

Part A (50%)

※ 注意：請於試卷內之「非選擇題作答區」標明題號依序作答。

- I. (8%) Viral infection can be interrupted by the correct use of drugs that target specific components of the HIV replicative process.
- (1) HIV is a (DNA/ RNA) virus (2%)
- (2) Please list **Two** potential steps that drugs can block in the HIV infection process and **explain**. (6%)
- II. (8%) Define the terms below. (1) promoter (2) Shine-Dalgarno sequence (3) operon (4) prions
- III. (3%) Please describe how the **riboswitch** region in the 5' untranslated leader of an mRNA controls the bacterial **transcription**.
- IV. (9%) There are several mechanisms of drug resistance. Please pick up **Three** mechanisms and **describe them in detail**.
- V. (3%) Aquatic magnetotactic bacteria use **magnetosomes** to orient themselves in the earth's magnetic field. Please describe the potential **advantages** for bacteria to have magnetosomes.
- VI. (8%) (1) Please describe the cell wall structures of Gram-positive and Gram-negative. (2) Please describe the differences in the cell wall between bacteria and archaea.
- VII. (3%) Halophiles generally are able to live in high-salt habitats. Please describe the strategy of how this kind of bacteria can tolerate a high-salt environment.
- VIII. (4%) Some chemical reagents are used to control microorganisms. Please list **Four** chemical reagents. (ex. ethanol)
- IX. (4%) Please explain the differences among passive diffusion, facilitated diffusion, and active transport.

Part B (50%)

- I. (6%) During the past decades, scientists realized that gut microbiome plays critical roles in host immunity, metabolism and even mental health. Therefore, some doctors/nurses would swab the mouths of newborns with maternal vaginal secretions after cesarian delivery. What is the purpose of this procedure? (3%) To study the gut microbiome of a selected host, which technique can we use and why (3%)?
- II. (12%) Explain the reason why the phenomenon occurs based on the properties of each microbial group (underlined).
- (1) β -lactam antibiotics are not effective against Mollicutes.
- (2) Thermal inactivation is not always effective on eliminating strains of Bacillus or Clostridium spp.
- (3) Agricultural biotechnology relies on a plant pathogen, Agrobacterium tumefaciens.
- (4) The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) evolves multiple variants (eg., Delta and Omicron) very quickly.
- (5) Exposure to food crops contaminated with Aspergillus flavus and A. parasiticus may lead to intoxications.
- (6) Forams, together with Haptophyta, are important for Earth's carbon budget.
- III. (6%) Increased amount of greenhouse gases entering atmosphere leads to climate change, especially global warming. What are "**greenhouse gases**"? Please define the term and give some examples (3%) Please give an example how human activities with the activities of microorganisms worsen the situation (3%).
- IV. (8%) **Phagocytosis** and **autophagy** are two parallel processes which accomplish ingestion and digestion of foreign materials such as pathogens. Please describe the processes occurs in phagocytosis and autophagy? (6%) Which process is required for macrophages to present antigen to naïve T- or B-cells for T-cell or B-cell activation? (2%)
- V. (4%) The discovery of heavy-chain antibodies from camelids (eg., llama) sheds light on development of new treatments for viral diseases, perhaps including Covid-19. Scientists found that nanobodies, the variable regions of such heavy-chain antibodies, can inactivate viruses in a manner similar to immunoglobulin G (IgG). Based on your knowledge about antibodies, please explain how nanobodies work to inactivate viruses?
- VI. (8%) Please define (1) food-borne disease (2) communicable disease (3) zoonotic disease (4) nosocomial infectious disease (4%) and give an example for each of them (4%).
- VII. (6%) (1) Mitosomes (2) stigma (3) cytostome (4) pseudopodia (5) contractile vacuoles (6) pyrenoid are organelles or structures of protists. What is the **main function** of each organelle/structure above?