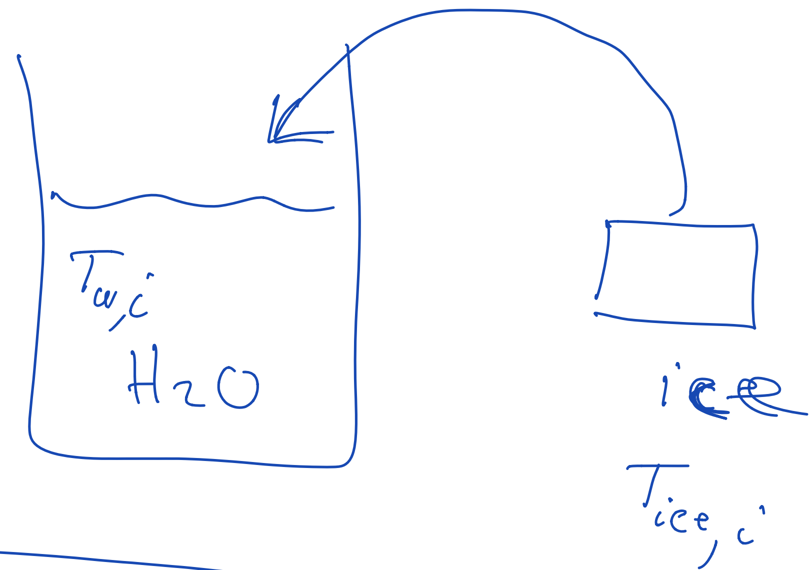
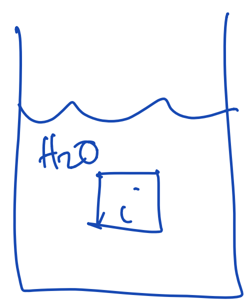


$$dU = dq + \cancel{dw}^{\,0}$$

system: water + ice



$$dU = dq = 0$$

$$0 = dq = dq_{ice} + dq_{water}$$

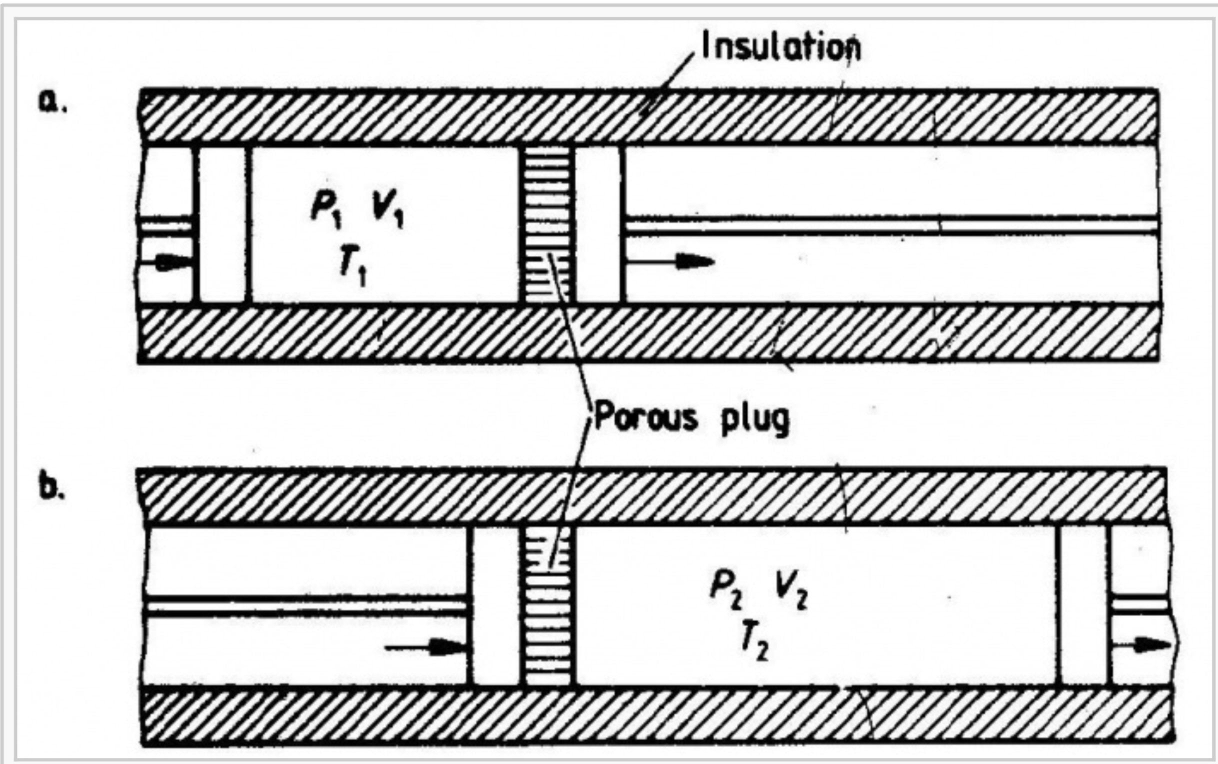
$$= C_{p,ice}(T)\, dT_{ice} + C_{p,H_2O}(T)\, dT_{ice}$$

