

題號： 149  
科目： 生化學  
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國立臺灣大學 113 學年度碩士班招生考試試題

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※第 1-25 題請務必作答在「選擇題作答區」※

For Questions 1-5, there may be more than one correct answer. Points will be given only if all answers are correct.

1. Development of mRNA vaccines helps against COVID-19. Dr. Karikó and Weissman won the 2023 Nobel Prize in Physiology or Medicine. Which discoveries described below are their main contribution? (4%)

- A) DNA base modification.
- B) RNA base modification.
- C) Base modification leads to increased inflammatory response.
- D) Base modification leads to reduced inflammatory response.
- E) The mRNA vaccines with base modification increased protein production.

2. Which functional groups of the common structure of amino acids are used to form peptide bonds? (4%)

- A) Amino group
- B) Side chain
- C) H atom
- D) Carboxyl group
- E) OH

3. Which descriptions of the differences between eukaryotic and prokaryotic transcription are wrong? (4%)

- A) Eukaryotic transcription occurs in the nucleus.
- B) The 28S, 18S, 5.8S, and 5S rRNAs of eukaryotes are formed from one primary transcript.
- C) There is no definite phase for prokaryotic transcription occurrence.
- D) The eukaryotic transcriptional unit has one or more genes (polycistronic).
- E) A single RNA polymerase of prokaryotes synthesizes all three types of RNA (mRNA, tRNA, and rRNA).

4. How do eukaryotes generate various isoforms of RNA transcript from one gene? (4%)

- A) Selective splicing
- B) Alternative 5' donor site
- C) Alternative 3' acceptor site
- D) Alternative polyadenylation site
- E) Different RNA polymerases

5. Which descriptions of ribozyme are right? (4%)

- A) Ribozyme is a protein.
- B) Ribozyme is an RNA.
- C) The substrate of ribozyme is proteins.
- D) The substrate of ribozyme is DNA.
- E) The substrate of ribozyme is RNA.

6. Glucose can form 16 isomers. Mannose and galactose are glucose's: (2%)

- A) D and L isomers
- B) Epimers
- C) Alpha and beta anomers
- D) Aldose-ketose isomers

見背面

7. Tautomers are isomers of organic compounds that readily interconvert by a chemical reaction called tautomerization. Which of the following tautomerisms does exhibit in the oxo group of purines and pyrimidines? (2%)
- A) lactam-lactim
  - B) amide-imidic acid
  - C) amine-imine
  - D) keto-enol
8. Which of the below is **NOT** involved in intron removal and the processing of mRNA precursors into mRNA? (2%)
- A) U2 snRNA
  - B) U3 snRNA
  - C) U4 snRNA
  - D) U6 snRNA
9. Which one of the following descriptions about mutations is **WRONG**? (2%)
- A) An adenosine replaced by a cytidine is a “transversion” mutation.
  - B) An adenosine replaced by a guanosine is a “transition” mutation.
  - C) A nonsense mutation results in a different amino acid being inserted in the protein.
  - D) Silent mutation means a change at the DNA level that does not result in any change of amino acid in the encoded protein.
10. Which of the following product will be synthesized in platelets and upon release cause vasoconstriction and platelet aggregation? (2%)
- A) Thromboxanes
  - B) Prostacyclins
  - C) Leukotrienes
  - D) Lipoxins
11. Prostanoids are synthesized by: (2%)
- A) Pentose phosphate pathway
  - B)  $\beta$ -oxidation pathway
  - C) Lipoxygenase pathway
  - D) Cyclooxygenase pathway
12. In the *lac* operon, the CAP (cyclic AMP activator protein)-cAMP complex functions as: (2%)
- A) A positive regulator
  - B) An operator
  - C) A repressor
  - D) All are wrong

5'-ACTGTATCGGAT-3' (coding)  
3'-TGACATAGCCTA-5'

13. The transcribed sequences complementary to the coding sequences above are: (2%)

- A) 5'-ACTGTATCGGAT-3'
- B) 5'-ACUGUAUCGGAU-3'
- C) 5'-ATCCGATACAGT-3'
- D) 5'-AUCCGAUACAGU-3'

14. Which one of the following descriptions is WRONG? (2%)

- A) Caffeine is a trimethylxanthine.
- B) Theophylline is a dimethylxanthine.
- C) Theobromine is the hypoxanthine derivative of cocoa.
- D) Theobromine and theophylline are similar but lack the methyl group at N-1 and at N-7, respectively.

