

國立中山大學 107 學年度碩士暨碩士專班招生考試試題

科目名稱：生物化學【生科系碩士班乙組】

題號：421001

※本科目依簡章規定「不可以」使用計算機(混合題)

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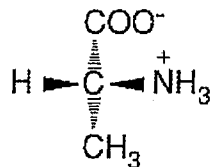
(一) 單選題 (60分，每題3分，共20題)：

1. 5-Phosphoribosyl-a-pyrophosphate (PRPP) is a synthetic precursor for all of the following *except*:
 A) AMP B) histidine C) UMP D) tryptophan E) arginine

2. If the binding of a small molecule to an enzyme "induces" a change in conformation that makes the enzyme site complimentary in structure to the geometric and electronic properties of the small molecule, then _____.
 A) the interaction is an example of an induced fit.
 B) the interaction will result in inhibition.
 C) the enzyme will be inactivated.
 D) the enzyme is subject to allosteric regulation.
 E) None of the above.

3. From the following, choose the best description of the figure:

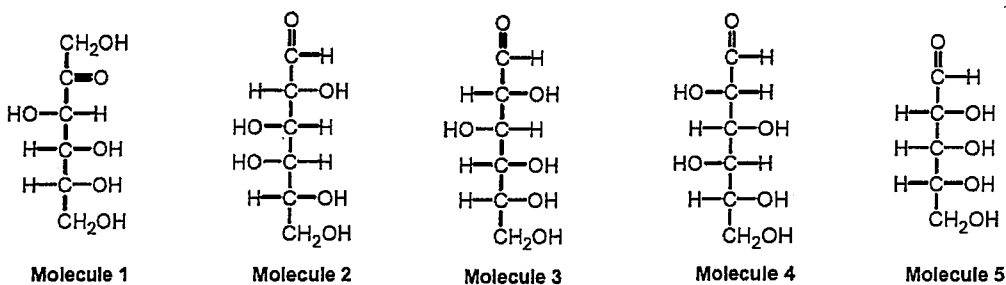
- A) L-Alanine
- B) D-Alanine
- C) L-Serine
- D) D-Serine
- E) D,L-Serine



4. Which of the following is not an intermediate in the citric acid cycle?

- A) Acetyl-CoA
- B) Oxaloacetate
- C) Succinate
- D) Isocitrate
- E) Malate

5. In the following figure, which two molecules are epimers?



- A) Molecules 1 and 5
- B) Molecules 2 and 3
- C) Molecules 3 and 4
- D) Molecules 2 and 4
- E) Molecules 1 and 3

6. Coconut oil contains only a very small amount of unsaturated fatty acids. How can it still have a low melting point?

- A) It contains a lot of long-chain fatty acids.
- B) It contains mostly short-chain fatty acids.
- C) It has only a few hydrogen bonds per fatty acid chain.
- D) a) and c) are true.
- E) b) and c) are true.

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7. Human alcohol dehydrogenase is capable of oxidizing several substrates; the kinetic parameters for these substrates are given in the table below. Which is the most preferred substrate according to these values? Assume a constant enzyme amount of 1 mg when these experimental values were obtained.

Answer Choice	Substrate	K _m (μM)	V _{max} (μmol min ⁻¹)
A)	Hexanol	12	27
B)	Butanol	15	28
C)	Ethylene Glycerol	39	15
D)	Methonal	16	10
E)	Propanol	32	29

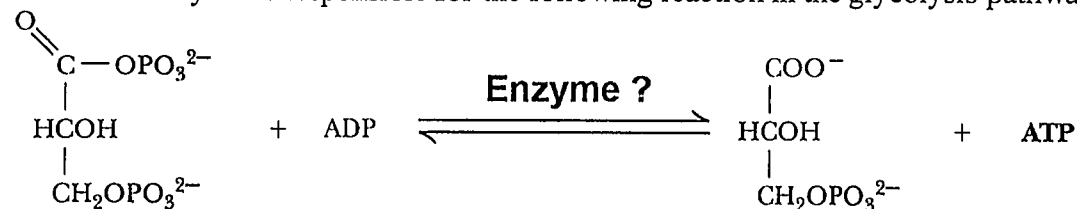
8. The use of NADPH as a source of reducing power for biosynthesis is favored by the fact that the cytosolic NADP⁺/NADPH ratio is:

- A) Much higher than in the mitochondrion.
- B) Very high, leading to nearly irreversible pathways.
- C) Approximately 1.0, allowing easy reversibility of pathways.
- D) Very low, allowing plentiful availability of reductant.
- E) This ratio cannot be calculated because it is an irrational number.

9. Proteins are effective buffers over a wide range of pHs because they usually contain:

- A) a large number of amino acids .
- B) amino acid residues with different pK_a values.
- C) amino-terminal and carboxyl-terminal residues that can donate or accept protons.
- D) peptide bonds that readily ionize, consuming H⁺ and OH⁻ ions.
- E) a large number of hydrogen bonds in α-helices.

