國立清華大學 103 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系 甲組（分子生醫工程組）

考試科目（代碼）：生物化學(2302)

I. 單選題: (10%; 2 points/question)

1. During strictly anaerobic exercise, muscle cells preferentially:

(A) convert carboxylate pyruvate to oxaloacetate.

(B) oxidize pyruvate to acetyl-CoA.

(C) convert decarboxylate pyruvate to acetaldehyde.

(D) reduce pyruvate to lactate.

(E) none of the above.

2. During the amino acid synthesis, Tryptophan is derived from which metabolic intermediate?

(A) α -ketoglutarate

(B) aspartate

(C) pyruvate

(D) 3-phosphoglycerate

(E) phosphoenolpyruvate

3. During fasting or starvation, the brain:

(A) converts endogenous fatty acids into β -hydroxybutyrate.

(B) utilizes β -hydroxybutyrate from the blood stream.

(C) utilizes amino acids for fuel from degradation of brain protein.

(D) utilizes its glycogen stores as a first responding source of fuel.

(E) all of the above.

4. Which of the following statement regarding "nucleosome" is **INCORRECT**?

(A) a stretch of 147 bp of double-stranded DNA is coiled in just less than 2 turns

(B) contains a central core of 8 histone proteins

(C) the core histones contains H1, H2, H3, and H4

(D) The N-terminal tails of the core histones protrude from the nucleosomes for posttranslational modifications

5. Regarding 5' capping of RNA, which of the following statement is **INCORRECT**?

(A) to protect the transcript from 5'→3'exonuclease attack

(B) to facilitate RNA splicing

(C) to promote the RNA secondary structure formation

(D) to facilitate transport of mRNAs from the nucleus to the cytoplasm

II. 名詞解釋: (30%; 3 points/question)

1. Chargaff's rules
2. Protein secondary structure
3. Phosphatidylcholine
4. Intron
5. Type II restriction enzymes
6. Molecular motors
7. Aerobic catabolism
8. Ketone bodies
9. Okazaki fragments
10. Third-base degeneracy

III. 問答題：如各題目配分

1. (7%)

Assuming that an unimolecular reaction S→P follows the Michaelis-Menten kinetic model in which the reaction rate can be expressed as:

$$v = \frac{V_{max}[S]}{K_M + [S]}$$

Derive this equation and specify the meanings of K_M and V_{max}. The inhibition of enzymatic catalysis can be classified as competitive, noncompetitive and uncompetitive inhibitions. Describe the mechanisms of these three types of inhibition.

2. (5%)

Compare the structural differences of the cell walls of Gram-negative and Gram-positive bacteria.

3. (7%)

(A) Draw the chemical structures of 3',5'-cyclic GMP, ATP, a short DNA fragment ATG and a short RNA fragment UAC, respectively.

(B) Describe the structural features of the A, B and Z forms of DNA double helix.

4. (5%)

Draw the chemical structure of α-D-glucopyranose and compare cellulose, amylose starch and glycogen in terms of the following characteristics:

(A) Synthesized in what kind of organism?

(B) Biological role?

(C) Chemical structure of the repeat unit?

(D) Linkage between monosaccharide units?

(E) Type of branching?

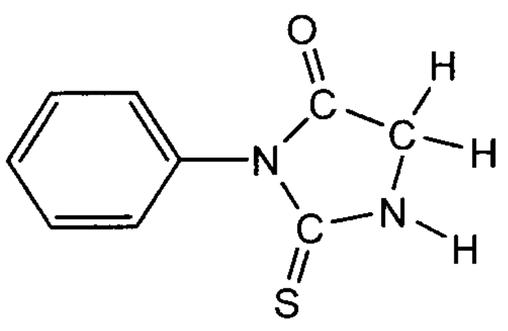
5. (7%)

Amino acid analysis of an octapeptide revealed the following composition:

2 Arg 1 Gly 1 Met 1 Trp 1 Tyr 1 Phe 1 Lys

The following facts were observed:

(A) Edman degradation gave



(B) CNBr treatment yielded a pentapeptide and a tripeptide containing Phe.

(C) Chymotrypsin treatment yielded a tetrapeptide containing a C-terminal indole amino acid (Trp) and two dipeptides.

(D) Trypsin treatment yielded a tetrapeptide, a dipeptide and free Lys and Phe.

(E) Clostripain treatment yielded a pentapeptide, a dipeptide and free Phe.

What is the amino acid sequence of this octapeptide?

6. (4%)

Consider the following peptide sequences:

EANQIDEMLYNVQCSLTTLEDTVPW

LGVHLDITVPLSWTWTLYVKL

QQNWGGLVVILTLVWFLM

CNMKHGDSQCDERTYP

YTREQSDGHIPKMNCDS

AGPFGPDGPTIGPK

Which of the preceding sequences would be likely to be found in each of the following:

(A) A parallel β -sheet

(B) An antiparallel β -sheet

(C) A tropocollagen molecule

(D) The helical portion of a protein in your hair

7.

ATP is an important molecule involving in the metabolism in many ways.

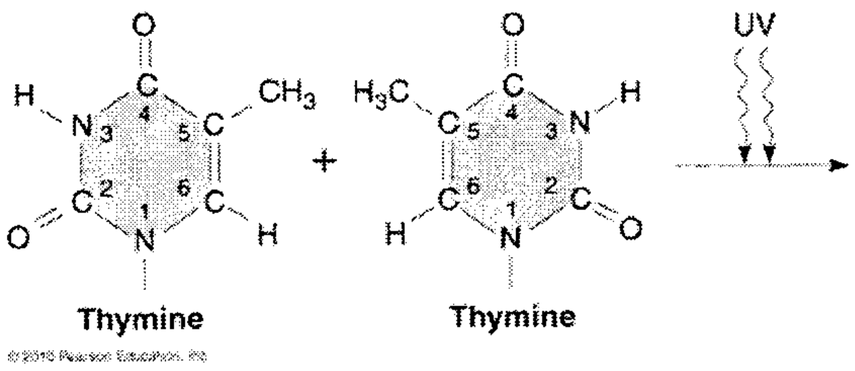
(A) (2%) What is the main structural difference between ATP, ADP and AMP?

(B) (3%) What are the two major metabolic roles of ATP?

8.

(A) (3%) What is the molecular basis of DNA mutation?

(B) (2%) Please predict the product of the following UV-induced mutation.



9. (5%)

Please explain the "end-replication problem" for the DNA replication in the cells. How the telomerase is utilized to solve this problem?

10. (10%)

What are the roles of mitochondria on the catabolism of biomacromolecules, including: carbohydrate, lipids and proteins?