國立成功大學 104 學年度碩士班招生考試試題

系所組別：生理學研究所

考試科目：細胞及分子生物學

考試日期：0212，節次：2

※ 考生請注意：本試題不可使用計算機。 **請於答案卷作答**，於本試題紙上作答者，不予計分。

Multiple choice and essay questions（總分 100；**多選題和問答題請一律寫在答案卷**）

1. (5%) Biological sequence information can be transferred between DNA, RNA and proteins. Please provide the name of each process described.

   Example 1: RNA → DNA = 'reverse transcription'
   Example 2: DNA→ protein = 'does not occur'

   a. DNA → RNA
   b. DNA → DNA
   c. Protein → DNA
   d. RNA → protein
   e. Protein → RNA

2. (5%) DNA and chromatin density can be regulated to affect gene expression. What is the difference between heterochromatin and euchromatin? Which state is more transcriptionally active? Why? Would you expect to find more histone acetylation in heterochromatin or euchromatin? What about DNA methylation?

3. (10%) Protein expression levels are determined by multiple factors including rate of transcription, translation, mRNA stability and protein turnover. Imagine that you found COX-2 protein expression was increased in a keratinocyte cell line after UV light exposure. Name or describe **two** techniques that you could perform to further identify the mechanism of up-regulation. Explain the potential results and interpretation.

4. (**多選題** 2.5%) Which of the following chemical structures comprise a DNA polymer?
   a. Ribose
   b. Deoxyribose
   c. Nitrogen base
   d. Triphosphate
   e. Phosphate

5. (**多選題** 2.5%) Which of the following statements about the structure of DNA are true?
   a. The phosphodiester bond connects two nucleotides by linking the 3' carbon of one sugar to the 5' carbon of another sugar
   b. Pyrimidines have two hydrogen bonds while purines have three

c. A double stranded DNA molecule with forward sequence AGGCTGGCCC will have a higher melting temperature than GAATGTTAAA
d. DNA typically exists in a double helical structure with two strands running anti-parallel to each other
e. The helical pitch (number of base pairs per complete turn of the helix) depends on how tightly the bases stack

6. (10%) How would you design an experiment to test whether DNA replication is conservative, semi-conservative or dispersive?

7. (5 %) If cells are exposed to gamma-irradiation and then allowed to replicate, what are two different cellular consequences that are dependent on DNA structure or function?

8. (**多選題** 2.5%) Which of the following statements are **true**?
a. Naturally occurring proteins consist of either straight or branched chains of amino acids
b. Amino acids are connected by covalent peptide bonds to form polypeptide chains
c. There are 20 standard amino acids
d. For humans, there are 9 essential amino acids meaning that those 9 cannot be synthesized by the body and must be ingested
e. Both the D- and L- enantiomers of Histidine, Valine and Leucine are used for protein synthesis

9. (**多選題** 2.5%) Which of the following amino acids are aromatic?
a. Proline
b. Isoleucine
c. Phenylalanine
d. Tyrosine
e. Tryptophan

10. (5 %) What is meant when people talk about the primary, secondary, tertiary and quaternary structure of proteins? How does primary structure affect secondary, tertiary and quaternary structure?

11. (6 %) Describe **three** post-translational modifications that can affect protein function. How is the effect on function mediated?

12. (4 %) Using cells or cellular extracts, how would you measure the function of the following two proteins?

a. Ataxia telangiectasia mutated (ATM): a kinase whose targets include a histone component (H2AX) and another kinase (CHK2)

b. Succinate Dehydrogenase (SDH): an enzyme that converts succinate to fumarate and thereby reduces FAD to FADH2

13. (2.5 %) What is the primary function of the cell membrane?

14. (**多選題** 2.5 %) Which of the following substances is/are found in cell membranes?

a. Phospholipids
b. Cholesterol
c. Proteins
d. Glycoproteins
e. Glycolipids

15. (**多選題** 2.5 %) Which molecules are known to form a **phosphoester bond** with a **phosphate group** in naturally occurring phospholipids?

a. Serine
b. Cysteine
c. Choline
d. Glycerol
e. Fatty acid

16. (2.5 %) Describe the fluid-mosaic model of cell membranes.

17. (2.5%) What is the difference between integral and peripheral membrane proteins?

18. (**多選題** 2.5 %) What are the major functional categories of cell membrane proteins?

a. Transport
b. Membrane stability
c. Receptor
d. Antioxidant
e. Metabolism

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19. (**多選題** 2.5 %) Which statements about channel and carrier proteins are **true**?

a. Channel proteins are usually peripheral proteins while carrier proteins are usually integral proteins
b. Both channel and carrier protein exchange substances across the plasma membrane
c. Both channel and carrier proteins can exchange ions
d. Channel proteins typically require ATP to function
e. Carrier proteins can function against a concentration gradient

20. (**多選題** 2.5 %) Temperature, cholesterol and unsaturated fatty acid content affect membrane fluidity. Which of the following statements are **true**?

a. Membranes are more fluid at low temperatures than high temperatures
b. At low temperatures, membranes with high cholesterol are more fluid
c. At high temperatures, membranes with high cholesterol are more fluid
d. At low temperatures, membranes with high unsaturated fatty acid content are more fluid
e. At high temperatures, membranes with high unsaturated fatty acid content are more fluid

21. (20 %) Provide a detailed description of how **two** of the following methods are performed. What does it measure? How do you prepare samples? How does the method work on a molecular level? What is the read-out or output? How do you interpret the read-out? What are some common technical problems that can interfere with interpretation?

Western blot, Real-time quantitative PCR, Immunohistochemistry or Immunocytochemistry, Cell viability assays, Chromatin immunoprecipitation, DNA/RNA sequencing, another well-known method for which you have knowledge or experience.