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Thermodynamics Outlines

Ideal gas law: $PV = nRT$

Relative density : $d = \frac{\rho_1}{\rho_2} = \frac{m_1}{m_2} = \frac{M_1}{M_2}$ (relative density of a gas 1 with respect to a gas 2)

Molar fraction: $\chi_i = \frac{n_i}{n_T}$ and **partial pressure :** $P_i = \chi_i P_T$

Pressure force work : $\delta W = -P_{ext} dV$

First law: - General case : $dK + dU = \delta W + \delta Q$

- System at rest: $dU = \delta W + \delta Q$

Enthalpy : $H = U + PV$ For a monobaric process: $\Delta H = Q_P$

Gibbs Free enthalpy: $G = H - TS$

For an ideal gas: $dU = n\bar{C}_V dT$ and $dH = n\bar{C}_p dT$,

Mayer relation : $\overline{C_P} - \overline{C_V} = R$ and $\overline{C_v} = \frac{R}{\gamma - 1}$ $\overline{C_p} = \frac{R\gamma}{\gamma - 1}$ $\bar{C}_p / \bar{C}_V = \gamma$

Hess' law: $\Delta_r \bar{H}_T^0 = \sum_{prod} \nu_{prod} \Delta_f \bar{H}_T^0 \text{(products)} - \sum_{reac} \nu_{reac} \Delta_f \bar{H}_T^0 \text{(reactants)}$

For a reversible adiabatic process of an ideal gas : $PV^\gamma = Cte$

Second law:

For a reversible elementary process : $dS = \delta Q_{rev} / T$

For an ideal heat reservoir : $\Delta S_{HR} = Q_{HR} / T_{HR}$

For any system : $\Delta S_\sigma = S_e + S_c$ with $S_c = 0$ if the process is reversible

with $S_c > 0$ if the process is irreversible

For an isolated system (universe) : $\Delta S_{univ} = \sum_j \Delta S_{\sigma j} = 0$ if the process is reversible

and $\Delta S_{univ} > 0$ if the process is irreversible.

Clapeyron's equation : $\frac{dP^*}{dT} = \frac{\Delta_{trs}\bar{H}}{T\left(\bar{V}_{final} - \bar{V}_{initial}\right)}$

where $\Delta_{trs}\bar{H}$ is the enthalpy variation of the change of state

$\bar{V}$ is the molar volume of the substance in the considered phase.

Data :

R = 8,314 J.K^{-1}. mol^{-1}
T(K) = θ(°C) + 273
1 atm = 101325 Pa = 1.01325 bar = 760 mmHg = 760 Torr