

八十四學年度 生物醫學 所                      組碩士班研究生入學考試

科目 生物化學 科號 1101 共 二 頁第 一 頁 \*請在試卷【答案卷】內作答

1. Proteins (30%)

- (1) Draw the predominant ionic structure of histidine ( $pK_a$  of side chain = 6.0) at pH 3.0, at pH 7.0, and at pH 13.0. (5%)
- (2) Calculate the isoelectric point of histidine. (5%)
- (3) Why is histidine a particularly versatile amino acid residue in terms of its involvement in enzymatic reaction mechanisms? Use chymotrypsin as an example. Describe briefly. (5%)
- (4) Indicate which of the following substances have binding sites on hemoglobin.  
(a)  $H^+$  (b)  $Ca^{++}$  (c) ATP (d)  $O_2$  (e) AMP (f) organic phosphates (g) CO (5%)
- (5) Explain briefly the relationship between  $K_M$  and the dissociation constant of the enzyme-substrate complex,  $K_{ES}$ . (10%)

2. Metabolism (40%)

- (1) Select the enzymes in the following that regulate the citric acid cycle. (5%)  
(a) citrate synthase (b) aconitase (c) isocitrate dehydrogenase (d)  $\alpha$ -ketoglutarate dehydrogenase (e) succinyl CoA synthetase (f) succinate dehydrogenase (g) fumarase (h) malate dehydrogenase
- (2) The concentration of chloride ion in blood serum is about 0.10 M. The concentration of chloride ion in urine is about 0.16 M.  
(a) Calculate the energy expended by the kidneys in transporting chloride from plasma to urine ( $R: 1.98\text{cal/mol}\cdot K$ ). Assume that the temperature is  $37^\circ C$ . (10%)  
(b) How many  $Cl^-$  ions could be transported per mole of ATP hydrolyzed? (5%)
- (3) Which of the following statements about the hormonal regulation of glycogen synthesis and degradation are correct? (5%)  
(a) Insulin increases the capacity of the liver to synthesize glycogen.  
(b) Insulin is secreted in response to low levels of blood glucose.  
(c) Glucagon and epinephrine have opposing effects on glycogen metabolism.  
(d) Glucagon stimulates the breakdown of glycogen, particularly in the liver.  
(e) The effects of all three of the regulating hormones are mediated by cyclic AMP.
- (4) (a) A cow lives on water and grass. Grass contains small quantity of protein and fat. How does a cow produce so much milk and beef that contains mostly protein and fat. Please draw biochemical pathways you know to account for this biotransformation and specify the source of amino acids in this particular conversion. (10%)  
(b) Milk contains a large quantity of calcium and phosphate. Why? (5%)

3. Nucleic Acids (30%)

- (1) Suppose that you determined the DNA sequence of 5'-GCCATTGCA-3' by the Sanger dideoxy method. Describe the principle of this method. Please also sketch the gel pattern that revealed the sequence of this oligonucleotide. (10%)

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- (2) The human immunodeficiency virus (HIV) is a retrovirus. The RNA genome of the virus is converted to a double-stranded DNA molecule by the action of reverse transcriptase. Subsequent integration into host DNA, transcription, splicing, and translation lead to the production of new viruses. Antisense RNA molecules have been investigated as potential antiviral agents. At what steps in the retrovirus cycle would antisense RNA molecules be most effective as inhibitors of viral replication? Explain briefly. (10%)
- (3) Several inherited diseases due to inborn errors of purine and pyrimidine metabolism have been well studied. The most striking example, called the Lesch-Nyhan syndrome, is compulsive self-destructive behavior.
  - (a) Explain the biochemical mechanism that leads to this disorder. (5%)
  - (b) What are the possible biochemical consequences of patients with the Lesch-Nyhan syndrome? Explain briefly. (5%)