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General Physics II, Midterm 2
PHYS1020AA, AB, AC, Class year 114-2
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SN:____________________, Name:____________________

Note: You can use pencil or any pen in answering the problems. Dictionary, calculators and mathematics tables ***are NOT*** *allowed. Please hand in both solution and this problem sheet.* ***ABSOLUTELY NO CHEATING!***

Problems 1/2 (2 problems, 40 points)

1. **Adiabatic** (20%) (a, 5%) What is an adiabatic process? (b, 5%) If a system is undergoing an adiabatic process, how can you change its internal energy? (c, 10%) For ideal gas, in an adiabatic process, prove $PV^{\gamma} = constant$. Note: $\boldsymbol{P}$ is the pressure of the gases, $\boldsymbol{V}$ is the volume, $\gamma = C_p/C_v$, where ***Cp*** is the constant pressure Molar specific heat, ***Cv*** is the constant volume Molar specific heat.

2. **Free expansion:** (20%). (a) What Thermal dynamic process can be defined as free expansion? (d) A system after free expansion process, what has changed?

Solution:

1 (a) No heat transfer, (b) By doing work to the system or by the system.

(c)

(b) We know , $\Delta E_{in} = nC_v dT = Q + W = 0 - PdV$ (for adiabatic process

$nC_v dT = -PdV$ or, $ndT = -\dfrac{PdV}{C_v}$

Now for a ideal gas, PV=nRT

Using differntiation we can write ,

$PdV + VdP = nRdT$

$PdV + VdP = -\dfrac{PdV}{C_v} R = -\dfrac{(C_p - C_v)PdV}{C_v}$, Since $R = C_p - C_v$

$PdV[1 + \dfrac{(C_p - C_v)}{C_v}] = -VdP$

$\dfrac{dV}{V}(1 + \gamma - 1) + \dfrac{dP}{P} = 0$, Since $\dfrac{C_p}{C_v} = \gamma$

Using integration we get, $\ln P + \ln V^{\gamma} = \ln C$, Where C is constant

$\therefore \quad PV^{\gamma} = \text{Constant}$

2 (a) Free expansion =Adiabatic and $\Delta W=0$

(b) According to first law of Thermodynamics, $\Delta T=0$ and $\Delta E_{int}=\Delta W=\Delta Q=0$; i.e. nothing has changed. However, according to the 2^{ND} law of thermodynamics, the entropy changed and $\Delta S>0$.