

國 立 清 華 大 學 命 題 紙

95 學年度 生命科學院、生命科學院醫學生物科技學程 系(所) 甲 組碩士班入學考試

科目 微生物學 科目代碼 0804、1103 共 3 頁第 3-1 頁 *請在【答案卷卡】內作答

I. Single choice (30%):

1. Which of the following reagents are used in Gram staining?
 - a. Methylene blue and carbolfuchsin
 - b. India ink and Congo red
 - c. Methylene blue and Safranin
 - d. Crystal violet and Safranin
 - e. Acridine orange and Crystal violet
2. Which of the following staining methods can be used for the identification of Mycobacterium tuberculosis?
 - a. Gram stain
 - b. Negative staining
 - c. Acid-fast stain
 - d. Any of the above techniques is equally valid
 - e. None of the above is valid
3. Moist heat sterilization readily kills viruses, bacteria and fungi; this sterilization is commonly carried out using a device called autoclave. In general, which of the following pressure, temperature and time are used in the autoclave?
 - a. 5 pounds / in², 105°C, 15 min
 - b. 10 pounds / in², 115°C, 20-30 min
 - c. 15 pounds / in², 121.5°C, 15-20 min
 - d. 20 pounds / in², 124.5°C, 15-30 min
 - e. 25 pounds / in², 134.5°C, 10-30 min
4. Oral thrush is a fairly common disease in newborns. Which of the following fungus is the main causing agent of this disease?
 - a. *Aspergillus fumigatus*
 - b. *Histoplasma capsulatum*
 - c. *Cryptococcus neoformans*
 - d. *Candida albicans*
 - e. *Blastomyces dermatitidis*
5. Alfatoxins are fungus-derivatives and are found most commonly in moist grains and nut products. Which of the following is the action of mode of alfatoxins?
 - a. Alfatoxins bind with ribosomal subunit to inhibit protein synthesis and cause misreading of mRNA.
 - b. Alfatoxins bind to the cell membrane and disrupt its structure and permeability.
 - c. Alfatoxins inhibit the cells' DNA polymerase and thus interfere with DNA replication and other activities involving DNA.
 - d. Alfatoxins intercalate with the cells' nucleic acids and act as mutagens.
 - e. Alfatoxins block RNA synthesis by binding to and inhibiting the DNA-dependent RNA polymerase.
6. The lactose (*lac*) operon of *Escherichia coli* is one of the best-studied systems for gene regulation. Which of the following statement is incorrect?
 - a. Lac operon function can be positively regulated by cAMP-CAP (catabolite activator protein).
 - b. Mutation of repressor (LacI^-) can lead to a constitutive expression of the *lac* operon.
 - c. The lac repressor (LacI) inhibits transcription by interfering with the binding of RNA polymerase to its promoter.
 - d. The operator is a protein that negatively regulates *lac* gene expression.
 - e. In the presence of lactose, the *lac* repressor (LacI) binds to lactose and thus losses its inhibitory activity on the *lac* gene expression.

國立清華大學 生命題紙

95 學年度 生命科學院、生命科學院醫學生物科技學程 系(所) 甲 組碩士班入學
考試科目 微生物學 科目代碼 0804、1103 共 3 頁第 3-2 頁 *請在【答案卷卡】內作答

7. Which of the following statement related to SARS (severe acute respiratory syndrome) is correct?
- SARS is caused by a rotavirus.
 - SARS is caused by a cytomegalovirus.
 - SARS genetic material is single-stranded RNA.
 - SARS genetic material is double-stranded DNA.
 - SARS is caused by a parvovirus and its genetic material is single-stranded DNA.
8. Which of the following statement related to influenza is incorrect?
- Influenza is a respiratory system disease caused by orthomyxoviruses.
 - Based on the antigens (HA and NA), influenza viruses are classified into A, B, C and D groups.
 - The antigens HA and NA represent hemagglutinin and neuraminidase, respectively.
 - Antigenic drift results from the accumulation of mutations of HA and NA in a single strain of flu virus within a geographic region.
 - The flu virus attaches to epithelium of the respiratory system by the HA spike protein.
9. Neutrophil granules contain a variety of microbicidal substances including defensins. Susceptible microbial targets of defensins include gram-positive and gram-negative bacteria, yeasts, molds and some viruses. Which of the following represents the action of defensins against bacteria and fungi?
- Defensins catalyze the oxidation of SCN^- by ambient H_2O_2 to produce highly reactive oxidized hypothiocyanite ions (OSCN^-). OSCN^- has direct antimicrobial activity.
 - Defensins block transcription by binding to and inhibiting the DNA-dependent RNA polymerase.
 - Defensins form voltage-dependent membrane channels that allow ionic efflux.
 - The enzyme activities of defensins involve in the degradation of microbial cell wall and lead to cell lysis.
 - Defensins kill bacteria and fungi by forming pores in the cell membrane.
10. Which of the following microbe is not a food-borne pathogen
- Escherichia coli*
 - Candida glabrata*
 - Listeria monocytogenes*
 - Yersinia enterocolitica*
 - Campylobacter jejuni*
11. The human herpesvirus 8 is closely associated with which of the following diseases?
- Nasopharyngeal carcinoma
 - Neuroblastoma
 - Burkitt's lymphoma
 - Kaposi's sarcoma
 - Adult T cell leukemia
12. In most of cases, the main biochemical composition of bacterial capsule is
- Lipopolysaccharides
 - Polysaccharides
 - A mixture of proteins
 - Phenolic compounds
 - Lipid bilayers
13. Compared with enveloped viruses, non-enveloped viruses
- are more sensitive to organic solvents
 - require close contact between humans for transmission
 - are more resistant to dry environments
 - generally contain RNA genome
 - cause primarily sex-transmitted diseases
14. Bacterial two-component systems are normally composed of a response regulator and a
- serine/threonine phosphatase
 - sensor histidine kinase
 - heat shock protein
 - sigma factor
 - RNA polymerase

