Chapter 14

① a) product : conc. ↑ over time
b) less reactants left to collide takes longer and slows rate

② D B is reactant since ↓
A is product A is increasing its' conc. at higher rate than B is decreasing

③ a) 0^x
b) $3^x = 9$ $x = 2$
c) $2^x = 8$ $x = 3$

④ 2 (greatest conc. of NO)

⑤ a) 1 & 2 (same slope but diff. conc)
b) 2 & 3 ; 3 slope isn't as steep so it is slower

⑥ a) $8 \longrightarrow 4 \longrightarrow 2$
0 min (15 min) 30 min
half_life = time to cut amount in half

b) $8 \xrightarrow{①} 4 \xrightarrow{②} 2 \xrightarrow{③} 1 \xrightarrow{④} 0.5$

$\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \ldots = \frac{1}{16}$

⑦ 1) reactants 2) activation energy
3) energy or enthalpy of rxn 4) products

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10) 1 = B
2 transition states = activated comp.
B → C
exothermic

12) a) ~~$2A_2$~~ + $2AB$ + $2AC \rightarrow$ ~~$2A_2$~~ + $2C$ + $2A_2B$

$2AB + 2AC \rightarrow 2C + 2A_2B$

b) A present in middle (made then used)

c) A_2 - present at start and end of reaction but not in overall reaction

15) a) time 0 = 0.0M (no reaction yet)
time 10 = 0.065 - 0.051 = 0.014 moles A used so, moles B made
time 20 = 0.065 - .042 = .023 moles B
time 30 = 0.065 - .036 = .029 moles B
time 40 = 0.065 - .031 = .034 moles B

b) time 10 = $\frac{(.065 - .051)\,M^{01}}{.1\,L \cdot 600S} =$ 2.3×10^{-4} 1/s

10 min | 60s / 1 min = 60s

time 20 = $\frac{(.051 - .042)}{600S} =$ 1.5×10^{-4} M/S

time 30 = 1.0×10^{-4} M/S
time 40 = 8.0×10^{-3} M/S

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15) c) $\frac{(0.051 - 0.036)}{1\ L \cdot (20 \cdot 60)} = 1.3 \times 10^{-4}\ M/s$

19) a) $-\frac{\Delta[H_2O_2]}{\Delta t} = \frac{\Delta[H_2]}{\Delta t} = \frac{\Delta[O_2]}{\Delta t}$

b) $-\frac{1}{2}\frac{\Delta[N_2O]}{\Delta t} = \frac{1}{2}\frac{\Delta[N_2]}{\Delta t} = \frac{\Delta[O_2]}{\Delta t}$

c) $-\frac{\Delta[N_2]}{\Delta t} = -\frac{1}{3}\frac{\Delta[H_2]}{\Delta t} = \frac{1}{2}\frac{\Delta[NH_3]}{\Delta t}$

20) a) $-\frac{1}{2}\frac{\Delta[H_2O]}{\Delta t} = \frac{1}{2}\frac{\Delta[H_2]}{\Delta t} = \frac{\Delta[O_2]}{\Delta t}$

b) $-\frac{1}{2}\frac{\Delta[SO_2]}{\Delta t} = -\frac{\Delta[O_2]}{\Delta t} = \frac{1}{2}\frac{\Delta[SO_3]}{\Delta t}$

c) $-\frac{1}{2}\frac{\Delta[NO]}{\Delta t} = -\frac{1}{2}\frac{\Delta[H_2]}{\Delta t} = \frac{\Delta[N_2]}{\Delta t} = \frac{1}{2}\frac{\Delta[H_2O]}{\Delta t}$

21) a) $-\frac{1}{2}\frac{\Delta[H_2]}{\Delta t} = -\frac{\Delta[O_2]}{\Delta t}$

$-\frac{1}{2}(.85) = -\frac{\Delta[O_2]}{\Delta t}$

$0.425\ M/s = \boxed{0.43\ M/s}$ 2 s.f.

