

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°C. What amount of heat must be removed during such compression in order to ensure isothermal nature of the process. [$a = 2.264 \text{ atmL}^2\text{Mol}^{-2}$; $b = 0.0428 \text{ LMol}^{-1}$]. For approximation you may use ideal gas equation for volume calculation. [$1 \text{ Latm} = 101.325 \text{ J}$]

Ques. 2 Ten moles of an ideal monoatomic gas initially at 10 atm and 27°C 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 becomes 1 atm. Calculate W, Q, ΔU , ΔH in each case. ($R = 8.314 \text{ JK}^{-1}\text{Mol}^{-1}$).

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 $\gamma = 1.40$ 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°C in the pressure range 0 to 60 atm. The Joule-Thomson coefficient of N_2 can be represented by the equation, $\mu_{J,T_A} = [0.0142 - 2.608 \times 10^{-4}P] \text{ K atm}^{-1}$. Calculate ΔH when ten moles of N_2 , a van der Waals gas expands isothermally at 300°C from 45 atm to 30 atm. [$\bar{C}_P = 7/2R$]

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