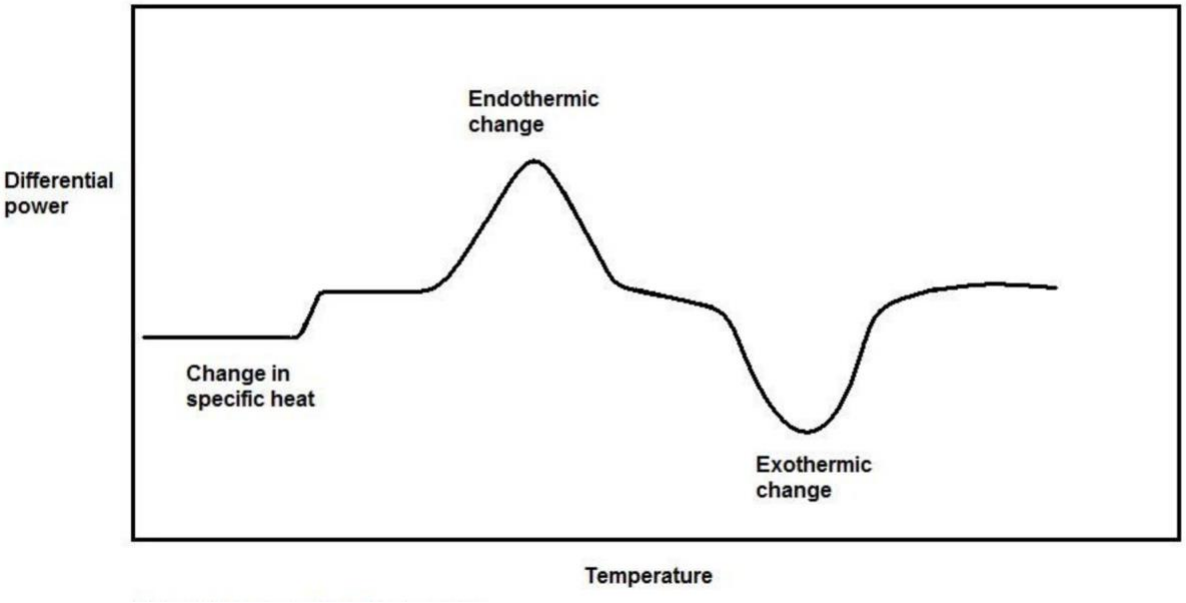
Problem Sets

Engineering Lab

1. Define the following terms: glass transition temperature, melting, crystallization, decomposition
2. Identify the glass transition, melting, and crystallization temperature in the following diagram



3. Which thermal processes would apply to a metallic substance?

Mass and Energy Balances I

Sample	**Chemical Formula**	**T_m (K)**	**ΔH_{fusion} (kJ/mol)**	**ΔS_{fusion} (J/mol K)**
Cyclohexane	C_6H_{12}	279.6	2.68	9.57
Dodecane	$CH_3(CH_2)_{10}CH_3$	263.5	36.8	161.5
Octadecane	$C_{18}H_{38}$	301.0	60.8	203.6
Table 1. The accepted value are from the NIST database.				

1. Determine the relationship between the entropy of fusion and the molecular weight of a hydrocarbon.
2. From the relationship established in question 1, predict the ΔS_{fusion} and ΔH_{fusion} for Octane (C_8H_{18}). The entropy of fusion is calculated by utilizing the following equation:

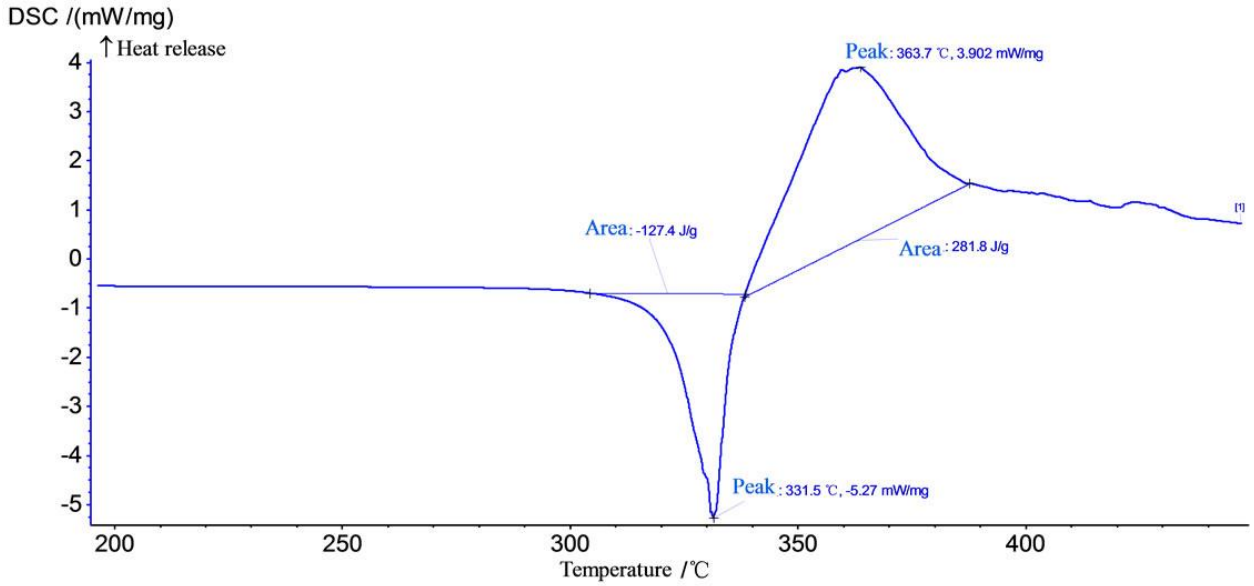
$$\Delta S_{fusion} = \frac{\Delta H_{fusion}}{T_m}$$

