國立清華大學 102 學年度碩士班入學考試試題

系所班組別：生命科學院甲組(0504)、醫學生物科技學程(0507)

考試科目（代碼）：微生物學(0403、0703)

I. Single choice (1.5 points each, total 36%)

1. Which of the following has been a major technological problem with producing a vaccine to the H5N1 avian influenza?

   A. It was difficult to identify the most antigenic regions of the virus.

   B. The virus can not be grown in cultured cells.

   C. It was difficult to produce enough of the vaccine strain in chicken eggs.

   D. It was difficult to produce a reassortant virus strain.

   E. The virus replicates to very low titers.

2. Why must adjuvants be used when administering a killed or recombinant virus vaccine?

   A. These vaccines must be given as injections.

   B. These vaccines are less efficient at stimulating the immune system.

   C. These vaccines are not as safe as live attenuated vaccines.

   D. These vaccines are less stable than live attenuated vaccines.

   E. These vaccines must be given in several doses.

3. Which of the following is a disadvantage of using aluminum salts as an adjuvant for vaccines?

   A. They do not stimulate Th2 cells which are involved in the humoral immune response.

   B. They do not enhance the release of interferons.

   C. They do not stimulate Th1 cells which are involved in the cellular immune response.

   D. They do not interact with the viral antigens properly.

   E. They do not stimulate the cytotoxic T lymphocytes.

4. Which of the following is NOT an antigen presenting cell?

   A. All of the below are antigen presenting cells.

   B. B lymphocyte

   C. Macrophage

   D. Cytotoxic T lymphocyte

   E. Dendritic cell

5. Which of the following describes the primary difference between the normal PrP^{C} protein and the disease version of the protein (PrP^{Sc}).
   A. PrP^{Sc} contains additional octapeptide repeats at the N-terminus.
   B. PrP^{Sc} contains more beta sheet structure than PrP^{C}.
   C. PrP^{Sc} lacks the sugar residues that are attached to PrP^{C}.
   D. PrP^{Sc} is not exposed on the surface of the cell.
   E. PrP^{Sc} does not bind to copper like PrP^{C} does.
6. Which of the following groups of organisms is the primary host for baculoviruses?
   A .mammals
   B. insects
   C. plants
   D. bacteria
   E. worms
7. Which of the following statement for archaeal transcription and translation is <u>not true</u>?
   A. The TATA-box-binding protein is also used for the *Archaea* in promoter recognition.
   B. Archaeal RNA polymerases resemble eukaryotic RNA polymerases II and III.
   C. DNA-dependent RNA polymerase in the *Archaea* is sensitive to rifampicin.
   D. The mRNA splicing, capping and poly A tailing are absent in the *Archaea*.
   E. Similar to bacterial transcripts, some archaeal mRNAs are polycistronic.
8. In the following statements, which is a <u>correct</u> characteristic for exotoxins or endotoxins?
   A. Exotoxins usually do not cause fever.
   B. Endotoxins are mostly heat sensitive and inactivated at 60-80°C.
   C. Exotoxins are synthesized directly chromosomal genes, not by genes on plasmids.
   D. Endotoxins are highly antigenic.
   E. Exotoxins can cause septic shock.

9. Biogeochemical cycling is the sum of microbial and chemical process which can drive the flow of elements between waters, sediments and the atmosphere. Which of the following statement related to biogeochemical cycling is <u>not true</u>?
   A. Microorganisms such as *Desulfovibrio* can transform mercury to methylated forms which are transported to water and the atmosphere.
   B. Nitrogen oxides, CH_4 and CO_2 are called greenhouse gases.
   C. Lignin can be degraded by microorganisms only under oxic conditions.
   D. Cellulose can be degraded by microorganisms either with oxygen (O_2) or without oxygen.
   E. The Methylococcaceae are a family of bacteria that can use CO_2 as their sole carbon and energy source.
10. Choose one <u>correct</u> answer related to human diseases caused by bacteria.
   A. The enteropathogenic *E. coli* (EPEC) can produce one or both distinct enterotoxins, heat-stable enterotoxin (ST) and heat-labile enterotoxin (LT), which are responsible for the diarrhea
   B. The enteroaggregative *E. coli* (EAggEC) strains generate Shiga-like toxins, Stx-1 and Stx-2
   C. *E. coli* O157:H7 strain is a major form of EPEC
   D. Toxic shock syndrome (TSS) is a staphylococcal disease caused by toxins such as enterotoxin C1 and staphylococcus enetrotoxin B
   E. Cholera is a food-borne and waterborne disease, caused by *Pseudomonas aeruginosa*
11. Which of the following is <u>not true</u> for pathogenicity and bacterial infection?
   A. The G+C nucleotide content significantly differ between pathogenicity islands and the remaining bacterial genome
   B. Pathogenicity islands are typically associated with genes encoding tRNA
   C. Virulence is the ability of bacteria to cause disease, and pathogenicity refers to the degree or intensity of virulence.
   D. The presence of viable bacteria in the bloodstream is called bacteremia
   E. Pathogenicity islands increase bacterial virulence and are absent in nonpathogenic bacteria of the same genus or species.

