

國立臺北科技大學 100 學年度碩士班招生考試

系所組別：3610、3620 生物科技研究所甲、乙組

第一節 生物化學 試題

第一頁 共三頁

注意事項：

1. 本試題共四大題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

I. 單選題，每題 2 分，共 70%，務必將答案填寫於答案紙上

(Single Choice Questions, 2 points each, 70%, **must fill the answers onto the sheets**) :

1. What significant roles does water play in biochemistry?
(A) Water is a participant in many reactions, all biomolecules are soluble in water, and water helps regulate pH and temperature.
(B) Water is a participant in many reactions, water is an important solvent, and water helps regulate pH and temperature.
(C) Water is a participant in many reactions, water is an important solvent, and water helps regulate pressure and temperature.
(D) Water is a participant in all reactions, all biomolecules are soluble in water, and water helps regulate pressure and temperature.
(E) None of the above are true.
2. Which of the following statements about hydrogen bonds is **false**?
(A) The donor is a hydrogen atom bonded to a less electronegative atom than hydrogen.
(B) The more linear the bond, the stronger the attraction.
(C) The acceptor must contain a non-bonded pair of electrons.
(D) It is a type of non-covalent bond.
3. Biomolecules such as DNA, RNA, proteins and carbohydrates are made up of covalently bound constituent elements. These biomolecules are able to reversibly interact with other biomolecules by means of weaker non-covalent bonds. Which of the following statements correctly characterizes a form of non-covalent bonding?
(A) A hydrogen bond is formed between temporary dipoles.
(B) An ionic bond is formed between fully charged atoms or molecules.
(C) Bonds that form between non-polar groups are called van der Waals interactions.
(D) A hydrophobic bond forms between temporary dipoles.
4. Which of the following are true of the hydrogen bonds in water?
(A) They rarely break and reform.
(B) They have a strong bond energy of 460 kJ/mol.
(C) They are too weak to play a significant role in biochemistry.
(D) They have a weak bond energy of 20 kJ/mol.
5. What is the pH when 20 ml of 0.1 M NaOH are added to 100 ml of 0.1 M lactic acid? The pKa of lactic acid is 3.85. pH =
(A) 1.8×10^{-5}
(B) 4.75
(C) 3.25
(D) 10
6. The amino acids with charged side chains include:
(A) aspartate, glutamate, lysine and arginine.
(B) aspartate, glutamate and glycine.
(C) aspartate, lysine and arginine.
(D) aspartate, glutamate, lysine, glycine and arginine.
(E) none of the above
7. Which statement(s) is (are) consistent with the arrangement of hydrophobic amino acids buried in a core of the protein, away from interactions with water?
(A) The side chains of the hydrophobic amino acids are altered by interaction with protons.
(B) In a denatured protein in which water molecules form a cage-like boundary at the interface with the hydrophobic amino acids, the highly ordered arrangement of water molecules is thermodynamically unfavorable.
(C) Water molecules are thermodynamically stable when they can interact directly with polar amino acids, and hydrophobic amino acids are buried away from interactions with water.
(D) A and B
(E) A, B and C
8. Bends or loops are considered to be non-regular secondary structures because they do not repeat. Which of the following is true of bends?
(A) Bends do not reverse the direction of a polypeptide chain.
(B) Bends connect regions of alpha-helices and beta-sheets.
(C) Glycine and proline are absent from bends.
(D) Bends are usually found at the C terminus.
9. Allosteric enzymes are large, oligomeric proteins that have catalytic sites for binding substrates and regulatory sites that bind effectors. The separate oligomers influence one another; they work cooperatively. This is evidenced by the characteristic rate curves for allosteric enzymes which have:
(A) Michaelis-Menten kinetics
(B) Hyperbolic kinetics
(C) Sigmoidal kinetics
(D) Regulatory kinetics
(E) Concerted kinetics
10. Several methods of cleavage (such as proteolytic enzymes) are used in determining the primary structure of a protein
(A) to give overlapping peptides, which can be compared to obtain a complete sequence.
(B) to use less material in each experiment.
(C) so that results from different laboratories can be compared.
(D) to distinguish between the N-terminal and C-terminal amino acids of the protein.

