Assignment 2

Indian Institute of Science Education and Research

CHM202: Energetics and dynamics of chemical reactions

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Ques. 1 One gm mole of methane, which is a van der Waals gas, is compressed isothermally and reversibly from 1 atm to 400 atm at 0^0C.What amount of heat must be removed during such compression in order to ensure isothermal nature of the process. [a= 2.264 atmL^2Mol^{-2}; b=0.0428$LMol^{-1}$]. For approximation you may use ideal gas equation for volume calculation. [1Latm=101.325J]

Ques. 2 Ten moles of an ideal monoatomic gas initially at 10 atm and 27^0C is allowed to expand in two ways separately (i) isothermally against a constant pressure of 1 atm and (ii) isothermally and slowly until the pressure becomes1 atm. Calculate W, Q, ΔU, ΔH in each case. (R=8.314 $JK^{-1}Mol^{-1}$).

Ques. 3 The gas in a cloud chamber at a temperature of 292 K undergoes a rapid expansion. Assuming the process is adiabatic, calculate the final temperature if γ = 1.40 and the volume expansion ratio is 1.28.

Ques. 4 Joule-Thomson coefficient of a gas can be expressed as,

$$\mu_{J,T_A} = -\frac{1}{C_P}\left(\frac{\partial H}{\partial P}\right)_T$$

At 300^0C in the pressure range 0to 60 atm. The Joule-Thomson coefficient of N_2 can be represented by the equation, μ_{J,T_A} =[0.0142-2.608×10^{-4}P] K $atm^{-1.}$ Calculate ΔH when ten moles of N_2, a van der Waals gas expands isothermally at 300^0C from 45 atm to 30 atm. [$\overline{C}_P$ = 7/2R]

Ques.5 Show that the Joule-Thomson coefficient is zero for an ideal gas under all cases.