

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 115 學年度碩士班考試入學試題

系所班組別：生命科學暨醫學院

甲組(生物與醫學科學組)

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. 考試開始後，請於作答前先翻閱整份試題，是否有污損或試題印刷不清，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. 提早交卷者不可攜出試題，請將試題連同答案卷(卡)交予監考人員，攜出將以違規論處。當節考試結束後試題將置於講台，可自行取回，本試場不負保管責任。
7. 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)

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*請在【答案卡】作答

一、單選題 (2 points/each, 共 50 分)

1. Which is true regarding photosynthetic bacteria?
 - A. Green bacteria carry out oxygenic photosynthesis, using water as an electron donor.
 - B. Endosymbiotic purple bacteria are thought to have evolved into chloroplasts.
 - C. Akinetes of the filamentous cyanobacteria *Anabaena* play a role in nitrogen fixation and the production of glutamate.
 - D. Phycobilisomes of cyanobacteria play a role in light-harvesting and contain the pigments phycocyanin and phycoerythrin.
 - E. Green sulfur bacteria are obligate aerobic photolithoautotrophs that can use hydrogen as an electron donor.
2. In a comparison among *Bacteria*, *Archaea*, and *Eukarya*, please choose the correct statement.
 - A. Both *Archaea* and *Eukarya* contain membrane-enclosed nucleus with nucleolus.
 - B. mRNA introns are present in *Archaea* and *Eukarya*.
 - C. Both *Archaea* and *Eukarya* are insensitive to kanamycin.
 - D. Methanogenesis is present in *Bacteria* and *Archaea*.
 - E. Both *Bacteria* and *Eukarya* do not contain muramic acid in their cell wall.
3. Which statement is not true for the Proteobacteria?
 - A. Mitochondria likely originated from the genus *Rickettsia*.
 - B. The genus *Shewanella* is useful for the bioremediation of radionuclide-contaminated environments.
 - C. Under anaerobic conditions, *E. coli* facilitates mixed acid fermentation that can produce multiple acids (acetic, succinic, formic, lactic), ethanol, H₂ and CO₂.
 - D. *Yersinia pestis* is the causative agent for the disease called plaque.
 - E. The genus *Klebsiella* contains pathogens that cause diverse diseases of plants, including blights and wilts.

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4. Bacterial capsule can be best visualized using:
 - A. Gram staining
 - B. Albert's staining
 - C. Simple staining
 - D. Acid-fast staining
 - E. Negative staining
5. Which of the following bacterial toxin can inhibit protein synthesis in the host?
 - A. Shiga toxin
 - B. Botulinum toxin
 - C. Tetanus toxin
 - D. Pertussis toxin
 - E. Cholera toxin
6. The most common cause of burn-derived sepsis is:
 - A. *Escherichia coli*
 - B. *Pseudomonas aeruginosa*
 - C. *Klebsiella pneumoniae*
 - D. *Salmonella typhimurium*
 - E. *Proteus mirabilis*
7. Which of the following antibiotic can block bacterial RNA synthesis?
 - A. Cycloserine
 - B. Chloramphenicol
 - C. Tetracycline
 - D. Rifampicin
 - E. Ampicillin
8. The major sterol in the fungal plasma membrane is ____, which is also an important target of antifungal drugs.
 - A. Stigmasterol
 - B. Cholesterol
 - C. Ergosterol
 - D. Lanosterol
 - E. Campesterol

