國立成功大學 108 學年度碩士班招生考試試題

系　　所：生物化學暨分子生物學研究所、臨床藥學與藥物科技研究所

考試科目：生物化學

考試日期：0224，節次：1

※ 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。

一、選擇題：（13 分，每題 1 分）

1. Hydroxylation of IMP to form GMP occurs in conjunction with the _____ of _____.

(A) oxidation; NADH
(B) reduction; NAD^+
(C) oxidation; NADPH
(D) reduction; $NADP^+$
(E) none of the above

2. In animals, elevated levels of PRPP will

(A) activate pyrimidine biosynthesis.
(B) activate purine biosynthesis.
(C) activate both pyrimidine and purine biosynthesis.
(D) inhibit pyrimidine biosynthesis; activate purine biosynthesis.
(E) inhibit purine biosynthesis; activate pyrimidine biosynthesis.

3. Which of the following glycolytic intermediates is the common precursor to serine, cysteine, and glycine?

(A) fructose-6-phosphate
(B) glyceraldehyde-3-phosphate
(C) dihydroxyacetone phosphate
(D) 3-phosphoglycerate
(E) pyruvate

4. The presence of SGOT and SGPT in the serum indicate potential

(A) starvation and brain tissue damage.
(B) inflammation.
(C) heart attack or liver damage.
(D) lung or breast cancer.
(E) none of the above

5. Which of the following amino acid breakdown reactions would be catalyzed by an aminotransferase?

(A) Alanine → Pyruvate
(B) Threonine → Acetyl CoA
(C) Asparagine → Aspartate
(D) Homocysteine → Methionone
(E) HMG-CoA → Acetoacetate

6. Lesch-Nyhan syndrome, a result of hypoxanthine-guanine phosphoribosyltransferase deficiency, there is a(n) _____.

(A) accumulation of hypoxanthine
(B) accumulation of GMP
(C) complete breakdown of purine biosynthesis
(D) excess of degradation of IMP and GMP
(E) accumulation of IMP

7. Which amino acids are purely ketogenic?

(A) Arginine and lysine.
(B) Lysine and leucine.
(C) Tryptophan only.
(D) Valine and isoleucine..
(E) Methionine and serine.

8. At neutral pH, the main ionic form of ammonia is _____.

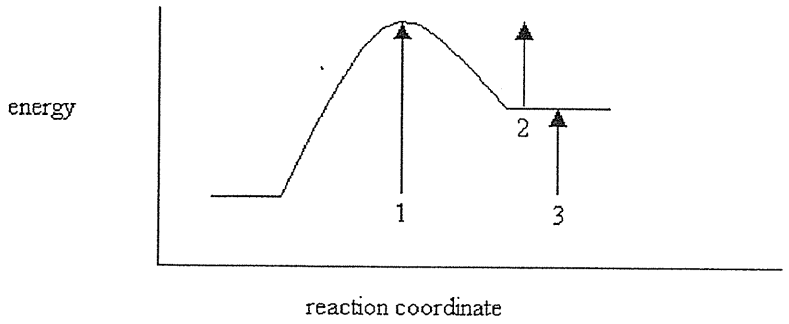
(A) N_2
(B) NH_4^+
(C) NH_3
(D) NH_2^-
(E) None of the above

9. An enzyme's active site contains an arginine residue and a glutamate residue with pKa's of 2.9 and 9.1, respectively. Both residues are actively involved in the catalytic mechanism and they are the only two ionizable residues in the active site. What would you expect for the optimum pH of the enzyme?

(A) 3.0
(B) 4.0
(C) 6.0

(D) 8.0
(E) 9.0

10. On the energy diagram below, which arrow(s) represent the activation energy for the forward and reverse reactions?



(A) Arrow 1 is the activation energy for both the forward and reverse reactions.
(B) Arrow 1 is the activation energy for the forward reaction and arrow 2 is the activation energy for the reverse reaction.
(C) Arrow 1 is the activation energy for the forward reaction and arrow 3 is the activation energy for the reverse reaction.
(D) Arrow 3 is the activation energy for the forward reaction and arrow 2 is the activation energy for the reverse reaction.
(E) Arrow 2 is the activation energy for the forward reaction and arrow 3 is the activation energy for the reverse reaction.

