Answer on Question #71342 – Chemistry – General Chemistry

Task:

A 1.00-L gas sample at 100 °C and 550 torr contains 52.0% helium and 48.0% xenon by mass. What are the partial pressures of the individual gases?

PHe ____ torr?
PXe ____ torr?

Solution:

Let's assume that there is 100 g of gas mixture, then:

$$m(He) = m(mixture) * w(He) = 100g * 0.52 = 52g;$$
$$m(\mathrm{Xe}) = m(mixture) * w(\mathrm{X}e) = 100g * 0.48 = 48g.$$

Molar mass of helium: M(He) = 4.00 g/mol.
Molar mass of xenon: M(Xe) = 131.29 g/mol.

52 g of He, convert to moles:

moles He = grams/molar mass

$$\mathrm{n}(He) = \frac{m(He)}{M(He)} = \frac{52g}{4.00\,g/mol} = 13\,\mathrm{moles};$$

48 g of Xe, convert to moles:

moles Xe = grams/molar mass.

$$\mathrm{n}(\mathrm{X}e) = \frac{m(\mathrm{X}e)}{M(\mathrm{X}e)} = \frac{48g}{131.29\,g/mol} = 0.3656\,\mathrm{moles};$$

Find total moles gases:

$$\mathrm{n(total)} = n(\mathrm{He}) + \mathrm{n(Xe)} = 13 + 0.3656 = 13.3656\ \mathrm{moles}.$$

The pressure of each gas is directly proportion to its mole fraction.

Mole fraction of He = moles He / total moles.

$$mole\ fraction\ He = \frac{n(He)}{n(total)} = \frac{13\,moles}{13.3656\,moles} = 0.9726$$

Thus, the mole fraction of Xe must be 1-0.9726 = 0.0274.

So the partial pressure He will be its mole fraction X total pressure of 550 torr and the partial pressure of the Xe will be its mole fraction x the total of 550 torr.

P(He) = mole fraction He x P(total).

$$P(He) = 0.9726 * 550\,torr = 534.93\,torr.$$

P(Xe) = moles fractiion Xe x P(total).

$$P(\mathrm{X}e) = 0.0274 * 550\,torr = 15.07\,torr.$$

Answer: P(He) = 534.93 torr;

P(Xe) = 15.07 torr