$$C_p^{ice}(T)\,dT = -C_p^{H_2O}(T)\,dT_{H_2O}$$

Joule-Thomson Experiment

NMR: Bicycle Tire w/Pump

$\mu_{JT} > 0$ $\quad \Delta T < 0$ $\quad \mu_{JT} = \left(\frac{\Delta T}{\Delta P}\right)_H$ $\quad \Delta P < 0$



Apply 1st Law: System: gas

$$dU = \cancel{dq}^{\,0} + dw = dw$$

$$\Delta U = w_{net} = -P_1(0 - V_1) - P_2(V_2 - 0)$$

$$\Delta U = P_1 V_1 - P_2 V_2$$

$$\Delta U + P_2 V_2 - P_1 V_1 = 0$$

$$\Delta U + \Delta(PV) = 0$$

$$\Delta(\underbrace{U+PV}_{\equiv H}) = 0$$

$$\boxed{\Delta H = 0} \quad !!!$$

$$dH(T,P) = \left(\frac{\partial H}{\partial T}\right)_P dT + \left(\frac{\partial H}{\partial P}\right)_T dP$$

$$= C_p(T)\,dT + \left(\frac{\partial H}{\partial P}\right)_T dP$$

J-T exp:

$$dH = 0 = C_p(T)\,dT + \left(\frac{\partial H}{\partial P}\right)_T dP$$

$$-C_p(T)\,dT_H = \left(\frac{\partial H}{\partial P}\right)_T dP_H$$

$$\left(\frac{\partial H}{\partial P}\right)_T = -C_p(T)\left(\frac{\partial T}{\partial P}\right)_H$$

$$\underbrace{\left(\frac{\partial T}{\partial P}\right)_H}_{\mu_{J\text{-}T}} = \lim_{\Delta P \to 0}\left(\frac{\Delta T}{\Delta P}\right)_H$$