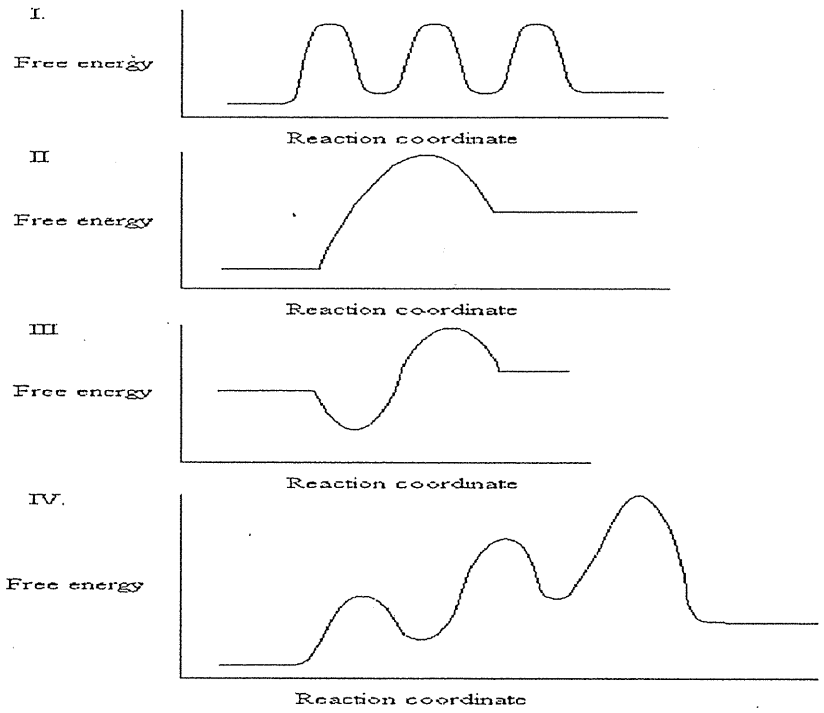
11. In a laboratory experiment you completed a study of enzyme kinetics. The following data were collected:

Substrate concentration [S] (umolar)	50	120	300	500	800	1300	1800	2500
Velocity of Enzymatic reaction (umolar/min)	30	87	110	130	170	208	215	210

Estimate the Km for this substrate: enzyme combination without graphing the data.

(A) 260
(B) 860
(C) 460
(D) 1060
(E) 1720

12. The graphs below all represent the same chemical reaction, but each employing a different catalyst. Which enzyme uses the most efficient mechanism of catalysis?



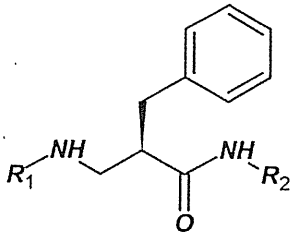
(A) See Graph I.
(B) See Graph II.
(C) See Graph III.
(D) See Graph IV
(E) See Graph I and IV.

13. When add an inhibitor with fixed concentration to the enzymatic reaction of **[QI]**, the velocity (umolar/min) of the reaction became: 46, 85, 99, 110, 120, 135, 148, 150. What is the function of this inhibitor?

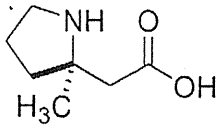
(A) Irreversible inhibition
(B) Competitive inhibition
(C) Noncompetitive inhibition
(D) Uncompetitive inhibition
(E) Non-classical inhibition

二、選擇題：（20 分，每題 2 分）

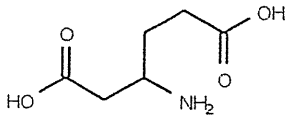
14. Which of the following compounds derived from β-amino acid(s)?



