University of Mohamed Khider, Biskra
Faculty of Exact Sciences, Natural and Life Sciences
Department: Materials Science
First Year - Common Trunk

Academic Year: 2023/2024
Course: Chemistry 2

Series N ° : 4

Exercise N°1:

Calculate the bond energy of the **C=O** bond in the compound glycine (Gly) $H_2N\text{-}CH_2\text{-}COOH$, knowing that the standard molar enthalpy change for the formation of this compound from its elements in their standard state is ΔH°f (Gly) = -536.71 KJ/mol.

Given:

The standard enthalpy of sublimation of glycine ΔH°Sub (Gly) = 175.90 KJ/mol.

$$C_{(s)} \rightarrow C_{(g)} \quad \Delta H_1^0 = 717.70\ Kj.mol^{-1}$$
$$H_{2\,(g)} \rightarrow 2H_{(g)} \quad \Delta H_2^0 = 435.56\ Kj.mol^{-1}$$
$$O_{2\,(g)} \rightarrow 2O_{(g)} \quad \Delta H_3^0 = 497.84\ Kj.mol^{-1}$$
$$N_{2\,(g)} \rightarrow 2N_{(g)} \quad \Delta H_4^0 = 943.84\ Kj.mol^{-1}$$

The bond	N-H	C-N	O-H	C-O	C-H	C-C
The bond energy $E_{(A\text{-}B)}$ (Kj/mol)	390.41	304.30	462.31	357.39	412.57	345.27

Exercise N°2:

Consider 1 kg of air as an ideal gas undergoing a Carnot cycle. AB and CD are isothermal processes, and BC and DA are adiabatic processes, with temperatures at point A equal to T_1 = 300K and pressures at points C, B, A respectively as P_3 = 9 atm, P_2 = 3 atm, P_1 = 1 atm:

Calculate the efficiency of the cycle using two different methods:

a) Using the heat balance (bilan).

b) Using the temperatures at the two ends of the cycle.

Calculate the ΔS of air during the four transformations. Given Cp = 103 J/Kg.K ; γ = 7/5.

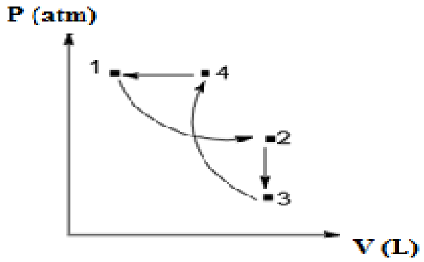
Exercise N°3:

0.056 m³ of an ideal gas undergoes heating at constant volume from the initial state (T_1 = 38°C, P_1 = 1.03 atm) to the second state (P_2 = 1.72 atm), then undergoes heating at constant pressure to a volume of 0.126 m³.

For each transformation, calculate the final temperature, the amount of heat, work done, and the change in both internal energy and entropy. Cv = 20.82 J/mol.K.

Exercise N°4:

Let the Clapeyron diagram represent a series of reversible transformations for one mole of an ideal gas with the given data in the table:



	P (atm)	V (L)	T (K)
1	10	1	600
2	2	5	600
3	1	5	300
4	10	1.25	750

Calculate ΔS for each transformation, then ΔS for the cycle.

Given: Cp = 5.03 cal/K.mol; R = 2 cal/mol.K; Cv = 3.03 cal/K.mol.

Exercise N°5:
Ammonia gas at temperature 24 °C and pressure 10 atm is liquefied. We condense 1 mole of ammonia gas (P_1 = 1 atm, T_1 = -20°C) to one mole of liquefied ammonia (P_2 = 10 atm, T_2 = 24°C). Assume ideal behavior for ammonia gas and neglect the volume of the liquid state compared to the gas state.

Calculate ΔH, ΔU, and ΔS for the aforementioned transformation.

Given:
$Cp(NH_3)g$ = 24.66 J/mol.K; $\Delta HVap(NH_3)$ = 19.825 KJ/mol at 24°C and 10 atm

Exercise N°6:
Calculate the change in entropy (ΔS) during the transformation of 1 mole of solid iodine at 25°C to gaseous iodine at 184°C under atmospheric pressure using the following data:

$Cp(I_2$ solid) = 54.6 J/K.mol; $Cp(I_2$ liquid) = 81.5 J/K.mol; ΔH_{fus} = 15633 J/mol.
$T_{fusion}(I_2$ solid) = 113.6°C; $\Delta H_{Vaporization}$ = 25498 J/mol. $T_{vaporization}(I_2$ liquid) = 184°C.

Exercise N°7:
Consider the following chemical reaction, which takes place at a temperature of 25°C:

$$H_2S\,(g) + 3/2O_2\,(g) \longrightarrow H_2O\,(g) + SO_2\,(g)$$

1- Calculate the change in standard enthalpy and the change in internal energy for this reaction.
2- Calculate the change in standard entropy for this reaction.
3- What is the nature of this reaction?
4- Calculate the change in standard enthalpy for this reaction at 800 K.

Given: Under standard conditions (P = 1 atm, T = 298 K), we have:

	$H_2S_{(g)}$	$O_{2(g)}$	$H_2O_{(g)}$	$SO_{2\,(g)}$
ΔH^0_f(KJ / mole)	-20.6	0	-241.8	-296.8
S^0(J / mole.^{0}K)	205.8	205.1	188.8	248.2
C_P (J / mole.^{0}K)	34.2	29.4	33.6	39.9