

注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。


國立清華大學 109 學年度碩士班考試入學試題

系所班組別：生命科學院
甲組

科目代碼：0403

考試科目：微生物學

—作答注意事項—

1. 請核對答案卷（卡）上之准考證號、科目名稱是否正確。
2. 作答中如有發現試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清（含未依範例畫記）致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「**國立清華大學試場規則及違規處理辦法**」，無法因本試題封面作答注意事項中未列明而稱未知悉。

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考試科目（代碼）：微生物學(0403、0703)

共 8 頁，第 1 頁 *請在【答案卷】作答

I. Single choice (2% each, total 44%)

1. Which of the statement is not true for fungi?
 - A. Members of *Ascomycota* (al known as sac fungi) include yeasts and molds.
 - B. The respiratory tract is the major portal of entry for the genus *Aspergillus* that can lead to pulmonary aspergillosis.
 - C. Members of *Basidiomycota* (al known as club fungi) include mushrooms.
 - D. Oropharyngeal candidiasis or oral thrush is commonly caused by the fungi such as *Cryptococcus neoformans* and *Histoplasma capsulatum*.
 - E. Aflatoxins are toxins produced by fungi and can cause chronic and acute liver disease and liver cancer.

2. Which statement of pathogenicity and infection is correct?
 - A. Intoxications are diseases caused by a specific toxin produced by pathogens.
 - B. The infectious disease caused by bacterial toxins in the blood is called bacteremia.
 - C. Pathogenic *Escherichia coli* can cause food-borne diseases such as gastritis and peptic ulcer disease.
 - D. Bacteria such as *Chlamydia* species are obligate extracellular pathogens.
 - E. Infectious diseases passed from animals to human are known as mycoses.

3. Which of the following statement is not true for comparison of *Bacteria*, *Archaea* and *Eukarya*?
 - A. Nitrogen fixation are existed in *Bacteria* and *Archaea*.
 - B. Membrane-enclosed nucleus with nucleolus are present in *Eukarya*, but not in *Bacteria* and *Archaea*.
 - C. Gas vesicles are present in *Eukarya* and *Archaea*, but not in *Bacteria*.
 - D. Messenger RNAs go through splicing, capping and poly-A tailing in *Eukarya*, but not in *Bacteria* and *Archaea*.
 - E. *Archaea* are insensitive to rifampicin that inhibits DNA-dependent RNA polymerase.

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共 8 頁，第 2 頁 *請在【答案卷】作答

4. Choose a wrong answer from the following statement related to recombinant DNA technology and microbial genomics?
- A. Multiple displacement amplification (MDA) is a non PCR-based DNA amplification method that can amplify DNA even from a single cell.
 - B. Because the type I and II restriction enzymes cut DNA directly at their recognition sites, they are commonly used in gene cloning.
 - C. Metagenomics is used to study the diversity and metabolic potential of microbial communities without culturing individual microbes.
 - D. In the blue-white screening for the identification of recombinant bacterial colonies, the white colonies are predicted to have plasmids containing DNA insert.
 - E. DNA can be introduced into microbial cells by transformation or electroporation.
5. Please choose one wrong statement for the Gram-positive bacteria.
- A. The alpha-hemolysis is that the genus *Streptococcus* grow on blood agar, characterized by a clear zone of complete lysis of red blood cells.
 - B. Toxic shock syndrome is a staphylococcal disease and results from the massive overproduction of cytokines by T cells.
 - C. The cell walls of Mycobacteria have high lipid content and mycolic acids, which make them acid-fast.
 - D. Tetanus is a food-borne disease caused by *Clostridium tetani*.
 - E. Streptomycetes are important sources of many clinically used antibiotics.

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共 8 頁，第 3 頁

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6. Choose a correct one from the following statements.
- A. The cyanobacteria contain only the photosystem I, and therefore perform oxygenic photosynthesis using water as an electron donor.
 - B. The anammox reaction is a process for aerobic ammonia oxidation to generate nitrogen gas.
 - C. The purple sulfur bacteria perform anoxygenic photosynthesis using chlorophyll a that can absorb blue and red light.
 - D. *Pseudomonas aeruginosa* degrades most hexoses by the Entner-Doudoroff pathway.
 - E. Prochlorophytes are the only prokaryotes to contain chlorophyll b than makes them as possible ancestors of the chloroplasts.
7. Acid-fast organisms such as *Mycobacterium tuberculosis* contain _____ constructed from mycolic acids in their cell walls.
- A. proteins
 - B. carbohydrates
 - C. peptidoglycan
 - D. DNA
 - E. lipids
8. Which of the following description is not correct?
- A. Ernst Ruska designed the first transmission electron microscope (TEM) and won the 1986 Nobel Prize in Physics.
 - B. Carl Linnaeus defined the binomial nomenclature system for naming microbes.
 - C. Louis Pasteur developed (or adopted) a set of criteria that could be used to establish a causative link between a particular microorganism and a particular disease?
 - D. Carl Woese began the ribosomal RNA studies that led to the division of prokaryotic organisms into the Bacteria and the Archaea.
 - E. Edward Jenner developed and documented the first vaccination procedure against smallpox (天花).

