

國立成功大學

113學年度碩士班招生考試試題

編 號：56

系 所：生命科學系

科 目：生物化學及分子生物學

日 期：0202

節 次：第 3 節

備 註：不可使用計算機

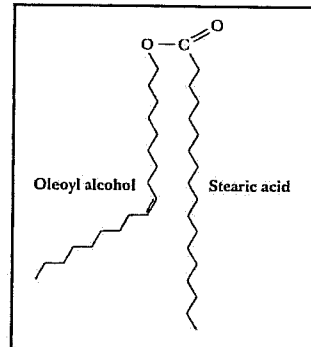
※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

Part I (Total 35 points)

Multiple Choice Questions

1. (2 points) The structure is an example of:

- (A) Terpenes
- (B) Triglycerides
- (C) Waxes
- (D) Sphingolipids
- (E) Steroids



2. (2 points) Membranes with unsaturated fatty acids in their components are more flexible and fluid because:

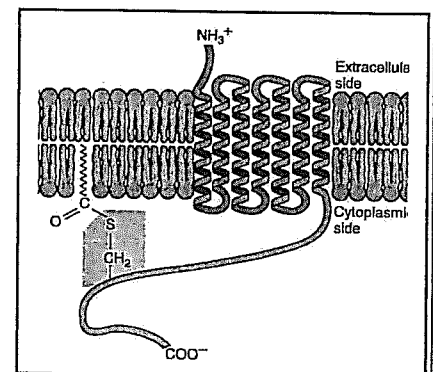
- (A) Unsaturated fatty acids pack closely together to form ordered arrays
- (B) Unsaturated fatty acids bend at the double bond preventing close packing
- (C) Saturated fatty acids have a bend or "kink" that produces more fluid aggregates
- (D) Unsaturated fatty acids have *cis* double bonds that prevent formation of the bend or "kink"
- (E) All of the above are correct

3. (2 points) The lipid composition of cell membrane affects the membrane fluidity. Which of the following fatty acids increases the membrane fluidity most?

- (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)

4. (2 points) G-protein-coupled receptor is anchored into membranes by:

- (A) Amide-linked myristoyl anchors
- (B) Thioester-linked fatty acyl anchors
- (C) Amide-linked prenyl anchors
- (D) Thioether-linked prenyl anchors
- (E) Glycosyl phosphatidylinositol anchors



5. (2 points) The K_m and V_{max} of hexokinase I for glucose are $100 \mu\text{M}$ and $30 \mu\text{M}/\text{min}$, respectively. The K_m and V_{max} of hexokinase II for glucose are 10 mM and $50 \mu\text{M}/\text{min}$, respectively. Which statement is correct about the kinetics of these two enzymes?
- (A) If the glucose concentration is $50 \mu\text{M}$, the reaction velocity of hexokinase I will be $20 \mu\text{M}/\text{min}$.
 - (B) If the glucose concentration is $50 \mu\text{M}$, the reaction velocity of hexokinase I will be $25 \mu\text{M}/\text{min}$.
 - (C) If the glucose concentration is 1 mM , the reaction velocity of hexokinase II will be $30 \mu\text{M}/\text{min}$.
 - (D) If the glucose concentration is 30 mM , the reaction velocity of hexokinase II will be $50 \mu\text{M}/\text{min}$.
 - (E) Compared to hexokinase II, hexokinase I is more efficient when the glucose concentration is higher than 10 mM .
6. (2 points) A possible function of NADPH is to:
- (A) provide reducing equivalents to synthesize glucose from CO_2 .
 - (B) carry electrons from anabolic reactions.
 - (C) provide a source of hydrogens for oxidative biosynthesis.
 - (D) be reduced by hydride ions to form NAD^+ .
 - (E) produce an oxidative product.
7. (2 points) In glycolysis, which enzyme catalyzes substrate-level phosphorylation:
- (A) phosphoglycerate kinase
 - (B) hexokinase
 - (C) phosphofructokinase
 - (D) glucokinase
 - (E) phosphoglucoisomerase
8. (2 points) Under anaerobic conditions, skeletal muscle generates lactate from pyruvate to:
- (A) lower the pH
 - (B) promote release of oxygen from hemoglobin
 - (C) generate additional ATP
 - (D) be warning of muscle fatigue
 - (E) regenerate NAD^+ for further glycolysis
9. (2 points) In the electron-transport chain, which complex reduces molecular oxygen?
- (A) complex I
 - (B) complex II
 - (C) complex III
 - (D) UQH/UQH₂ pool
 - (E) complex IV

10. (2 points) The major tissues carrying out gluconeogenesis are the ____ and ____.
- (A) brain; muscles
 - (B) muscles; kidneys
 - (C) liver; kidneys
 - (D) liver; red blood cells
 - (E) red blood cells; brain
11. (2 points) A transaldolase in the pentose phosphate pathway is an enzyme that catalyzes:
- (A) transfers of three-carbon units from a ketose to an aldose.
 - (B) isomerization of ketoses into aldoses such as the conversion of ribulose-5-phosphate to ribose-5-phosphate.
 - (C) epimerization of ketoses such as the conversion of xylulose-5-phosphate into ribulose-5-phosphate.
 - (D) TPP-dependent transfer of 2-carbon units to the recipient aldose.
 - (E) transfer of keto groups from C-2 to C-3 of a ketose.
12. (6 points) We were doing experiments to measure the catalytic efficiency of an enzyme. We added 2 mM, 4 mM, and 6 mM of substrate in the enzyme-catalyzed reaction, and got the reaction velocity as 0.5 mM/sec, 0.8 mM /sec, and 1 mM/sec, respectively. Please use Hanes-Woolf equation to calculate V_{\max} and K_m .

