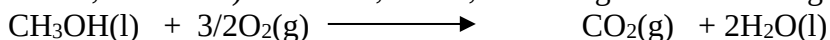


Series N °:3

Exercise N°1:

The complete combustion of one mole of liquid methanol under standard conditions of pressure and temperature ($T = 298 \text{ K}$, $P = 1 \text{ atm}$) releases 2,725 kJ, according to the following equation:



- 1- Calculate the standard molar enthalpy of formation for liquid methanol.
- 2- Calculate the enthalpy change for this reaction at 60°C .
- 3- Determine the change in enthalpy for this reaction at 127°C and under a pressure of 1 atm. It's known that at this pressure, methanol boils at 64.5°C , water at 100°C , and the heat of vaporization is given as: $\Delta H_{\text{vap}}(\text{CH}_3\text{OH})_{\text{l}} = 35,4 \text{ kJ/mol}$; $\Delta H_{\text{vap}}(\text{H}_2\text{O})_{\text{l}} = 44 \text{ KJ/mol}$

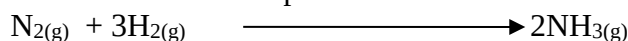
Data: at 298 K

$$\Delta H_{\text{f}}(\text{CO}_2)_{\text{g}} = -393,5 \text{ KJ/mol} ; \quad \Delta H_{\text{f}}(\text{H}_2\text{O})_{\text{l}} = -285,2 \text{ KJ/mol}$$

The element	$\text{CH}_3\text{OH}(\text{g})$	$\text{H}_2\text{O}(\text{g})$	$\text{CH}_3\text{OH}(\text{l})$	$\text{H}_2\text{O}(\text{l})$	$\text{CO}_2(\text{g})$	$\text{O}_2(\text{g})$
$C_p(\text{J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1})$	53,5	38,2	81,6	75,2	36,4	34,70

Exercise N°2:

Let the following chemical reaction occur at a temperature of 298 K:



- 1- Calculate the standard molar enthalpy change for this reaction, $\Delta H^\circ_{\text{R},298}$, and deduce the corresponding change in internal energy, $\Delta U^\circ_{\text{R},298}$.
- 2- Calculate the bond energy of N-H at a temperature of 298 K.
- 3- Calculate the change in enthalpy for this reaction at 500 K ($\Delta H^\circ_{\text{R},500 \text{ K}}$).

$$\Delta H^\circ_{\text{f},298}(\text{N} \equiv \text{N}) = -945 \text{ KJ/mol} ; \quad \Delta H^\circ_{\text{f},298}(\text{H}-\text{H}) = -335 \text{ KJ/mol}$$

The element	$\text{N}_2(\text{g})$	$\text{H}_2(\text{g})$	$\text{NH}_3(\text{g})$
$\Delta H^\circ_{\text{f},298}(\text{KJ / mole})$	0	0	-46,21
$C_p(\text{J / mole} \cdot ^\circ\text{K})$	29,13	28,84	35,66

Exercise N°3:

Let the following reaction be:



- 1- Calculate the standard enthalpy change for this reaction at 650 K.
- 2- Calculate the standard enthalpy of formation for CCl_4 .
- 3- Calculate the bond energy $E(\text{C}-\text{Cl})$.
- 4- Calculate the standard enthalpy of formation for trichloromethane (chloroform, CHCl_3).

Data: at 298 K :

$$\Delta H^\circ_{\text{f}}(\text{HCl}) = -92.3 \text{ kJ} \cdot \text{mol}^{-1}; \quad \Delta H_{\text{vap}}(\text{CHCl}_3) = 38,5 \text{ kJ} \cdot \text{mol}^{-1}; \quad \Delta H^\circ_{\text{f}}(\text{CH}_4) = -74.6 \text{ kJ} \cdot \text{mol}^{-1}; \quad \Delta H_{\text{Sub}}(\text{C}) = 716.6 \text{ kJ} \cdot \text{mol}^{-1}$$

Element	$\text{CH}_4(\text{g})$	$\text{Cl}_2(\text{g})$	$\text{HCl}(\text{g})$	$\text{CCl}_4(\text{g})$	Bond	C-H	C-C	C-O	Cl-Cl	H-H
$C_p(\text{J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1})$	35.71	33.93	29.12	83.51	$E(\text{kJ} \cdot \text{mol}^{-1})$	414	347	351	242.6	436