1). The Henry's law constant for ethanol in diethyl ether at 20°C is 160 torr. Find the activity and activity coefficient of ethanol (component 2) in diethyl ether (component 1) at 20°C for a mole fraction of ethanol equal to 0.100, using both convention I and convention II. The partial pressure of ethanol at this composition and temperature is 12.45 torr, and the vapor pressure of pure ethanol at this temperature is 44.40 torr. (16%)

2) At 18°C the total volume of a solution formed from $MgSO_4$ and 1.000 kg of water fits the expression

$$V/cm^3 = 1001.21 + 34.69\,(m - 0.070)^2$$

Calculate the partial molar volumes of the salt and the solvent when $m = 0.050\ mol\ kg^{-1}$. (17%)

3). The enthalpy of vaporization of a certain liquid is found to be 14.4 $kJ\cdot mol^{-1}$ at 180 K, its normal boiling point. The molar volumes of the liquid and the vapour at the boiling point are 115 $cm^3\ mol^{-1}$ and 14.5 $dm^3\cdot mol^{-1}$ respectively. Estimate dP/dT from the Clapeyron equation and estimate the percentage error in its value if the Clausius-Clapeyron equation is used instead. (16%)

4). The isotope $^{32}_{15}P$ emits β radiation and has a half-life of 14.3 days. Calculate the decay constant in s^{-1}. What percentage of the initial activity remains after (a) 20 days, (b) 100 days? (17%)

5) The free energy change for the reaction S(rhombic) = S(monoclinic) over the limited temperature range 298 to 369 K at standard pressure is given by the equation

$$\Delta G^\circ_T = 83.68 - 0.356\,T\ln T + 2.389\,T - (1.38\times10^{-3})\,T^2 \quad J\,mol^{-1}$$

What is the value of ΔH° at 325 K? (17%)

6). Calculate the number of collisions per square centimeter per second of oxygen molecules with a wall at a pressure of 1 bar and 25°C (17%)