Mass and Energy Balances II (Note will gather data for polyethylene)

1. If the molecular weight of polyethylene was increased to 70,000 what would be the effect on the T_g, T_m, and T_c.
2. If the heat of fusion for 100% crystalline polyethylene is 68.4 cal/g (Bernhard Wunderlich, 1967) what would be the degree of crystallinity for the polyethylene used in the lab. The degree of crystallinity can be calculated as:

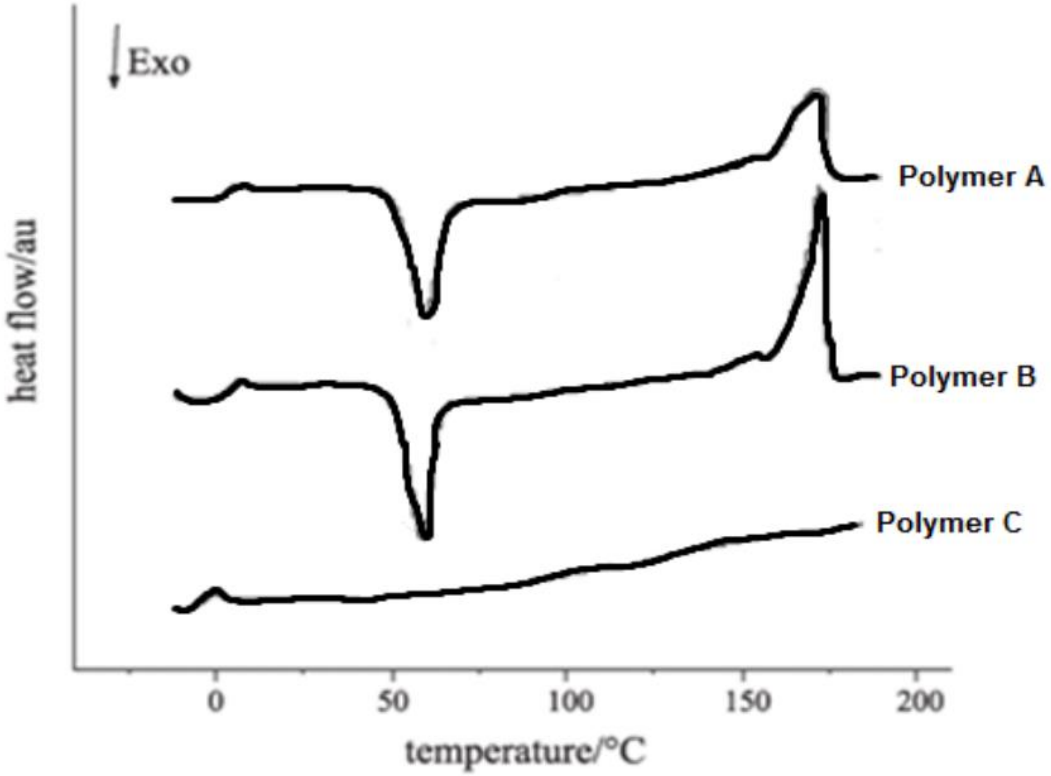
$$\%Crystallinity = \frac{\Delta H_{experimental}}{\Delta H_{theoretical}}$$

Thermodynamics



1. Identify the exothermic and endothermic processes in the DSC diagram shown above.
2. Determine the entropy and gibbs free energy for each peak pictured above if the substance shown above is Benzene.
3. Calculate the total energy change for the two processes for a benzene sample weighing 100 mg.

Polymers/Materials



1. Identify the thermal transitions of each polymer and determine the temperature of the transition.
2. For a process that requires a high impact toughness and high mechanical strength, determine the polymer that would be most suitable for this application.
3. Now assume that Samples a-c are all the same polymer that have been processed differently. Which of these was cooled the most quickly from the melted state? Explain your reasoning based on the graph above.