

國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：生物化學【生醫所碩士班】

題號：4055

共 6 頁 第 1 頁

單選題（每題 2 分，總計 100 分）。

1. The three-dimensional structure of an enzyme in complex with its substrate was determined by X-ray crystallography. The structure revealed that a methionine residue in the active site of the enzyme is in close proximity to an isoleucine residue on a substrate. Which of the following would be the **predominant** interaction between these two amino acids? (A) Covalent bond; (B) Disulfide bond; (C) Hydrogen bond; (D) Ionic interaction; (E) Hydrophobic interaction.
2. A new drug to treat ulcers of the stomach has a critical amino group and a carboxyl group with pKa values of ~9 and ~4. In order to be active, both groups need to be in their acid (HA) form. Would this drug likely be effective if given orally? (The typical pH of the stomach is ~2)(A) Yes, both groups will be in acid form; (B) No, only the amino group will be in acid form; (C) No, only the carboxyl group will be in acid form; (D) No, both groups will be in the conjugate base form; (E) Yes, both groups will be in the conjugate base form.
3. Fructose intolerance and galactose intolerance are similar in that they both:
(A) Fail to trap the sugar inside the cell; (B) Deplete the cell of reducing power; (C) Fail to split a 6-carbon sugar into 3-carbon units; (D) Effectively sequester inorganic phosphate; (E) only affect infants.
4. A 33-year old man with a BMI of 38 was prescribed orlistat (Xenical) as part of his treatment to reduce obesity. Orlistat works in the small intestine to block the absorption of dietary fat. When taking orlistat he may need to supplement his diet with several compounds, including: (A) Linoleic acid; (B) Cholesterol; (C) Fat soluble vitamins; (D) Linoleic acid and fat soluble vitamins; (E) Linoleic acid, cholesterol, and fat soluble vitamins.
5. Sphingomyelin is (A) A lipid which functions mainly as a storage form of energy; (B) Synthesized using phosphatidate as the key intermediate of the pathway; (C) A major glycolipid of nerve cell membranes; (D) The major component of lung surfactant, and indicates fetal lung maturity; (E) A membrane lipid containing a sphingosine backbone, an amide linked fatty acid, and phosphoryl- choline as the headgroup.
6. The conversion of proinsulin to insulin requires the activity of two enzymes. Which of the following best represents the classification of these two enzymes? (A) Transferases; (B) Hydrolases; (C) Lyases; (D) Isomerases; (E) Oxidoreductases.
7. Pyrimidine nucleotides are catabolized ... (A) To the respective bases, which are primarily salvaged; (B) To carbon skeletons that are used for other, metabolic pathways; (C) Only down to nucleosides; (D) Extensively in patients with gout; (E) To uric acid, which is excreted.
8. Which one of the following statements about the absorption of lipids from the intestine is **correct**? (A) Dietary triacylglycerols are partially hydrolyzed and absorbed as free

國立中山大學 101 學年度碩士暨碩士專班招生考試試題

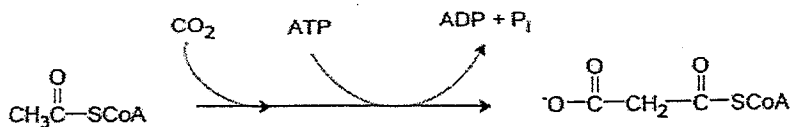
題號：4055

科目：生物化學【生醫所碩士班】

共 6 頁 第 2 頁

fatty acids and monoacylglycerol; (B) Dietary triacylglycerols must be completely hydrolyzed to free fatty acids and glycerol before absorption; (C) Release of fatty acids from triacylglycerols in the intestine is inhibited by bile salts; (D) Lipoprotein lipase (LPL) degrades the dietary lipids for absorption by the intestinal mucosal cells; (E) Formation of chylomicrons does not require protein synthesis in the intestinal mucosa.

