

**CEM 882 Problem Set 1 – Due Thursday, January 30 – Please email or share a pdf to weliky@chemistry.msu.edu**

Please show all units in each step of a calculation.

1. (20 points) Hair is composed of  $\alpha$  helical keratin protein. For hair that is growing at 15 cm/year, what is the time in units of s required to add one amino acid to the end of the keratin protein? You will need to look up the dimensions of the  $\alpha$  helix.
2. (20 points) Consider a helix that is in middle of a protein structure, i.e. does not contain the N-terminus or C-terminus of the protein. Relative to Pro being at the N-terminus of a helix, would Pro residues have equal, greater, or lesser probability of being in the C-terminus of a helix? Provide a brief explanation of the reasoning for your choice. Your answer should include a drawing of the chemical structure of a segment of a protein that contains a Pro.
3. (20 points) Provide an explanation based on charge for why polylysine (a protein containing only lysine) forms regular  $\alpha$  helical structure at pH 12 but not at pH 7.