Partial Pressure in Chemistry Questions with Solutions

Q1. Which of the following gas mixtures at room temperature obeys Dalton's law of partial pressures?

a.) NO and O_2
b.) CO and CO_2
c.) NH_3 and HCl
d.) SO_2 and O_2

Correct Answer– (b.) CO and CO_2

Q2. A closed container at a constant temperature contains equal molar quantities of hydrogen gas and oxygen gas. Which of the following quantities for the two gases will be the same?

a.) partial pressure
b.) average kinetic energy
c.) average molecular velocity
d.) All of the above

Correct Answer– (a.) partial pressure and (b.) average kinetic energy

Q3. The partial pressure of the gaseous component divided by the total vapour pressure of the mixture will be equal to which of the following option?

a.) mass of components
b.) mole fraction of the component
c.) mass% of the component
d.) molecular mass of the component

Correct Answer– (b.) mole fraction of the component.

Q4. For a dilute solution, Raoult's law states that:

a.) The relative lowering of vapour pressure is equal to the mole fraction of solute
b.) The relative lowering of vapour pressure is equal to the mole fraction of solvent
c.) relative lowering of vapour pressure is proportional to the amount of solute in solution
d.) The vapour pressure of the solution is equal to the mole fraction of the solvent

Correct Answer– (a.) The relative lowering of vapour pressure is equal to the mole fraction of solute

Q5. At a total pressure of 10 atm, 56 g of nitrogen and 96 g of oxygen are mixed isothermally. The ratio of oxygen and nitrogen partial pressures is:

a.) 3:2
b.) 2:3
c.) 3:1
d.) 2:1

Correct Answer– (a.) 3:2
Explanation:
Moles of nitrogen is 56/28 = 2 mol
Moles of oxygen is 96/32 = 3 mol
Total moles = 5 mol
Mole fraction of nitrogen is ⅖ = 0.4
Mole fraction of oxygen is 1 – 0.4 = 0.6
Partial pressure of oxygen is 0.6 × 10 = 6 atm
Partial pressure of nitrogen is 0.4 × 10 = 4 atm
Therefore, the ratio will be 6:4 = 3:2.

Q6. State Dalton's law of partial pressure.

Answer. Dalton's partial pressure law states that when two or more gases that do not react chemically are enclosed in a vessel, the total pressure equals the sum of their partial pressures.

Q7. What is the partial pressure in the atmosphere?

Answer. At sea level, with an atmospheric pressure of 760 mm Hg, the partial pressures of the various gases can be estimated to be 593 mm Hg for nitrogen, 160 mm Hg for oxygen, and 7.6 mm Hg for argon.

Q8. What factors influence partial pressure?

Answer. The partial pressure of a single gas is equal to the total pressure multiplied by its mole fraction. The Ideal Gas Equation applies equally well to mixtures of gases as it does to pure gases because it is based solely on the number of particles and not the identity of the gas.

Q9. Hydrogen, helium, neon, and argon are all components of a gas mixture. The mixture has a total pressure of 93.6 kPa. Helium, neon, and argon have partial pressures of 15.4 kPa, 25.7 kPa, and 35.6 kPa, respectively. What is the pressure extended by the hydrogen?

Answer. Using Dalton's Law of Partial Pressure:
$P_{Total} = P_{hydrogen} + P_{helium} + P_{neon} + P_{argon}$

$93.6 \text{ kPa} = P_{hydrogen} + 15.4 \text{ kPa} + 25.7 \text{ kPa} + 35.6 \text{ kPa}$
$P_{hydrogen} = 16.9 \text{ kPa}$

Q10. Three gases are held in a container: oxygen, carbon dioxide, and helium. The three gases have partial pressures of 2.00 atm, 3.00 atm, and 4.00 atm, respectively. How much is the total pressure inside the container?