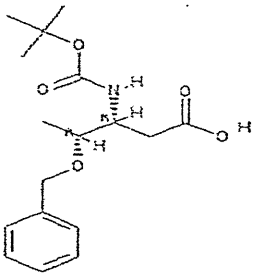
1



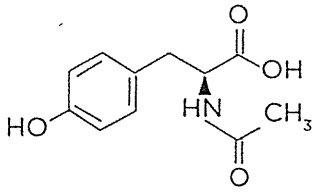
2



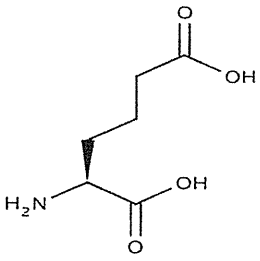
3



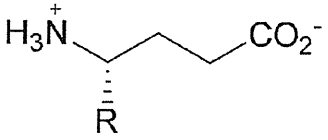
4



5



6



7

(A) 1, 2, 4
(B) 2, 4, 7
(C) 2, 3, 6
(D) 2, 3, 4
(E) 2, 4, 5

15. Which of the following statements is (are) true?

1. All amino acids contain a chiral α–carbon and only L-enantiomers are found.
2. Aromatic amino acids, i.e., tyrosine, tryptophan, and phenylalanine, account for most of the UV absorbance by protein in the region around 280 nm
3. An amino acid is a zwitterion at pH=8.
4. When a carbon atom has four different substituents attached to it, it is called asymmetric carbon.
5. The negative charge on the α-carboxylate of a zwitterion is delocalized over the two oxgen atoms.

(A) 1,2
(B) 2, 3, 4
(C) 1, 2, 3
(D) 3, 4
(E) 3, 4, 5

16. Which of the following peptides carries a net +2 charge at pH 6.2?

1. KYAHQRD
2. ERHDPNL
3. HFLKQHM
4. KKDWHPV
5. DEKFRRH

(A) 2, 4, 5
(B) 1, 3, 4
(C) 1, 2, 3
(D) 1, 4, 5
(E) 3, 4, 5

17. Natural proteins most commonly contain linear polypeptides between 100 and 1000 residues in length. The reasons polypeptides outside this range may be disfavored include:

1. Larger polypeptides are easier to non-specifically aggregate and precipitate in the solution.
2. Smaller polypeptides do not form stable folded structures.
3. Smaller polypeptides typically assemble into prion-like aggregates.
4. Amide linkages are not strong enough to keep larger polypeptides intact.
5. Ribosomes are more difficult to synthesize larger polypeptides.

(A) 1, 2
(B) 2
(C) 2, 3, 5
(D) 3,
(E) 2, 4, 5

18. A nonapeptide was determined to have the following amino acid composition: $(Lys)_2$, $(Gly)_2$, $(Phe)_2$, His, Leu, Met. The native peptide was incubated with 1-fluoro-2,4-dinitrobenzene (FDNB; R1= 1st amino acid from N-terminal) and then hydrolyzed; 2,4-dinitrophenylhistidine was identified by HPLC. When the native peptide was exposed to cyanogen bromide (CNBr), an octapeptide and free glycine

were recovered. Incubation of the native peptide with trypsin (R1= R, K) gave a pentapeptide, a tripeptide, and free Lys. 2,4-Dinitrophenyl-histidine was recovered from the pentapeptide, and 2,4-dinitrophenylphenylalanine was recovered from the tripeptide. Digestion with the enzyme pepsin (R2= W, Y, F) produced a dipeptide, a tripeptide, and a tetrapeptide. The tetrapeptide was composed of $(Lys)_2$, Phe, and Gly. The native sequence was determined to be:

(A) His–Leu–Gly–Lys–Lys–Phe–Phe–Gly–Met.
(B) His–Phe–Lys–Lys–Gly–Leu–Met–Phe–Gly.
(C) His–Leu–Phe–Gly–Lys–Lys–Phe–Met–Gly.
(D) Gly–Leu–Phe–Lys–Phe–Gly–Gly–Lys–His.
(E) His–Phe–Leu–Gly–Lys–Lys–Phe–Met–Gly.

