

Solutions to Practice Problems for Biochemistry, Session 5: Biochemical Reactions, Enzymes and ATP

Question 1

You are looking at the following biological reactions that are catalyzed by specific enzymes as shown below.



Note:

- In Reaction #1, Enzyme E1 catalyzes the conversion of Compound A to Compound B. This reaction is truly reversible and the reverse reaction is as likely as the forward reaction.
- In Reaction #2, Enzyme E2 catalyzes an energy requiring reaction that uses Compounds C and D as substrates to produce Compound E.
- In Reaction #3, Enzyme E3 catalyzes an energy producing reaction that converts Compound F to Compound G.

a) Draw the energy profiles of reactions #1, #2 and #3 on the axes given below. On the diagram, please label the reactants and the products.



b) You decide to reproduce Reaction #2 in three test tubes. You may assume that this biological reaction occurs at a 37°C and a pH of 7.4 under normal conditions.

- **Test tube #1:** You perform the reaction at 70°C and a pH of 7.4 and observe that no Compound E is produced. When the temperature is brought to 37°C, Compound E is produced at a rate similar to normal condition.
- **Test tube #2:** You perform the reaction at 37°C and a pH of 10.4 and observe that no Compound E is produced. When the pH is brought to 7.4, Compound E is produced at a rate similar to normal condition.
- **Test tube #3:** You perform the reaction at 37°C and a pH of 7.4 in the presence of proteases and observe that no Compound E is produced. The effect of protease treatment persists even after its removal from reaction mixture.

Explain the effect of the changed reaction parameters in each of the above test tubes on structure and function of Enzyme E2.

Reaction parameters	Effect on Enzyme E2	Is the effect reversible/ irreversible?
70°C in test tube #1	Denaturation/Unfolding	Reversible – Can refold when temperature lowered back to 37°C
10.4 pH in test tube #2	Denaturation/Unfolding	Reversible - Can refold when pH is lowered back to 7.4
Protease in Test tube #3	Digestion/Degradation	Irreversible - the peptide bonds that hold the primary amino acid sequence of the enzyme are disrupted resulting in individual amino acids.

Biochemistry Problems And Solutions

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