$$\frac{[S]}{v} = \left(\frac{1}{V_{\max}} \right) [S] + \frac{K_m}{V_{\max}}$$

13. (7 points) Please calculate the total ATP yield from glucose oxidation through glycolysis, the TCA cycle, and oxidative phosphorylation, using the glycerol-phosphate shuttle and malate-aspartate shuttle for NADH oxidation, respectively.

Part II (Total 25 points)

Multiple Choice Questions

14. (2 points) The function of the eukaryotic DNA replication factor PCNA (*proliferating cell nuclear antigen*) is similar to that of the β -subunit of bacterial DNA polymerase III in that it:
- A) facilitates replication of telomeres.
 - B) forms a circular sliding clamp to increase the processivity of replication.
 - C) has a 3' \rightarrow 5' proofreading activity.
 - D) increases the speed but not the processivity of the replication complex.
 - E) participates in DNA repair.

15. (2 points) In contrast to bacteria, eukaryotic chromosomes need multiple DNA replication origins because:
- A) eukaryotic chromosomes cannot usually replicate bidirectionally.
 - B) eukaryotic genomes are not usually circular, like the bacterial chromosome is.
 - C) the processivity of the eukaryotic DNA polymerase is much less than the bacterial enzyme.
 - D) their replication rate is much slower, and it would take too long with only a single origin per chromosome.
 - E) they have a variety of DNA polymerases for different purposes, and need a corresponding variety of replication origins.
16. (2 points) In homologous recombination in *E. coli*, the protein that assembles into long, helical filaments that coat a region of DNA is:
- A) DNA methylase.
 - B) DNA polymerase.
 - C) histone.
 - D) RecA protein.
 - E) RecBCD enzyme.
17. (2 points) When a DNA molecule is described as replicating bidirectionally, that means that it has two:
- A) chains.
 - B) independently replicating segment.
 - C) origins.
 - D) replication forks.
 - E) termination points.
18. (2 points) Topoisomerases can:
- A) change the linking number (L) of a DNA molecule.
 - B) change the number of base pairs in a DNA molecule.
 - C) change the number of nucleotides in a DNA molecule.
 - D) convert D isomers of nucleotides to L isomers.
 - E) interconvert DNA and RNA.
19. (2 points) In Cori cycle, which compound is recycled from muscle to liver.
- A) glutamine
 - B) alanine
 - C) lactate
 - D) lysine
 - E) glucose

20. (2 points) If a person's urine contains unusually high concentrations of urea, which one of the following diets has he or she probably been eating recently?
- A) High carbohydrate, very low protein
 - B) Very high carbohydrate, no protein, no fat
 - C) Very, very high fat, high carbohydrate, no protein
 - D) Very high fat, very low protein
 - E) Very low carbohydrate, very high protein
21. (2 points) Urea synthesis in mammals takes place primarily in tissues of the:
- A) brain.
 - B) kidney.
 - C) liver.
 - D) skeletal muscle.
 - E) small intestine.
22. (2 points) Which one is the most abundant amino acid in human body fluids and tissues.
- A) Phenylalanine
 - B) glutamine
 - C) methionine
 - D) serine
 - E) glycine
23. (2 points) Gout is a disease caused by excess _____
- A) Acetic acid
 - B) Urea
 - C) Phenylalanine
 - D) Uric acid
 - E) Thymidine
24. (2 points) 5-fluorouracil (5-FU) is a thymine analog used in chemotherapy. Which enzyme is inhibited by 5-FU?
- A) nucleotidase
 - B) adenosine deaminase
 - C) dCMP deaminase
 - D) xanthine oxidase
 - E) thymidylate synthase

25. (3 points) B-form DNA in vivo is a _____-handed helix, _____ Å in diameter, with a rise of _____ Å per base pair.
- A) left; 20; 3.9
 - B) right; 18; 3.4
 - C) right; 18; 3.6
 - D) right; 20; 3.4
 - E) right; 23; 2.6

Part III (Total 40 points)

26. (5 points) Describe how the 5' splice site, 3' splice site, and branch point are determined during RNA splicing.
27. (5 points) Describe and contrast the underlying mechanisms by which ribosome recognizes the translation start codon AUG between prokaryotes and eukaryotes.
28. (5 points) What are the roles of ATP during protein degradation by proteasome?
29. (5 points) Describe and contrast the mechanism of promoter recognition between prokaryotes and eukaryotes.
30. (5 points) Describe the mechanism and function of SUMOylation.
31. (5 points) What is the role of ATP during the aminoacylation of tRNA?
32. (2 points) What is the committed step during fatty acid biosynthesis?
(3points) How is it regulated?
33. (5 points) Describe three mechanisms that could regulate eukaryotic protein translation.