$\mu_{J\text{-}T}$ ← Joule thomson Coefficient

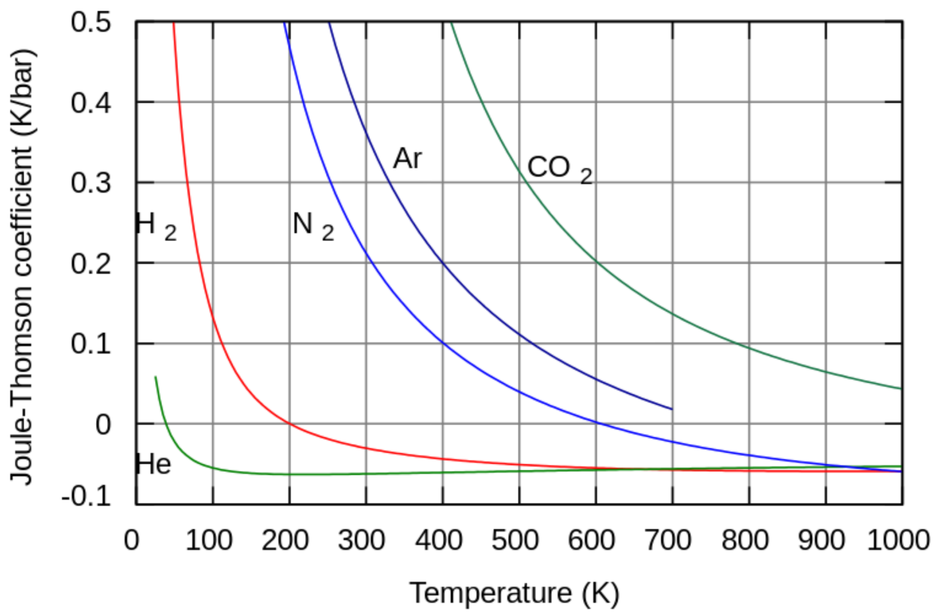
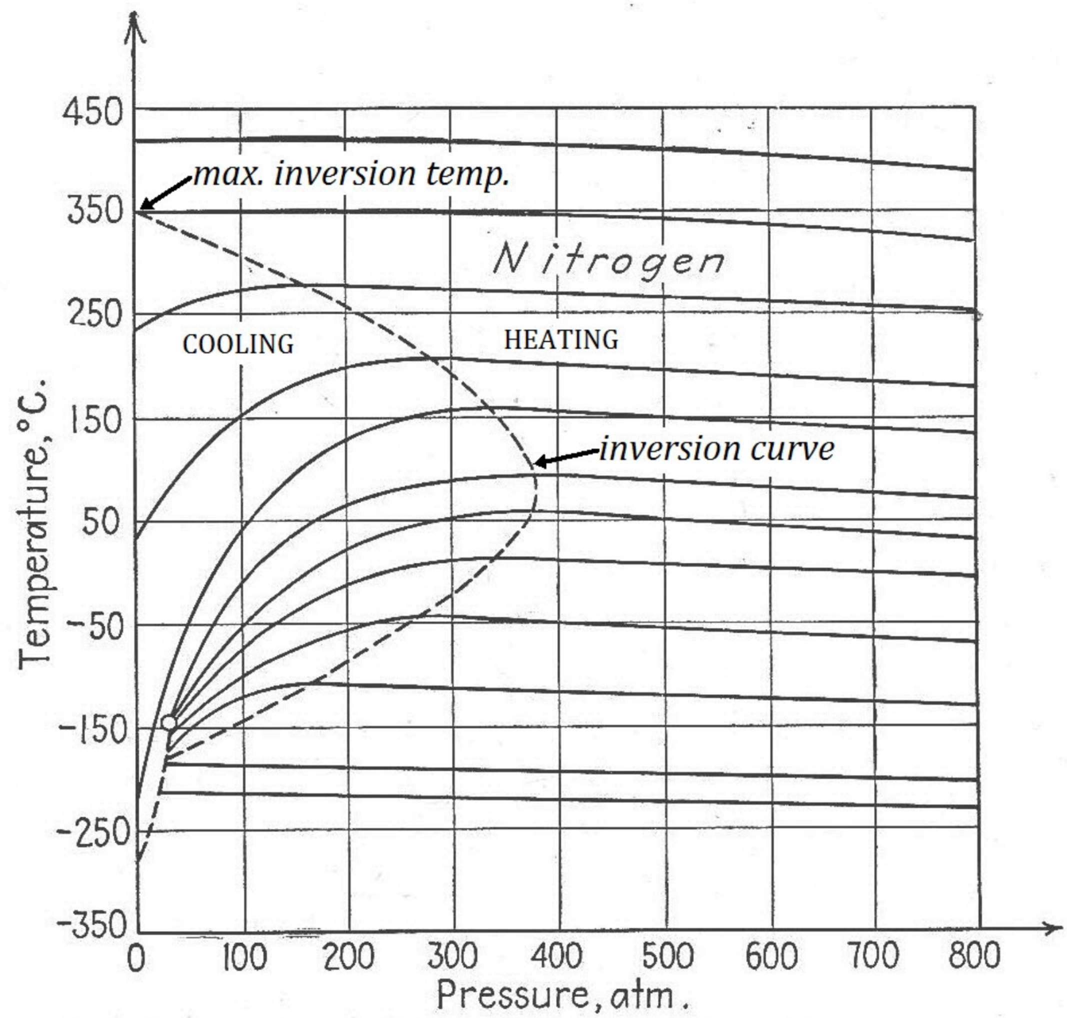


Fig. 1 – Joule-Thomson coefficients for various gases at atmospheric pressure.



Isenthalpic curves and inversion curve for nitrogen

Problem 1.

Heat Capacities are constant