Work done by ideal gas

Molar mass of an atom or molecule:

$$M = N_A \cdot m_{atom} \longrightarrow [M] = \frac{g}{mole}$$

Amount of substance of mass m:

$$n = \frac{m}{M} \longleftrightarrow p \cdot V = \frac{m}{M} \cdot R \cdot T$$

Work done by gas at constant pressure:

$$W_{gas} = p \cdot \Delta V \longrightarrow \begin{matrix} \Delta V > 0 \Rightarrow W > 0 \\ \Delta V < 0 \Rightarrow W < 0 \end{matrix}$$

Homework 27

Problem 1.
There is a 1-liter bottle filled with water at 27 ℃. The water is liquid at this temperature because there is an attractive force between the molecules. Imagine that we have suddenly "turned off" this attracting force. What is the pressure in the bottle now?
Hint: the mass of 1 liter of water is 1 kg, and the molar mass of water is 18 grams/mole.

Problem 2.
Find the molar mass of molecular oxygen O_2 using the periodic table (see the last page). Using it, find the mass of oxygen in a 10-liter cylinder if it has temperature T=13 ℃ and pressure $p = 9 \cdot 10^6\ Pa$ (note that it is $90\times$ the normal atmospheric pressure!). How long can the oxygen in this cylinder sustain a scuba diver, if an average person needs to inhale about 2 grams of oxygen per minute?

Problem 3.
See the next page!

Homework 27

Problem 3.

There is a cylinder with a piston. The mass of the piston is $100\ kg$, and its area is $10\ cm^2$. The cylinder contains 32 grams of oxygen at $T_1 = 273\ K$. The cylinder is heated to $T_2 = 373\ K$. How does the piston position change? How does the potential energy of the piston change? What work is done by the gas? Neglect atmospheric pressure.

Problem 4*.

How much hydrogen H_2 (in grams) is in a cylinder with a piston if it performs work of $400\ J$, being heated from $250\ K$ to $680\ K$? The gas pressure was maintained constant.

Periodic Table of the Elements