Task:

A mixture containing 0.538 mol He(g) and 0.103 mol Ar(g) is confined in a 7.00-L vessel at 25oC. Calculate the partial pressure of helium and the total pressure of the mixture in atm.

Solution:

To calculate the total pressure of the mixture we have to use the Ideal Gas Law:

$P \cdot V = n \cdot R \cdot T$

P – the total pressure (atm)

V – the volume (L)

n – the total number of moles of gases

R – universal gas constant (0.082 L · atm / mol · K)

T – Kelvin temperature

The total number of moles is

$n = 0.538 + 0.103 = 0.641$ mol

Kelvin temperature is

$T(K) = 273 + T(°C)$

$T(K) = 273 + 25 = 298$ K

The total pressure is

$P = n \cdot R \cdot T / V$

$P = 0.641 \cdot 0.082 \cdot 298 / 7.00 = 2.24$ atm

The partial pressure of gas in the mixture depends on the total pressure and the mole fraction

$P_i = x_i \cdot P$

The mole fraction is

$X_1 = n_1 / (n_1 + n_2)$

The mol fraction of He

X(He) = 0.538 / 0.641 = 0.84

The mol fraction of Ar

X(Ar) = 0.103 / 0.641 = 0.16

The partial pressure of He is

$P_{He} = 0.84 \cdot 2.24 = 1.88$ atm

The partial pressure of Ar is

$P_{Ar} = 0.16 \cdot 2.24 = 0.36$ atm

Answer: P = 2.24 atm; P_{He} = 1.88 atm; P_{Ar} = 0.36 atm