

本試題是否可以使用計算機: 可使用, 不可使用 (請命題老師勾選)

1. **Definition of Biological Terms.** Please "clearly" define the following items:

- (1) Energy carriers and Electron carriers in biological systems(10 pt)
- (2) Cellular respiration and fermentation (10 pt)
- (3) Substrate level phosphorylation and Oxidative phosphorylation (10 pt)
- (4) Dehydrogenation and Proton-Motive Force (10 pt)

2. **DNA Science.** Please clearly explain what is the "Central Dogma" stated by Francis Crick in 1957. Please specifically state what chemical compounds and how do they involve in the central dogma. (10 pt)

3. **Enzyme Regulation.** Please describe and give examples regarding how do microorganisms regulate their metabolism. (10 pt) (Hint: regulation of enzyme synthesis and regulation of enzyme activity)

4. **Bioenergetics.** Consider the hypothetical transformation $X \rightarrow Y$, for which $\Delta G^{\circ} = 20 \text{ kJ/mol}$ at 25°C (298K). ($R=8.315 \text{ J/mol/K}$)

(a) What is the ratio $[Y]/[X]$ at equilibrium? (6 pt)

(b) Suppose X and Y participate in a sequence of reactions during which ATP is hydrolyzed to ADP and Pi, The overall reaction is



Calculate $[Y]/[X]$ for this reaction at equilibrium. Assume that the concentrations of ATP, ADP, and Pi are all 1 M when the reaction is at equilibrium. ($\text{ATP} \rightarrow \text{ADP} + \text{Pi}$ $\Delta G^{\circ} = -32 \text{ kJ/mol}$) (6 pt)

(c) We know that $[\text{ATP}]$, $[\text{ADP}]$, and $[\text{Pi}]$ are not 1 M under physiological conditions.

Calculate $[Y]/[X]$ for the ATP-coupled reaction when the values of $[\text{ATP}]$, $[\text{ADP}]$, and $[\text{Pi}]$ are those found in *E. coli* cell ($[\text{ATP}]=7.9 \text{ mM}$, $[\text{ADP}]=1.04 \text{ mM}$, and $[\text{Pi}]=7.9 \text{ mM}$). (8 pt)

5. **Tools to study microbial ecology.** The start of 21st century marks a period of revolutionary advancement in our ability to study microbial ecology. Please list 3 traditional and 3 molecular tools that can be used to study microbial ecology and comment on their advantages and disadvantages in studying microbial ecology. (20 pts)