國立清華大學 命題紙

95 學年度 生命科學院、生命科學院醫學生物科技學程 系(所) 甲 組碩士班入學
 考試科目 微生物學 科目代碼 0804、1103 共 3 頁第 3-3 頁 *請在【答案卷卡】內作答

15. The major type of immunoglobulin able to cross the placenta is

- a. IgA
- b. IgM
- c. IgG
- d. IgD
- e. All of above

II. Choose one or more of the term(s) (from 1 to 35) that has the best relevance to each of the following statement. (20%)

- | | | | |
|---|---|---------------------|------------------------|
| (1) YM shift | (2) transduction | (3) R factor | (4) lactoferrin |
| (5) transposase | (6) chlamydospores | (7) Chlamydiae | (8) conjugation |
| (9) budding yeast | (10) conjugative transposons | (11) anaerobes | |
| (12) lysogen | (13) prophage | (14) Col plasmids | (15) host restriction |
| (16) hyphae | (17) capsids | (18) Mesophiles | (19) bacteriocins |
| (20) proteomics | (21) composite transposons | (22) transformation | |
| (23) Division (or Phylum) <i>Ascomycota</i> | (24) <i>Saccharomyces cerevisiae</i> | | |
| (25) Methanogens | (26) phagocytosis | (27) siderophores | (28) bacteriorhodopsin |
| (29) <i>Schizosaccharomyces pombe</i> | (30) Division (or Phylum) <i>Zygomycota</i> | | |
| (31) Archae | (32) proteases | (33) 2,3-butanediol | (34) fission yeast |
| (35) denitrifying bacteria | | | |

- _____ 1. The first eukaryotic organism whose whole genome has been sequenced.
- _____ 2. Many fungal pathogens of humans and animals are dimorphic.
- _____ 3. Bacterial proteins that can destroy other related bacteria.
- _____ 4. Transposable elements that contain genes other than those required for transposition.
- _____ 5. The transfer of genetic information between bacteria mediated by bacteriophages.
- _____ 6. A group of organisms differ in many ways from both bacteria and eukaryotes.
- _____ 7. A group of microorganisms essential for nitrogen cycle on earth.
- _____ 8. Small organic compounds produced by bacteria to sequester iron.
- _____ 9. The study of the entire protein profile of a given organism.
- _____ 10. Plasmids that confer bacteria drug resistance.

III. Short answers (50%)

1. In the year of 2005, Nobel Prize in Physiology or Medicine went to Drs. Barry Marshall and Robin Warren for their study in a bacterial infectious disease. Please briefly describe their contributions and work, including the names of the bacteria and the name of the disease. (8%)
2. A student was asked to determine the viable count of a suspension of bacteria. He plated out the cell suspension according to the following protocol:
 1 ml of bacterial suspension + 9 ml diluent (e.g. sterile water)
 then 0.5 ml of this + 4.5 ml diluent
 then 0.1 ml of this + 9.9 ml diluent
 then 0.5 ml of this + 4.5 ml diluent
 then 0.1 ml of this + 9.9 ml diluent
 then 1 ml of this + 9.0 ml diluent
 then 0.1 ml of this, added to a plate of Nutrient Agar
 He then placed the agar plate in an incubator with 37°C and allowed the cells to grow for 24 hours. He found that a total of 140 colonies grew on the plate. Approximately what was the cell number in the original bacterial suspension (please show your result as cfu/ml)? **Please show your calculation!** (6%)
3. Briefly explain the mode of action of penicillin and chloramphenicol. (6%)
4. Explain the definition of Numerical Aperture and Working Distance in a microscope (6%)
5. What are the structure and major functions of bacterial fimbriae (6%)
6. You were asked to clone the RNA polymerase gene from influenza virus. Please describe your strategy. (6%)
7. How does the sugar phosphotransfer system (PTS) work in bacteria? (6%)
8. Please give an example to describe the importance of microRNA in bacteria? (6%)