

14.25 (a) Consider the combustion of $\text{H}_2(\text{g})$: $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{H}_2\text{O}(\text{g})$. If hydrogen is burning at the rate of 0.48 mol/s, what is the rate of consumption of oxygen? What is the rate of formation of water vapor? (b) The reaction $2\text{NO}(\text{g}) + \text{Cl}_2(\text{g}) \longrightarrow 2\text{NOCl}(\text{g})$ is carried out in a closed vessel. If the partial pressure of NO is decreasing at the rate of 56 torr/min, what is the rate of change of the total pressure of the vessel?

$$\textcircled{1} \quad \frac{\Delta n_{\text{total}}}{\Delta t} = -\frac{\Delta n_{\text{NO}}}{\Delta t} - \frac{\Delta n_{\text{Cl}_2}}{\Delta t} + \frac{\Delta n_{\text{NOCl}}}{\Delta t} \quad \begin{array}{l} 2 \text{ mol NO} \\ 2 \text{ mol NOCl} \end{array}$$

$$\frac{\Delta n_{\text{total}}}{\Delta t} = -\frac{\Delta n_{\text{NO}}}{\Delta t} - \frac{\Delta n_{\text{Cl}_2}}{\Delta t} + \frac{\Delta n_{\text{NOCl}}}{\Delta t}$$

$$\frac{\Delta n_{\text{total}}}{\Delta t} \frac{RT}{V} = -\frac{\Delta n_{\text{Cl}_2}}{\Delta t} \frac{RT}{V}$$

$$\frac{\Delta P_{\text{total}}}{\Delta t} = -\frac{\Delta P_{\text{Cl}_2}}{\Delta t} \quad [\text{equal } V]$$

$$\textcircled{2} \quad \text{rate} = -\frac{\Delta n_{\text{Cl}_2}}{\Delta t} = -\frac{1}{2} \frac{\Delta n_{\text{NO}}}{\Delta t}$$

$$\text{i.e.} \quad -\frac{\Delta n_{\text{Cl}_2}}{\Delta t} \frac{RT}{V} = -\frac{1}{2} \frac{\Delta n_{\text{NO}}}{\Delta t} \frac{RT}{V}$$

$$-\frac{\Delta P_{\text{Cl}_2}}{\Delta t} = -\frac{1}{2} \frac{\Delta P_{\text{NO}}}{\Delta t}$$

$$\begin{aligned}\frac{\Delta P_{ch}}{\Delta t} &= \frac{1}{2} \frac{\Delta P_{no}}{\Delta t} \\ &= \frac{1}{2} \left(\frac{5.6 \text{ torr}}{\text{min}} \right)\end{aligned}$$

$$\frac{\Delta P_{ch}}{\Delta t} = \frac{2.8 \text{ torr}}{\text{min}} \quad [\text{eqn 2}]$$

substit eqn 2 into eqn 1

$$\begin{aligned}\frac{\Delta P_{total}}{\Delta t} &= - \frac{\Delta P_{ch}}{\Delta t} \\ &= - \frac{2.8 \text{ torr}}{\text{min}}\end{aligned}$$

0

