國　立　清　華　大　學　命　題　紙

99 學年度生命科學院甲組及醫學生物科技學程碩士班入學考試

科目 生物學 科目代碼 (0202)、0502 共 4 頁第 1 頁 *請在【答案卷】內作答

一、選擇題（共 20 分）

Single choice (2 points for each question)

1. All of the following pertain to herpes simplex-1 (HSV-1) except
   A. it causes cold sores and herpes keratitis.
   B. it is latent in the lumbosacral spinal nerve ganglia.
   C. it is transmitted by mucous membrane contact with lesions.
   D. it causes herpetic whitlow in health-care workers.
   E. it causes gingivostomatitis.

2. All of the following can be recognized by toll-like receptors except
   A. single-stranded viral RNA.
   B. lipopolysaccharide.
   C. flagellin.
   D. host cell membrane proteins.
   E. lipoteichoic acid.

3. All the following pertain to measles (rubeola) except:
   A. involves a fatal complication called subacute sclerosing panencephalitis (SSPE).
   B. transmitted by direct contact with the rash.
   C. humans are the only reservoir for the pathogen.
   D. secondary bacterial otitis media and sinusitis occur.
   E. dry cough, sore throat, fever, conjunctivitis are symptoms.

4. Which drug/s interfere with the action of an HIV enzyme needed for final assembly and maturation of the virus?
   A. Reverse transcriptase inhibitors.
   B. Protease inhibitors.
   C. Fusion inhibitors.
   D. Integrase inhibitors.
   E. RNase H inhibitors.

5. Which of the following chemical can not be effective against spores?
   A. glutaraldehyde.
   B. iodine.
   C. Gamma radiation.
   D. autoclaving.
   E. chlorine.

6. The time required to kill 90% of the microorganisms or spores in a sample at a specified temperature is the
   A. thermal death time (TDT).
   B. decimal reduction time (D value).
   C. thermal death point (TDP).
   D. z value.
   E. F value.

7. Given a log phase bacterial culture with 2 × 105 cells per ml and a generation time of 30 minutes, how long does it take the culture to reach a density of 6.4 × 106 cells per ml?
   A. 1 hour 30 mins.
   B. 2 hours 30 mins.
   C. 3 hours 30 mins.
   D. 4 hours 30 mins.
   E. 5 hours 30 mins.

8. Which of the following statement about bacterial staining is not true?
   A. In capsule stain, crystal violet is used as a primary stain
   B. Acid-fast stain can be used to identify Mycobacterium tuberculosis, the causing agent for tuberculosis
   C. In acid-fast staining, methylene blue is used as the primary stain and carbol fuchsin is used as the counterstain agent
   D. Schaeffer-Fulton method is used to differentiate between spores and vegetative cells of the genera Clostridium and Bacillus
   E. Because heat fixation is not required for a negative stain, the cells are not distorted by chemicals used in the staining procedure

9. Which is not true for the following antibacterial drugs?
   A. Penicillins contain a beta-lactam ring and can inhibit bacterial protein synthesis
   B. Tetracyclins bind to the small ribosomal subunit and inhibit bacterial protein synthesis
   C. Rifampin can inhibit bacterial DNA-dependent RNA polymerase
   D. The minimal inhibitory concentration (MIC) is the lowest concentration of a drug which can kill a bacterial pathogen
   E. Many penicillin-resistant bacteria produce beta-lactamase that hydrolyzes a bond in the beta-lactam ring of penicillin and inactivates the antibiotic

10. Which is true for the following statements related to the Archaea?
   A. The Archaea contain complex internal membranous organelles
   B. The Archaea lack polycistronic mRNA
   C. The Archaea lack chlorophyll-based photosynthesis
   D. The Archaea have mRNA splicing, capping and poly A tailing
   E. The methanogenic archaea can use methane as an energy source

二、問答題（共 80 分）

11. Precise regulation of transcription requires both positive and negative control. The positive regulators are often called transcription factors (TFs), while the negative regulators are sometimes called repressors. Transcription factors bind to DNA via specific motifs. Please briefly describe three possible mechanisms by which repressors downregulate transcription. **(9 points)**

12. In some cases, transcription factors and repressors are encoded by the same gene. Please briefly describe how a gene can give rise to both transcription factors and repressors. **(2 points)**

13. There are three overlapping regulatory elements upstream of the promoter of the human IFN-β gene. These regulatory elements are recognized by TFs NF-κB, IRF-1 and ATF-c-Jun. None of these TFs function on their own; i.e., two or more of the TF-activated elements are required to turn on the IFN-β gene. What is the most likely explanation? **(3 points)**

14. Besides TFs and repressors, there are other influences affecting how and when genes are expressed that provide additional diversity. The study of these other influences is called the science of epigenetics.
   (1) Please name two principle epigenetic events in the mammalian genome. **(4 points)**
   (2) How do these two events possibly contribute to simultaneously turning on a number of genes situated consecutively in the chromosome? **(2 points)**

15. A molecule has a characteristic size and shape. Why molecular shape is crucial in biology? **(5 pionts)**

16. As a cell grows, its plasma membrane expands. Does this involve endocytosis or exocytosis? Explain. **(5 pionts)**

17. Imagine a new type of cells was discovered on Mars in an organism growing in benzene, a nonpolar liquid. The cell had a lipid bilayer made of phospholipids, but its structure was very different from that of our cell membrane. **(10 pionts)**
    (1) Draw what might be a possible structure for this new type of membrane. What might be characteristic features of the phospholipid head groups?
    (2) What properties would you except to find in membrane proteins imbedded in this membrane?

18. Define "homeostasis", and draw a diagram to illustrate a negative feedback for thermoregulation. **(5 pionts)**

19. What is the advantage of double circulation in birds and mammals? **(5 pionts)**

20. What is MHC? What are the interactions of cytotoxic T cells and helper T cells with MHC molecules? **(5 pionts)**

21. Describe "fast block to polyspermy" and "slow block to polyspermy" using sea urchin as an example. **(5 pionts)**

22. Describe summation of postsynaptic potentials and initiation of action potential. **(5 pionts)**

23. Why sensory reception by hair cells can distinguish two opposite directions? **(5 pionts)**

24. Name one biotic factor and one abiotic factor that affect the distribution of organisms, and explain how these factors exert their influences. **(5 pionts)**

25. Distinguish Batesian mimicry and Müllerian mimicry. **(5 pionts)**