Problem set 6

Due April 25, 2024

1. Demonstrate that the reversible work exerted by an ideal gas (n moles) that expands from volume V_1 to volume V_2, $V_2 > V_1$, at constant absolute temperature T and constant external pressure p is equal to the change of its free energy.

   Hint: Use the formula for work exerted under the above conditions that has been derived during the lecture on the Carnot cycle and use the Guggenheim diagram to compute the derivative of the free energy in volume at constant temperatures.

2. The partition coefficient of terminally-blocked L-methionine (Ac-L-Met-NHMe) between n-octanol (n-oct) and water (wat) at $t = 25°$C is equal to $P = x_{n-oct}/x_{wat} = 0.25$, where x_{n-oct} and x_{wat} denote the molar fractions of L-methionine in the n-octanol and water phase, respectively (data from Fauchère and Pliška, *Eur. J. Med. Chem.*, **18**, 369-375, 1983). Determine the difference of the chemical potentials of L-methionine in the two phases ($\mu_{n-oct} - \mu_{wat}$) at $t = 25°$C.