9. Which of the following statements about **protein structure** is **correct**? (A) The α -helix is stabilized primarily by ionic interactions between the side chains of amino acids; (B) The formation of the disulfide bond in a protein requires that the two participating cysteine residues be adjacent to each other in the primary sequence of the protein; (C) The stability of quaternary structure in proteins is mainly due to covalent bonds among the subunits; (D) The denaturation of proteins always leads to irreversible loss of secondary and tertiary structure; (E) The information for the correct folding of a protein is contained in the specific sequence of amino acids along the polypeptide chain.
10. A substrate S can be degraded by two different isozymes (#1 and #2), both obeying Michaelis-Menten kinetics. The K_m for isozyme #1 is 0.1 mM and the corresponding value for isozyme #2 is 10 mM. Both isozymes have the same V_{max} . If $[S] = 5$ mM, which of the following statements is correct? (A) Isozyme #1 will degrade S faster than isozyme #2; (B) Isozyme #2 will degrade S faster than isozyme #1; (C) Isozyme #1 will degrade S at a rate equal to half of its maximal velocity; (D) Isozyme #2 will degrade S at a rate equal to half of its maximal velocity; (E) Isozyme #2 will degrade S at its maximal velocity.
11. What is the correct enzyme name for the reaction drawn below? (A) malonyl-CoA synthase; (B) acetyl CoA kinase; (C) fatty acyl CoA synthetase; (D) acetyl CoA carboxylase; (E) acetyl CoA synthetase.



12. Which of the following **correctly** describes galactose metabolism? (A) Galactose is a substrate for hexokinase; (B) Primarily ingested in the form of sucrose; (C) Galactokinase and galactose 1-phosphate uridyl transferase deficiencies cause mental retardation; (D) Galactose 1-phosphate uridyl transferase releases free glucose; (E) UDP-galactose requires a phosphoglucomutase to convert it to UDP-Glucose.
13. Which of the following amino acid sequences is likely to be found in the **membrane-spanning domain** of an integral membrane protein? (A) -Leu-Ile-Glu-Asn-Cys-Trp-; (B) -Leu-Arg-Ala-Ser-Val-Phe-; (C) -Leu-Val-Pro-Asn-His-Met-; (D) -Leu-Arg-Ile-Asp-Val-Lys-; (E) -Leu-Val-Met-Phe-Ala-Ile-.
14. Select the **non-protein component** that forms part of an active enzyme. (A) Apoenzyme; (B) Coenzyme; (C) Holoenzyme; (D) Isoenzyme; (E) Zymogen.

