pV=nRT

1. $P_1 = 10\,atm$ $T_1 = 300K$ (a) $P_2 = 5\,atm$, $T_1 = T_2 = 300K$, $V_2 = 2V_1 = 4.92L$, $V_1 = 2.46L$

등온 조건에서 $\Delta U = q + w = 0$, $q = -w = nRT\int_{V_1}^{V_2} \frac{1}{V} dV = 1728.85J$, $\Delta S = \int \frac{dq}{T} = \frac{1}{T}\int dq = \frac{\Delta q}{T} = 5.76 J/K$

(b) In adiabatic proses. $dq = 0$ $\Delta S = \int \frac{dq}{T} = 0$

(c) $w = 0$ $dq = dU = nC_v dT$ $\Delta S = \int \frac{dq}{T} = nC_v \int_{T_1}^{T_2} \frac{1}{T} dT = -8.64 J/K$, $T_2 = \frac{P_2 V}{nR} = \frac{1}{2} T_1$

2. $T_1 = 300K$, $P_1 = 10\,atm$, $V = \frac{nRT}{P} = 2.46L$

(a) : 입자가 진공상태에서 외부개입없이 자발적 반응 $T_1 = T_2$, $\Delta U = 0$, $\Delta H = 0$, $w = pdV = 0\ (p=0)$, $q = -w = 0$

$\Delta S = Nk\ln\Omega = 1N_A \times \frac{R}{N_A} \ln\frac{V_2}{V_1} = 9.134 J/K$,

(b) $T_3 = 400K$, $V_3 = V_2 = 3V_1 = 7.38L$, $P_3 = \frac{nRT}{V} = \frac{40}{9} atm$

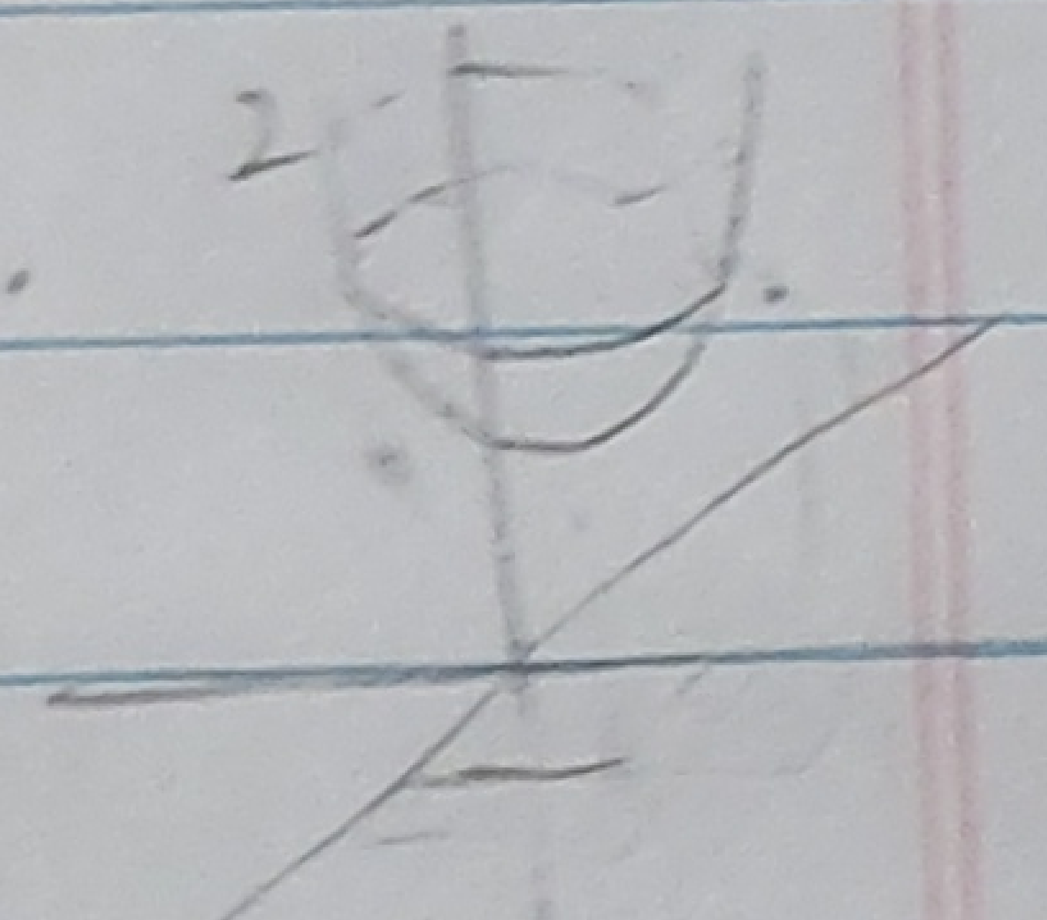
$w = \int p\,dV = 0$, $q = \Delta U = nC_v\Delta T = 1240.1J$, $\Delta H = nC_p dT = 2078.5J$, $\Delta S = \int_{T_2}^{T_3} nC_v \frac{1}{T} dT = 3.588 J/K$

(c) $T_4 = T_3 = 400K$, $V_4 = 3V_3 = 22.14L$, $P_4 = \frac{nRT_4}{V_4} = \frac{40}{27} atm$

$\Delta U = 0$, $\Delta H = 0$, $W = \int p\,dV = -nRT\int_{V_3}^{V_4} \frac{1}{V} dV = -3653.54J$, $q = -w = 3653.54J$, $\Delta S = \int \frac{dq}{T} = \frac{1}{T}\int dq = \frac{\Delta q}{T} = 9.134 J/K$

(d) $T_5 = 300K$, $P_5 = P_4 = \frac{40}{27} atm$, $V_5 = \frac{nRT_5}{P_5} = 16.605L$

$\Delta U = nC_v\Delta T = -1240.1J$, $q = \Delta H = nC_p\Delta T = -2078.5J$, $w = \Delta U - q = 831.4J$ $\Delta S = \int \frac{dq}{T} = nC_p \int_{T_4}^{T_5} \frac{1}{T} dT = -5.979 J/K$

3. 

