國立清華大學 103 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)

Ⅰ. Single choice

1. The nucleic acids carried by viruses usually consist of (1.5%)
   A. DNA.
   B. RNA.
   C. either DNA or RNA.
   D. both DNA and RNA simultaneously.
   E. neither DNA nor RNA.

2. The protein coat surrounding the viral genome is called the (1.5%)
   A. capsule.
   B. capsid.
   C. matrix.
   D. envelope.
   E. nucleic acid.

3. Viral envelopes are composed of (1.5%)
   A. proteins.
   B. lipids.
   C. carbohydrates.
   D. all of the choices
   E. none of the choices.

4. Glycoprotein spikes protruding from the outer surface of viral envelopes function as (1.5%)
   A. toxins.
   B. factors that bind to host cells.
   C. cell lysis factors.
   D. factors needed for site specific recombination.
   E. none of the choices.

5. Which is not true of viruses? (1.5%)
   A. They are obligate intracellular parasites
   B. They can be destroyed with antibiotics
   C. They can be observed with an electron microscope
   D. They are acellular
   E. They replicate only inside host cells

6. A complete virus particle is called a (1.5%)
   A. capsid.
   B. nucleocapsid.
   C. virion.
   D. cell.
   E. matrix.

7. Mannitol salt agar (MSA) only allows the growth of halophiles; nonhalophiles will not grow. Among the halophiles, mannitol fermenters release acid that turns the pH indicator yellow; mannitol nonfermenters leave the medium red. Onto MSA you inoculate a nonhalophilic mannitol nonfermenter, a halophilic mannitol fermenter and a halophilic mannitol nonfermenter. Here the medium acts as a _____ medium. (2%)
   A. general purpose
   B. selective
   C. enrichment
   D. differential
   E. both selective and differential

8. At 5:30 p.m. a closed flask of sterile broth is inoculated with 10,000 cells. The lag phase lasts 30 min. At 10:30 p.m. the culture enters stationary phase with a population of 80 million cells. At what time is the population most close to a half of the maximum? ($\log 2 = 0.301$, $\log 65 = 1.813$) (2%)
   A. 7:30 p.m
   B. 8:50 p.m
   C. 9:50 p.m
   D. 10:10 p.m
   E. 11:40 p.m

9. Which of the following methods can not be used to measure microbial growth in a sample? (2%)
   A. measuring total cell mass.
   B. light scattering in a spectrophotometer.

C. measuring the content of lipopolysaccharide (LPS) to estimate the number of Gram positive bacteria in aquatic samples.
D. using plating methods to measure colony forming units per ml.
E. counting a known volume of cells in a hemocytometer.

10. In transmission electron microscopy, spreading a specimen out in a thin film with uranyl acetate, which does not penetrate the specimen, is called (2%)
A. freeze-etching.
B. negative staining.
C. counter staining.
D. simple staining.
E. shadow staining.

11. When bacterial genes are transferred to another bacterium by direct cell-to-cell contact, it is called _____. (2%)
A. conjugation.
B. transduction.
C. transfection.
D. transformation.
E. translocation.

12. Which of the following is wrong about nitrogen fixation? (2%)
A. It is a process of reduction of atmospheric nitrogen to ammonia.
B. It requires large ATP expenditure.
C. Nitrogen is reduced by two-electron additions.
D. Cyanobacteria and the symbiotic bacterium *Rhizobium* have this system and play a critical role in the nitrogen cycle.
E. It is catalyzed by the enzyme nitrogenase which is produced by some bacteria, Archaea and eukaryotes.

13. Which of the following statement related to the fungi is true? (1.5%)
A. The basidium of the *Ascomycetes* fungi is involved in sexual reproduction.
B. *Saccharomyces cerevisiae* is belonging to the *Ascomycetes* fungi.
C. Histoplasmosis is a disease caused by the budding yeast *Cryptococcus neoformans*.

D. *Candida albicans* is a major yeast used in the production of beer.

E. Yeast is a multicellular fungus that reproduces asexually by budding or fission.

14. Which of the following statement is <u>not true</u> for antimicrobial chemotherapy? (1.5%)

A. Penicillins are antibiotics that can interfere with bacterial cell wall synthesis.

B. Transpons can contribute to the spread of drug-resistant pathogens in hospitals.

C. The Kirby-Bauer method is a disk diffusion test that can be used to determine the level of activity for an agent against a pathogen.

D. Chloramphenicol inhibits bacterial nucleic acid synthesis.

E. The minimal inhibitory concentration (MIC) is the lowest concentration of a drug that prevent growth of a pathogen.

15. Microorganisms interact with other organisms in different ways. Which of the following statement is <u>incorrect</u> for different ways of microbial interactions. (1.5%)

A. Commensalism means that a microorganism lives on or within animals without injuring or benifiting the animals.

B. Mutualism is a relationship in which both organisms gain from the association and are unable to survive without it.

C. Amensalism is a relationship in which the product of an organism has a positive effect on another organism.

D. Syntrophism is an interaction in which the growth of one organism depends on or is improved by one or more growth factors or nutrients produced by a neighboring organism.

