

※ 注意：請於試卷內之「非選擇題作答區」依序作答，並應註明作答之大題及小題題號。

**Part A (50 points)**

- I. (4 points) Bacterial cells possess cytoskeletal elements that are functionally analogous to those found in eukaryotic cells. These include: (A) Tubulin homologues (B) Actin homologues (C) Intermediate filaments-like proteins.  
Please see the bacteria behaviors below and match the cytoskeleton protein.  
(A) Cell division  
(B) Positioning magnetosomes  
(C) Induce curvature in curved rods  
(D) Plasmids segregation
- II. (5 points) How do ionizing radiation, ultraviolet radiation, and visible light harm microorganisms?
- III. (4 points) When bacteria replicate their DNA, how is the Okazaki fragment removed and synthesized into a complete DNA strand?
- IV. (6 points) Please define the terms below. (1) Promoter (2) Shine-Dalgarno sequence (3) Wobble (in base pairing)
- V. (5 points) (1) What is "alternative splicing"? (2) What is the importance of "alternative splicing"?
- VI. (6 points) (1) How do chemolithotrophs obtain their ATP? (2) What is their common source of carbon? (3) When chemolithotrophs use "reverse electron flow" to generate NADH?
- VII. (8 points) Bacteria could generate drug resistance to antibiotics. (1) Please list **three** mechanisms that bacteria use to build resistance. (2) Please list **one** strategy to prevent drug resistance.
- VIII. (6 points) Ribosomes have three tRNA binding sites. Please explain the distinct roles of each site during the translation process.
- IX. (6 points) (1) What is chemotaxis? (2) What are the benefits of chemotaxis for bacteria? (3) How do bacteria detect the presence of chemoattractants?

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**Part B (50 points)**

- I. (5 points) (a) *Bifidobacterium* (b) *Corynebacterium* (c) *Mycobacteria* (d) *Rhodococcus* (e) *Frankia* (f) *Streptomyces* (g) *Bacillus thuringiensis* (h) *Bacillus subtilis*

Please match the term above to the question below (Only 1 answer).

- (1) parasporal body
  - (2) antibiotic production
  - (3) mycolic acid
  - (4) Probiotics
  - (5) snapping division (cells in palisades)
- II. (5 points) What are (1) the  $\lambda$  (lambda) prophage and (2) the lytic phage and please explain (3) the roles of CII and (4) Cro proteins in the phage life cycle?
- III. (5 points) After the T4 phage infect the host cells, it can form the concatemers and glycosylation of Hydrothymethylcytosine (HMC). Please explain. (1) What are the concatemers? (2) Why does it produce HMC with glycosylation?
- IV. (4 points) Please compare (1) the HIV (Retroviruses) and (2) HBV (Hepadnaviruses) genome replication and protein synthesis.
- V. (4 points) Describe the most reliable method for the diagnosis of COVID19 and also explain the process completely.
- VI. (6 points) In nitrogen cycle, please describe (1) the nitrogen fixation (2) the anammox (3) comammox
- VII. (4 points) Explain what is the (1) holobionts and (2) Gut-Brain Axis for microbiome investigation, please give a simple example for each term.
- VIII. (5 points) Antibody kinetics is the basis for vaccination, please describe (1) the primary antibody response and (2) the secondary antibody response (please also indicate what kind of the antibody would be produced by the B cells)
- IX. (8 points) Describe (1) the antigen, (2) epitopes, (3) valence and (4) avidity in the immunity.
- X. (4 points) Describe the type IV hypersensitivity in the immune response.