※ 考生請注意 本試題 ☑可 ☐不可 使用計算機

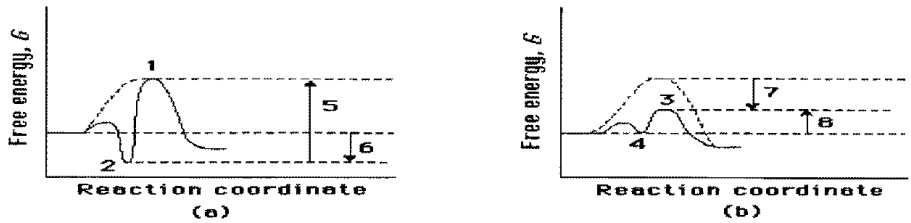
請將答案寫在答案卷上，並清楚註明題號。

一、選擇題（30 分，每小題 2 分）

1. At pH 7.0, converting a glutamic acid to γ-carboxyglutamate will have what effect on the overall charge of the protein containing it?
   A) It will become more negative
   B) It will become more positive.
   C) It will stay the same.
   D) There is not enough information to answer the question.
   E) The answer depends on the salt concentration.

2. Which of the following statements about protein-ligand binding is correct?
   A) The K_a is equal to the concentration of ligand when all of the binding sites are occupied.
   B) The K_a is independent of such conditions as salt concentration and pH.
   C) The larger the K_a (association constant), the weaker the affinity.
   D) The larger the K_a, the faster the binding.
   E) The larger the K_a, the smaller the K_d (dissociation constant).

3 Compare the two reaction coordinate diagrams below and select the answer that correctly describes their relationship. In each case, the single intermediate is the ES complex.



   A) (a) describes a strict "lock and key" model, whereas (b) describes a transition-state complementarity model.
   B) The activation energy for the *catalyzed* reaction is #5 in (a) and is #7 in (b).
   C) The activation energy for the *uncatalyzed* reaction is given by #5 + #6 in (a) and by #7 + #4 in (b).
   D) The contribution of binding energy is given by #5 in (a) and by #7 in (b).
   E) The ES complex is given by #2 in (a) and #3 in (b).

4. The biological role of restriction enzymes is to:
   A) aid recombinant DNA research. B) degrade foreign DNA that enters a bacterium.
   C) make bacteria resistant to antibiotics. D) restrict the damage to DNA by ultraviolet light.
   E) restrict the size of DNA in certain bacteria.

5. The PCR reaction mixture does *not* include:
   A) all four deoxynucleoside triphosphates. B). DNA ligase
   C) DNA containing the sequence to be amplified. D) heat-stable DNA polymerase.
   E) oligonucleotide primer(s).

6. The technique known as two hybrid analysis for detecting interacting gene products depends on:
   A) activation of DNA polymerase by the nearby binding of hybridizing protein complexes.
   B) direct binding of a Gal4p activation domain to a DNA sequence in the promoter region.
   C) having a promoter that responds directly to one of the two proteins whose interactions is being measured.
   D) hybridization of DNA segments corresponding to the two genes being examined.
   E) stimulation of transcription by interaction of two Gal4p domains via fused protein sequences.

(背面仍有題目,請繼續作答)

※ 考生請注意 本試題 ☑可 ☐不可 使用計算機

7. Which one of the following compounds does *not* have a large negative free-energy of hydrolysis?
   A) 1,3-bis phosphoglycerate
   B) 3-phosphoglycerate
   C) ADP
   D) Phosphoenolpyruvate
   E) Thioesters (for example, acetyl-CoA)

8. Which of the following statements is *incorrect*?
   A) Aerobically, oxidative decarboxylation of pyruvate forms acetate that enters the citric acid cycle.
   B) In anaerobic muscle, pyruvate is converted to lactate.
   C) In yeast growing anaerobically, pyruvate is converted to ethanol.
   D) Reduction of pyruvate to lactate regenerates a cofactor essential for glycolysis.
   E) Under anaerobic conditions, pyruvate does not form because glycolysis does not occur.

9. Cellular isozymes of pyruvate kinase are allosterically inhibited by:
   A) high concentrations of AMP.
   B) high concentrations of ATP.
   C) high concentrations of citrate.
   D) low concentrations of acetyl-CoA.
   E) low concentrations of ATP.

10. Which of the following is *not* true of the citric acid cycle?
   A) All enzymes of the cycle are located in the cytoplasm, except succinate dehydrogenase, which is bound to the inner mitochondrial membrane.
   B) In the presence of malonate, one would expect succinate to accumulate.
   C) Oxaloacetate is used as a substrate but is not consumed in the cycle.
   D) Succinate dehydrogenase channels electrons directly into the electron transfer chain.
   E) The condensing enzyme is subject to allosteric regulation by ATP and NADH.

