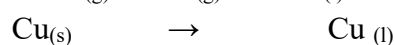
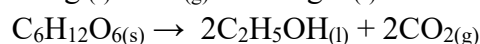
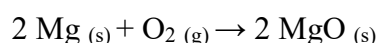


Tutorial Series N°3- Bis

Exercise 1

A-Predict the sign of the entropy change $\Delta S_{\text{reaction}}$ (positive or negative) for the following reactions:



One mole of liquid water at room temperature \rightarrow one mole of liquid water at 50°C

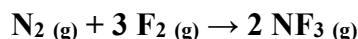
B-Which of the following processes are accompanied by an increase in entropy?

- 1) evaporation of water - 2) precipitation of AgCl(s) - 3) condensation of water vapour to ice - 4) mixing of natural gas (CH₄) and air - 5) dissolution of KBr(s) in water

Exercise 2

NF₃ is a synthetic gas that is a powerful greenhouse gas (GHG) with a global warming potential (GWP) 17,000 times greater than that of CO₂ (over 100 years) and a lifetime in the atmosphere of 740 years.

Predict the sign of ΔS° , then calculate the value of ΔS° for the reaction, using the following data:



Substance	$S_{298\text{K}}^\circ$ (J/mol·K)
F ₂ (g)	203
N ₂ (g)	192
NF ₃ (g)	261

Exercise 3

Determine the change in entropy when one mole of ice at -10°C is transformed into one mole of water at 25°C under atmospheric pressure.

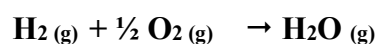
Given: Normal melting temperature of ice $t_f = 0^\circ\text{C}$

$$\text{Latent heat of fusion or enthalpy of fusion of ice } L_F = \Delta_F H_{273,15\text{K}}^\circ = 6019 \text{ J mol}^{-1}$$

$$C_p(\text{ice}) = 37,62 \text{ J mol}^{-1}\text{K}^{-1}; C_p(\text{water}) = 75,24 \text{ J mol}^{-1}\text{K}^{-1}$$

Exercise 4

A-1-Calculate $\Delta S^\circ_{298\text{K}}$ the entropy change of the following reaction:



knowing that:

$S^{\circ}_{298K}(\text{H}_2)_g = 31,2 \text{ cal mol}^{-1}\text{K}^{-1}$; $S^{\circ}_{298K}(\text{O}_2)_g = 49,0 \text{ cal mol}^{-1}\text{K}^{-1}$; $S^{\circ}_{298K}(\text{H}_2\text{O})_g = 45,1 \text{ cal mol}^{-1}\text{K}^{-1}$

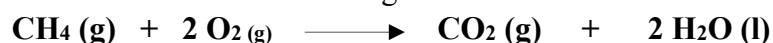
2-For this same reaction, what would be the change in entropy (ΔS°_{800K}) at 800 K.

We give : $C_p(\text{H}_2)_g = 6,9 \text{ cal mol}^{-1}\text{K}^{-1}$, $C_p(\text{O}_2)_g = 7,0 \text{ cal mol}^{-1}\text{K}^{-1}$ et $C_p(\text{H}_2\text{O})_g = 8,0 \text{ cal mol}^{-1}\text{K}^{-1}$

B-Calculate the entropy change that accompanies the preparation of a mixture of ideal gases made up of 1.00 moles of oxygen and 2.00 moles of hydrogen, in the absence of a chemical reaction and when the process is isothermal.

Exercise 5 (for students)

Combustion of methane leads to the following reaction:



Calculate for this reaction under standard conditions:

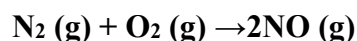
1. The standard entropy change of reaction $\Delta_r S^{\circ}_{298K}$
2. The standard entropy change $\Delta_r S_T^{\circ}$ at $T=373,15 \text{ K}$

Data: $R = 8,314 \text{ J}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$

Compounds	$\text{CH}_4(\text{g})$	$\text{O}_2(\text{g})$	$\text{CO}_2(\text{g})$	$\text{H}_2\text{O}(\text{l})$
$S^{\circ}_{298K} (\text{J}\cdot\text{mol}^{-1} \text{K}^{-1})$	186,26	4205,14	213,74	69,91
$C_p (\text{J}\cdot\text{mol}^{-1} \text{K}^{-1})$	35,31	29,36	37,11	75,29

Exercise 6

Calculate the standard free enthalpy ΔG° at 25°C of the following reaction:



In an aqueous medium and in acidic solution, hydroxylamine NH_2OH is capable of fixing a proton in an instantaneous equilibrium to give the hydroxylamonium ion



Calculate the standard free enthalpy of the reaction.

Data : $\Delta_f G^{\circ}(\text{NH}_2\text{OH}) = -23,35 \text{ kJ}\cdot\text{mol}^{-1}$; $\Delta_f G^{\circ}(\text{NH}_3\text{OH}^+) = -57,61 \text{ kJ}\cdot\text{mol}^{-1}$; $\Delta_f G^{\circ}(\text{H}^+) = 0 \text{ kJ}\cdot\text{mol}^{-1}$