MATE 315, Homework 1 due 01/18/07

1) Where was your first Co-op? What were your daily activities? Was it a pleasant experience?

2) The processing of polymers differs from that of metals and ceramics in several important ways. Metals and ceramics are generally cast from a Newtonian melt with low viscosity. Most processing of metals occurs in the solid state through processes such as rolling and drawing. Consider the formation of an aluminum can, a glass bottle and a plastic bottle for a beer container.

   a) List what you think of the advantages of each as a container.
   b) Briefly explain how each of these containers might be made. (Continuous, batch or semi-continuous operations?)
   c) Consider the overall economic feasibility (cost assessment) of these containers and their processing.
   d) Consider the aesthetic appeal and safety of the three materials.

3) Plot the log of viscosity versus shear rate for an aluminum melt, a silica (glass) melt and for a typical polymer.

   a) Explain the different behaviors observed in this plot.
   b) For the polymer what viscosity would be used to compare between different molecular weights?

4) Generally, the most important properties of a polymer are the molecular weight and molecular weight distribution.
      i) From a processing perspective explain why you would want to know in detail the molecular weight distribution of a polymer.
      ii) For a polymer with a broad molecular weight distribution, which part of the distribution is most important to polymer flow?

5) Using simple shear flow between two plates, show that the rate of strain and the velocity gradient are different terms for the same tensor. For simple shear flow between parallel plates does the shear rate vary across the gap?