注意：背面尚有試題

11. According to the steady-state assumption
 (A) the product concentration does not change significantly.
 (B) the substrate concentration is large and does not change significantly.
 (C) the concentration of enzyme-substrate complex remains constant with time.
 (D) the free enzyme concentration is always in great excess to the concentration of enzyme-substrate complex.
12. The addition of a phosphoryl group to a OH group of a sugar by a kinase is a form of:
 (A) Dehydrogenation
 (B) Reduction
 (C) Oxidation
 (D) Esterification
13. Enzymes that form C-C and C-S bonds are called:
 (A) lyases
 (B) hydrolases
 (C) ligases
 (D) oxidoreductases
14. Which statement about vesicles is **false**?
 (A) The formation and assembly of polar lipids into a bilayer is a spontaneous process.
 (B) Vesicles are useful tools to study membrane processes.
 (C) Vesicles can be used to study transport.
 (D) Vesicles can be used to study fluidity of membranes.
 (E) Vesicles are similar in size to cells.
15. Glycolipids are particularly important in these structures:
 (A) Membranes.
 (B) Lipoproteins.
 (C) The brain and nervous system.
 (D) Membranes, the brain and the nervous system.
 (E) All of these are correct.
16. A useful method for studying membrane proteins in place in the membrane is
 (A) nuclear magnetic resonance.
 (B) x-ray crystallography.
 (C) treatment with mercaptoethanol.
 (D) treatment with detergents.
17. Which of the following statements concerning messenger RNA is **true**?
 (A) It is the most abundant of the commonly occurring forms of RNA.
 (B) It has extensive intrachain hydrogen bonding.
 (C) It turns over rapidly.
 (D) All of the above are true.
18. Why is thymine used in DNA rather than uracil?
 (A) Thymine is more hydrophobic, so it stacks better in the helix.
 (B) If cytosine is deaminated, it forms uracil, which can be easily distinguished from thymine.
 (C) Thymine is not capable of wobbling, so it pairs more accurately than uracil.
 (D) All of these are correct.
19. Which of the following is a characteristic of eukaryotic, but not prokaryotic, DNA replication?
 (A) Topoisomerases are required.
 (B) A primer is needed on the lagging strand only.
 (C) Histone biosynthesis must take place.
 (D) There is only one origin of replication.
20. RNA replicase synthesizes RNA from an RNA template. RNA replicase differs from RNA polymerase in that:
 (A) It requires ATP.
 (B) It is found in viruses.
 (C) It has proofreading capability.
 (D) The synthesis of RNA proceeds in the 3'-5' direction.
21. Which of the following RNA sequences could form a hairpin loop?
 (A) ACGUUUCGUAUCGUACACACGU
 (B) GCATCGAUCGUCUCGAUCGUGC
 (C) ACAGACAGACAGUCUGUCUGUC
 (D) AAUUAACCAAGGAACCGGUUCC
 (E) none of the above
22. The general steps in DNA repair include:
 (A) endonuclease cleavage, exonuclease removal of the mononucleotide, polymerase filling of the gap and ligase action to close the gap.
 (B) deamination reversal of the damaged base, polymerase filling of the gap and telomerase action to seal the gap.
 (C) exonuclease removal of the mononucleotide, glycoside action to replace the mononucleotide.
 (D) cleavage across both strands in overlapping cuts, followed by polymerase and ligase action.
 (E) none of the above
23. The cyclic form of sugars
 (A) has one more chiral center (the anomeric carbon) than the openchain form.
 (B) loses a chiral center compared to the open-chain form.
 (C) is not usually found in nature.
 (D) has one more carbon atom than the open-chain form.
 (E) has one less carbon atom than the open-chain form.
24. A bacterial cell wall is composed of:
 (A) A polysaccharide consisting of a single type of monosaccharide unit and cross-linking oligopeptides.
 (B) A polysaccharide consisting of 2 types of monosaccharide units and cross-linking oligopeptides.
 (C) A polysaccharide consisting of 3 types of monosaccharide units and cross-linking oligopeptides.
 (D) Two different polysaccharides and 1 type of oligopeptide, which are cross-linked.

