國立清華大學 104 學年度碩士班考試入學試題

系所班組別：生命科學院甲組、醫學生物科技學程

考試科目（代碼）：微生物學(0403、0703)

A. 單選題 (每題 2 分，共 24 分)

1. 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. Robert Koch developed (or adopted) a set of criteria that could be used to establish a causative link between a particular microorganism and a particular disease.
   C. Charles Chamberland developed porcelain bacterial filters which were later used in the study of tobacco mosaic disease and led to the discovery of viruses.
   D. Antony van Leeuwenhoek is credited with developing vaccines against chicken cholera, anthrax, and rabies.
   E. Joseph Lister revolutionized surgery by introducing phenol as a disinfectant.

2. At 5:30 p.m. a closed flask of sterile broth is inoculated with 20,000 bacterial cells. The lag phase lasts 30 min. At 10:20 p.m. the culture enters stationary phase with a population of 160 million cells. What is the mean growth rate of this bacterium? (log 2 = 0.301)
   A. 2 generation/hr
   B. 2.5 generation/hr
   C. 3 generation/hr
   D. 3.5 generations/hr
   E. 4 generations/hr

3. The transfer of genes between bacterial or archaeal cells by viruses is called _____.
   A. conjugation.
   B. transfection.
   C. transformation.
   D. translocation.
   E. transduction.

4. Which of the following is not a characteristic of phosphoenolpyruvate: sugar phosphotransferase system (PTS)?
   A. Most aerobic bacteria have PTSs.
   B. chemically modifies the molecules as it is brought into cell.
   C. enzyme II transports only specific sugars and varies with the PTS, whereas enzyme I and HPr are common to all PTSs
   D. It is a type of energy-dependent transport.
   E. It is an important example of group translocation.

5. Which of the following statements is not correct for the microscopy used in microbiological studies?
   A. Scanning electron microscope (SEM) can produce a 3-dimensional image of specimen's surface features.
   B. Scanning tunneling microscope (STM) applies a sharp probe to move over the specimen surface at a constant distance can be used to study surfaces that do not conduct electricity well.
   C. By applying transmission electron microscope (TEM), a denser region in the specimen scatters more electrons and therefore appears darker in the image.
   D. Confocal scanning laser microscope (CSLM) uses a laser beam to illuminate a fluorescently stained specimen.
   E. The Dark-Field microscope produces a bright image of the object against a dark background.

6. Which of the following is wrong about bacteria?
   A. The nucleoid in bacteria is usually not membrane bound.
   B. The membranes in bacteria lack cholesterol.
   C. Some of bacteria have sex pili for mating (conjugation).
   D. Some of bacteria have type IV fimbriae (or pili) for motility or DNA uptake.
   E. The size of a bacterial ribosome is 80S.

7. Which of the following statement is true?
   A. The B subunit of diphtheria toxin can catalyze ADP-ribosylation of EF-2 and inhibit protein synthesis, leading to host cell death.
   B. Melanin is a major carbohydrate glucuronoxylomannan of *Cryptococcus neoformans* to protect the yeast from host defense based on oxygen- and nitrogen-derived products
   C. Different types of aflatoxin are identified in nature. Aflatoxin G1 is considered the most toxic and the mutagenic nature of aflatoxins is believed to be due to their DNA-damaging properties
   D. Streptolysin S (SLS) is a leukocidin and can be inactivated by oxygen
   E. Yeasts are a colloquial name of single-celled fungi and all belong to the *Ascomycetes*

8. Which of the following statement is wrong for microbial nitrification?
   A. The second step of nitrification is the oxidation of nitrite into nitrate.
   B. In the oxidation of ammonia, bacteria first use the ammonia monooxygenase to convert ammonia into hrdroxylamine.
   C. Bacteria of the *Nitrobacter* and *Nitrococcus* species involve in the oxidation of nitrite to nitrate.
   D. Bacteria of the *Nitrococcus* species use the hysroxylamine oxidoreductase to convert hydroxylamine to nitrate.
   E. The first step of nitrification is the biological oxidation of ammonia with oxygen into nitrite.

9. Which of the following statement is wrong?
   A. *Streptococcus mutans* is commonly found in the human oral cavity and can cause dental caries.
   B. *Bordetella pertussis* is the causing agent of whooping cough.
   C. Typhoid fever is caused by bacteria of the *Yersinia* species.
   D. *Helicobacter pylori* can cause gastritis and peptic ulcer disease.
   E. Cellulitis is a skin infection that is commonly caused by streptococci and *Staphylococcus aureus*.

10. Please choose one correct answer for photosynthetic bacteria.
    A. The green sulfur bacteria can use H_2 as an electron donor in anoxygenic photosynthesis.
    B. The purple nonsulfur bacteria use H_2, H_2S or S as an electron donor in anoxygenic photosynthesis.
    C. The cyanobacteria use organic molecules as an electron donor to perform oxygenic photosynthesis.
    D. Anoxygenic green bacteria contain chlorophyll a and commonly inhabit the upper layers of freshwater, where they can absorb large amounts of red and blue lights
    E.Hormogonia is a specialized cell of the cyanobacteria and is used for nitrogen Fixation.
11. Which of the following statement is not true for microbial evolution and taxonomy.
    A. DNA-DNA hybridization can be used to define bacteria at the genus level.
    B. Chemolithotrophy is absent in the *Eukarya*.
    C. Both whole cell protein profiling and the G+C content can be used to define bacteria at the subspecies level.
    D. Biovars represent bacterial strains that differ biochemically and physiologically.
    E. The 16S rDNA sequencing can be used to define bacteria at the strain level.
12. Which of the following statement is not true?
    A. Methylotrophic bacteria utilize reduced one-carbon compounds as sole carbon and energy source.
    B. The *Archaea* are insensitive to Rifampicin that inhibits DNA-dependent RNA polymerase.
    C. The *Archaea* lack membrane-enclosed nucleus with nucleolus.
    D. Pandemic disease refers to a disease that occurs occassionaly at irregular intervals.
    E. *Rickettsia* lack glycolytic pathway and do not use glucose as energy source.

B. 簡答題 (共 28 分)

1. Chemoorganoheterotroph (3 分)
2. Glycocalyx (3 分)
3. Viremia (2 分)
4. Slow infection (2 分)
5. What is the source of the middle-east respiratory syndrome Coronavirus? (2 分)
6. What are the cell sources of interferon-gamma? (2 分)
7. Virus-like particle (2 分)
8. Natural killer cells (2 分)
9. Viroids (2 分)
10. Describe the plaque assay as virology approach (2 分)
11. Endotoxin (2 分)
12. Mineralization (2 分)
13. Ecotype (2 分)

C. 問答題 (共 48 分)

1. (a) What are pure cultures, and why are they important? (3 分)

   (b) How are spread plates, streak plates, and pour plates prepared? (6 分)
2. Plot a bacterial growth curve in a closed system and describe the four phases of this curve and discuss the causes of each. (6 分)
3. Describe the roles of GP in Ebola virus (5 分)
4. Describe the Adenoviruses as vaccine vectors (5 分)
5. Describe the recombinant vaccine using in rabies (4 分)
6. Describe the functions of neuraminidase in influenza virus (4 分)

7. In biology, symbiosis represents two organisms commonly living together in an association with one another. At least three types of symbiosis are described: mutualism, commensalism and parasitism. Please explain the difference among these three types of relationship. (6 分)
8. In the era of genomics, many genome-wide approaches are developed for the use in biomedical research. Please briefly explain what metagenomics is in microbiology? (4 分) In addition, please describe and explain one possible application to use metagenomic approaches in bio-medical research. (5 分)