CY11001 (Physical Chemistry)

Tutorial 1

1. **The densities of ice and water at 0 °C are 0.9168 and 0.9998 g cm^{-3}, respectively. If ΔH for the fusion of ice at atmospheric pressure is 6.025 kJ/mol, what is ΔU? How much work is done on the system?**

2. **An average man weighing about 70 kg produces about 10460 kJ of heat every day.**
   (a) Suppose that man were an isolated system and that his heat capacity were 4.18 J K^{-1} g^{-1}. If his body temperature were 37 °C at a given time, what would be his temperature 24 h later?

   (b) A man is in fact an open system, and the main mechanism for maintaining his body temperature constant is evaporation of water. If the enthalpy of vaporization of water at 37 °C is 43.4 kJ/mol, how much water needs to be evaporated per day to keep the body temperature constant?

3. **Initially 0.1 mol of methane is at 1 bar pressure and 80 °C. The gas behaves ideally and the value of C_p/C_V is 1.31. The gas is allowed to expand reversibly and adiabatically to a pressure of 0.1 bar.**

   a. What are the initial and final volumes of the gas?

   b. What is the final temperature?

   c. Calculate ΔU and ΔH for the process.

4. **Prove that** $C_V = -\left(\frac{\partial U}{\partial V}\right)_T \left(\frac{\partial V}{\partial T}\right)_U$

5. **(a) Calculate the work done when 1 mol of an ideal gas at 2 bar pressure and 300 K is expanded isothermally with the external pressure held constant at 1.5 bar.**

   (b) Suppose instead that the gas is expanded isothermally and *reversibly* to the same final volume. Calculate the work done.

6. **Suppose that an iceberg weighing 10^9 kg were to drift into a part of the ocean where the temperature is 20 °C. What is the maximum amount of work that could be generated while the iceberg is melting? Assume the temperature of the iceberg to be 0 °C. The latent heat of fusion of ice is 6.025 kJ/mol. If the process occurred in one day, what would be the power produced?**