Solutions for Homework 1

2.1) 2 if the reaction is assumed to be elementary reaction. If not, the order of the reaction cannot be predicted from the stoichiometry equation. Experimental methods are required to evaluate the order if the reaction.

2.2) $2NO_2 + \frac{1}{2}O_2 = N_2O_5$

$$-\frac{r_{NO_2}}{2} = -\frac{r_{O_2}}{1/2} = \frac{r_{N_2O_5}}{1}$$

2.3) The rate expression for a given set of reaction does not change if the equation is rewritten in other form.

2.7

$T = 400K$

$$-\frac{dP_A}{dt} = 3.60\, P_A^2$$

(a)

$$\left[\frac{atm}{hr}\right] = [k]\,[atm^2]$$

$$\therefore [k] = (atm)^{-1}(hr)^{-1}$$

(b) For ideal gas

$$P_A V = n_A RT$$

$$\Rightarrow \quad P_A = C_A RT$$

$$-\frac{d(C_A RT)}{dt} = 3.66\,(C_A RT)^2$$

$$\Rightarrow -\frac{dC_A}{dt} = 3.66\,C_A^2\,(RT)$$

$$= 3.66 \times \frac{22.4}{273} \times 400$$

$$= 120\ hr^{-1}\left(\frac{mol}{l}\right)^{-1}$$

2.9)

$$K = K_0\, e^{-\frac{E_a}{RT}}$$

$$\frac{K_{650}}{K_{500}} = e^{-\frac{300,000}{8.314}\left(\frac{1}{923} - \frac{1}{773}\right)}$$

$$= 1971$$

2.11)

| speed (m/hr) | Temp, °C |
|---|---|
| 150 | 13 |
| 160 | 16 |
| 230 | 22 |
| 295 | 24 |
| 370 | 28 |

$$k = k_0 e^{-\frac{E_a}{RT}}$$

$$\ln k = \ln k_0 - \frac{E_a}{R} \times \frac{1}{T}$$

| ln(speed) | 1/T (×10³) |
|---|---|
| 5.01 | 3.4965 |
| 5.07 | 3.4602 |
| 5.44 | 3.3898 |
| 5.69 | 3.3670 |
| 5.91 | 3.3220 |

Plot graph between $\ln(\text{speed}) \times \frac{1}{T}$

The slope of graph $= -\frac{E_a}{R}$

From graph,

$$-\frac{E_a}{R} = -5420 \qquad R = 8.314$$

$$\therefore E_a = 5420 \times 8.314$$

$$= 45062 \text{ J}$$

$$= 45.062 \text{ kJ}$$