

※ 考生請注意：本試題不可使用計算機。

※ 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

**Part I (25 points)**

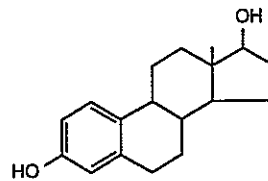
**Multiple Choice Questions:**

1. The lipid composition of cell membrane affects the membrane fluidity. Which of the following fatty acids increases the membrane fluidity most? (1 point)

- (A) Palmitic acid (Hexadecanoic acid)
- (B) Oleic acid (9-Octadecenoic acid)
- (C) Lignoceric acid (Tetracosanoic acid)
- (D) Stearic acid (Octadecanoic acid)
- (E) Arachidic acid (Eicosanoic acid)

2. The structure is an example of a(n): (1 point)

- (A) Terpenes
- (B) Triacylglycerol
- (C) Wax
- (D) Sphingolipid
- (E) Steroids



3. In the TCA cycle, carbon enters the cycle as \_\_\_\_\_ and exits as \_\_\_\_\_ with metabolic energy captured as \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_. (1 point)

- (A) malonate; water; NADH; ATP; NADPH
- (B) acetyl-CoA; CO<sub>2</sub>; NADH; ATP; NADPH
- (C) succinyl-CoA; CO<sub>2</sub>; ATP; NADH; NADPH
- (D) acetyl-CoA; CO<sub>2</sub>; ATP; NADH; [FADH<sub>2</sub>]
- (E) malonyl-CoA; water; NADH; [FADH<sub>2</sub>]; ATP

4. The final electron acceptor in the electron transport chain is? (1 point)

- (A) molecular oxygen
- (B) H<sub>2</sub>O
- (C) cytochrome c
- (D) UQ
- (E) NAD<sup>+</sup>

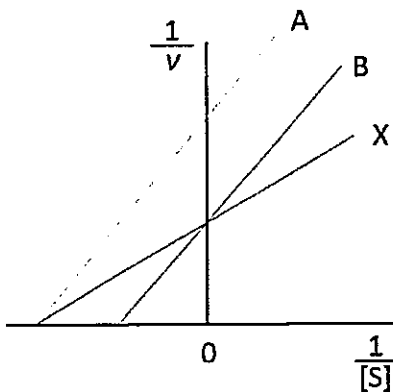
5. Photosynthetic phosphorylation and oxidative phosphorylation are similar processes. All of the following are common to BOTH processes EXCEPT: (1 point)

- (A) both have fixed and mobile electron carriers.
- (B) both contain cytochromes in their electron carrier chains.
- (C) both produce NADPH to be used in the reductive pentose phosphate pathway (Calvin cycle).
- (D) both represent a major route of ATP synthesis.
- (E) both have quinones as electron carriers.

Essay Questions:

6. The Lineweaver-Burt plot below showing line A for enzyme X with inhibitor A, line B for enzyme X with inhibitor B, and line X for enzyme X only.

- (A) Which inhibition can be reversed (inhibitor A or B?) if we add more substrates to the reaction? Why? (2 points)
- (B) Which inhibitor would lower  $V_{max}$ ? (1 point)



- 7. Chymotrypsinogen is an inactive precursor of chymotrypsin. How is chymotrypsinogen converted to chymotrypsin? (2 points)
- 8. Inivrase (saquinavir) is a drug for AIDS through inhibiting HIV-1 protease activity. Please explain how this drug could inhibit HIV-1 protease activity. (2 points)  
If you are a scientist, how would you design a drug to lower high serum cholesterol level? (1 point)
- 9. Enzyme activity can be regulated through covalent modifications, e.g., phosphorylation.  
What three amino acids could be phosphorylated? (2 points)  
What other kinds of covalent modifications could be found to regulate protein functions other than phosphorylation? Please give two more examples. (2 points)

10. Please describe the influences of the following molecules on glycogen phosphorylase activity.

(A) AMP (1 point)

(B) Phosphorylase kinase (1 point)

11. How do the following conditions affect the binding affinity of  $O_2$  to hemoglobin ?

(A) Increased  $CO_2$  in the blood (1 point)

(B) Decreased pH in the blood (1 point)

12. Please briefly explain the following terms.

(A) Ribozyme (1 point)

(B) Phosphatase (1 point)

13. Discuss the metabolites that can be synthesized from citrate in the tricarboxylic acid cycle. (2 points)

### Part II (25 points)

Multiple Choice Questions:

14. Which of the following statements regarding structural proteins is true? (2 points)

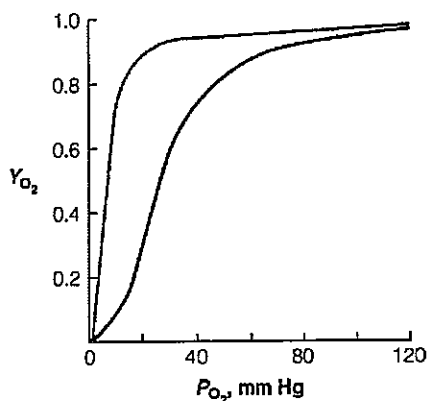
(A) silk fibroin is made from a repeat of three amino acids where each third amino acid is Gly

(B)  $\alpha$ -keratin is composed of peptides that contain mostly  $\alpha$ -helical structure with the exception of short sequences where the peptide folds back on itself

(C) collagen has its own helical structure where three individual peptides are wound around each other in a left-handed helix

(D) generally speaking, structural proteins are soluble in water

15. Based on the plot of oxygen saturation versus partial pressure of oxygen, which of the following statements is true? (2 points)



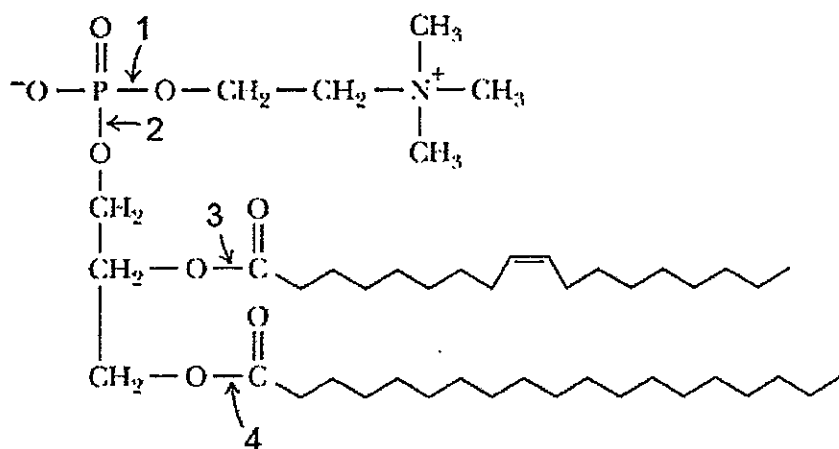
- (A) at oxygen pressure >100 mm Hg, hemoglobin dissociates into individual subunits so that it is able to bind oxygen similar to myoglobin
- (B) at typical resting capillary oxygen pressure of ~30 mm Hg, hemoglobin has only 1 of its 4 oxygen binding sites filled while myoglobin is nearly saturated with oxygen
- (C) under periods of extreme muscle exertion, capillary oxygen pressure can drop to 10 mm Hg, allowing release of ~90% of oxygen carried by hemoglobin
- (D) the structure of hemoglobin allows for complete release of oxygen in capillary beds at all times

16. Which of the following correctly identifies key elements present on the exterior of Gram-negative (GN) and Gram-positive (GP) bacteria? (2 points)

- (A) GN: single lipid bilayer; GP: two lipid bilayers
- (B) GN: single peptidoglycan layer; GP: multiple peptidoglycan layers
- (C) GN: extensively crosslinked peptidoglycans; GP: uncrosslinked peptidoglycan
- (D) GN: contains both *N*-acetylmuramic acid and *N*-acetylglucosamine; GP: contains only *N*-acetylmuramic acid

Short Answer Questions:

17. Which of the following bonds would be cleaved by Indian Cobra venom? What is the name of that enzyme in Indian Cobra venom? (4 points)



18. About 30% of glucose oxidation in the liver occurs via the pentose phosphate pathway, whereas in muscle cells, most glucose is oxidized by glycolysis. Briefly give a rationale for this observation. (5 points)

19. Indicate the hormone glucagon-induced cellular signal transduction affects glycogen metabolism in the liver. (10 points)

**Part III (50 points)**

Short Answer Questions:

20. Describe three kinds of DNA repair systems? (5 points)
21. Use the Lac operon as an example to describe the positive and negative gene regulation in prokaryotic cells. (5 points)
22. Describe three kinds of pre-mRNA processing in eukaryotic cells. (5 points)
23. How is the initiation codon "AUG" in mRNA identified during translation in eukaryotic cells? (5 points)
24. Describe the mechanism of transcription termination in prokaryotic cells. (5 points)
25. Describe processing and functions of siRNA. (5 points)
26. Describe the function and mechanism of chaperones in protein folding. (5 points)
27. Describe the function and mechanism of degradation by proteasome. (5 points)
28. Describe the roles of AMPK in energy regulation. How is AMPK regulated? (5 points)
29. Lipid is transported between tissues by LDL and HDL in blood. Describe their compositions and functions. (5 points)