$\frac{1}{2}(.85) = \frac{1}{2}\frac{[\Delta H_2O]}{\Delta t}$

$\frac{\Delta[H_2O]}{\Delta t} = \boxed{0.85\ M/s}$

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22) $\frac{\Delta C_2H_4}{\Delta t} = \frac{1}{2}\frac{[\Delta CO_2]}{\Delta t} = \frac{1}{2}\frac{\Delta[H_2O]}{\Delta t}$

$.025 = \frac{1}{2}\frac{\Delta[CO_2]}{\Delta t}$

$\frac{\Delta[CO_2]}{\Delta t} = 0.050\ M/s$

$\frac{\Delta[H_2O]}{\Delta t} = 0.050\ M/s$

23) a) won't change A is not part of rate law

No, rate constant only changes due to temperature

b) A = zero order
B = second order
overall = 0 + 2 = second order

c) rate $= K \cdot [M]^2$

$M/s = \frac{M}{s}\left|\frac{}{M^2}\right. = M^{-1}s^{-1}$ or $\frac{1}{M \cdot s}$

K units vary based on the overall order of the reaction

24) a) rate $= K[A][C]^2$ e) $3 \times 9 = 27$
b) doubles
c) no change
d) x9

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25) a) rate = $4.82 \times 10^{-3}[N_2O_5]$

b) rate = $4.82 \times 10^{-3}(0.0240)$
1.16×10^{-4} M/S

c) doubles 2.31×10^{-4} M/S

26) a) rate = $K[H_2][NO]^2$

b) rate = $(6.0 \times 10^4)(.015)(.035)^2$
= 11 M/S

c) rate = $(6.0 \times 10^4)(.01)(.1)^2$
= 6 M/S

27) a) rate = $K[CH_3Br][OH^-]$
$.0432 = K(5.0 \times 10^{-3})(.05)$
$K = 172.8$

b) $\frac{M}{S} = K \cdot M \cdot M$

$\frac{\cancel{M}}{S \cdot \cancel{M} \cdot M} = K$ $\frac{1}{S \cdot M}$ or $M^{-1}S^{-1}$

c) triple = .1296 = .13 M/S

29) OCl^-

$\frac{3.0 \times 10^{-3}}{1.5 \times 10^{-3}}$ $\frac{2.72 \times 10^{-4}}{1.36 \times 10^{-4}}$ OCl^- first order

$2^{\otimes} = 2$

I^-

$\frac{3.0 \times 10^{-3}}{1.5 \times 10^{-3}}$ $\frac{2.72 \times 10^{-4}}{1.36 \times 10^{-4}}$ I^- first order

$2^x = 2$

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29 cont. rate = $K[OCl^-][I^-]$

b) $1.36 \times 10^{-4} = K[1.5 \times 10^{-3}][1.5 \times 10^{-3}]$

$K = 60.4\ M^{-1}s^{-1}$

$\frac{M}{S} \mid \frac{}{M \cdot M}$

c) rate $= (60.4)(2 \times 10^{-3})(5 \times 10^{-4})$

6.04×10^{-5} M/S

30) a) ClO_2 $\left(\frac{.06}{.02}\right)^x = \left(\frac{.0248}{.00276}\right)$

$3^x = 9$

$x = 2$

OH^-

$\left(\frac{.09}{.03}\right)^x = \frac{.00828}{.00276}$

$3^x = 3$

$x = 1$

rate $= K[ClO_2]^2[OH^-]$

b) $.0248 = K(0.06)^2(.03)$

$K = 230\ M^{-2}s^{-1}$

$\frac{M}{S} \mid \frac{}{M^2 M}$

c) rate $= 230(.1)^2(.05)$

rate $= 0.12$ M/S

32) a) NO $\left(\frac{.252}{.126}\right)^x = \frac{5.64 \times 10^{-2}}{1.41 \times 10^{-2}}$

$2^x = 4$

$x = 2$

O_2 $\left(\frac{.0250}{.0125}\right)^x = \frac{1.13 \times 10^{-1}}{5.64 \times 10^{-2}}$

$2^x = 2$

$x = 1$

$\text{rate} = K[NO]^2[O_2]$

b) $\frac{M}{S \mid M^2 M}$ $\quad M^{-2}s^{-1}$

c) $1.41 \times 10^{-2} = K[.0126]^2(0.0125)$

$K = 7110 \ M^{-2}s^{-1}$

d) $\text{rate} = (7110)(.075)^2(.01)$

$= 0.400 M/s$

e) $\frac{1}{2}\frac{\Delta[NO]}{\Delta t} = \frac{\Delta[O_2]}{\Delta t}$

$\frac{1}{2}(.400) = 0.200 M/s$