25. Methanol is extremely toxic, but not directly. In the body, it is converted into formaldehyde; that's what's actually the poison. What kind of enzyme catalyses this conversion?
- (A) a kinase
 - (B) an isomerase
 - (C) a mutase
 - (D) a dehydrogenase
26. All of the following are characteristic of the coupling between glycolysis and the citric acid cycle **EXCEPT**:
- (A) glycolysis feeds acetyl CoA, via pyruvate, to the citric acid cycle.
 - (B) citrate inhibits glucokinase to regulate glycolysis.
 - (C) citrate builds up when citric acid cycle reaches saturation.
 - (D) citric acid cycle directs electrons into electron transport chain for the purpose of ATP production.
 - (E) ATP production via citric acid cycle, electron transport, and oxidative phosphorylation inhibits glycolysis.
27. Characteristics of succinate dehydrogenase include all **EXCEPT**:
- (A) it is also known as succinate-Coenzyme Q reductase.
 - (B) it has covalently bound FAD.
 - (C) it is a membrane-bound enzyme.
 - (D) it removes hydrogens from C-O bonds.
 - (E) it carries out either 1-electron or 2-electron transfers to/from FAD.
28. What are the three primary metabolic fates of pyruvate?
- (A) ethanol, acetyl-CoA, glucose
 - (B) acetyl-CoA, lactate, fructose
 - (C) ethanol, acetyl-CoA, lactate
 - (D) ethanol, creatine, glucose
 - (E) none of the above
29. The phosphogluconate pathway oxidizes glucose to produce ribose 5-phosphate and NADPH. This is an alternative mode for glucose metabolism. This pathway takes place in all of the following tissues **EXCEPT**:
- (A) Adipose tissue
 - (B) Skeletal muscle
 - (C) Liver
 - (D) Adrenal cortex
 - (E) Erythrocytes
30. How do triacylglycerols go through the cell membrane of adipocytes or muscle cells?
- (A) Active transport.
 - (B) Through the action of a permease.
 - (C) Diffusion.
 - (D) Through an antiport.
 - (E) They form micelles.

31. In humans, obesity is not caused by leptin levels, but by malfunctioning signal mechanisms. Which of the following do you think might be affected by high leptin concentrations binding to receptor?
- (A) Activation of acetyl CoA to malonyl CoA
 - (B) Lipase
 - (C) Phosphogluconate pathway
 - (D) Cholesterol synthesis
32. What is the importance of the purine nucleoside cycle?
- (A) It participates in the conversion of purines into pyrimidines.
 - (B) It generates fumarate, which inhibits the formation of AMP from IMP.
 - (C) It provides fumarate as an anaplerotic enhancement of the citric acid cycle.
 - (D) It inhibits the citric acid cycle in skeletal muscles.
 - (E) It is used in energy metabolism in the liver.
33. Amino acids biosynthesized from aspartate include all **EXCEPT**:
- (A) asparagine
 - (B) threonine
 - (C) methionine
 - (D) lysine
 - (E) glutamate
34. Which of the following metabolic pathways is strictly anabolic?
- (A) glycolysis
 - (B) gluconeogenesis
 - (C) citric acid cycle
 - (D) pentose phosphate cycle
 - (E) beta-oxidation of fatty acids
35. Ketone bodies are synthesized in the
- (A) cytosol of muscle.
 - (B) mitochondria of liver.
 - (C) endoplasmic reticulum of heart.
 - (D) plasma membrane of brain.
 - (E) none of the above.

II. 名詞解釋，每題 3 分，共 15 分 (Glossary illustration, 3 points each, 15%)

1. Nicotinamide adenine dinucleotide
2. Chemiosmotic coupling
3. Two common features of amino acid biosynthesis
4. Cyclic AMP
5. Biotin

III. Please draw the general features of a replication fork. (8%)

- IV. Last year, the National Aeronautics and Space Administration (NASA) of USA funded research discovered a new life style built with the toxic chemical, Arsenic (As). The microorganism found in the Mono Lake could uptake Arsenic, survive and even live on it. Please discuss the importance of this discovery and the possible metabolic pathway of Arsenic from the biochemical point of view. (7%)**