

**【單選題】第 1-30 題，每題 2 分，共 60 分**

※ 注意：請於試卷內之「選擇題作答區」依序作答。

1. What is the first enzyme structure to be solved via X-ray diffraction methods? What is the first enzyme in a pure form to be crystalized?  
(A) Myoglobin, Hemoglobin (B) Myoglobin, Lysozyme (C) Lysozyme, Myoglobin  
(D) Myoglobin, Urease (E) Lysozyme, Urease
2. While using the RS system for describing amino acids, which L-amino acid has the R configuration for its alpha-carbon?  
(A) Threonine (B) Isoleucine (C) Cysteine (D) Asparagine (E) Histidine
3. Please arrange glutamate, aspartate, arginine and lysine in order according to their  $pK_R$  (R for side chain) values (from small to large).  
(A) aspartate, glutamate, lysine, arginine (B) aspartate, glutamate, arginine, lysine  
(C) glutamate, aspartate, lysine, arginine (D) lysine, arginine, glutamate, aspartate  
(E) arginine, lysine, glutamate, aspartate
4. What does the term "m/z" stand for in mass spectrometry analysis?  
(A) Time of flight (B) LC MS/MS (C) MALDI-TOF MS (D) Mass to charge ratio  
(E) Methionine vs glutamine/glutamate
5. Why is the sickle-cell hemoglobin (HbS) mutation so prevalent in Africa and other tropical regions?  
(A) The oxygen binds with greater affinity to the proximal histidine residue of HbS.  
(B) People with sickle-cell trait are resistant to malaria, increasing the prevalence of the HbS allele.  
(C) Hemoglobin binds more oxygen with aggregations of  $\alpha$  chains found in sickle-cell hemoglobin.  
(D) Hemoglobin binds less oxygen with the reduction of the hemoglobin S chain.  
(E) Bonding of carbon dioxide to HbS molecules increases the binding of oxygen.
6. Which amino acids in elastase are found in the active site and are participants in substrate cleavage?  
(A) His, Ser, Asp (B) Two His residues (C) Two Asp residues (D) His, Ser, Arg (E) His, Cys, Asp
7. The number of substrate molecules converted to product in a given unit of time by a single enzyme molecule at saturation is referred to as the:  
(A) half-saturation constant. (B) maximum velocity ( $V_{max}$ ). (C) dissociation constant.  
(D) Michaelis-Menten constant ( $K_M$ ). (E) turnover number.
8. The simplest carbohydrates are  
(A) D-glyceraldehyde and L-glyceraldehyde (B) dihydroxyacetone, D-glyceraldehyd and L-glyceraldehyde  
(C) D-glyceraldehyde and glycerate (D) Glucose and fructose  
(E) dihydroxyacetone and glycerate
9. The most common feature found in membrane spanning proteins is  
(A) a triple helix of alpha-helices.  
(B) a helix-turn-helix arrangement of the peptide strands.

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- (C) alpha-helices of charged amino acids that form channels via extensive hydrogen bonding.  
(D) alpha-helices of nonpolar amino acids that pass through the membrane.  
(E) containing six-transmembrane domains.
10. In an amino acyl-tRNA, the amino acid is attached to the \_\_\_\_\_ of the tRNA.  
(A) stem-loop region (B) codon region (C) 3' end (D) 5' end (E) 3' end and 5' end
11. Which of the following pairs of pathways, if active at the same time, would be considered a futile cycle?  
A) gluconeogenesis and citric acid cycle. B) fatty acid  $\beta$ -oxidation and glycolysis. C) fatty acid synthesis and glycolysis. D) fatty acid synthesis and citric acid cycle. E) glycolysis and gluconeogenesis
12. During the oxidation of glucose within a typical animal cell, reduced electron carrier such as NADH are produced. What is the terminal electron acceptor of the electrons carried by NADH?  
A)  $\text{NAD}^+$ ; B) FAD; C)  $\text{O}_2$ ; D)  $\text{H}_2\text{O}$ ; E) none of the above
13. During aerobic glycolysis, pyruvate is most likely oxidized to \_\_\_\_\_ while in anaerobic glycolysis, pyruvate is converted to \_\_\_\_\_.  
A) acetaldehyde; ethanol  
B) acetyl CoA; glyceraldehyde  
C) acetyl CoA; lactate  
D) acetaldehyde; lactate  
E) none of the above
14. The conversion of 3-phosphoglycerate to phosphoenolpyruvate requires two reactions. Which of the following correctly identifies the types of reactions in the proper order of glycolysis?  
A) isomerization, hydration  
B) hydration, isomerization  
C) dehydration, isomerization  
D) isomerization, dehydration  
E) mutation, dehydration
15. When glucagon binds to its receptor on a liver cell, which of the following sequence of events occurs to activate protein kinase A?  
A) activation of adenylate cyclase, activation of G protein, production of cAMP  
B) activation of G protein, activation of adenylate cyclase, production of cAMP  
C) activation of G protein, production of cAMP, activation of adenylate cyclase  
D) production of cAMP, activation of adenylate cyclase, activation of G protein  
E) none of the above
16. Which of the following carbohydrates is the most common molecule exported by photosynthetic cells for use in other parts of the plant?  
A) amylose; B) amylopectin; C) glucose; D) sucrose; E) fructose
17. The oxidation reactions that convert pyruvate to  $\text{CO}_2$  are specifically catalyzed by \_\_\_\_\_ enzymes.

