

※ 注意：作答時，請於答案卷上標明作答之大題及其題號。

I. 單 選 題 (1 % each)

1. Which of the following is the major reaction that can provide free energy in metabolism?
A) protonation-deprotonation.
B) condensation
C) phosphorylation-dephosphorylation
D) oxidation-reduction
E) carboxylation-decarboxylation
2. The ion channel that opens in response to acetylcholine is an example of a _____ signal transduction system.
A) receptor-enzyme
B) voltage-gated
C) ligand-gated
D) serpentine receptor
E) G protein
3. Calmodulin is a:
A) cell surface calcium receptor.
B) calcium-dependent enzyme.
C) regulatory subunit of calcium-dependent enzymes.
D) competitive inhibitor of calcium-dependent enzymes.
E) noncompetitive inhibitor of calcium-dependent enzymes.
4. Ubiquitin is:
A) an analog of ubiquinone.
B) a component of the electron transport system.
C) a protein which tags another protein for degradation.
D) a vitamin.
E) a protein phosphorylase.
5. If the ΔG of the reaction $A \rightarrow B$ is -40 kJ/mol ,
A) the reaction will proceed spontaneously from left to right.
B) it will never reach equilibrium.
C) it will proceed rapidly at standard state.
D) it is an endergonic reaction.
E) it will not occur spontaneously.
6. Which of the following compounds has the largest negative value for the standard free-energy change (ΔG°) upon hydrolysis?
A) phosphoenolpyruvate
B) lactose
C) glucose 6-phosphate
D) glutamine
E) glycerol 3-phosphate

7. G-proteins can be activated on binding with
A) GMP
B) GDP
C) Guanine triphosphate
D) GTP
E) All of the above.
8. The major metabolic reactions of amino acids require the coenzyme
A) thiamine pyrophosphate
B) cyanocobalamin
C) retinol phosphate
D) pyridoxal phosphate
E) biotin
9. Phospholipase A₂ can hydrolyze
A) tripalmitin
B) lysolecithin
C) phosphatidylcholine
D) diacyl glycerol
E) arachidonate
10. The relationship between an oncogene and its proto-oncogene is that
A) The proto-oncogene is a precursor RNA which can be converted to an oncogene by reverse transcriptase.
B) Mutation in the proto-oncogene creates an oncogene that encodes a defective regulatory protein.
C) The proto-oncogene encodes a precursor protein that can be converted into an oncogene product.
D) The proto-oncogene is a protein-DNA complex which dissociates to a protein and an oncogene.
E) The proto-oncogene is carried by a virus and is converted into an oncogene when the virus infects a cell.

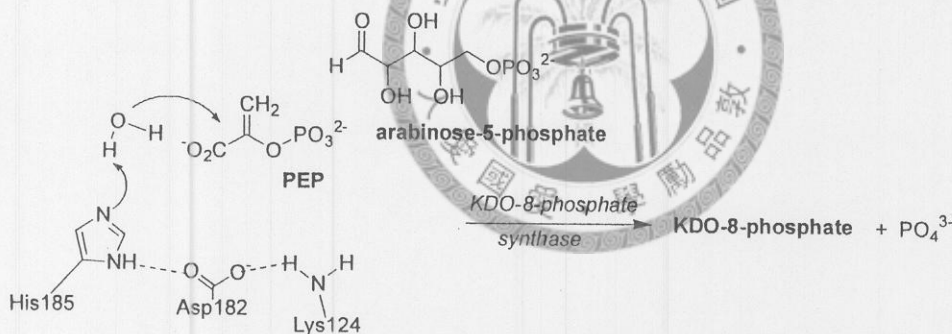
II. 填 空 題 (2 % each)

11. Metabolic pathways that require energy and yield complex molecules from simpler precursors are known collectively as ().
12. An enzyme's activity can be influenced by a ligand binding at a site other than the active site. This is called an () effect.
13. A genetic defect in the enzyme () is responsible for the disease phenylketonuria.
14. Histamine is derived from histidine by the action of the enzyme ().
15. 3',5'-cyclic AMP is synthesized from ATP by the enzyme ().

III.

- 1(a). Can you describe the reaction catalyzed by pyruvate dehydrogenase complex? You have to list the reactant and products. You may answer either their names or structures. (3%)
- 1(b). What are the enzyme cofactors involved in the enzyme reaction in addition to NAD^+ ? (3%)
- 1(c). In citric acid cycle, there is one reaction analogous to the previous enzyme step. Please list the name of the enzyme, as well as reactant and products (either their names or structures are OK). (2%)
- 1(d). As a matter of fact, both aforementioned enzyme complexes contain several component enzymes and have a compact arrangement in their structures. Could you list the advantages over such an arrangement? (4%)

IV. KDO-8-phosphate synthase is the enzyme to catalyze the condensation reaction between phospho(enol)pyruvate (PEP) and arabinose-5-phosphate. Due to the resolved X-ray crystallographic structures, the reaction mechanism has been suggested to go through the following pathway.



- 2(a) Could you explain the catalytic role of His185? (4%)
- 2(b) What is the role of Asp182 and Lys124? (4%)

V. In nature, all biomolecules are classified into four different categories—proteins, nucleic acids, carbohydrates and lipids. The research areas of carbohydrates are considered to be full of numerous unanswered questions in comparison with other biomolecules. This is the reason why Hermann Emil Fisher is the only Nobel Prize Laureate (1902) whose contribution is related to sugars. Can you list the current major challenges (at least two) to hamper the progress in this particular field? (10%)

VI. Gluconeogenesis is not the exact reversal of glycolysis. Although both pathways share several steps, three reactions of glycolysis are essentially irreversible. Can you identify the three reactions (please answer reactants and products) and explain the reason (why some reactions are reversible, but these three steps are not) in terms of energy? (10%)

VII. One interesting feature of the citric acid cycle is that several reactions are involved in the conversion from a symmetrical (achiral) molecule to a chiral compound or vice versa.

(a) Could you list the reactions (you may either answer the names of the reaction enzymes, or list the reactants and products)? (6%)

(b) Why are these enzymes able to catalyze such conversions? (4%)

VIII. What are the three components of nucleotides (6%)? What are the types of interactions that affect the conformation of double-stranded DNA (4%)?

IX. Define Okazaki fragments and describe how Okazaki fragments are joined during DNA synthesis inside the cells (5%).

X. Assume that a typical eukaryotic triose phosphate isomerase gene contains the correct sequences to permit accurate transcription in a prokaryotic cell. Would the resulting RNA be properly translated to yield the intact enzyme? Why? (5%)

XI. Is it true that sometimes mutations within an intron of a protein-coding gene can be detrimental? Why? (5%)

XII. A prokaryotic mRNA may contain many AUG codons. How does the ribosome distinguish AUG codons specifying initiation from AUG codons specifying internal methionine? (5%)

