

CH. 14 Kinetics

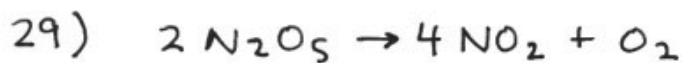


$$\text{Rate} = k [B]^2$$

a) A is a zero order reactant, so NO CHANGE in the rate!
 $[A]^0 = 1$
 $\left\{ \begin{array}{l} k \text{ is also constant.} \\ \text{Only a change in} \\ \text{temp. can change } k! \end{array} \right.$

b) B \rightarrow 2nd order
 A \rightarrow 0 order
 Overall rxn order \rightarrow 2nd order

c) $k = \frac{\text{Rate}}{[B]^2} = \frac{M s^{-1}}{M^2} = M^{-1} s^{-1}$



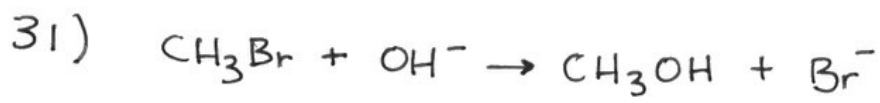
$$\text{Rate} = k [N_2O_5]$$

$$k = 4.82 \times 10^{-3} s^{-1}$$

a) $\text{Rate} = 4.82 \times 10^{-3} s^{-1} [N_2O_5]$

b) $\text{Rate} = 4.82 \times 10^{-3} s^{-1} (.0240 M)$
 $= 1.16 \times 10^{-4} M s^{-1}$

c) If double $[N_2O_5]$, rate doubles.
 d) If half $[N_2O_5]$, rate is halved. } N_2O_5 is 1st order reactant.



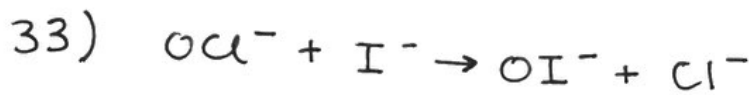
$$\text{Rate} = k [\text{CH}_3\text{Br}] [\text{OH}^-]$$

a) $k = \frac{.0432 \text{ M s}^{-1}}{(5.0 \times 10^{-3} \text{ M})(.050 \text{ M})} = 170 \text{ M}^{-1} \text{ s}^{-1}$

b) $1.7 \times 10^2 \text{ M}^{-1} \text{ s}^{-1}$

c) If $[\text{OH}^-]$ is tripled, rate will triple.

d) If $[\text{OH}^-]$ is tripled & $[\text{CH}_3\text{Br}]$ is tripled, rate will be 9x faster.



a) $\text{Rate} = k [\text{OCl}^-]^x [\text{I}^-]^y$

- when $[\text{OCl}^-]$ doubles, rate doubles, $\therefore \text{OCl}^-$ is 1st order
- when $[\text{I}^-]$ doubles, rate doubles, $\therefore \text{I}^-$ is 1st order

* $\text{Rate} = k [\text{OCl}^-] [\text{I}^-]$

b) $k = \frac{1.36 \times 10^{-4} \text{ M s}^{-1}}{(1.5 \times 10^{-3} \text{ M})(1.5 \times 10^{-3} \text{ M})} = 60 \text{ M}^{-1} \text{ s}^{-1}$

c) $\text{Rate} = 6.0 \times 10^1 \text{ M}^{-1} \text{ s}^{-1} (2.0 \times 10^{-3} \text{ M})(5.0 \times 10^{-4} \text{ M})$
 $= 6.0 \times 10^{-5} \text{ M s}^{-1}$



* NH_3 is 1st order (T 1 + 2)

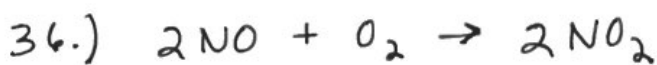
* BF_3 is 1st order (T 4 + 5)

a) $\text{Rate} = k[\text{BF}_3][\text{NH}_3]$

b) 2nd order overall

c) $k = \frac{.2130 \text{ M s}^{-1}}{(.250 \text{ M})^2} = 3.41 \text{ M}^{-1} \text{ s}^{-1}$

d) $\text{Rate} = 3.41 \text{ M}^{-1} \text{ s}^{-1} (.100 \text{ M})(.500 \text{ M})$
 $= .171 \text{ M s}^{-1}$



$$\text{Rate} = k[\text{NO}]^x[\text{O}_2]^y$$

NO is 2nd order

O₂ is 1st order

$$a) \quad \text{Rate} = k[\text{NO}]^2[\text{O}_2]$$

$$b) \quad k = \frac{\text{M s}^{-1}}{(\text{M})^2(\text{M})} = \text{M}^{-2} \text{s}^{-1}$$

$$c) \quad k_1 = \frac{1.41 \times 10^{-2}}{(.0126)^2(.0125)} = 7105 = 7.11 \times 10^3$$

$$k_2 = \frac{5.64 \times 10^{-2}}{(.0252)^2(.0125)} = 7105 = 7.11 \times 10^3$$

$$k_3 = \frac{1.13 \times 10^{-1}}{(.0252)^2(.0250)} = 7118 = 7.12 \times 10^3$$

$$\text{Avg} = 7.11 \times 10^3 \text{ M}^{-2} \text{ s}^{-1}$$

$$d) \quad \text{Rate} = 7.11 \times 10^3 \text{ M}^{-2} \text{ s}^{-1} (.0750 \text{ M})^2 (.0100 \text{ M}) \\ = .400 \text{ M s}^{-1} \rightarrow \text{Rate of disappearance of NO}$$

$$\text{Rate of disappearance of O}_2 = .200 \text{ M s}^{-1}$$

38. a) $\text{Rate} = k [\text{S}_2\text{O}_8^{2-}]^x [\text{I}^-]^y$

$\text{S}_2\text{O}_8^{2-}$ is 1st order reactant

I^- is \rightarrow

$$\frac{T3}{T2} \quad \frac{7.8 \times 10^{-6}}{3.9 \times 10^{-6}} = \frac{k (.036)^x (.054)^y}{k (.027)^x (.036)^y}$$

$$2 = (1.33)^x (1.5)^y$$

$$1.5 = 1.5^y \quad (y = 1)$$

$$\text{Rate} = k [\text{S}_2\text{O}_8^{2-}] [\text{I}^-]$$

b) $k = \frac{\text{Rate}}{[\text{S}_2\text{O}_8^{2-}] [\text{I}^-]} = \frac{\text{M s}^{-1}}{\text{M M}} = \text{M}^{-1} \text{s}^{-1}$

$$k_1 = \frac{2.6 \times 10^{-6}}{(.018)(.036)} = .0040$$

$$k_2 = \frac{3.9 \times 10^{-6}}{(.027)(.036)} = .0040$$

$$k_3 = \frac{7.8 \times 10^{-6}}{(.036)(.054)} = .0040$$

$$k_4 = \frac{1.4 \times 10^{-5}}{(.050)(.072)} = .0039$$

$$k_{\text{avg}} = .0040 \text{ M}^{-1} \text{ s}^{-1}$$

c) The rate of disappearance of $\text{S}_2\text{O}_8^{2-}$ is $\frac{1}{3}$ the rate of disappearance of I^- .

d) $\text{Rate} = (.0040)(.025)(.050)$

$$= 5.0 \times 10^{-6} \text{ M s}^{-1} = \text{rate of disapp. of } \text{S}_2\text{O}_8^{2-}$$

$$1.5 \times 10^{-5} \text{ M s}^{-1} = \text{rate of disapp. of } \text{I}^-$$