10. Which enzyme is responsible for the following reaction in the glycolysis pathway?



- (A) triose phosphate isomerase
- (B) glyceraldehyde 3-phosphate dehydrogenase
- (C) pyruvate kinase
- (D) phosphoglycerate kinase
- (E) glucose 6-phosphate isomerase

11. Excesses of ketone bodies (acetoacetate and β-hydroxybutyrate) are found in the blood of a patient who lacks insulin because:

- A) Ketone bodies are converted into glucose to cause hyperglycemia.
- B) Ketone bodies serve as a substitute for urea in stressful conditions.
- C) Lack of insulin means that glucose can't enter fat cells.
- D) Insulin stimulates glycogen breakdown.
- E) The kidney can't excrete ketone bodies in the absence of insulin.

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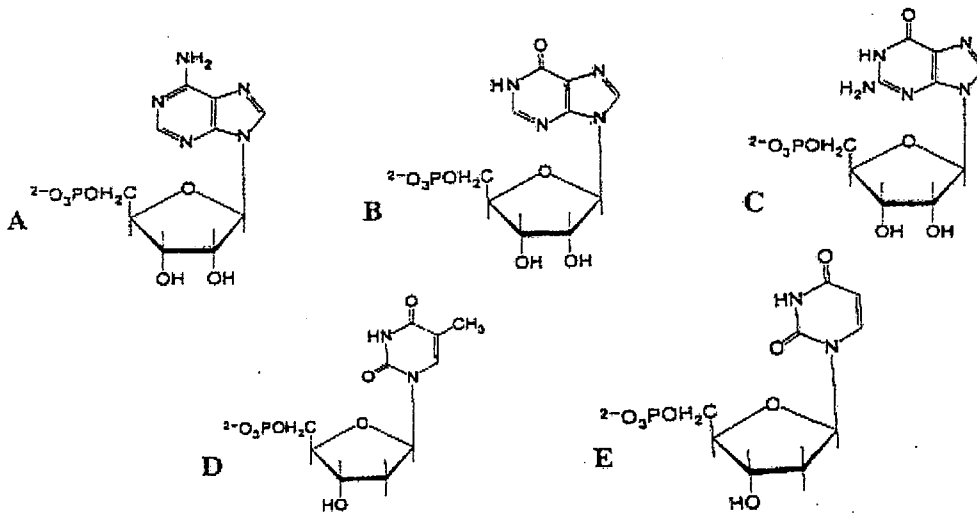
12. Photoheterotrophs require:

- A) organic carbon sources and oxidation-reduction reactions.
- B) carbon dioxide and light
- C) carbon dioxide and inorganic compounds.
- D) organic carbon sources and light.
- E) carbon dioxide and oxidation-reduction reaction.

13. Which of the following reactions is catalyzed by the enzyme HGPRT (hypoxanthine-guanine phosphoribosyl transferase) in the pathway to salvage purine bases? [PRPP = 5-phosphoribosyl-1-pyrophosphate] [THF = tetrahydrofolate]

- A) PRPP + hypoxanthine \rightarrow IMP + PPi
- B) glutamine + bicarbonate \rightarrow glutamate + carbamoyl phosphate
- C) glutamine + PRPP \rightarrow glutamate + 5-phosphoribosyl 1-amine
- D) dUMP + N⁵, N¹⁰-methylene THF \rightarrow dTMP + dihydrofolate
- E) CDP + NADPH \rightarrow dCDP + NADP⁺

14. A nucleotide that is the direct substrate of thymidylate synthase. Please choose the best answer from the structures below:



- A) compound A B) compound B C) compound C D) compound D E) compound E

15. Which of the following statements is **false** in reference to the mammalian synthesis of urea?

- A) Krebs was a major contributor to the elucidation of the pathway involved.
- B) The amino acid arginine is the immediate precursor to urea.
- C) The process of urea production is an energy-yielding series of reactions.
- D) The precursor to one of the nitrogen of urea is aspartate.
- E) The carbon atom of urea is derived from mitochondrial HCO₃⁻

16. In mammals, each of the following occurs during the citric acid cycle **except**:

- A) formation of α -ketoglutarate.
- B) generation of NADH and FADH₂.
- C) metabolism of acetyl-CoA to carbon dioxide and water.
- D) net synthesis of oxaloacetate from acetyl-CoA.
- E) oxidation of acetyl-CoA.

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17. What is the correct order of function of the following enzymes of β oxidation?

1. β -Hydroxyacyl-CoA dehydrogenase
 2. Thiolase
 3. Enoyl-CoA hydratase
 4. Acyl-CoA dehydrogenase
- A) 1, 2, 3, 4
B) 1, 4, 3, 2
C) 3, 1, 2, 4
D) 4, 2, 3, 1
E) 4, 3, 1, 2

18. Which of the following statements about the ratio “moles of ATP synthesized per half mole of oxygen consumed” for oxidative phosphorylation in mitochondria, is **false**?