E. Parasitism is a type of interaction in which one organism benefits from the other and the host is usually harmed.

16. Please choose one <u>correct</u> answer for the characteristics of bacterial exotoxins and endotoxins. (1.5%)

A. Endotoxins are proteins that often contain two components (A and B subunit).

B. Endotoxins produced by both gram-positive and gram-negative bacteria.

C. Most exotoxins are heat stable to 250℃.

D. Botulinum toxin is an exotoxin causing secretory diarrhea.

E. Endotoxins can cause fever by production of interleukin-1 and TNF.

17. Which of the following statement is not true for the anammox reaction? (1.5 %)

A. Anammox represents **an**aerobic **amm**onium **ox**idation.

B. In the anammox reaction, ammonium first combines with hydroxylamine (NH_2OH) to form hydrazine (N_2H_4) in a reaction catalyzed by the hydrazine oxidase.

C. Hydrazine is then oxidized by hydrazine oxidase, resulting in the formation of one N_2 and 4 protons.

D. The bacteria performing the anammox reaction belong to the phylum *Spirochaetes*.

E. The anammox reaction is estimated to contribute as much as 70% to nitrogen cycling in the oceans.

18. Please choose a wrong statement from the following characteristic comparisons between gram-positive bacteria, gram-negative bacteria and archaea. (1.5%)

A. Membrane-enclosed nucleus with nucleolus is present in the archaea.

B. Gram-positive bacteria are usually chemoorganoheterotrophic, with a few phototrophic.

C. Gram-negative bacteria can not form endospores.

D. The mRNA splicing and capping are absent in the archaea.

E. The achaeal membranes have branched chain hydrocarbons attached to glycerol by ether linakges.

19. Identification of microorganisms from clinical specimens is important to determine the cause of an infection. Which of the following is incorrect for selective media and biochemical tests used in the bacterial identification? (1.5%)

A. MacConkey agar is used to select and recover *Enterobacteriaceae* and related gram-negative rods.

B. In IMVic, the indole test is used to detect the production of indole from tryptophan.

C. Detection of catalase is to test the presence of catalase in bacteria to convert water and oxygen to hydrogen peroxide.

D. The oxidase test is used to detect the presence of cytochrome c oxidase that

reduces oxygen and artificial electron acceptors.

E. The ONPG test is used to detect the presence of an enzyme that can cleave lactose to glucose and galactose.

20. Bacteria can cause a wide variety of human diseases. Please choose a correct match between a disease and its causing agent. (1.5%)

A. Legionnaire's disease: *Mycobacterium tuberculosis*

B. Lyme disease: *Borrelia burgdorferi*

C. Rheumatic fever: *Helicobacter pylori*

D. Typhoid fever: *Escherichia coli*

E. Diphtheria: *Agrobacterium tumefaciens*

21. Please choose a wrong answer from the following statement related to food microbiology. (1.5%)

A. Food-borne infections involve ingestion of the pathogen, followed by their growth in the host with tissue invasion or the release of toxins.

B. Among the known alfatoxins, alfatoxin B2 is the most common and the most potent carcinogen.

C. Growth of the disease-causing microorganism is not required for food intoxication.

D. *E. coli* O157:H7 produces the Shiga-like toxin, which can cause hemolytic uremic syndrome.

E. The major fermented milk products depend on lactic acid bacteria.

22. Which characteristic is correct for the major groups of gram-negative photosynthetic bacteria. (1.5%)

A. Cyanobacteria use H_2 as a photosynthetic electron donor.

B. The nature of photosynthesis for cyanobacteria is anoxygenic.

C. The purple sulfur bacteria use chlorophyll a and phycobiliproteins as major photosynthetic pigments.

D. Bacteriochlorophyll a or b is the major photosynthetic pigment for the purple nonsulfur bacteria.

E. The nature of photosynthesis for the green sulfur bacteria is oxygenic.

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Ⅱ. Term description and short answers

1. PrPSc in prion (2%)
2. IgA (2%)
3. Innate immunity (2%)
4. Dendritic cells (2%)
5. Antigenic shift in orthomyxoviruses (2%)
6. Describe the influenza virus particle (3%)
7. Reassortment vaccines (2%)
8. What do you know about the rabies virus in Taiwan? (3%)
9. What do you know about H7N9 influenza A? (2%)
10. Describe the enterovirus 71 vaccine development in Taiwan. (2%)
11. What do you know about the Norovirus ? (3%)
12. Chemolithoheterotroph (3%)
13. Facultative anaerobe (3%)
14. Probiotics (2%)

Ⅲ. Long answers

1. Compare and contrast bacterial and archaeal cell membranes and cell walls in detail. (7%)

2. Describe each of the following plasmids and explain their importance: (a) conjugative plasmid, (b) F factor, (c) R factor, and (d) Col plasmid (8%)

3. Cyanobacteria contain both photosystem I and II. Please briefly compare the differences between these two photosystems during photosynthesis? (8%)

4. Invasiness is the ability for a bacterial pathogen to spread to adjacent or other tissues. Please explain the differences between bacteremia and septicemia? (8%)