12. Which is not true for the following descriptions?
    A. *E. coli* is facultatively anaerobic and can perform mixed acid fermentation.
    B. *Agrobacteria tumefaciens* is an important human pathogen that can cause Lyme disease.
    C. Methanotrophs are the bacteria that buse methane exclusively as their carbon and energy source.
    D. *Pseudomonas aeruginosa* can infect people with low resistance, such as cystic fibrosis patients, whereas *Pseudomonas syringae* is an important plant pathogen.
    E. Members of the order *Lactobacillales* can generate lactic acid as their major or sole fermentation product.
13. Which of the following statement is not true in the comparisons of purple-, green-photosynthetic bacteria and cyanobacteria?
    A. Akinetes are specialized cells of cyanobacteria that are resistant to desiccation.
    B. Cyanobacteria use phycobiliprotins as accessory pigments in photosynthesis.
    C. Prochlorophytes are the only prokaryotes to possess chlorophyll b and are good candidates as ancestors of endosymbionts that give rise to chloroplasts.
    D. For photosynthesis, the purple bacteria use chlorophyll a that can absorb blue and red light.
    E. Green sulfur bacteria (phylum *Chlorobi*) contain chlorosomes that are the most efficient light harvesting complexes found in nature.
14. Which one of the followings has not been used to evade host defense by bacteria?
    A. Bacterial capsules
    B. Lengthened O-chains in lipoposaccharides
    C. Bacterial intoxications
    D. Serum resistance
    E. The lethal dose 50 of the bacteria

15. ***S***. *cerevisiae* is also called the baker's yeast, what does the ***S*** stand for?
    A. *Scalinduamycota*
    B. *Sarcrodinimyces*
    C. *Schizosaccharomyces*
    D. *Saprolegnia*
    E. *Saccharomyces*
16. Which of the followings is not true?
    A. Mycoplasmas form endospores, which are resistant to high heat.
    B. Biovars represent bacterial strains that differ biochemically and physiologically.
    C. Disseminated tuberculosis can spread throughout of the body and can not be detected by the skin test.
    D. Urease is a virulence factor of *Helicobacter pylori*, which causes gastritis and peptic ulcer disease.
    E. *Rickettsia prowazekii* genome is closely related to modern mitochondrial genome.

17. At 6:30 p.m. a closed flask of sterile broth is inoculated with 10,000 cells. The lag phase lasts 1 hour. At 11:30 p.m. the culture enters stationary phase with a population of 65 million cells. At what time is the population most close to a half of the maximum? (log 2 = 0.301, log 65 = 1.813)
    A. 8:30 p.m
    B. 9:50 p.m
    C. 10:50 p.m
    D. 11:10 p.m
    E. 12:00 pm

18. Which of the following is not used as a means by bacteria to increase cell number:
    A. formation of baeocytes
    B. binary fission
    C. formation of gametes
    D. formation of spores
    E. budding

19. All of the following statements are true except:
    A. When the cell wall is removed from a Gram-negative bacterium, the resulting form is called a spheroplast.
    B. Enzymes secreted by Gram-positive bacteria are called exoenzymes.
    C. The periplasmic space is found both in Gram-positive and Gram-negative bacteria.
    D. Braun's lipoproteins found in Gram-negative bacteria connect outer membrane to peptidoglycan.
    E. Teichoic acids give the gram-negative bacterial cell wall its negative charge.

20. Chemotaxis is a process by which bacteria
    A. move away from a repellent or toward an attractant.
    B. avoid phagocytosis.
    C. move on solid surfaces by means of type IV fimbriae.
    D. move under heat shock conditions.
    E. avoid osmotic pressure.

21. Rigid, spiral-shaped bacteria with tufts of flagella at one or both ends are called
    A. vibrios.
    B. spirilla.
    C. spirochetes.
    D. sarcinae.
    E. coccobacilli.

22. All of the following statements are wrong except:
    A. Replisome is an assembled cell wall-synthesizing machinery.
    B. Divisome is the assembly of a group of proteins needed for DNA synthesis in bacteria.
    C. Mesosomes may be artifacts of chemical fixation of bacteria for electron microscopy.
    D. Carboxysome serves as a site for N_2 fixation.
    E. Magnetosomes allow the bacteria to move toward a chemical attractant.

23. The increase in temperature needed to reduce the decimal reduction time to 10% of its value is the _____
    A. thermal death time (TDT).
    B. decimal reduction time (*D* value).
    C. thermal death point (TDP).
    D. z value.
    E. *F* value.

24. An F' plasmid results when
    A. an $F^+ \times F^-$ mating is interrupted before completion.
    B. an Hfr $\times$ F^- mating is interrupted before completion.
    C. an integrated F plasmid is incorrectly excised, bringing host genes with it.
    D. an $F^+ \times F^-$ mating is completed.
    E. All of the above choices will result an F' plasmid.

II. Term description and short answer (22%)

1. Viruses (2%)
2. Killed virus vaccine (2%)
3. Severe acute respiratory syndrome (2%)
4. Cold sores (2%)
5. Virus-like particle (2%)
6. Complement system (2%)
7. microbiota (2%)
8. nosocomial infection (2%)
9. Photolithoautotroph (3%)
10. Lipopolysaccharide (3%)

III. Long answers (42%)

1. Describe the benefits of using subunit vaccines rather than live or inactivated virus vaccines. (5%)
2. Explain the role that antigenic drift and shift play in the ability of influenza to cause new outbreaks? (5%)
3. Most animal influenza viruses do not infect humans. Why? (3%)
4. Please explain what the difference is between endemic disease, epidemic disease, and pandemic disease. (9%)

5. The Human Microbiome Project is launched by the National Institutes of Health, USA. Please explain what the term "microbiome" means? (2%) Please explain how this project can be beneficial to human health? (3%)
6. How does the scanning electron microscope (SEM) operate, and in what way does its function differ from that of the transmission electron microscope (TEM)? (6%)
7. (a) Name the reagent used and state the purpose of each of the following in the Gram stain: mordant, primary stain, decolorizer, and counterstain. (4%) (b) Which step is the most crucial or most likely to cause poor results in the Gram stain? Why? (3%) (c) What part of the bacterial cell is most involved with Gram staining, and why? (2%)