- A) oxygenase; B) oxidase; C) decarboxylase; D) dehydrogenase; E) none of the above
18. In the citric acid cycle, acetyl-CoA reacts with \_\_\_\_\_ to produce \_\_\_\_\_.
- A) fumarate;  $\alpha$ -ketoglutarate  
B) oxaloacetate; citrate  
C) citrate; isocitrate  
D) succinyl-CoA; oxaloacetate  
E) malate; cis-aconitate
19. Which of the following is an inhibitor of citrate synthase, isocitrate dehydrogenase, and  $\alpha$ -ketoglutarate dehydrogenase?
- A) NADH; B) succinyl-CoA; C) ATP; D) acetyl-CoA; E) none of the above
20. Which of the following pathways takes place primarily within the inner mitochondrial membrane?
- A) fatty acid  $\beta$ -oxidation; B) electron transport; C) glycolysis; D) citric acid cycle; E) pentose phosphate pathway
21. Which amino acid is complexed to iron-sulfur clusters to enable them to associate with proteins?
- A) methionine; B) serine; C) lysine; D) tyrosine; E) cysteine
22. The first three reactions of  $\beta$ -oxidation are analogous to which of the following reaction sequences of the citric acid cycle?
- A) aconitase, isocitrate dehydrogenase,  $\alpha$ -ketoglutarate dehydrogenase  
B) isocitrate dehydrogenase,  $\alpha$ -ketoglutarate dehydrogenase, succinyl-CoA synthetase  
C)  $\alpha$ -ketoglutarate dehydrogenase, succinyl-CoA synthetase, succinate dehydrogenase  
D) succinate dehydrogenase, fumarase, malate dehydrogenase  
E) fumarase, malate dehydrogenase, citrate synthase
23. What process in the human body taking rest consumes most of the ATP that is produced?
- A) movement of actin/myosin  
B) maintenance of membrane potentials  
C) active transport of glucose and amino acids  
D) cellular growth  
E) none of the above
24. Which of the following is the regulatory step in cholesterol synthesis?
- A) HMG-CoA synthase; B) HMG-CoA lyase; C) HMG-CoA reductase; D) squalene synthase;  
E) squalene epoxidase
25. Ubiquitin is added to \_\_\_\_\_ residues of the target protein by reaction with the terminal \_\_\_\_\_ group of ubiquitin.
- A) lysine; carboxyl  
B) serine; carboxyl  
C) cysteine; carboxyl

- D) glutamate; amine  
E) glutamine; amine

26. In photosynthesis, light energy is transformed into ATP and biosynthetic reducing power into  
A) NADPH. B) NADH. C) AMP. D) ADP. E) None of the above.

27. Enzymes that digest the triacylglycerols into free fatty acids and monoacylglycerol are called  
A) hydrases. B) ligase. C) lipases. D) reductases. E) dehydrogenases.

28. The half-life of a cytosolic protein is primarily determined by the  
A) length of the protein chain. B) amino terminal residue. C) C-terminal sequence. D) All of above. E)  
None of the above.

29. Organisms capable of carrying out reduction of atmospheric nitrogen include  
A) some bacteria and archaea. B) higher eukaryotic organisms, such as mammals. C) all plants. D) fungi,  
including yeasts and molds. E) none of the above.

30. What is the committed step in fatty acid synthesis?  
A) Binding of the fatty acyl group to the acyl carrier protein. B) Synthesis of malonyl CoA. C) Transacylase  
reaction. D) The formation of acetoacetyl-ACP. E) None of the above

【問答題】第 31 題到第 35 題請簡明扼要說明，每題 6 分。第 36 題 10 分請盡可能充分  
而有條理的說明。

31. Please draw a hexapeptide composed of Glutamine-Isoleucine-Tyrosine-Threonine-Histidine-Proline  
(Q-I-Y-T-H-P) in Fisher projection orientation.
32. Please briefly explain the following biochemical terms or observations.  
(a) Concensus motif (found in proteins)  
(b) What is the van der Waals radii?  
(c) Why the peptide bond is rigid and planar?
33. Please draw the following sugar molecules.  
(a) alpha-D-mannose 6-phosphate  
(b) 2-Deoxy-D-ribose  
(c) N-Acetyl-beta-D-glucosamine
34. Please describe the three basic hypotheses of Michaelis-Menten kinetics.
35. Please describe two roles of phosphoinositol 4,5-bisphosphate (PIP<sub>2</sub>) in signal transduction pathways.
36. Please describe in detail the basic principles for the regulation of cellular metabolism.

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