- A) Uncoupling protein in brown fat can increase the value of the ratio.
B) Experimental measurements have often found ratios of between 2 and 3 when NADH is the electron donor.
C) This ratio is sometimes called the P/O
D) Uncertainty in the value of this ratio in living cells is one reason that ATP yield from complete oxidation of glucose is not known precisely.
E) The value of the ratio can be non-integral.

19. The term “nitrogen fixation” refers to:

- A) Rapid breathing during exercise.
B) The urea cycle.
C) Incorporation of nitrogen from the atmosphere into ammonia.
D) Delayed oxidation of the lactate produced during strenuous exercise.
E) Ribonucleotide reductase.

20. The de novo biosynthesis of purines derives two of the four carbons in the base ring structure from:

- A) N^{10} -formyl- H_4 folate
B) Aspartic acid
C) Glutamine
D) Threonine
E) Carbamoyl phosphate

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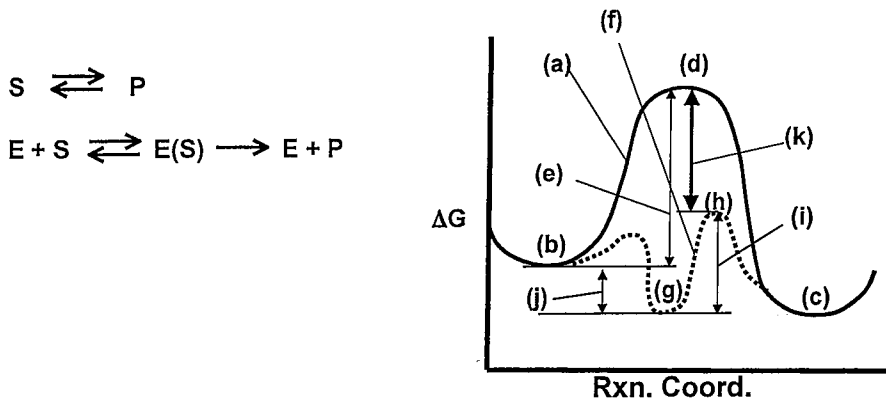
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(二) 簡答與填充題: (40分，共5大題)

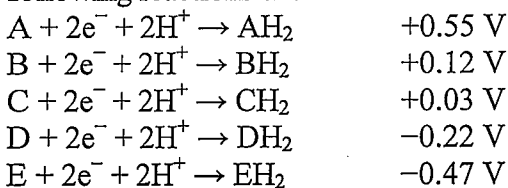
I. The free energy-reaction coordinate diagram shown below compares the following non-enzymatic reaction with the corresponding enzymatic reaction: (每小題1分，共10分)



Identify elements (a)-(k) of the free energy diagram from the list given below:

- _____ (1) Energy well for the E(S) complex.
- _____ (2) Ground state energy well for reactants.
- _____ (3) Activation energy for the rate-limiting step of the enzyme-catalyzed reaction.
- _____ (4) Activation energy for the non-enzymatic reaction.
- _____ (5) Energy surface of lowest energy for the non-enzymatic reaction.
- _____ (6) Energy surface of the lowest energy pathway for the enzyme-catalyzed reaction.
- _____ (7) Transition state for the rate-limiting step of the enzyme-catalyzed reaction.
- _____ (8) Ground state energy well for products.
- _____ (9) Free energy change for the conversion of reactants to products.
- _____ (10) Transition state for the non-enzymatic reaction.

II. An unusual bacterium that has been shown to have a five-component electron transfer chain. The following reactions show the E_0' values for these five components:



The order of electron flow in this bacterium is : (please put in A, B, C, D, E) (每格 1 分，共 5 分)

_____ \rightarrow _____ \rightarrow _____ \rightarrow _____ \rightarrow _____

III. Please briefly describe the terms:

- (a) Cori cycle (5 分)
- (b) Futile cycle (5 分)

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IV. A peptide has the sequence Val-Cys-Thr-Ala-Lys-Asp-Pro-Gln-Ser-Tyr-Arg-Gly-His-Glu. and answer the following questions.

pK_R of amino acids: Asp (3.6); Arg (12.5); His (6.0); Glu (4.2); Lys (10.6); Tyr (10.1); Cys (8.2), α -COOH pK_a (3.8); α -NH₃⁺ pK_a (8.5).

(1) What is the net charge of the molecule at pH 3? _____ (1 分)

(2) Estimate the pI for this peptide. _____ (1 分)

(3) Please answer with the correct amino acid to the following questions (每格 1 分，共 3 分)

(a) What amino acid has an amide group? _____

(b) What amino acid absorbs UV light the most? _____

(c) What amino acid has a sulfhydryl side chain? _____

V. (1) Please explain what's the electron transfer chain (ETC). (5 分)

(2) Please draw a simple diagram of ETC including the major players and their functions. (5 分)