

科目：生物化學【生醫所碩士班】 ✓

(1) (10 points) Please describe what is chromatin remodeling and biological outcomes? Describe the molecular machinery and mechanism that regulate chromatin remodeling. (10 points)

(2) (10 points) The absorbance of two mixtures of complementary deoxy-oligonucleotides at 260 nm is compared as a function of temperature.

Temperature (°C)	Mixture containing A/T nucleotides ($A_{260 \text{ nm}}$)	Mixture containing G/C nucleotides ($A_{260 \text{ nm}}$)
5	0.5	0.78
55	0.9	0.78
95	0.9	0.98

- Please describe why the absorbance changes as a function of temperature.
- Why A/T mixtures and G/C mixtures have different temperature-dependent behaviors.

(3) (10 points) Please design the experimental procedures for identifying DNA-protein interaction is related to gene expression *in vivo*.

(4) (10 points) The transmembrane proteins are responsible for multiple biological events and are subjected to glycosylation.

- Please describe the method how to identify the proteins with transmembrane domains?
- In which organelle does glycosylation take place?

(5) (10 points) Predict the effects of the following on the phase transition temperature (T_m) and/or membrane fluidity in pure dipalmitoleic-phosphatidylcholine vesicles. Palmitoleic acid is a 16 carbon chain with a double bond at position 9.

- Introducing dipalmitic-phosphatidylcholine into the vesicle. Palmitic acid is a straight 16 carbon chain without double bonds. The molar ratio of dipalmitoleic-phosphatidylcholine : dipalmitic-phosphatidylcholine is 7:3.
- Introducing cholesterol into the vesicle. The cholesterol content is 30% of total lipid.

(6) (10 points) siRNA is rapidly becoming the method of choice to study loss-of-function of end products.

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- a. One key control that researchers sometimes miss is to rescue the knock-down phenotype by re-expressing the gene of interest. Why is this so important?
- b. Compare the origins and biological functions of siRNA and miRNA.

(7) (10 points) Please explain the structural feature of enzymes that follow a sigmoidal saturation curve or hyperbolic saturation curve.

(8) (10 points) The catalytic center of serine proteases is universally conserved. A typical catalytic center for serine protease contains a 'catalytic triad' including serine, histidine and aspartic acid. Serine, histidine and aspartic acid are subjected to mutagenesis and converted into alanine. The effect on K_m and K_{cat} are listed as following.

Mutants	K_{cat} (S^{-1})	K_m (μM)
Wild-type	6.3×10^{-1}	450
S \rightarrow A	5.4×10^{-3}	700
H \rightarrow A	1.0×10^{-4}	1500
D \rightarrow A	1.0×10^{-2}	1700
D \rightarrow A; H \rightarrow A	1.0×10^{-3}	400
H \rightarrow A; S \rightarrow A	5.4×10^{-5}	420
D \rightarrow A; S \rightarrow A	5.9×10^{-5}	430
D \rightarrow A; H \rightarrow A; S \rightarrow A	9.0×10^{-5}	730

- a. Consider the K_m values. What is the role of each residue in the catalytic triad in substrate binding?
- b. Consider the K_{cat}/K_m values. Please propose a model for the role of each residue in the catalytic triad.
- (9) (20 points) Please describe the biological functions of the following compounds and/or its derivatives.
- Steroid hormones
 - Sphingolipids
 - Nitric oxide
 - Arachidonic acid

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Questions and short answers: (Total 100 points)

注意：考生不得在試題紙上作答 請在本校所提供之答案卷上作答

問答及簡答題(共 100 分)

1. Briefly describe the roles of the following cellular components.
(18 points)

- a. Mitochondria
- b. Ribosomes
- c. Lysosomes
- e. Cell membrane
- f. Golgi
- h. Nucleosome

2. Restriction enzymes have been utilized extensively by molecular biologists, yet these enzymes are naturally occurring enzymes that play a role in their own organisms. **a.** How do restriction enzymes provide bacteria with a primitive kind of immune response? And how does it work? (4 points) **b.** Explain why bacteria containing restriction enzymes do not kill themselves. (4 points)

3. Cancer cells are immortal. **a.** Please explain what is meant by this statement. (3 points) There had been some reports about an "immortality gene" which had been isolated. It was in fact a telomerase gene. With what you have learned in class or from the textbook, describe **b.** what is a telomere? (3 points), **c.** what is the function of telomerase? (3 points), and **d.** why might telomerase be considered an immortality gene? (3 points)

4. The transcription of eukaryotic protein encoding genes results in mRNA precursors (pre-mRNAs). The pre-mRNAs undergo a number

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- mRNAs. **a.** What is thought to be one of the functions of the cap structure placed at the 5' end of the RNA? (2 points) **b.** How is the 3' end of the pre-mRNA generated? (2 points) **c.** What is the structure that is placed on the 3' end of the pre-mRNA? (2 points)
5. **a.** Why the p53 gene was first defined as an oncogene, or tumor promoter? (3 points) **b.** and how did the scientist finally confirm the p53 function as a tumor-suppressor protein? (3 points) **c.** What will occur if the *p53* gene in a cell with damaged DNA is inactivated? (2 points)
6. **a.** What are the functions of tight junction and gap junction? (6 points) **b.** How can happen to tissues when tight junctions do not function properly? (2 points) **c.** EDTA, a divalent cation chelator, is found in many enzyme-free cell dissociation buffers. Please propose an explanation for how EDTA promotes the dissociation of animal cell tissue? (4 points)
7. **a.** Please describe the functional properties of the head, neck, and tail domains of myosin. (4 points) **b.** Explain how force is generated by actin-myosin interaction. You may use a labeled diagram if you wish. (4 points)
8. **a.** Which processes are examples of programmed cell death? (3 points) **b.** What is autophagy? (4 points) **c.** Please name two diseases in which autophagy may play an important role to prevent or halt the progression of the disease. (2 points)
9. You have performed a gene therapy approach to curing cystic fibrosis in mice. You can deliver the "correct" gene into all cells in the mouse, yet you find that the delivery of this gene has no effect on the mouse's symptoms - there is no any improvement. Give two reasons why this might be the case. (4 points)

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10. You have isolated a complete genomic DNA clone for a cancer causing gene you are studying (upstream sequences, all introns and exons, and downstream sequences). You want to evaluate a number of drugs designed to inhibit the expression of this gene. How would you utilize this clone in conjunction with a GFP reporter gene or a luciferase reporter gene to determine the levels of expression of this gene in a tissue after treatment with these various drugs? (5 points)

11. During development, both growth and differentiation are important. Define what is meant by these terms. (4 points)

12. How does the extent of methylation affect the ability of DNA to be transcribed? (3 points)

13. Please describe a function of glycosylation (attaching sugars) of cell membrane. (3 points)