

Gas Mixtures and Gas Stoichiometry

Partial pressures, molar volume and gas volumes in reactions

Name _____ Class _____ Date _____

EQUATIONS AND DATA

$PV = nRT$ · $R = 0.08206 \text{ L}\cdot\text{atm}/(\text{mol}\cdot\text{K})$ · $T(\text{K}) = t(^{\circ}\text{C}) + 273.15$ · $1 \text{ atm} = 760 \text{ mmHg} = 101.325 \text{ kPa}$

$P(\text{total}) = P(\text{A}) + P(\text{B}) + \dots$ · $P(\text{A}) = x(\text{A}) P(\text{total})$ · molar volume 22.4 L/mol (0°C , 1 atm)

Water vapour pressure: 19.8 mmHg at 22°C · Molar masses (g/mol): He 4.003 · O_2 32.00 · Zn 65.38 · NaN_3 65.02

Show units in every step.

A. Partial pressures

1. State Dalton's law, and explain why the partial pressure of a gas is proportional to its mole fraction.

2. Dry air at 1.00 atm is $78.1\% \text{ N}_2$, $20.9\% \text{ O}_2$ and $0.93\% \text{ Ar}$ by moles. Calculate each partial pressure in atm and in kPa .

3. 2.00 g of helium and 8.00 g of oxygen are placed in a 10.0 L container at 27°C . Calculate (a) the moles of each gas (b) the mole fraction of helium (c) each partial pressure and the total pressure.

B. Gases collected over water

4. Oxygen is collected over water at 22 °C. The volume is 0.500 L and the total pressure is 748 mmHg. Calculate (a) the pressure of the dry oxygen in atm (b) the moles and mass of oxygen collected.

C. Gas stoichiometry

5. 1.31 g of zinc reacts with excess hydrochloric acid: $\text{Zn} + 2 \text{HCl} \longrightarrow \text{ZnCl}_2 + \text{H}_2$. Calculate the volume of hydrogen formed at 25 °C and 1.00 atm.

6. All gases are at the same temperature and pressure. (a) What volume of oxygen is needed to burn 2.00 L of propane? (b) What volume of CO_2 forms? $\text{C}_3\text{H}_8 + 5 \text{O}_2 \longrightarrow 3 \text{CO}_2 + 4 \text{H}_2\text{O}$

7. What volume does 0.250 mol of nitrogen occupy at 0 °C and 1 atm? Why can't you use the same molar volume at 25 °C?

D. Challenge

8. A car airbag inflates with nitrogen from the decomposition of sodium azide:
 $2 \text{NaN}_3 \longrightarrow 2 \text{Na} + 3 \text{N}_2$. What mass of sodium azide is needed to fill a 60.0 L airbag at 25 °C and 1.10 atm?