A bottle with volume 3 m^3 is filled with oxygen gas. Its temperature is 20°C and pressure equals 1.45 bar. The molar mass of oxygen is M=32 g/mol. Oxygen gas here is assumed to be ideal gas. Please determine:

1) the mass of gas in bottle;
2) the number of oxygen gas molecules.

Solution:

1) We first determine the specific gas constant for oxygen gas:

$$R_{O2} = \frac{R}{M_{O2}}$$

where R=8.314 J/mol·K is the universal gas constant.

Then we calculate the gas mass through the ideal gas law:

$$p \cdot V = m \cdot R_{O2} \cdot T = m \cdot \frac{R}{M_{O2}} \cdot T \quad \Longrightarrow \quad m = \frac{p \cdot V}{R \cdot T} \cdot M_{O2}$$

$$\Longrightarrow m = \frac{1.45 \cdot 10^5 Pa \cdot 3m^3}{8.314 \ \frac{J}{mol \cdot K} \cdot (20 + 273.15)K} \cdot 32 \frac{g}{mol} = 5711.36 \ g$$

2) We should first calculate the mole of gas in bottle: n=m/M

$$N = N_A \cdot n = N_A \cdot \frac{m}{M_{O2}} = 6.022 \cdot 10^{23} mol^{-1} \cdot \frac{5711.36 \ g}{32 \frac{g}{mol}} = 1.075 \cdot 10^{26}$$

Here N_A is Avogadro constant and equals $6.022 \cdot 10^{23} mol^{-1}$