1. Explain why polypropylene has a lower enthalpy of crystallization than polyethylene, but a higher melting temperature.

2. Give the relation for strain energy in a rubber as a function of the extension ratios, and from this develop equations governing the extension ratio and the engineering stress for equi-biaxial tension ($\lambda_x = \lambda_y = \lambda$).

3. Write the matrix form of the 3-D linear elastic constitutive equations relating strain and stress in terms of $E$, $\nu$ and $G$. Give approximate values of $E$ and $\nu$ for metals, ceramics, plastics and rubber. What molecular factors govern the magnitudes of these parameters? What do we mean by “linear” and “elastic?” Can a material be elastic but not linear? Linear but not elastic? (Give examples.)

4. Draw plots of modulus versus temperature for various polymers: amorphous, semicrystalline, crosslinked, non-crosslinked. Provide typical numerical values for the axes, and explain why the plots have the shape they do.