

Amino Acid Racemization

This activity deals with the kinetics and equilibrium of optical isomer conversion of amino acids. You will need the interactive Excel spreadsheet to complete the questions below:

http://academic.pgcc.edu/~ssinex/excelets/racemization_kinetics.xls

1. Consider the reaction on the kinetics tab: L-amino acid \leftrightarrow D-amino acid
For any amino acid with only one chiral or asymmetric carbon, what is the value of the equilibrium constant?

Carefully sketch and label a concentration as a function of time graph. When is equilibrium established? Label on the graph.



2. For a natural sample of an amino acid, how would the D/L ratio change with time?
3. Now go to the temperature tab, which is set up for the amino acid - leucine. At a temperature of 298 K, how would you characterize the reaction rate?

4. Increase the temperature to see what happens. How do the forward and backward rate constants change?

5. What does this say about the activation energy for the forward and backward reactions?

6. Calculate the activation energy, E_a , for the forward and backward reactions using the Arrhenius equation. Show your calculation.

7. Draw and label a potential energy diagram for this reaction.



8. What is the value of ΔH for this reaction?

9. Since this reaction is relatively slow at surface temperatures (20 - 30°C), it has been used to determine the age of fossil bones. Go to the age dating tab where the age of a sample, assuming the only L- leucine was present in it initially, can be determined by using the experimentally determined D/L ratio. What is the age of a sample with a D/L = 0.24, assuming the temperature is 300K for the environment where the fossil formed.

10. How is the age of a sample influenced by a change in temperature?