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共 8 頁，第 4 頁 *請在【答案卷】作答

9. Which of the processes named here is the least likely to contribute to the evolution of genetic diversity of Bacteria and Archaea?
- A. Binary fission
 - B. Mutation
 - C. Horizontal gene transfer
 - D. Sexual reproduction
 - E. Selection and isolation
10. Which of the following is correct about bacteria?
- A. Some bacteria contain intra-cytoplasmic membranes to provide a larger membrane surface for greater metabolic activity.
 - B. The nucleoid in bacteria contains chromosome and histones.
 - C. Most of the membranes in bacteria contain cholesterol.
 - D. Some of bacteria have type III secretion system for mating (conjugation).
 - E. The size of a bacterial ribosome is 80S.
11. Which of the following statements is not correct:
- A. When the cell wall is removed from a Gram-positive bacterium, the resulting form is called a protoplast.
 - B. When the cell wall is removed from a Gram-negative bacterium, the resulting form is called a spheroplast.
 - C. Sortase is a protein enzyme of bacteria that catalyzes covalent attachment of some surface proteins to peptidoglycan.
 - D. Lipopolysaccharide (LPS) contributes to the negative charge on cell surface of Gram-negative bacteria.
 - E. Cell wall protects against plasmolysis but not against osmotic lysis.

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共 8 頁，第 5 頁 *請在【答案卷】作答

12. If the decolorizer (脫色劑) is left on too long in the Gram-staining procedure, Gram-positive organisms will be stained _____ and Gram-negative organisms will be stained _____.
- A. pink; pink
 - B. purple; purple
 - C. purple; colorless
 - D. purple; pink
 - E. colorless; purple
13. Which of these methods can be used to determine the number of viable microorganisms in a sample?
- A. light scattering in a spectrophotometer.
 - B. measuring colony forming units per ml.
 - C. counting a known volume of cells in a hemocytometer.
 - D. measuring total cell mass.
 - E. counting with a Coulter counter.
14. The time required to kill 90% of the microorganisms or spores in a sample under specified conditions is the _____.
- A. thermal death time (TDT).
 - B. thermal death point (TDP).
 - C. decimal reduction time (D value).
 - D. z value.
 - E. F value.
15. The simplest viruses consist of
- A. RNA only.
 - B. RNA or DNA in a protein coat.
 - C. Protein only.
 - D. RNA or DNA in a protein coat covered with lipid envelope.
 - E. RNA, DNA and enzymes in a protein coat with a lipid envelope

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共 8 頁，第 6 頁 *請在【答案卷】作答

16. Nonenveloped viruses most often gain access to eukaryotic host cells by
- A. fusion with the host cell plasma membrane followed by entrance of the nucleocapsid into the cytoplasm.
 - B. pinocytosis.
 - C. endocytosis.
 - D. nucleic acid injection through the plasma membrane.
 - E. None of these
17. 0.2 ml of a 10^{-4} dilution of a virus preparation yields 90 plaques. What is the number of PFU per ml in the undiluted virus preparation?
- A. 9.0×10^5
 - B. 4.5×10^7
 - C. 4.5×10^6
 - D. 9.0×10^8
 - E. 1.8×10^5
18. A _____ assay is most useful for determining the viability of a viral preparation.
- A. direct (electron microscopic) count
 - B. hemagglutination
 - C. agarose
 - D. polymerase chain reaction
 - E. plaque
19. Which of the following is not true of viroids?
- A. Extracellular viroids have a lipid bilayer envelope.
 - B. Viroids have no protein capsids.
 - C. Viroid RNA does not serve as mRNA nor does it direct the synthesis of mRNA.
 - D. Viroids are small circular ssRNA molecules.
 - E. None of these

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共 8 頁，第 7 頁

*請在【答案卷】作答

20. Which of the following encodes its own capsid proteins?
- A. Satellite protein
 - B. Satellite virus
 - C. Satellite RNA
 - D. Prion
 - E. Satellite DNA
21. Dendritic cells
- A. play an important role in the development of allergies and hypersensitivity.
 - B. contain granules with histamine and other pharmacologically active substances that contribute to the inflammatory response.
 - C. are mainly important in the defense against protozoan and helminth parasites.
 - D. are capable of recognizing specific pathogen-associated molecular patterns and play an important role in nonspecific resistance.
 - E. are mainly important in the defense against *Cryptosporidium* spp.
22. Blood cell development occurs in the bone marrow of mammals during the process of _____.
- A. hemolysis
 - B. homeostasis
 - C. hemostasis
 - D. hematopoiesis
 - E. homeoviscous

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II. Term description and short answers (3% each, total 36%)

1. metagenomics
2. reverse vaccinology
3. minimal inhibitory concentration (MIC) of a drug
4. secondary metabolites of microorganisms
5. methylophore
6. Siderophore
7. Viable but nonculturable (VBNC)
8. Chemolithoheterotroph
9. viral neutralization
10. inflammasome
11. chimeric antigen receptor T cells
12. mimivirus

III. Short answer (6%)

1. Chromatic adaptation allows oxygenic photosynthetic bacteria to modulate relative of pigments phycocyanin and phycoerythrin. Please explain how the chromatic adaptation works (1) in the presence of orange light and (2) in the presence of blue (or blue-green) light. (6%)

IV. Long answer (14%)

1. How does a confocal scanning laser microscope (CSLM) operate (4%), (2) and in what way does its function and operation differ from that of an epifluorescence microscope? (4%)
2. Why antigenic shift and antigenic draft are so important in infectious disease spreading? (6 %)