Answer. Using Dalton's Law of Partial Pressure:
$P_{Total} = P_{oxygen} + P_{carbondioxide} + P_{helium}$
$P_{Total} = 2 + 3 + 4 = 9$ atm

Q11. At 255K, a 2L mixture of helium, nitrogen, and neon has a total pressure of 815 mmHg. What mass of neon is present in the mixture if the partial pressure of helium is 201 mmHg and the partial pressure of nitrogen is 351 mmHg?

Answer. Given:
$P_{Total} = 815$ mmHg
$P_{He} = 201$ mmHg
$P_{N} = 351$ mmHg
$P_{Total} = P_{He} + P_{N} + P_{Ne}$
$P_{Ne} = 815 – 201 – 351 = 263$ mmHg = 0.346 atm
Using ideal gas law PV = nRT

$$n = \frac{PV}{RT}$$

$$n = \frac{0.346\ atm \times 2L}{0.08206 \frac{L.atm}{mol.K} \times 255K}$$

n = 0.03307 moles of Ne
Converting moles into grams:
0.3307 moles of Ne × (20.18 g / 1 mole of Ne) = 0.667g

Q12. At 25°C, a 4.0 L container is filled with 2.0 g neon and 8.0 g helium. What is the total pressure of the mixture?

Answer.
The number of moles of neon:
$n_{neon} = 2/20.2 = 0.099$ mol
The number of moles of helium:
$n_{helium} = 8/4.003 = 2$ mol
Total moles = 0.099 + 2 = 2.1 mol
Using ideal gas law to calculate the total partial pressure:
PV = nRT

$$P = \frac{2.1\ mol \times 0.08206 \frac{atm.L}{mol.K} \times 298.15K}{4L}$$

$P_{Total} = 12.8$ atm ≅ 13 atm.

Q13. A container containing two gases, helium and argon, contains 30.0% helium by volume. If the total pressure inside the container is 4.00 atm, calculate the partial pressures of helium and argon.

Answer. Since the temperature and pressure remain constant, according to Avogadro's Hypothesis: Two equal-volume of gas at the same temperature and pressure contain the same number of molecules.
Therefore, 30% volume of helium = 30% molecules
Hence, mole fraction of helium = 0.3
Partial pressure of helium will be 4 atm × 0.3 = 1.2 atm
Partial pressure of argon:
P_{argon} = 4 – 1.2 = 2.80 atm.

Q14. A flask contains 14.0 g of hydrogen, 84.0 g of nitrogen, and 2.00 moles of oxygen. What is the total pressure in the flask if the partial pressure of oxygen is 78.00 mm of mercury?

Answer. Given:
Mass of hydrogen = 14 g
Mass of nitrogen = 84 g
Moles of oxygen = 2 mol
Partial pressure of oxygen = 78 mm Hg

The number of moles of H is:

$$n_H = \frac{14g}{1.00\ g/mol} = 13.8mol$$

The number of moles of N is:

$$n_N = \frac{84g}{28.014\ g/mol} = 2.9mol$$

Total number of moles = 13.8 + 2.9 + 2 = 18.7 mol

Mole fraction of each gas:

Gas	Moles	Mole fraction
Hydrogen	13.8	13.8/18.7 = 0.73
Nitrogen	2.9	2.9/18.7 = 0.15
Oxygen	2	2/18.7 = 0.1

Determining partial pressure of hydrogen and nitrogen by using the given information about oxygen by ratio and proportion method:

Hydrogen:

$$\frac{0.1}{78\ mmHg} = \frac{0.73}{x}$$

x = 569.4 mmHg

Nitrogen:

$$\frac{0.1}{78\ mmHg} = \frac{0.15}{y}$$

y = 117 mmHg

Total partial pressure = 569.4 + 117 + 78 = 764.4 mmHg

Q15. To avoid serious problems, such as "the bends," deep-sea divers must use special gas mixtures in their tanks rather than compressed air. Divers are subjected to a pressure of approximately 10 atm at depths of approximately 350 ft. A typical gas cylinder used for such depths has a volume of 10.0 L and contains 51.2 g of O_2 and 326.4 g of He. At 20°C, what is the partial pressure of each gas, and what is the total pressure in the cylinder?

