

## 一、選擇題 (每題 2 分, 答錯不倒扣)

\* 本大題請於試卷內之「選擇題作答區」依序作答 \*

1. What is the approximate mass of a protein containing 200 amino acids? (Assume there are no other protein modifications.)  
(A) 20,000 (B) 11,000 (C) 22,000 (D) 222,000 (E) None of the above.
2. Which is not correct concerning the models that are accepted to describe cooperative binding?  
(A) In the sequential model, the binding of a ligand changes the conformation of the subunit to which it binds, which in turn induces a change in neighboring subunits.  
(B) All known allosteric proteins exhibit either the concerted or sequential model exclusive of the other.  
(C) Both models incorporate a low affinity T-state and a higher affinity R-state.  
(D) Both models explain the sigmoid-shaped binding curve.  
(E) In the concerted model, all molecules exist either in the T-state or the R-state.
3. What two properties of water are important for biological interactions?  
(A) the polarity of water  
(B) the density of water  
(C) the cohesive properties of water  
(D) A and C  
(E) B and C
4. Excess alcohol consumption can lead to Wernicke-Korsaff syndrome due to the lack of the vitamin thiamine. Which of the following metabolic conversions cannot occur in the absence of thiamine?  
(A) Pyruvate + CO<sub>2</sub> → oxaloacetate  
(B) Pyruvate → acetyl-CoA + CO<sub>2</sub>  
(C) α-ketoglutarate → succinyl-CoA + CO<sub>2</sub>  
(D) Phosphoenolpyruvate + CO<sub>2</sub> → oxaloacetate  
(E) B and C
5. The ultimate reductant in synthesis of deoxyribonucleotides is:  
(A) FADH<sub>2</sub> (B) NADH (C) NADPH (D) quinine (E) none of the above
6. Tryptophan is a precursor for the neurotransmitter(s)  
(A) serotonin (B) norepinephrine (C) adenine (D) all of the above (E) none of the above
7. The carbon skeletons for amino acids are intermediates found in  
(A) glycolysis (B) citric acid cycle (C) pentose phosphate pathway  
(D) all of the above (E) none of the above.
8. Ketogenic amino acids are degraded to which of the following metabolites?  
(A) pyruvate (B) acetyl-CoA (C) acetoacetate (D) all of the above (E) B and C

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9. Two-dimensional electrophoresis is a combination of what two techniques?

- (A) isoelectric focusing and affinity chromatography
- (B) ion-exchange chromatography and SDS-PAGE
- (C) affinity chromatography and SDS-PAGE
- (D) isoelectric focusing and SDS-PAGE
- (E) isoelectric focusing and ion-exchange chromatography

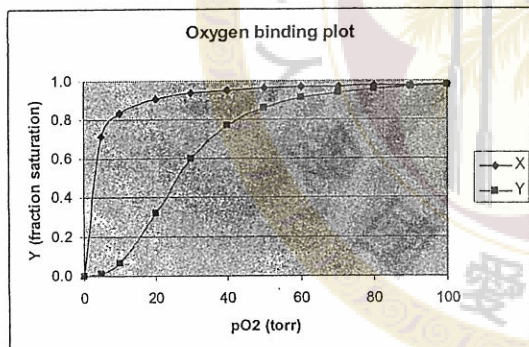
10. The use of synthetic peptides includes

- (A) use as antigens for making antibodies
- (B) drugs
- (C) "hooks" used in purification
- (D) all of the above
- (E) A and C

11. Which of the following describes the Bohr effect?

- (A) Lowering the pH results in the release of  $O_2$  from oxyhemoglobin.
- (B) Increasing the pressure of  $CO_2$  results in the release of  $O_2$  from oxyhemoglobin.
- (C) Increasing the pH increases the T-form of hemoglobin.
- (D) All of the above.
- (E) A and B.

12. Which of the following is not correct concerning the oxygenation plot of proteins X and Y shown below?



- (A) Protein X exhibits tighter oxygen binding than protein Y.
- (B) Protein Y would function as a better transport protein than protein X.
- (C) Protein X exhibits cooperative binding, whereas Y does not.
- (D) Protein X corresponds to myoglobin, and protein Y corresponds to hemoglobin.
- (E) Protein Y contains multiple binding sites.

13. Metal ion catalysis is facilitated by any of several mechanisms, including

- (A) electrophilic activity, which stabilizes negative charges on an intermediate.
- (B) promoting formation of nucleophiles by affecting adjacent molecules.
- (C) direct binding to substrate, increasing substrate-enzyme contacts.
- (D) A and C.
- (E) all of the above.