15. Which one of the following subunits is NOT contained in the basic DNA-dependent RNA polymerase of the bacterium *Escherichia coli*? (2%)

- A)  $\alpha$  subunit
- B)  $\beta$  subunit
- C)  $\omega$  subunit
- D)  $\sigma$  subunit

16. Which of the following descriptions about apolipoproteins is CORRECT? (2%)

- A) Apo A-I is the ligand for LDL receptor, while Apo B-100 binds to HDL receptor.
- B) Nascent VLDL and nascent chylomicron both contain Apo C and E.
- C) Apo C-II serves as the enzyme cofactor of lipoprotein lipase.
- D) Apo B-48 on VLDL and Apo B-100 on LDL were encoded from two different genes, and the peptide sequence homology are about 70%.
- E) Apo B-100 contains LDL receptor binding domain, but Apo-E cannot bind to LDL receptor.

17. Which of the following descriptions about acylglycerol and sphingolipid synthesis is CORRECT? (2%)

- A) In adipose tissue, glycerol 3-phosphate is synthesized by the phosphorylation of glycerol.
- B) Glycerol 3-phosphate is phosphorylated by glycerol kinase, and there is no alternative synthesis pathway from glycolysis.
- C) Glycerol 3-phosphate acyltransferase is the rate limiting step of triacylglycerol synthesis.
- D) Phosphatidylcholine synthesis involve ADP-activated choline.
- E) All sphingolipids are formed from ceramide.

見背面

18. Which of the following statements about lipoproteins is INCORRECT? (2%)

- (A) High density lipoproteins (HDL) absorbs cholesterol and carries it back to the liver.
- (B) Chylomicrons are mainly composed of cholesterol absorbed from the gut.
- (C) Very low density lipoprotein (VLDL) are large triglyceride-rich lipoproteins produced in liver.
- (D) Low density lipoproteins (LDL) are the main transporters of cholesterol in the blood, carry cholesterol from the liver to cells throughout the body.
- (E) Intermediate density lipoproteins (IDL) are derived from VLDL after removal of triacylglycerol.

19. Seahorse XFe analyzer is designed to measure oxygen consumption rate. Which of the following drug can be added to measure the maximum oxygen consumption rate of cells to estimate the maximal mitochondrial function? (2%)

- A) High concentration of glucose.
- B) Substrate of Isocitrate dehydrogenase, Isocitrate.
- C) Carbonyl cyanide-p-trifluoromethoxyphenylhydrazone (FCCP): uncouplers which disrupt the permeability of the inner membrane.
- D) High concentration of pyruvate.
- E) Antimycin A: complex III inhibitor.

20. Which of the following statements is NOT one of the major metabolic functions of liver? (2%)

- A) Bile production to facilitate lipid digestion and absorption.
- B) Both synthesis and oxidation of fatty acids.
- C) Synthesis of triacylglycerols and phospholipids.
- D) Conversion of ketone bodies into acetyl-CoA, which then enters the Krebs cycle and be oxidized for energy production.
- E) Both synthesis and metabolism of plasma lipoproteins.

21. Which of the following descriptions about cholesterol synthesis and metabolism is CORRECT? (2%)

- A) The rate limiting step of cholesterol synthesis is regulated by HMG-CoA synthase.
- B) Cholesterol transported with lipoprotein in the blood circulation are mostly as free form cholesterol, while the cholesterol stored in adipose tissue are esterified by long chain fatty acids.
- C) Insulin activates HMG-CoA reductase by promoting its dephosphorylation.
- D) Monoclonal antibody against proprotein convertase subtilisin/kexin 9 (PCSK9) lowers serum LDL cholesterol by enhancing the degradation of the LDL receptor.
- E) Increased amount of cholesterol activates transcription factor sterol regulatory element-binding protein (SREBP) to increase HMGCR (Gene of HMG-CoA reductase) mRNA transcription.

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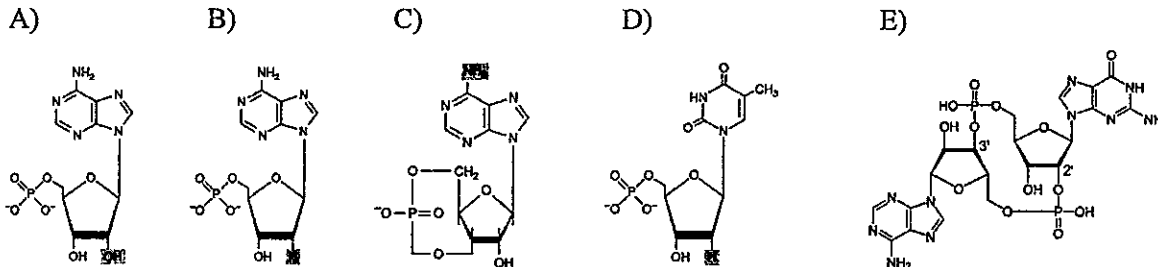
22. Which of the following description about nucleic acid is **INCORRECT**? (2%)