國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：生物化學【生醫所碩士班】

題號：4055

共 6 頁 第 3 頁

15. A patient is suffering from cirrhosis of the liver resulting in very low production of bile salts. Which of the following compounds would **not** be affected in its digestion and absorption from the gut? (A) Vitamin A; (B) Cholesterol; (C) Sucrose; (D) Triglyceride; (E) Vitamin K.
16. Which of the following describes a universal property of buffers? (A) Buffers are usually composed of a mixture of strong acids and strong bases; (B) Buffers work best at the pH at which they are completely dissociated; (C) Buffers work best at the pH at which they are 50% dissociated; (D) Buffers work best at one pH unit lower than the pKa value; (E) Buffers work equally well at all concentrations.
17. If an enzyme was removed from a reaction that it catalyzed, which of the following statements would be true regarding the reaction left to proceed in an uncatalyzed way: (A) The reaction rate would increase; (B) The ΔG would increase; (C) The ΔG would decrease; (D) The activation energy would increase; (E) The activation energy would decrease.
18. Which of the following transporters is **correctly** matched with what it transports? (A) Carnitine: fatty acids; (B) LDLs: dietary triacylglycerols (TAGs); (C) Citrate: malonyl CoA; (D) Albumin: ketone bodies; (E) Glycerol-phosphate: protons (H^+).
19. Which of the following **correctly** characterizes the pyruvate dehydrogenase complex? (A) It uses biotin as a cofactor; (B) It is positively regulated by phosphorylation; (C) It is negatively regulated by AMP; (D) Its product can be converted directly into glucose; (E) It is critical for deciding the fate of pyruvate within the cell.
20. Methotrexate is a potent anti-cancer agent that starves dividing cells of deoxyribonucleotides through direct inhibition of which of the following enzymes? (A) Ribonucleotide reductase; (B) Xanthine oxidase; (C) Carbamoyl phosphate synthetase II; (D) Thymidylate synthetase; (E) Dihydrofolate reductase.
21. A tissue's response to insulin includes all of the following **except**: (A) Activation of the tyrosine kinase domain of the insulin receptor; (B) Activation of a phosphatase; (C) Phosphorylation of target proteins; (D) Activation of family of proteins called insulin receptor substrates (IRS); (E) Activation, as a general rule, of target proteins.
22. Which of the following situations would result in an increase in ketone body synthesis? (A) High insulin/glucagon ratio; (B) High citrate levels in the cytosol; (C) High levels of fructose-2,6-bisphosphate; (D) Low oxaloacetate levels in the mitochondria; (E) Low acetyl CoA levels in the mitochondria.
23. The tertiary structure(three-dimensional structure)of a protein is determined by: (A) Its amino acid sequence; (B) The total charge on the molecule; (C) Its amino acid composition; (D) The number of proline residues; (E) Whether or not the proteins acidic.
24. An increased anion gap is consistent with: (A) An increase in plasma concentration of chloride ions; (B) An increase in plasma concentration of bicarbonate; (C) An increase in plasma concentration of organic acids; (D) A decrease in plasma

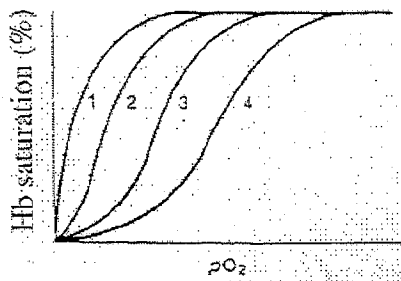
國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：生物化學【生醫所碩士班】

題號：4055
共 6 頁 第 4 頁

concentration of sodium ions; (E) A decrease in plasma concentration of potassium ions.

25. Which of the following statements **incorrectly** describes metabolism and metabolic control? (A) The liver plays a central role in producing and storing energy; (B) Hormone are regulators of the response to changes in metabolic needs; (C) Maintenance of circulating glucose is critical because your muscles require it as an energy source; (D) Catabolic processes create ATP, building materials, and reducing power; (E) Metabolism produces three main waste products, NH_3 , H_2O , and CO_2 .
26. Which of the following pathways does **not** make or use NADPH? (A) Fatty acid synthesis; (B) Cholesterol synthesis; (C) Pentose phosphate pathway; (D) Sphingolipid synthesis; (E) Beta-oxidation of fatty acids.
27. The digestion and absorption of dietary lipids requires all of the following **except**: (A) Pancreatic lipase; (B) Bile salts; (C) Phospholipase A2; (D) Chylomicron formation; (E) Hormone-sensitive lipase.
28. Several oxygen saturation curves are shown in the figure below. Assuming that curve 3 corresponds to data obtained from venous blood perfusing the skeletal muscle at **rest**, which of the curves would most closely reflect the corresponding data during **exercise**? (A) Curve 1; (B) Curve 2; (C) Curve 3; (D) Curve 4; (E) None of above.



