

國立成功大學

112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： 0207

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)

1. Which amino acid is found often at the lipid-water interface in the membrane? (2 points)

- (A) Gln
- (B) Trp
- (C) Lys
- (D) Phe
- (E) Ala

2. Which statement is wrong about membrane channels? (2 points)

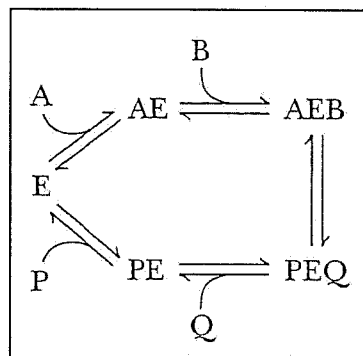
- (A) Magnesium channel is formed from tetramers of protein subunits
- (B) The selectivity filter of potassium channel is "TVGYG"
- (C) Osteoclasts use proton pumps to secret acid into the space between the osteoclast membrane and the bone surface for bone remodeling
- (D) Cardiac glycoside inhibits Na^+ , K^+ ATPase and results in hypertension in humans
- (E) All of the above are correct

3. Which one does not need ATP as energy for their functions? (2 points)

- (A) ABC transporters
- (B) Bacteriorhodopsin
- (C) Proton pumps
- (D) Na^+ , K^+ ATPase
- (E) Calcium pumps

4. In the reaction mechanism below, ___ are competitive for binding to free enzyme E. (2 points)

- (A) P and A
- (B) A and B
- (C) B and Q
- (D) Q and A
- (E) none of the above



5. You find an unknown protein X and analyze the protein sequence. You find a potential phosphorylation site "LARKKGSIH" on protein X. Which kinase could phosphorylate protein X? (2 points)

- (A) cAMP dependent protein kinase, target sequence*: R(R/K)X(S*/T*)
- (B) cGMP dependent protein kinase, target sequence*: (R/K)KKX(S*/T*)
- (C) phosphorylase kinase, target sequence*: KRKQIS*VRGL

(D) mitogen-activated protein kinase, target sequence*: PXX(S*/T*)P

(E) none of the above

6. Which of the following conditions decreases the binding affinity of O₂ to hemoglobin? (2 points)

(A) Increased 2,3 -BPG in the blood

(B) Decreased CO₂ in the blood

(C) Increased pH in the blood

(D) Decreased 2,3 -BPG in the blood

(E) Decreased H⁺ in the blood

7. Photosynthetic phosphorylation and oxidative phosphorylation are similar processes. All of the following are common to BOTH processes EXCEPT: (2 points)

(A) both have fixed and mobile electron carriers.

(B) both contain cytochromes in their electron carrier chains.

(C) both produce NADPH to be used in the reductive pentose phosphate pathway (Calvin cycle).

(D) both represent a major route of ATP synthesis.

(E) both have quinones as electron carriers.

8. All of the enzymes of gluconeogenesis may be found in the cytosol EXCEPT _____ which is only found in the mitochondria. (2 points)

(A) PEP carboxykinase

(B) pyruvate carboxylase

(C) fructose-1,6-bisphosphatase

(D) glucose-6-phosphatase

(E) all are only in cytosol

9. In the TCA cycle, carbon enters the cycle as _____ and exits as _____ with metabolic energy captured as _____, _____ and _____. (2 points)

(A) malonate; water; NADH; ATP; NADPH

(B) acetyl-CoA; CO₂; NADH; ATP; NADPH

(C) succinyl-CoA; CO₂; ATP; NADH; NADPH

(D) acetyl-CoA; CO₂; ATP; NADH; [FADH₂]

(E) malonyl-CoA; water; NADH; [FADH₂]; ATP

10. Which of the following correctly and completely describes electron movement in electron transport? (2 points)

(A) NADH → complex I → complex III → coenzyme Q → Complex IV → O₂

(B) [FADH₂] → complex II → cytochrome c → complex III → coenzyme Q → Complex IV → O₂

(C) NADH → complex I → coenzyme Q → complex III → cytochrome c → Complex IV → O₂

(D) [FADH₂] → complex I → coenzyme Q → complex III → Complex IV → O₂

(E) none of the above

11. Since phosphorylation of Ser14 activates glycogen phosphorylase, we are going to do site-directed mutagenesis to manipulate the activity of glycogen phosphorylase.

- (1) Which amino acid should we use to replace Ser14 for constitutive inhibition of glycogen phosphorylase? (2 points)
- (2) Which amino acid should we use to replace Ser14 for constitutive activation of glycogen phosphorylase? (2 points)

12. What are uncouplers of oxidative phosphorylation? (3 points)

13. Please compare the difference between glycerol-phosphate shuttle and malate-aspartate shuttle for NADH oxidation. (4 points)

14. What are the metabolic fates of NADH and pyruvate produced in glycolysis under normoxia and hypoxia? (4 points)

Part II: (Total 25 points)

15. Chargaff's rules state that in typical DNA: (2 points)

- (A) $A = G$.
- (B) $A = C$.
- (C) $A = U$.
- (D) $A + T = G + C$.
- (E) $A + G = T + C$.

16. Current estimates indicate that humans have about _____ genes. (2 points)

- (A) 3,000
- (B) 10,000
- (C) 30,000
- (D) 100,000
- (E) 300,000

17. Topoisomerases can: (2 points)

- (A) change the linking number (Lk) 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.

18. *E. coli* DNA polymerase III: (2 points)

- (A) can initiate replication without a primer.
- (B) is efficient at nick translation.
- (C) is the principal DNA polymerase in chromosomal DNA replication.
- (D) represents over 90% of the DNA polymerase activity in *E. coli* cells.
- (E) requires a free 5'-hydroxyl group as a primer.

19. In contrast to bacteria, eukaryotic chromosomes need multiple DNA replication origins because: (2 points)

- (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.

20. The 5' → 3' exonuclease activity of *E. coli* DNA polymerase I is involved in: (2 points)

- (A) formation of a nick at the DNA replication origin.
- (B) formation of Okazaki fragments.
- (C) proofreading of the replication process.
- (D) removal of RNA primers by nick translation.
- (E) sealing of nicks by ligase action.

21. B-form DNA in vivo is a _____-handed helix, _____ Å in diameter, with a rise of _____ Å per base pair. (2 points)

- (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

22. Which of the following is a palindromic sequence? (2 points)

- (A) AGGTCC
TCCAGG
- (B) CCTTCC
GCAAGG
- (C) GAATCC
CTTAGG
- (D) GGATCC
CCTAGG
- (E) GTATCC
CATAGG

23. Please use replication bubble to show how DNA replication works. In the model, please show 5' and 3' DNA ends, origin, leading strand, lagging strand, primers, Okazaki fragments. (9 points).

Part III: (Total 40 points)

24. Describe the transcription termination mechanisms used by prokaryotes. (4 points)
25. Name three post-transcriptional modifications of mRNA in eukaryotes. Describe their functions. (6 points)
26. Describe the functions of prokaryotic translation elongation factors, EF-Tu, EF-Ts and EF-G. (6 points)
What is the role of GTP in those processes? (2 points)
27. MicroRNA is a class of small RNAs that are important for regulation of gene expression. How do they do it? (4 points)
28. What is autophagy? How is it initiated? (4 points)
29. How does Hsp70 (DnaK) help protein folding? (4 points)
What is the role of ATP in those processes? (2 points)
30. NADH and NADPH are two important electron carriers in cellular metabolism. Describe their functions (4 points).
31. What is the function of LDL (Low Density Lipoprotein)? (2 points)
Why is LDL often described as a bad lipoprotein? (2 points)