11. Which of the following statements concerning the oxidation of fatty acids is true?
   A) About 1,200 ATP molecules are ultimately produced per 20-carbon fatty acid oxidized.
   B) One $FADH_2$ and two NADH are produced for each acetyl-CoA.
   C) The free fatty acid must be carboxylated in the position by a biotin-dependent reaction before the process of oxidation commences.
   D) The free fatty acid must be converted to a thioester before the process of oxidation commences.
   E) Two NADH are produced for each acetyl-CoA.

12. Which one of the following statements about enzymes that interact with DNA is true?
   A) *E. coli* DNA polymerase I is unusual in that it possesses only a 5′ → 3′ exonucleolytic activity.
   B) Endonucleases degrade circular but not linear DNA molecules.
   C) Exonucleases degrade DNA at a free end.
   D) Many DNA polymerases have a proofreading 5′ → 3′ exonuclease.
   E) Primases synthesize a short stretch of DNA to prime further synthesis.

13. Which one of the following statements about mRNA stability is true?
   A) Degradation always proceeds in the 5′ to 3′ direction.
   B) Degradation of mRNA by polynucleotide phosphorylase yields 5′-nucleoside monophosphates.
   C) In general, bacterial mRNAs have longer half-lives than do eukaryotic mRNAs.
   D) Rates of mRNA degradation are always at least ten-fold slower than rates of mRNA synthesis.
   E) Secondary structure in mRNA (hairpins, for example) slows the rate of degradation.

※ 考生請注意 本試題 ☑可 ☐不可 使用計算機

14. Which of the following statements about tRNA molecules is *false*?
A) A, C, G, and U are the only bases present in the molecule.
B) Although composed of a single strand of RNA, each molecule contains several short, double-helical regions.
C) Any given tRNA will accept only one specific amino acid.
D) The amino acid attachment is always to an A nucleotide at the 3′ end of the molecule.
E) There is at least one tRNA for each of the 20 amino acids.

15. Protein amino acid side chains can hydrogen bond in the major groove of DNA, and discriminate between each of the four possible base pairs. In which one of the following groups of amino acids can all three members potentially be used in such DNA-protein recognition?
A) Ala, Asn, Glu B) Arg, Gln, Leu C) Asn, Gln, Trp
D) Asn, Glu, Lys E) Glu, Lys, Pro

二、非選擇題 (70 分)

1. The Lineweaver-Burk (double reciprocal) plot is more useful than the standard V_o vs. [S] plot in determining kinetic constants (V_{max} and K_m) for an enzyme because maximum velocity(V_{max}) is never achieved experimentally. Following data obtained from an enzyme catalyzes the reaction A → B. The initial rate of the reaction was measured as a function of the concentration of A. Please use Michaelis-Menten equation and these data to draw the Lineweaver-Burk (double reciprocal) plot and calculate the V_{max} and K_m for the enzyme. (15分)

[A], micromolar	V_0, nmoles/min
0.05	0.08
0.1	0.16
0.5	0.79
1	1.6
5	7.3
10	13
50	40
100	53
500	73
1,000	76
5,000	79
10,000	80
20,000	80

2. Each of the following reagents or conditions will denature a protein. For each, describe in one or two sentences what the reagent/condition does to destroy native protein structure. (10 分)

(a) urea
(b) high temperature
(c) detergent
(d) low pH

(背面仍有題目,請繼續作答)

※ 考生請注意 本試題 ☑可 □不可 使用計算機

3. You have been given three different species of bacteria by your research advisor. You are told that one species lives by fermentation and is a facultative anaerobe; one lives by oxidation of glucose via citric acid cycle and oxidative phosphorylation; and one lives by photosynthesis. All are capable of consuming glucose. You manage, somehow, to mix up the three bacterial cultures. Without resorting to any biochemical tests, how can you use different laboratory growth conditions to determine which culture is which? (10 分)

4. Cellular respiration can be studied in isolated mitochondria by measuring oxygen consumption under different conditions. If 0.01 M sodium malonate is added to actively respiring mitochondria that are using pyruvate as fuel source, respiration soon stops and a metabolic intermediate accumulates.

a). What is the structure of this intermediate? (3 分)
b). Explain why it accumulates. (3 分)
c). Explain why oxygen consumption stops. (5 分)
d). Aside from removal of the malonate, how can this inhibition of respiration be overcome? Explain. (4 分)

5. (a) Consider the following hypothetical short mRNA; what would be the sequence of the protein produced if this were translated in an *E. coli* cell? (4分)

5'-AUAGGAGGUUUGACCUAUGCCUCGUUUAUAGCC-3'

(b) The template strand of a segment of double-stranded DNA contains the sequence:

(5')CTT TGA TAA GGA TAG CCC TTC

(i) What is the base sequence of the mRNA that can be transcribed from this strand? (2分)
(ii) Suppose the other (complementary) strand is used as a template for transcription. What is the amino acid sequence of the resulting peptide, starting from the 5′ end and using only the first reading frame? (4分)

6. 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 with1-fluoro-2,4-dinitro-benzene (FDNB) 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 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 produced a dipeptide, a tripeptide, and a tetrapeptide. The tetrapeptide was composed of $(Lys)_2$, Phe, and Gly. What is the sequence of this native peptide? (10分)