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9. Please choose the wrong statement regarding the nitrogen cycle mediated by bacteria.
- A. Azotobacter species fix nitrogen from the air, and the product of nitrogen fixation is ammonia.
 - B. The anammox reaction is an aerobic process performed by bacteria in the phylum Planctomycetes, in which ammonium ion is oxidized to nitrogen gas using nitrite as the terminal electron acceptor.
 - C. Nitrification by bacteria is a two-step process in which ammonium is oxidized to nitrite and then to nitrate.
 - D. In denitrification, nitrates are reduced to nitrogen gas during anaerobic respiration.
 - E. Bacteria of the genera Nitrobacter and Nitrococcus convert nitrite to nitrate.
10. Which air filtration system is capable of removing 99.97% of particles?
- A. Surgical mask
 - B. Cloth mask
 - C. Depth filter
 - D. HEPA filter
 - E. Membrane filter
11. The most common archaeal cell envelope structure external to the plasma membrane is the:
- A. Capsule
 - B. Outer membrane
 - C. Peptidoglycan layer
 - D. Lipopolysaccharide layer
 - E. S-layer

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12. Which phase of the microbial growth curve is associated with genetic diversity and evolution?
- A. Lag phase
 - B. Exponential phase
 - C. Stationary phase
 - D. Death phase
 - E. Long-term stationary phase
13. Loss of the MinCDE system in *E. coli* would most likely lead to:
- A. Elongated filamentous cells
 - B. Septa forming near cell poles
 - C. Inhibition of DNA replication
 - D. Defective MreB localization
 - E. Failure of chromosome condensation
14. Why do Gram-positive bacteria retain crystal violet dye during Gram staining?
- A. Presence of an outer membrane
 - B. High lipid content
 - C. Thick, highly cross-linked peptidoglycan
 - D. Teichoic acid removal
 - E. Porin closure
15. Which conclusion best explains why *Mycoplasma* (微漿菌) species are intrinsically resistant to β -lactam antibiotics?
- A. They lack ribosomes
 - B. They possess an outer membrane
 - C. They have altered porins
 - D. They lack a cell wall
 - E. They degrade antibiotics enzymatically

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*請在【答案卡】作答

16. Which limitation applies to Koch's postulates?
- A. Some pathogens cannot be cultured
 - B. They cannot be used for bacteria
 - C. They require genetic sequencing
 - D. They apply only to viruses
 - E. They exclude animal models
17. Which factor most limits the usefulness of fluorescence microscopy for long-term live-cell imaging?
- A. Low numerical aperture
 - B. Requirement for thin specimens
 - C. Photobleaching and phototoxicity
 - D. Inability to label proteins
 - E. Low magnification
18. Which of the following sentence best describes why viruses are considered necessary intracellular pathogens?
- A. They can reproduce independently, but they tend to replicate faster inside cells.
 - B. They lack ribosomes and mitochondria and must hijack host machinery to make new virions.
 - C. They reproduce only through cell division and require host nutrients for energy.
 - D. They are always larger than bacteria, so they must use host cells for transport.
 - E. They can replicate their genome outside cells but require cells only for entry.
19. Which pairing correctly matches "recognition and attachment" for naked vs. enveloped viruses?
- A. Naked: glycoprotein spikes; Enveloped: capsid proteins.
 - B. Naked: host antibodies; Enveloped: host ribosomes.
 - C. Naked: capsid proteins; Enveloped: viral glycoproteins (spikes).
 - D. Naked: MHC class I; Enveloped: MHC class II.
 - E. Naked: RNA polymerase; Enveloped: DNA polymerase.

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*請在【答案卡】作答

20. A student describes a viral particle as “genome enclosed in capsid.” Which term is the most precise match?
- A. Capsomer.
 - B. Virion envelope.
 - C. Micelle.
 - D. Nucleocapsid.
 - E. Glycoprotein spike.
21. You run flow cytometry on lymphocytes to identify T cells. Which marker strategy best matches the samples?
- A. Identify T cells by CD16 and CD56 positivity.
 - B. Identify T cells by CD4 and CD8.
 - C. Identify helper T cells by MHC class I expression.
 - D. Identify cytotoxic T cells by MHC class II expression.
 - E. Identify all lymphocytes by TCR only; CD markers are not used.
22. Which sentence best describes the primary vs. secondary antibody response to a viral antigen?
- A. Primary response produces high-affinity IgG first; secondary response produces IgM only.
 - B. Primary response is rapid and strong because memory B cells activate immediately.
 - C. Primary response produces IgM first (lower affinity) and IgG later (higher affinity).
 - D. Primary and secondary responses are identical in timing and strength.
 - E. Secondary response is weaker because antibodies suppress memory B-cell activation.