29. What is the problem with expressing eukaryotic genes in bacteria? (A) No proofreading; (B) No excision of introns; (C) Not making exons; (D) Size limitations; (E) Vitamin requirements.
30. A protein's quaternary structure refers to: (A) Allosteric; (B) Two or more polypeptide chains forming a multisubunit structure; (C) Disulfide bond; (D) Isozyme; (E) Extended chain.
31. Hair contains the fibrous protein α keratin. How does a permanent wave (perm) change the shape of hair? (A) Hair fibers are stacked; (B) α -keratin is converted from the 'soft' to 'hard' form; (C) Disulfide bonds are broken and reformed; (D) Hair is made water-soluble; (E) Formation of hydrogen bonds.
32. The salt-tolerant bacteria *Halobacterium halobium* contains the protein bacteriorhodopsin in its cell membrane. Bacteriorhodopsin consists of a bundle of α -helical rods. How does this protein allow *H. halobium* to live in water with a high salt concentration? (A) Bacteriorhodopsin turns the cell dormant; (B) Bacteriorhodopsin

國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：生物化學【生醫所碩士班】

題號：4055
共 6 頁 第 5 頁

- acts as a proton channel in the membrane; (C) Bacteriorhodopsin forms salt crystals; (D) Bacteriorhodopsin acts as an O_2 carrier; (E) None of the above.
33. Enzyme action can be influenced by the presence of inhibitors. Which of the following statements **correctly matches** the type of inhibitor with its effect on an enzyme? (A) Irreversible and renders the enzyme permanently inactive; (B) Competitive and inhibitor binds only to ES complex, only important when $[S]$ high, V_{max} lower, K_m lower; (C) Noncompetitive and can be overcome with high $[S]$; V_{max} unchanged, K_m higher; (D) Uncompetitive and cannot be overcome with high $[S]$; V_{max} lower, but K_m unchanged; (E) All of the above.
34. 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.
35. Ribozymes behave like protein enzymes **except** that they: (A) Work solely on nucleotides; (B) Have no tertiary structure; (C) Probably have less substrate selectivity than protein enzymes; (D) Do not require cofactors; (E) Do not care about working PH value.
36. Which of the following statements about glycoproteins is **not** true? (A) They are O or N-linked; (B) They are found on cell surfaces; (C) They serve as cell markers; (D) They bind to iron; (E) They bind to lectins.
37. The levels of Na^+ and K^+ in a cell are maintained by the Na^+-K^+ ATPase pump. This is an example of active transport across a membrane. This pump: (A) Creates ATP; (B) Pumps K^+ and Na^+ in; (C) Is an example of antiport; (D) Required light absorption; (E) Is regulated by oxygen.
38. The hyperchromic effect refers to the increase in the UV absorption of DNA. This is a result of: (A) Annealing; (B) Melting of DNA; (C) Renature of DNA; (D) B- to Z-DNA conversion; (E) Increased hydrogen bonding between strands.
39. In order to package the 3×10^9 nucleotides of DNA into the nucleus, the DNA is wound around histones. These are proteins that bind to the DNA. The interaction of histones and DNA involves: (A) A/T, G/C pairing between histones and DNA; (B) H-bonding between arginine and lysine residues and the DNA phosphate backbone; (C) Basic residues of the histone and the phosphate backbone of DNA; (D) Proteolysis; (E) Methylation.
40. DNA replication is not perfect; a mistake is made for every 10^4 to 10^5 nucleotides added. However, there are proofreading enzymes that excise incorrect bases and insert the correct one. Which of the following enzymes proofread DNA? (A) DNA ligase; (B) DNA gyrase; (C) DNA Polymerase I and II; (D) DNA Polymerase III; (E) Topoisomerase III.

