University of Djillali Bounaama Khemis Miliana **1^{st} Year LMD ST/1^{st} Year Engineer**
Faculty of Sciences and Technology
Department of Renewable Energies

Series N° 2

Exercise 1:

Consider two moles of oxygen dioxide, a gas assumed to be ideal, which can be reversibly transitioned from the initial state A (P_A, V_A, T_A) to the final state B ($P_B = 3\ P_A$, V_B, $T_B = T_A$) via two distinct paths:

Path 1: Isothermal transformation.

Path 2: Transformation composed of an isochoric followed by an isobaric transformation.

1. Represent both paths on a Clapeyron diagram.
2. Calculate, in each case, the work involved as a function of T_A.

Data: $T_A = 300$ K.

Exercise 2:

I. Calculate the quantity of heat required to raise the temperature of the air in a room from 0°C to 1°C.

Data: $\rho_{air} = 1.30$ g/L; dimensions of the room: 5m x 4m x 2.5m, $c_{air} = 820$ J/kg.K.

II. Calculate the internal energy change for each of the following systems:

1. A system absorbs Q = 2 kJ while providing external work W = 500 J.
2. A gas maintained at constant volume releases Q = 5 kJ.
3. Adiabatic compression of a gas is accomplished with work W = 80 J.

Exercise 3:

One mole of a monatomic ideal gas undergoes the following reversible transformations successively:

	State 1	$\xrightarrow{A}$	State 2	$\xrightarrow{B}$	State 3	$\xrightarrow{C}$	State 1
PV (L.atm)	22,4		22,4		44,8		22,4
P(atm)	2		4		4		2

1. Give the nature of each transformation.
2. Calculate the work for each transformation.
3. Calculate the internal energy change during transformation C.
4. Deduce, without calculation, the internal energy change during transformation B.

Data: $\gamma=5/3$

Exercise 4:

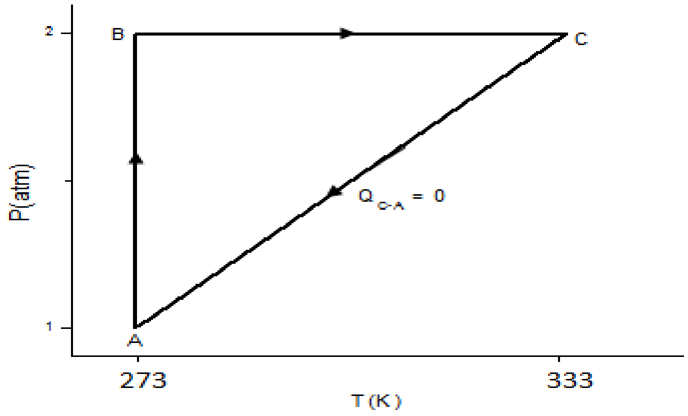
A mole of an ideal gas undergoes the following reversible transformations:

- Transformation A-B such that $\Delta H_{A\text{-}B} = Q_{A\text{-}B}$ and $Q_{A\text{-}B} = 1050$ cal.
- Transformation B-C such that P.V=constant.
- Transformation C-A such that $T.V^{(\gamma-1)}$=constant.

1. Provide the nature of each transformation.
2. Determine the missing parameters for each transformation.
3. Represent the cycle on the Clapeyron diagram (P, V).
4. Calculate in calories, for each transformation and for the cycle: the work (W), the quantity of heat exchanged (Q), and the enthalpy change (ΔH).

Data: c_p=7 cal/mol.K, c_v=5 cal/mol.K, T_A=300 K, P_A=1 atm, R=0.082 atm.L/mol.K=2 cal/mol.K,
1 atm.L=101.3 J, 1 cal=4.18 J.

Exercise 5:
One mole of gas assumed to be ideal undergoes the reversible cycle of transformations represented below in coordinates (P, T):



1. Identify the nature of each transformation.
2. Evaluate the variables P, V, T for each of the states A, B, C.
3. Calculate, for each transformation and for the cycle: the work W, the quantity of heat Q, the internal energy change ΔU, and the enthalpy change ΔH.
Data: R=8.31 J/mol.K, c_p=29.12 J/mol.K, c_v=20.8 J/mol.K

Exercise 6:
Calculate the enthalpy change when one mole of iodine changes from 300K to 500K under a pressure of 1atm. The molar specific heats of pure substances are given as follows:
c_p (I_2, solid) = 5.4 cal/mol.K
c_p (I_2, liquid) = 19.5 cal/mol.K
c_p (I_2, gas) = 9.0 cal/mol.K
The molar enthalpies of phase changes (latent heats) are:
ΔH°vaporization at 457K = 6.10 kcal/mol
ΔH°fusion at 387K = 3.74 kcal/mol