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*請在【答案卡】作答

23. Which description most closely matches the basic genome and structure type of Coronaviruses?
- A. Small, non-enveloped viruses with segmented negative-sense ssRNA.
 - B. Small, enveloped viruses with negative-sense ssRNA and a helical capsid only.
 - C. Large, non-enveloped viruses with double-stranded DNA.
 - D. Medium-sized, enveloped viruses with segmented double-stranded RNA.
 - E. Large, enveloped viruses with positive-sense single-stranded RNA
24. Which combination correctly describes influenza virus classification and key structural and genomic features?
- A. Paramyxoviridae; nonsegmented positive-sense ssRNA; no envelope glycoproteins.
 - B. Orthomyxoviridae; segmented negative-sense ssRNA; envelope glycoproteins HA and NA.
 - C. Flaviviridae; segmented dsRNA; envelope glycoproteins M and E.
 - D. Retroviridae; negative-sense ssRNA with reverse transcriptase; capsule proteins H and N.
 - E. Coronaviridae; segmented positive-sense ssRNA; envelope glycoproteins HA and NA.
25. A recovered patient is re-exposed to the same virus months later. Which sentence best describes the secondary response?
- A. Rapid activation of memory B cells, leading to high IgG concentrations.
 - B. Slower and weaker than the primary response because memory cells suppress immunity.
 - C. IgM is always higher than IgG due to lack of class switching.
 - D. No antibody response occurs because the virus is cleared by fever alone.
 - E. Only innate immunity is involved; adaptive immunity does not respond.

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二、Matching questions 配合題 (2 points/each)(共 12 分)

Please match each of the following questions (on the top) with a proper answer (on the bottom).

(1) A fungus can cause meningitis: _____; (2) The primary bacterium links to peptic ulcers: _____; (3) Drugs targeting the fungal cell wall: _____; (4) A food-borne bacterial pathogen: _____; (5) An obligate intracellular bacterium: _____; (6) The oldest (deepest) branch of *Bacteria*: _____.

(A) *Lactobacillus acidophilus*, (B) *Mycoplasma pneumoniae*, (C) *Agrobacterium tumefaciens*, (D) Caspofungin, (E) Fluconazole, (F) *Cryptococcus neoformans*, (G) *Nitrococcus* species, (H) *Aspergillus fumigatus*, (I) Anammox reaction, (J) *Helicobacter pylori*, (K) Prochlorophytes, (L) *Streptococcus pneumoniae*, (M) *Shewanella* species, (N) *Listeria monocytogenes*, (O) the Mollicutes, (P) Amphotericin B, (Q) *Caulobacter* species, (R) *Streptococcus mutans*, (S) *Candida tropicalis*, (T) Flucytosine (5-FC), (U) *Deinococcus* species, (V) *Chlamydia* species, (W) Resistance to desiccation, (X) the phylum *Aquifex*, (Y) *Prochlorococcus*, (Z) *Legionella pneumophila*.

三、Term description (共 18 分)

1. RNA world hypothesis (3 分)
2. Viable but non-culturable (VBNC) state (3 分)
3. Magnetosomes (3 分)
4. Zoonotic transmission (3 分)
5. Cap-snatching (3 分)
6. Multibasic cleavage site in influenza virus (3 分)

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*請在【答案卷】作答

四、Short answers 簡答題(共 12 分)

1. What is the difference between the end products of homolactic and heterolactic fermentation in *Lactobacillus* species? (5 分)
2. Define "metagenomics" and its advantage in virology. (4 分)
3. What is the main difference between "active" and "passive" immunity? (3 分)

五、Long answers (8 分)

1. Discuss the mechanisms by which microorganisms develop resistance to antibiotics. (8 分)