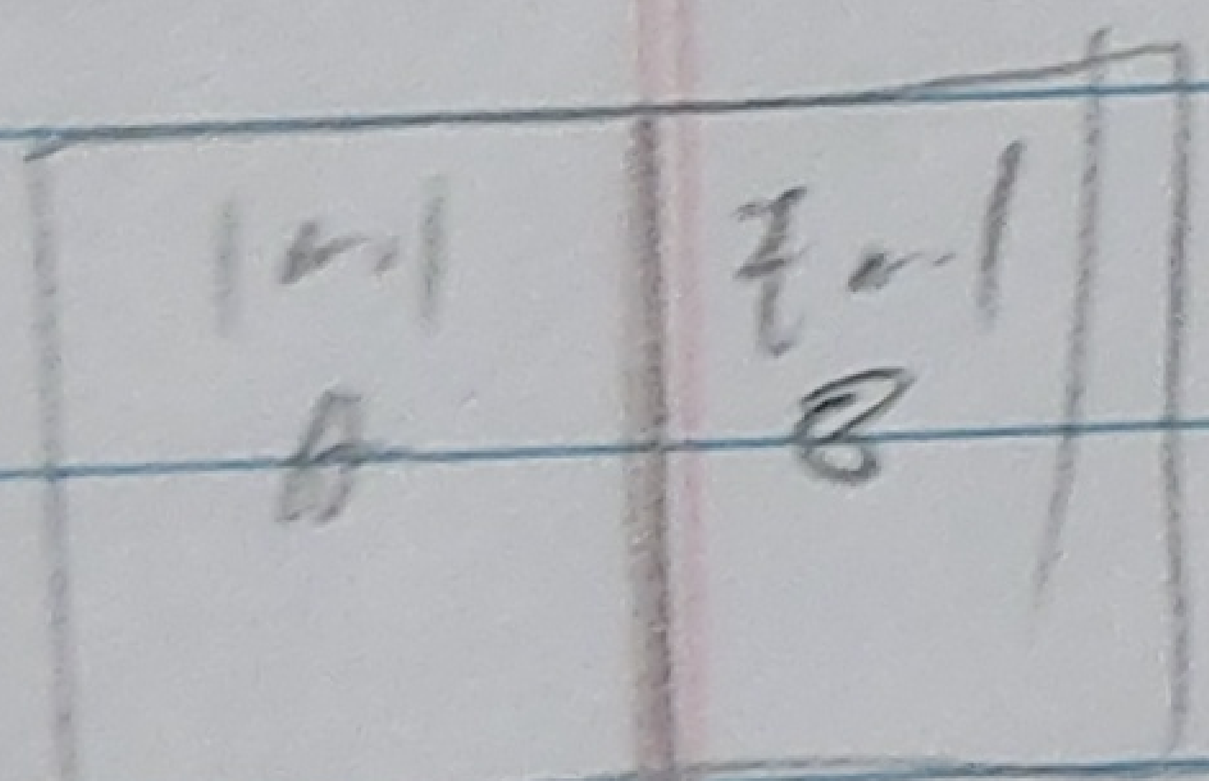
$z' = 0$ 이 되는 (x,y) => $f_x(x,y) = 2x-4$ $(f_x(a,b), f_y(a,b)) = (0,0)$, $x=2, y=2$

$x+y=1$, $y = 1-x$, $z = (x-2)^2 + (-x-1)^2 + 4$, $z' = 2x-4+2x+2 = 4x-2$, $(x=0.5,\ y=0.5)$

(b),(c) $F(x,y,\lambda) = (x-2)^2 + (y-2)^2 + \lambda(x+y-1) + 4$ $F_x = 2x-4+\lambda = 0$ $x = -\frac{\lambda}{2}+2$, $y = -\frac{\lambda}{2}+2$

$F_y = 2y-4+\lambda = 0$ $-\lambda+4 = 1$, $\lambda = 3$, $(x,y) = (\frac{1}{2}, \frac{1}{2})$

$F_\lambda = x+y-1 = 0$

4. 

(a) $\Delta S_A = Nk\ln\Omega = 1N_A \frac{R}{N_A} \ln\frac{V_2}{V_1} = 9.134 J/K$ $\Delta S = \Delta S_A + \Delta S_B =$

$\Delta S_B = Nk\ln\Omega = 1N_A \frac{R}{N_A} \ln\frac{V_2}{V_1} = 9.134 J/K$

(b) $\Delta S_A = Nk\ln\Omega = 2N_A \frac{R}{N_A} \ln\frac{V_2}{V_1} = 18.268 J/K$

$\Delta S_A = Nk\ln\Omega = 1N_A \frac{R}{N_A} \ln\frac{V_2}{V_1} = 9.134 J/K$

(c) 같은 기체끼리 섞였을 때는 동일 $S_i = S_f$ $\Delta S = \Delta_f - \Delta_i = 0$