Answer. Given:
Mass of helium = 326.4 g, mass of oxygen = 51.2g
Temperature = 20°C = 293.1K

The number of moles of He is:

$$n_{He} = \frac{326.4g}{4.003\ g/mol} = 81.54mol$$

The number of moles of O_2 is:

$$n_{O_2} = \frac{51.2g}{32\ g/mol} = 1.60mol$$

Using ideal gas law to calculate the partial pressure of each gas:
PV = nRT
For helium gas,

$$P_{He} = \frac{n_{He}RT}{V}$$

$$P_{He} = \frac{81.54\ mol \times 0.08206\frac{atm.L}{mol.K} \times 293.1K}{10.0L}$$

P_{He} = 196.2 atm

For oxygen gas,

$$P_{O_2} = \frac{n_{O_2}RT}{V}$$

$$P_{O_2} = \frac{1.60\ mol \times 0.08206 \frac{atm.L}{mol.K} \times 293.1K}{10.0L}$$

P_{O2} = 3.85 atm

The total pressure = Sum of the two partial pressures

$P_T = P_{He} + P_{O2}$ = 196.2 + 3.85 = 200.1 atm.

Practice Questions on Partial Pressure

Q1. Dalton's Law of partial pressure is not applicable for which of the following?

a.) reactive gases
b.) non-reacting gases
c.) solids
d.) All of the above

Correct Answer– (b.) non-reacting gases and (c.) solids

Q2. In a closed system, a sample of gas A evaporates over water. What is the pressure of gas A if the total pressure is 780 torr and the pressure of water vapour is 1 atm?

a.) 1 atm
b.) 0.03 atm
c.) 0.3 atm
d.) 3.0 atm

Correct Answer– (b.) 0.03 atm

Q3. At 50.0 °C, 80.0 litres of oxygen are collected over water. The room has an atmospheric pressure of 96.00 kPa. Determine the partial pressure of oxygen.

Answer. Water has a vapour pressure of 12.34 kPa at 50.0 °C.

$P_{Total} = P_{oxygen} + P_{water}$

96 kPa = P_{oxygen} + 12.34 kPa

P_{oxygen} = 89.66 kPa.

Q4. A cylinder of compressed natural gas has a volume of 20.0 L and contains 1813 g of methane and 336 g of ethane. Calculate the partial pressure of each gas at 22.0°C and the total pressure in the cylinder.

Answer. Given:

Mass of methane = 1813 g, mass of ethane = 336 g

Temperature = 22°C = 295.15 K

The number of moles of methane is:

$$n_{methane} = \frac{1813g}{16.04\ g/mol} = 113.03mol$$

The number of moles of ethane is:

$$n_{ethane} = \frac{336g}{30.07\ g/mol} = 11.17mol$$

Using ideal gas law to calculate the partial pressure of each gas:
PV = nRT

For methane gas,

$$P_{methane} = \frac{n_{methane}RT}{V}$$

$$P_{methane} = \frac{113.03\ mol \times 0.08206\frac{atm.L}{mol.K} \times 295.15K}{20.0L}$$

$P_{methane}$ = 136.87 atm ≅ 137 atm

For ethane gas,

$$P_{ethane} = \frac{n_{ethane}RT}{V}$$

$$P_{ethane} = \frac{11.17\ mol \times 0.08206\frac{atm.L}{mol.K} \times 295.15K}{20.0L}$$

P_{ethane} = 13.5 atm ≅ 14 atm

The total pressure = Sum of the two partial pressures
$P_T = P_{methane} + P_{ethane}$ = 137 + 14 = 151 atm.

Q5. What is the pressure of the resulting gas mixture if 3.00 mol of N_2 and 4.00 mol of O_2 are placed in a 35.0 L container at 25.0 °C?

Answer. According to Dalton's law of partial pressure, the total pressure in the container is the sum of the partial pressure of all the gases in it.
Total moles of gases: 3 + 4 = 7 mol
Using the ideal gas law: PV = nRT
P × 35 = 7 × 0.8206 × 273 K
P = 4.48 atm.