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 ° :1

Exercise 1:

Determine the type of system for the following statements:

- A solid substance for a burning candle.
- An alarm clock that is working.
- A car engine running.
- Air present inside a non-moving car tire.
- An electric motor that is running.

Exercise 2:

1- Calculate the derivatives of the following functions and demonstrate that they are valid and accurate total differential equations: $f(x,y) = x^2 + y^2$, $g(x,y) = x.y$

2- We can write the differential equation for the quantity of heat (Q) as a function of pressure (P) and temperature (T) in the following form: $dQ = (-RT/P)dP + C_p(T)dT$ Where :

Cp(T) : The molar specific heat of a gas is related only to the temperature and R: the ideal gas constant.

- Is heat quantity a function of state?

Exercise 3:

1- In standard conditions of pressure and temperature, one mole of an ideal gas occupies a volume of 22.4 liters. Calculate the ideal gas constant, R, in the following cases:

- Pressure (Pa) ; Volume (m^3)
- Pressure (atm) ; Volume (l)
- Pressure (mmHg); Volume (l)
- Pressure (bar); Volume (m^3)

Provide the results in $J \cdot mol^{-1} \cdot K^{-1}$; $cal \cdot mol^{-1} \cdot K^{-1}$ and $l \cdot atm \cdot mol^{-1} \cdot K^{-1}$

2- What is the energy equivalent of 1 atm·L in joules (J) and calories (cal)?

Exercise 4:

1- A glass vessel with a volume of 5 liters contains hydrogen at a temperature of 40 °C and a pressure of 2.57 atm. If this container is cooled to a second state, where its temperature becomes 25 °C, considering hydrogen as an ideal gas:

- Calculate the new pressure.

2- Connect the previous container in its second state to another vessel with a volume of 5 liters containing 20 g of air at a temperature of 25 °C. Calculate:

- The total pressure of the gas mixture.
- The mole fractions and partial pressures of the components of the mixture.

Given data: Air composition (mass ratios) O: 16; H: 1; N: 14; (N_2: 80%; O_2: 20%).

Exercise 5:

- The quantity of hydrogen gas occupies a volume V = 200 cm^3 at a temperature T_1 = 10°C and pressure P_1 = 650 mmHg. What is the volume occupied by the same quantity at a temperature T_2 = 0°C and pressure P_2 = 760 mmHg?
- What is the volume occupied by a mass m = 1g of oxygen gas at a temperature T = 100°C and pressure P = 740 mmHg?
- What is the volume, under standard conditions, occupied by 9.4×10^{21} gas molecules?
- Calculate the number of molecules present in 1 ml of gas under standard conditions. (Assume all gases are ideal)

Exercise 6:

Calculate the amount of heat required during the transformation of 1 kg of ice at -10°C to water vapor at a temperature of 117°C under a pressure of 1.013 bar. Given that:

$Cp(H_2O)s = 38\ J \cdot K^{-1} \cdot mol^{-1}$, $Cp(H_2O)l = 75\ J \cdot K^{-1} \cdot mol^{-1}$, $Cp(H_2O)g = 33\ J \cdot K^{-1} \cdot mol^{-1}$,
$Lf(H_2O, 273K) = 6\ kJ \cdot mol^{-1}$, $Lvap(H_2O, 373K) = 40.6\ kJ \cdot mol^{-1}$, $M(H_2O) = 18 \times 10^{-3}\ kg \cdot mol^{-1}$