$2\ N_2O_5 \rightarrow 4\ NO_2 + O_2$

The rate of formation of $O_2$ is 1/2 times as fast as compared to the rate of disappearance of $N_2O_5$.

rate of formation of $O_2$ = 1/2 x 2.5 x $10^{-6}$ mol / L·s = 1.25 x $10^{-6}$ mol / L·s

7.(a) $I^-_{(aq)} + OCl^-_{(aq)} \rightarrow Cl^-_{(aq)} + OI^-_{(aq)}$

$$\text{Rate} = \frac{-\Delta[I^-]}{\Delta t} = \frac{-\Delta[OCl^-]}{\Delta t} = \frac{\Delta[Cl^-]}{\Delta t} = \frac{\Delta[O^-]}{\Delta t}$$

(b) $3\ O_{2(g)} \rightarrow 2\ O_{3(g)}$

$$\text{Rate} = -\frac{1}{3}\frac{\Delta[O_2]}{\Delta t} = \frac{1}{2}\frac{\Delta[O_3]}{\Delta t}$$

(c) $4\ NH_{3(g)} + 5\ O_{2(g)} \rightarrow 4\ NO_{(g)} + 6\ H_2O_{(g)}$

$$\text{Rate} = -\frac{1}{4}\frac{\Delta[NH_3]}{\Delta t} = -\frac{1}{5}\frac{\Delta[O_2]}{\Delta t} = \frac{1}{4}\frac{\Delta[NO]}{\Delta t} = \frac{1}{6}\frac{\Delta[H_2O]}{\Delta t}$$

(d) $CH_{4(g)} + 2\ O_{2(g)} \rightarrow CO_{2(g)} + 2\ H_2O_{(g)}$

$$\text{Rate} = -\frac{\Delta[CH_4]}{\Delta t} = -\frac{1}{2}\frac{\Delta[O_2]}{\Delta t} = \frac{\Delta[CO_2]}{\Delta t} = \frac{1}{2}\frac{\Delta[H_2O]}{\Delta t}$$

8. (a) $[CH_4] = \frac{\text{mol}}{\text{L}} = \frac{8.0\ \text{mol}}{2.00\ \text{L}} = 4.0\ \text{mol / L}$

Rate of consumption of $CH_4$ = $\frac{\text{concentration}}{\text{time}} = \frac{4.0\ \text{mol / L}}{3.2\ \text{s}} = 1.25\ \text{mol / L·s}$

(b) Rate of consumption of $O_2$

$CH_{4(g)} + 2\ O_{2(g)} \rightarrow CO_{2(g)} + 2\ H_2O_{(g)}$

The rate of consumption of $O_2$ is 2 times as fast as compared to the rate of consumption of $CH_4$ is

2 x 1.25 mol / L·s = 2.50 mol / L·s