國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：生物化學【生醫所碩士班】

題號：4055

共 6 頁 第 6 頁

41. The site of protein synthesis is: (A) The nucleus; (B) The ribosome; (C) The cell membrane; (D) The Mitochondria; (E) Lysosome.
42. Regulatory proteins all have the ability to bind DNA, primarily in the major groove. Which of the following are examples of regulatory protein structure motifs? (A) Leucine zipper; (B) α -helix; (C) β -strand; (D) $\alpha\beta\alpha$ structure; (E) Clawed motif.
43. If a cell has high levels of ATP, which of the following enzymes will be negatively affected? (A) Fructose 1, 6-bisphosphatase; (B) Hexokinase; (C) Phosphofructokinase and pyruvate kinase; (D) Glycogen phosphorylase; (E) Glycogen synthetase.
44. A good reducing agent is one that: (A) Easily accepts electrons; (B) Readily donates electrons; (C) Reduces easily; (D) Captures electrons easily; (E) Oxygenized easily.
45. The site of amino acid catabolism is the: (A) Stomach; (B) Small intestine; (C) Large intestine; (D) Liver; (E) Peripheral tissues.
46. All the information for the construction of proteins and enzymes resides in the DNA. Thus DNA directs the synthesis of proteins. This nucleotide information on the DNA must be converted to amino acids, the constituent building blocks of proteins. The first step is conversion of the DNA into mRNA in a process called transcription. Which of the following statements are **true** of transcription? (A) The transcription process copies the entire DNA molecule, making an exact RNA replica; (B) DNA polymerase directs the synthesis of RNA from DNA; (C) Only viruses transcribe proteins; (D) Transcription involves the replicase enzyme; (E) mRNA contains U instead of T residues.
47. The Henderson-Hasselbalch equation is also important in buffer preparation. How much carbonic acid and bicarbonate should be added to make a 10 mM solution of pH=7 ($pK_{a1}=6.4$)? (A) 2 mM, 8 mM; (B) 8 mM, 10 mM; (C) 5 mM, 5 mM; (D) 10mM, 0 mM; (E) 3 mM; 7 mM.
48. What animals use for cell-to-cell communication to send signals between individuals. (A) Gap junction; (B) Autocrine; (C) Exocrine; (D) Paracrine; (E) Hormone.
49. DNA replication is semiconservative. Why do you think this is? (A) Requires less energy; (B) Only one DNA strand can be copied at a time; (C) RNA primer limitations; (D) DNA replication starts at specific sites only; (E) Increased fidelity.
50. Which of the following statements is not true of telomerase? (A) Telomerase contains a ribozyme; (B) Telomerase activity decreases as the cell ages; (C) Telomerase adds a repeating sequence to the 5' end of DNA; (D) Telomerase adds a repeating sequence to the 3' end of DNA; (E) Telomerase is found only in eukaryotes.

國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：細胞分子生物學【生醫所碩士班】

題號：4056
共 1 頁 第 1 頁

一、問答題 (72%)

Simple questions:

1. Simply draw an animal cell containing all the major organelles and indicated how the secretory proteins are made and released? (10 points)
2. What is microRNA? How may these RNAs participate in the regulation of gene expression of cells? (8 points)
3. Please describe how the cell cycle is controlled by different cyclin- dependent kinase molecules? (8 points)
4. The expression of gene A requires the binding of two proteins on the promoter region; please describe two different approaches to study the binding sites of those two proteins. (8 points)
5. Please describe why there is a need for having special structures at the end of eukaryotic chromosomes and for the enzyme telomerase. (8 points)
6. How is a misfolded protein recognized? How can a cell distinguish proteins that are meant for degradation? Please list two different diseases which are caused by protein misfolding and aggregation. (10 points)
7. Please write a paragraph essay in which you consider those following issues: Why cancer is describe as a disease of old age; why is cancer more common in our later years? Are most human cancers hereditary? What is the role of environmental factors in cancer causation? The establishment of an aggressive, metastatic cancer involves a "Darwinian struggle" among clonal populations; how does clonal selection serve a promote cancer progression? (12 points)
8. Please describe ions and membrane features affect membrane potential of a neuron. (8 points)

二、名詞解釋 (28%)

Please define the following terms :

1. Autophagy
2. Senescence
3. Transforming growth factor receptor pathway
4. Gap junctional communication (GJC)
5. Peroxisome
6. proto-oncogenes
7. Lipid rafts