrect? (a) transcription and translation are coupled in prokaryotes (b) molecular chaperones in eukaryotic cells are not as important as those in prokaryotic cells (c) In  $F^+ \times F^-$  mating, the recipient cell becomes  $F^+$ , and the donor cell remains  $F^+$  (d) Bird flu virus uses a reverse transcriptase to produce double stranded DNA for its gene expression
- (3) Which antibiotic inhibits cell wall synthesis? (a) vanomycin (b) rifampicin (c) streptomycin (d) actinomycin
- (4) Which of the following is not a regulatory mechanism used to control the *trp* operon in *E. coli*? (a) repression (b) catabolite repression (c) attenuation (d) all of the above are used.
- (5) Below is the table of comparison in photosynthetic systems of plant cells and green/purple bacteria. Which row contains wrong information?

	Plant cell	Green and purple bacteria
(a) photosystems II	Present	Absent
(b) $2H_2O \rightarrow O_2 + 4H^+$	Present	Present
(c) $CO_2$ fixation	Present	Present
(d) primary products of energy conversion	ATP+NADPH	ATP

Part B (50%)

VI. Explain in the taxonomy (including classification, nomenclature and identification), (a) based on what criteria that natural classification can be used to distinguish various microorganisms? (3 %) (b) Which way is the best and explain why? (3 %) (c) If you are a numerical taxonomist can you explain that the simple matching coefficient ( $S_{SM}$ ) is different from Jaccard coefficient ( $S_j$ ) (4 %) ?

VII. Regarding Archaeal (a) can you present schematic the G(+) and G(-) about Archaeal cell walls (3 %)? Plus, (b) does Gram-negative archaeal have outer membrane and whether they are resistant to penicillin (2 %)? So, (c) please explain their cell wall different from the eubacteria in term of chemistry analysis (3 %) (d) Please give their applied uses in biotechnology (2%)

VIII. Matches (10 %)

- |                  |                                   |
|------------------|-----------------------------------|
| a. Rhizobium     | (A) cause stomach ulcer           |
| b. Agrobacterium | (B) utilize one carbon source     |
| c. Bdellovibrio  | (C) stick-land reaction           |
| d. Methylococcus | (D) free living nitrogen fixation |
| e. Helicobacter  | (E) T-DNA plasmids                |
| f. Caulobacter   | (F) Nitrogen fixation             |
| g. Bacillus      | (G) Exchange ADP with ATP         |
| h. Azotobacter   | (H) swarmer cells                 |
| i. Rickettsia    | (I) predator                      |
| j. Clostridia    | (J) Parasporal body               |

IX. Immunology (a) What is the hybridoma and what does it can do? How do you establish the hybridoma? (3 %) (b) Explain why IgE is beneficial or harmful to the body? (3 %) (c) what is the complement (2 %) and (d) indicate a complement pathway to destroy the invader pathogens (2 %)

X. (a) What is the primary metabolites (2 %) and (b) what is the secondary metabolites (2%) and (c) what is the microarray and what is it useful (3 %)? (d) what is the Q-PCR (3 %)?