Questions for Module # 25

Q.1 50 g oxygen gas (298 K and 1 bar) expands reversibly and adiabatically to the double volume. Calculate the changes in internal energy (ΔU) and entropy (ΔS). Calculate also the entropy production (ΔS_i). Assume that the gas follows the ideal gas law.

Q.2 Calculate the change in Gibbs free energy of melting of ice at normal pressure at the following temperatures: $-10\ °C$, $0\ °C$, $10\ °C$ and $30\ °C$. The enthalpy of melting is 6024 J mol^{-1}, and the entropy of melting is 22.05 J (K mol)$^{-1}$.

Q.3 At the melting point (1 bar), $-38.9\ °C$, the densities of, respectively, liquid and solid mercury are 13,690 kg m^{-3} and 14,193 kg m^{-3}. The melting enthalpy of mercury at this temperature is 9750 J (kg)$^{-1}$. Determine the melting point of mercury at 3549 bar. The experimentally determined melting point of mercury at 3540 bar is $-19.9\ °C$. Please, comment about the difference and suggest an explanation to the discrepancy.

Q.4 In order to make medical instruments sterile, they have to be treated at $120\ °C$ to eliminate the spores of certain bacteria. Which pressure is required to reach a boiling point of water at $120\ °C$. The enthalpy of evaporation of water is 40,600 J mol^{-1}.