Series 1 (parte 1)

Exercise 1 :

Calculate the value of the perfect gas constant 'R'; for one mole of gas occupying a volume of 22.4L, under standard conditions (T= 0 °C and P = 1atm).

Exercise 2 :

A perfect gas undergoes a transformation from state (1) to state (2) following three different paths (a, b and c) with:

The 1st transformation is isochoric then isobaric (way a), the 2nd is isobaric then isochoric (way b) and the 3rd is such that PV=Cte (way c).

Condition (1): P1 = 1 bar; V1= 3 L

State (2): P2 = 3 bar; V2= 1 L

1) Represent the three transformations in Clapeyron coordinates;

2) Calculate the work in the three cases and deduce the heat exchanged;

3) Are they received or given up by the system?

Exercise 3:

One mole of perfect gas at an initial temperature of 298K expands from a pressure of 5 atmospheres to a pressure of 1 atmosphere. In each of the

following cases :

1. reversible isothermal relaxation

2. reversible adiabatic relaxation

a) the final temperature of the gas

b) the variation of the internal energy of the gas

c) the work performed by the gas

d) the amount of heat involved

e) the enthalpy variation of the gas

Exercise 4 :

The initial state of one mole of perfect gas is characterized $p_1 = 2 \cdot 10^5$ Pa, V_1 = 14 l. This gas is successively subjected to the following reversible transformations :

An isobaric trigger that doubles its volume ;

An isothermal compression that brings it back to its initial volume ;

An isochoric cooling which brings it back to the initial state.

1. Determine the parameters p, V and T for each state.

2. Represent the transformation cycle on the Clapeyron diagram.

3. Calculate the work W, the heat Q and the internal energy variation ΔU corresponding to each transformation.

Data: R = 8.31 J/(mol*K); c_p =29.09 J/(mol*K), c_V = 20.8 J/(mol*K)

Exercise 5:

Calculate the standard enthalpy ΔH°r,298K of the following reaction :

$CO\ (g) + 3H_2(g) \rightarrow CH_4(g) + H_2O\ (g)$

a) Deduce therefrom the value of the internal energy ΔU°r,298K of the same reaction.

b) Is this reaction endothermic or exothermic?

The standard enthalpies of the combustion reactions ΔH°r,298K of CO, H_2 and CH_4 :

$CO\ (g) + 1/2O_2\ (g) \rightarrow CO_2\ (g)$ ΔH°r,298K (1) = -283 kJ

$H_2\ (g) + 1/2O_2\ (g) \rightarrow H_2O\ (g)$ ΔH°r, 298K (2**)** = -241, 8 kJ

$CH_4\ (g) + 2O_2\ (g) \rightarrow CO_2\ (g) + 2H_2O\ (g)$ ΔH°r, 298K (3) = -803, 2 kJ

Exercise 6 :

Calculate the standard enthalpy ΔH°r,298K of the following reaction :

$C_2H_4\ (g) + H_2O\ (g) \rightarrow C_2H_5OH\ (g)$

data : $\Delta H_f°$,298 (C2H4,g) = 33,6 kJ.mol^{-1}

$\Delta H_f°$,298 (C_2H_5OH,g) = -275,9 kJ.mol^{-1}

$\Delta H_f°$,298 (H_2O,g) = -242,4 kJ.mol^{-1}