14. Restriction endonucleases cut DNA at specific sites. How many different patterns can be formed by a four-base sequence combination of any four bases?  
(A) 64 (B) 256 (C) 16 (D) 1024 (E) 4096
15. Hemoglobin-binding of oxygen is best described as a  
(A) concerted model.  
(B) Michaelis-Menten model.  
(C) sequential model.  
(D) combination of sequential and concerted models.  
(E) None of the above.
16. Which of the following is an epimer pair?  
(A) D-glucose and L-glucose  
(B) D-glucose and D-galactose  
(C)  $\alpha$ -D-glucose and  $\beta$ -D-glucose  
(D) D-glucose and D-fructose  
(E) D-mannose and D-galactose
17. Which of the following is not a reducing sugar?  
(A) glyceraldehyde (B) trehalose (C) cellobiose (D) maltose (E) fructose
18. Which of the following is not a heteropolysaccharide?  
(A) agarose (B) chitin (C) peptidoglycan (D) heparin (E) all of the above
19. Which of the following molecules or substances contain, or are derived from, fatty acids?  
(A) sphingolipids (B) prostaglandins (C) beeswax (D) all of the above (E) none of the above
20. The fluidity of the lipid side chains in the interior of a bilayer is generally increased by:  
(A) an increase in temperature.  
(B) an increase in fatty acyl chain length.  
(C) a decrease in the number of double bonds in fatty acids.  
(D) an increase in the percentage of phosphatidyl ethanolamine.  
(E) all of the above.
21. Which of these statements is generally true of integral membrane proteins?  
(A) Their hydropathy plots reveal one or more regions with a high hydropathy index.  
(B) They are glycosylated.  
(C) They are more stable than cytosolic proteins.  
(D) They undergo constant rotational motion that moves a given domain from the outer face of a membrane to the inner face and then back to the outer.  
(E) None of the above.



22. Which of the following molecules cannot serve as the starting material for the synthesis of glucose via gluconeogenesis in mammals?  
 (A) glycerol (B) lactate (C) glycine (D) oxaloacetate (E) acetate
23. Entry of acetyl-CoA into the citric acid cycle is decreased when:  
 (A) the ratio of  $[NAD^+]/[NADH]$  is high.  
 (B) NADH is rapidly oxidized through the respiratory chain.  
 (C) the ratio of  $[ATP]/[ADP]$  is low  
 (D) the ratio of  $[ATP]/[ADP]$  is high.  
 (E)  $[AMP]$  is high.
24. Which enzyme is the major regulatory control point for  $\beta$ -oxidation?  
 (A) pyruvate carboxylase  
 (B) acetyl CoA dehydrogenase  
 (C) methylmalonyl CoA mutase  
 (D) enoyl CoA isomerase  
 (E) carnitine acyl transferase I
25. The major regulator of sucrose biosynthesis in plants is:  
 (A) fructose 6-phosphate  
 (B) glucose 6-phosphate  
 (C) fructose 1,6-bisphosphate  
 (D) fructose 2,6-bisphosphate  
 (E) sucrose

二、簡答題：請依題號順序作答

1. How does one determine if two homolog proteins are paralogs or orthologs? (2 points)
2. Which of the following peptides is more likely to take up an  $\alpha$ -helical structure, and why? (4 points)  
 (a) GGACRFPWDQPGTPN  
 (b) SEAENDEMARAALKA
3. Please predict protein structure based on primary amino acid sequence data. Consider the following amino acid sequence. (6 points)

No	1	2	3	4	5	6	7	8	9	10	11	12	13
a.a.	I	A	H	G	P	G	W	F	E	A	A	M	C

No	14	15	16	17	18	19	20	21	22	23	24	25	26
a.a.	K	Y	E	A	Q	M	D	G	P	Q	C	A	F

- (a) Where might bends occur?  
 (b) Where might intrachain disulfide cross-linkages be formed?

(c) Assuming that this sequence is part of a larger globular protein, indicate the probable location (the external surface or interior of the protein) of the following amino acid residues: Asp, Ile. Explain your reasoning.

4. At pH 7.0, in what order would the following three peptides be eluted from a column filled with a cation-exchange polymer? Their amino acid compositions are: (4 points)

Protein A: Ala 5%, Glu 10%, Gly 10%, Leu 5%, Asp 10%, Arg 5%, Met 5%, Cys 5%, Tyr 5%, Phe 5%, His 5%, Val 5%, Pro 5%, Thr 5%, Ser 5%, Asn 5%, and Gln 5%.

Protein B: Ala 5%, Glu 5%, Ser 5%, Leu 10%, Arg 10%, His 5%, Ile 10%, Phe 5%, Tyr 5%, Lys 10%, Gly 15%, Pro 5%, and Trp 10%.

Protein C: Ala 5%, Val 5%, Gly 10%, Asp 5%, Leu 5%, Arg 5%, Ile 5%, Phe 5%, Tyr 5%, Lys 5%, Trp 5%, Ser 5%, Thr 5%, Glu 5%, Asn 5%, Pro 10%, Met 5%, and Cys 5%.

5. Estimate the  $V_{max}$  and  $K_m$  of the enzyme-catalyzed reaction for which the following data were obtained. (4 points)

[S] (M)	$V_0$ (mM/min)	[S] (M)	$V_0$ (mM/min)
$2.5 \times 10^{-5}$	36	$4 \times 10^{-4}$	144
$4 \times 10^{-5}$	51	$1 \times 10^{-3}$	165
$1 \times 10^{-4}$	90	$2 \times 10^{-2}$	178
$2 \times 10^{-4}$	122	$1 \times 10^{-1}$	180

6. Describe the metabolic functions of the oxidative pentose phosphate pathway and the reductive pentose phosphate pathway. (4 points)

7. All of the intermediates in the glycolytic pathway are phosphorylated. Describe the reasons why this might be advantageous to the cell. (4 points)

8. What is the most significant chemical difference between triacylglycerols and glycerophospholipids that leads to their different functions? (4 points)

9. List the precursor(s) for the biosynthesis of (a) sucrose, (b) cellulose, and (c) glycogen. (2 points each)

10. Define the following terms (3 points each)

- (a) Lectins
- (b) Membrane rafts
- (c) Mutarotation
- (d) Ketone bodies