- A) DNA synthesis involves a more intricate and precise proofreading, the DNA repair mechanisms are preserved among all organisms.
- B) The initiation steps of DNA and RNA synthesis both require RNA primers.
- C) During RNA replication, only a portion of the genome is synthesized, whereas during DNA replication, the entire genome is synthesized.
- D) Many short fragments, called "Okazaki fragments", formed on the lagging strand of DNA synthesis.
- E) Mitochondrial DNA is circular, which is structurally similar to bacterial DNA.

23. Which of the following description purine and pyrimidine de novo synthesis **INCORRECT**? (2%)

- A) The initial reaction of purine biosynthesis is forming phosphoribosyl pyrophosphate (PRPP).
- B) Both adenosine monophosphate (AMP) and guanosine monophosphate (GMP) can be derived from inosine monophosphate (IMP).
- C) The so-called orotate pathway of pyrimidine de novo synthesis involves using PRPP serves as a scaffold for the subsequent assembly of the pyrimidine ring to form uridine 5'-monophosphate (UMP).
- D) Thymidylate synthase is the sole enzyme responsible for de novo biosynthesis of thymidine monophosphate (TMP).
- E) *Cross-regulation* exists between purine and pyrimidine biosynthesis, suggesting coordinated control of their biosynthesis.

24. Which of the following nucleotide serves as a key second messenger in signaling pathway? (2%)



25. Which of the following is a nucleotide, which is composed of a nitrogenous base, a pentose sugar and a phosphate? (2%)

- A) Adenine
- B) Guanylate
- C) Thymidine
- D) Deoxycytidine

※第 26-35 題請務必作答於「試卷內頁作答區」※

26. In each of the following pairs of amino acids, identify which amino acid would be most soluble in water: (4%)

- A. Glu, Ile
- B. Tyr, Phe
- C. Ser, Ala
- D. Trp, His

27. Draw the tetrapeptide Tyr-Asp-Ile-Met at physiological pH. (4%)

見背面

28. You wish to determine the sequence of a short peptide. Cleavage with trypsin yields three smaller peptides with the sequences Leu-Glu, Gly-Tyr-Asn-Arg, and Gln-Ala-Phe-Val-Lys. Cleavage with chymotrypsin yields three peptides with the sequences Gln-Ala-Phe, Asn-Arg-Leu-Glu, and Val-Lys-Gly-Tyr. What is the sequence of the intact peptide? (4%)
29. In the following polypeptide, where might bends or turns occur? (2%) Where might intrachain disulfide cross-linkages be formed? (2%)  
Phe-Ala-His-Cys-Thr-Trp-Gly-Phe-Pro-Glu-Ser-Ala-Met-Arg-Trp-Glu-Ala-Asn-Asp-Gly- Pro-Met-Glu-Ala-Phe-Cys-His-Arg-
30. Which peptide has greater absorbance at 280 nm ? (2%)  
A. Ser-Val-Trp-Asp-Phe-Gly-Tyr-Trp-Ala  
B. Gln-Leu-Glu-Phe-Thr-Leu-Asp-Gly-Tyr  
C. Asp-Ile-Asn-Pro-Thr-Arg-Asp-Val-Phe  
D. Asn-Phe-Gln-Met-Thr-Leu-Tyr-Lys-Tyr
31. Please determine the pI of the following peptides: Lys-His-Trp-Ser-Gly-Gly-Leu-Arg-Pro-Gly (2 %)

Amino acid	pK <sub>1</sub>	pK <sub>2</sub>	pK <sub>R</sub>
Arg	2.17	9.04	12.48
His	1.82	9.17	6.00
Trp	2.38	9.39	
Ser	2.21	9.15	
Gly	2.34	9.60	
Leu	2.36	9.60	
Lys	2.18	8.95	10.53
Pro	1.99	10.96	

32. Please describe the biological functions of co-enzyme Q and Q cycle in mitochondria? (5%)
33. Please provide an explanation why fatty acid catabolism can turn off glycolysis and turn on gluconeogenesis? (5%)
34. What is the process of glycogen biosynthesis from glucoses? (5%)
35. What is the biosynthesis of heme? (5%)

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