19. Amino acid residues can be found in the 3rd position of type II β turn that connects two polypeptide II helixes are:

1. Gly
2. Lys
3. Pro
4. Glu
5. Cys

(A) 1
(B) 1, 3
(C) 1, 3, 5
(D) 1, 2, 3, 4
(E) 1, 2, 3, 4, 5

20. Which of the following statements concerning the process of *spontaneous* folding of proteins are *false*?

1. It may be an essentially random process.
2. It may be defective in some human diseases.
3. It may involve a gradually increasing range of conformational species.
4. It may involve initial formation of a highly compact state.
5. It may involve initial formation of local secondary structure.

(A) 1, 3
(B) 2, 3
(C) 1, 4, 5
(D) 2, 3, 5
(E) 1, 3, 4

21. Pauling and Corey's studies of the peptide bond showed that:

1. Peptide bonds are essentially planar, rotating about the C—N axis.
2. Peptide bonds in the polypeptides non-covalently stabilize 3-D structure.
3. No atoms should approach one another more closely than allowed by their Van der Var interactions.
4. Primary structure of all proteins is similar, although the secondary and tertiary structure may differ greatly.
5. Bond angles and lengths should be like those for respective free amino acids.

(A) 1, 2, 5
(B) 1, 2
(C) 2, 3, 5
(D) 2, 4
(E) 2, 3, 4

22. The Myoglobin and the subunits of hemoglobin have:

(A) no obvious structural relationship but very similar Hill coefficient upon oxygen binding .
(B) very similar Hill coefficient upon oxygen binding, but different primary and tertiary structures.
(C) very similar primary structures and similar Hill coefficient upon oxygen binding , but different tertiary structures.
(D) very similar primary and tertiary structures, but different Hill coefficient upon oxygen binding .
(E) very similar tertiary structures, but different primary structures and different Hill coefficient upon oxygen binding .

23. Why is the decreased affinity of fetal hemoglobin for BPG advantageous?

(A) Decreased BPG binding biases the adult hemoglobin toward the R state.
(B) With fewer BPG molecules bound there are more heme residues available for O_2 binding.
(C) More free BPG is available to bind to adult hemoglobin, resulting in a shift to the R state.
(D) BPG is available to bind to fetal myoglobin, helping to release O_2 in fetal muscle tissue.
(E) None of the above

三、簡答題（17分，如題標示）

24. DNA polymerase requires both a template, to be copied, and a primer, which provides a 3' hydroxyl from which polymerase can extend. Yet the following DNA molecule supports DNA polymerase

activity. Please explain. (3 pts)

pTGACACAGGTTTAGCCCATCGATGGG-OH

25. Some bacteria require p-aminobenzoate in the culture medium for normal growth, and their growth is severely inhibited by the addition of sulfanilamide, one of the earliest sulfa drugs. Moreover, in the presence of this drug, 5-aminoimidazole-4-carboxamide ribonucleotide (AICAR) accumulates in the culture medium. These effects are reversed by the addition of excess p-aminobenzoate. (a) What is the role of p-aminobenzoate in these bacteria? (b) Why dose AICAR accumulate in the presence of sulfanilamide? (c) Why are the inhibition and accumulation reversed by the addition of excess amount of p-aminobenzoate? (9 pts)

26. Please describe in detail about the relationship between urea cycle, citric acid cycle, and mitochondria. (5 pts)

三、問答題（50 分，每題 10 分）

27. There are three stages of cellular respiration/catabolism, including the acetyl-CoA production, the acetyl-CoA oxidation, and the ATP production. According to the first law of thermodynamics, i.e., energy cannot be created or destroyed, only converted from one form to another. Please describe in detail about the forms of energy change during the catabolism of Glucose to ATP at these stages.

28. What is a "futile cycle"? Give an example of a potential futile cycle in carbohydrate metabolism, and describe methods used by cells or organisms to avoid the operation of the futile cycle.

29. There are few, if any, humans with defects in the enzymes of the citric acid cycle. Explain this observation in terms of the role of the citric acid cycle.

30. Describe the mechanism for moving acetyl-CoA produced in the mitochondrial matrix into the cytosol for fatty acid synthesis.

31. Describe the signaling cascade initiated by leptin binding to its receptor.