ChemE 378, Assignment #17

Special Problems

14.25 *The density and associated percent crystallinity for two polytetrafluoroethylene materials are as follows:*

ρ (g/cm^3)	crystallinity (%)
2.144	51.3
2.215	74.2

(a) Compute the densities of totally crystalline and totally amorphous polytetrafluoroethylene.

(b) Determine the percent crystallinity of a specimen having a density of 2.26 g/cm^3.

1. Your company Polyflex makes a linear low density polyethylene (LLDPE) which is actually a random copolymer (single units of of 1-2,butylene interspersed in longer segments of polyethylene) containing 90 wt% ethylene and 10 wt% polybutylene and having a weight-average molecular weight of 250,000 g/mol. Think of PE with short ethylene groups sticking out sideways every few units, like the barbs on barbed wire. In your job as a technical representative you are asked to supply the following information to a potential customer along with calculations and information that document your methods.

a. Whether it is a material of low or high crystallinity (explain reasoning).

b. Expected melting point, glass transition temperature, density, and tensile strength relative to LDPE and HDPE (estimate actual values; explain your reasoning).

2. We are planning a climbing expedition to Denali (Mt. McKinley). Our team is looking for suitable, light polymer ropes. The ropes must be affordable, flexible, strong, and abrasion resistant with a high impact strength for supporting climbers and equipment. We anticipate normal weather (about 15-25°C) most of the time with an occasional blizzard with temperatures as low as -40°C.

a. Specify a polymer of reasonable cost that might be available in rope form and is suitable for the intended use during these conditions.

b. Estimate the minimum diameter capable of supporting 200 lbs (person and pack) without significant plastic deformation with a safety factor of 1.5. Note that if a range of strengths are given, you should use the lowest value to allow for safety.

3. Choose suitable polymers for the following applications; briefly justify your choices.

Application	Polymer(s) selected	Justification of selection (document sources, e.g. tables and figures)
compact discs (CDs) for music		
automobile tires in Alaska		
battery case		
carbonated beverage bottles		
carpet		
electric wire insulator		
garden hose		
motorcycle helmet		
safety glasses		
sprinkler pipe		