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1st Year LMD ST/SM, 1st Year Engineer

Series N° 1

Exercise 1:

1) List the different units of pressure and provide the relationships between these units.
2) Convert 350 mmHg to bar, Pa, and atm.
3) State the different temperature scales and provide the relationships between these scales.
4) Convert: 25°C and -100°C to °F, 0°F to °C and K, 0 K to °C and °F.
5) Calculate the value of the ideal gas constant R in $L.atm.mol^{-1}.K^{-1}$, $J.mol^{-1}.K^{-1}$, and $cal.mol^{-1}.K^{-1}$, knowing that one mole of an ideal gas occupies a volume of 22.4 L at a pressure of 1 atm and a temperature of 0°C.

Exercise 2:

An ideal gas initially in an equilibrium state characterized by P_1=2 atm and V_1=2L undergoes an isothermal expansion until P_2=0.5 atm. What is the volume of the final state?

Exercise 3:

A mass of nitrogen (assumed to be an ideal gas) occupies a volume of 20L at 20°C. It is heated under constant pressure (isobaric process). What volume does it occupy at 120°C?

Exercise 4:

A quantity of air, assumed to be an ideal gas (M=29g/mol), is under a pressure of 10 bars and a temperature of 5°C, contained in a closed and perfectly rigid chamber with a capacity of 5L. Determine the gas pressure at 80°C and the volumic mass in both equilibrium states.

Exercise 5:

The analysis of a 100g sample of air collected at sea level yields the following results: N_2: 75.52%, O_2: 23.15%, Ar: 1.28%, CO_2: 0.046%.

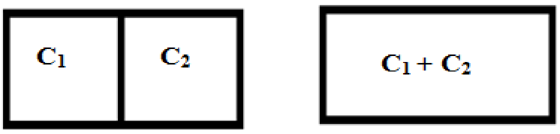
1) Calculate the number of moles of each gas present in this sample.
2) Calculate the mole fraction as well as the partial pressure of each gas.

Data: P_t = 1 atm. N(14), O(16), Ar(40), C(12).

Exercise 6:

A closed, perfectly rigid horizontal cylinder is divided into two compartments, C_1 and C_2, by a partition. At the initial state, compartment C_1 contains 10 moles of oxygen (O_2) at temperature T_1=27°C and pressure P_1=2 atm, and compartment C_2 contains 20 moles of nitrogen (N_2) at temperature T_2=127°C and pressure P_2=3 atm. The partition is removed, and the equilibrium temperature of the mixture T_m reaches 90°C. Assuming both gases are ideal, determine:

1) The pressure of the mixture.
2) The partial pressure of O_2 and N_2.
3) The volumic mass of the mixture.
4) The density of the mixture.



Initial state   Final state

Data: N: 14g/mol, O: 16g/mol

Exercise 7:

We consider two rigid-walled containers, one containing hydrogen and the other containing methane. At the beginning, we have:

H_2 p_1= 5 atm ; T_1= 250 K ; V_1= 10 liters

CH_4 P_2= 40 atm ; T_2= 300 K ; V_2= 40 liters

1) Calculate the masses of hydrogen and methane contained in each container.

2) We heat the two containers to a temperature of 350 K, calculate the pressure of H_2 and that of CH_4.

3) Using a tap, we then connect the two containers; what happens? Calculate the partial pressures of each gas. Deduce the total pressure.

4) We close the tap; calculate the masses of H_2 and CH_4 in each container.

Exercise 8:

An aerosol can contains 50 mL of gas (considered ideal) at a pressure of 1.0×10^7 Pa and a temperature of 20°C.

1) Calculate the quantity of matter (in mol) of this gas.
2) Deduce its molar volume under these conditions.
3) By applying Mariotte's law, calculate the volume of gas that this can is likely to release into the air at 20°C and atmospheric pressure.