

Series N° 1 : States of matter

Exercise: 1

Provide the dimensions and fundamental units of the various physical quantities listed below: speed v , acceleration a , force F , area A , volume V , density ρ , energy E , pressure P , and charge q .

Exercise: 2

Initially, a perfect gas with a volume of $V_1 = 5 \text{ m}^3$ is at a pressure of $P_1 = 500 \text{ Pa}$. It is compressed, while maintaining a constant temperature, to a volume of $V_2 = 2 \text{ m}^3$. What is the final pressure P_2 ?

Exercise: 3

1. What is the volume of 4 moles of an ideal gas if $P = 3 \text{ atm}$ and $T = 300 \text{ K}$?
2. A gas occupies a volume of 6 m^3 at a pressure of 1 atm . What will the pressure be if the volume changes to 4.5 m^3 , with the temperature remaining constant?
3. If the temperature of a gas increases from 0°C to 100°C at constant pressure, by how much will the volume change.

Given: Boltzmann constant $k_B = 1.38 \times 10^{-23} \text{ J/K}$;

Ideal gas constant $R = 0.082 \text{ L} \cdot \text{atm} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} = 8.31 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$

Exercise:4

If dry air is considered a homogeneous mixture of perfect gases with a molar mass

$M = 29 \text{ g/mol}$, consisting of 78% nitrogen (N_2) and 21% oxygen (O_2) with other gases present in small quantities, and if the pressure of the air at sea level is 1 atm , calculate at 0°C :

-The partial pressures of oxygen and nitrogen at sea level.