Simple Rate Laws

Problem One

Experiment	[A] (mol/L)	[B] (mol/L)	Initial Rate (mol L^{-1} sec^{-1})
1	3	2	5
2	3	4	20
3	6	4	40

1) Write the rate law.

2) Determine the value for k and specify its units.

Problem Two

Experiment	[A] (mol/L)	[B] (mol/L)	Initial Rate (mol L^{-1} sec^{-1})
1	1	12	3
2	4	12	12
3	4	16	16

1) Write the rate law.

3) Determine the value for k and specify its units.

Problem Three

Experiment	[A] (mol/L)	[B] (mol/L)	Initial Rate (mol L^{-1} sec^{-1})
1	18	3	9.5
2	18	6	19.0
3	9	6	19.0

1) Write the rate law.

2) Determine the value for k and specify its units.

Problem Four

Experiment	[A] (mol/L)	[B] (mol/L)	Initial Rate (mol L^{-1} sec^{-1})
1	2	4	R_1
2	4	4	$R_2 = 4\ R_1$
3	4	8	$R_3 = 16 R_1$

1) Write the rate law.

2) Determine the value for k and specify its units.

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Problem Five

Experiment	[A] (mol/L)	[B] (mol/L)	Initial Rate (mol L^{-1} sec^{-1})
1	0.0035	0.0700	3.13×10^{-2}
2	0.0035	0.1400	1.25×10^{-1}
3	0.0070	0.1400	5.01×10^{-1}

1) Write the rate law.

2) Determine the value for k and specify its units.

Problem Six

Experiment	[A] (mol/L)	[B] (mol/L)	Initial Rate (mol L^{-1} sec^{-1})
1	3	3	x
2	6	6	$8x$
3	3	6	$4x$

1) Write the rate law.

2) Determine the value for k and specify its units.

Problem Seven

Experiment	[A] (mol/L)	[B] (mol/L)	[C] (mol/L)	Initial Rate (mol L^{-1} sec^{-1})
1	0.015	0.025	0.033	1.5×10^{-5}
2	0.015	0.025	0.066	6.0×10^{-5}
3	0.015	0.050	0.066	12.0×10^{-5}
4	0.030	0.050	0.066	24.0×10^{-5}

1) Write the rate law.

2) Determine the value for k and specify its units.

Problem Eight

Experiment	[A] (mol/L)	[B] (mol/L)	[C] (mol/L)	Initial Rate (mol L^{-1} sec^{-1})
1	5	5	1	x
2	5	10	2	$2x$
3	10	5	1	$4x$
4	5	10	1	$2x$

1) Write the rate law.

2) Determine the value for k and specify its units.

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Simple Rate Laws

Problem One

In experiment 1 & 2 [A] is constant and [B] goes from 2 to 4, so up by 2. The initial rate goes from 5 to 20, so up by four. Since $2^2=4$, B is second order.

In experiment 2 & 3, [B] is constant and [A] goes from 3 to 6, so up by 2. The initial rate goes from 20 to 40, so up by 2. Since $2^1=2$, A is first order.

A=1 B=2 Rate = $k[A]^1[B]^2$

$$k = 0.417 \frac{L^2}{mol^2 \text{ x sec}} \text{ or } M^{-2} \text{ sec}^{-1}$$

Problem Two

In experiment 1 & 2 [B] is constant and [A] goes from1 to 4, so up by 4. The initial rate goes from 3 to 12, so up by four. Since $4^1=4$, A is first order.

In experiment 2 & 3, [A] is constant and [B] goes from 12 to 16, so up by 4/3. The initial rate goes from 12 to 16, so up by 4/3. Since $\frac{4^1}{3} = \frac{4}{3}$, B is first order.

A=1 B=1 Rate = $k[A]^1[B]^1$

$$k = 0.25 \frac{L^1}{mol^1 \text{ x sec}} \text{ or } M^{-1} \text{ sec}^{-1}$$

Problem Three

In experiment 1 & 2 [A] is constant and [B] goes from 3 to 6, so up by 2. The initial rate goes from 9.5 to 19.0, so up by two. Since $2^1=2$, B is first order.

In experiment 3 & 2, [B] is constant and [A] goes from 9 to 18, so up by 2. The initial rate goes from 19.0 to 19.0, so up by 1. Since $2^0=1$, A is zero order.

A = zero B = 1 Rate = $k[A]^0[B]^1$ or just Rate = $k[B]^1$

$$k = 3.17 \frac{1}{\text{seconds}} \text{ or } \text{sec}^{-1}$$

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Problem Four

In experiment 1 & 2 [B] is constant and [A] goes from2 to 4, so up by 2. The initial rate goes from R_1 to $4R_1$, so up by four. Since $2^2=4$, A is second order.

In experiment 2 & 3, [A] is constant and [B] goes from 4 to 8, so up by 2. The initial rate goes from R_2 ($4R_1$) to 16 R_1, so up by 4. Since $2^2=4$, B is second order.

A=2 B=2 Rate = $k[A]^2[B]^2$

$$k = \frac{R_1}{0.0156} \frac{L^3}{mol^3 \times sec} \text{ or } M^{-3}\ sec^{-1}$$

Problem Five

In experiment 1 & 2 [A] is constant and [B] goes from 0.0700 to 0.1400, so up by 2. The initial rate goes from 3.13×10^{-2} to 1.25×10^{-1}, so up by four. Since $2^2=4$, B is second order.

In experiment 2 & 3, [B] is constant and [A] goes from 0.0035 to 0.0070, so up by 2. The initial rate goes from 1.25×10^{-1} to 5.01×10^{-1}, so up by 4. Since $2^1=4$, A is second order.

A=2, B=2 Rate = $k[A]^2[B]^2$

$$k = 5.21 \times 10^5 \frac{L^3}{mol^3 \times sec} \text{ or } M^{-3}\ sec^{-1}$$

Problem Six

In experiment 1 & 3 [A] is constant and [B] goes from 3 to 6, so up by 2. The initial rate goes from x to 8x, so up by eight. Since $2^3=8$, B is third order.

In experiment 3 & 2, [B] is constant and [A] goes from 3 to 6, so up by 2. The initial rate goes from 20 to 40, so up by 2. Since $2^1=2$, A is first order.

A = 1, B = 2 Rate = $k[A]^1[B]^2$

$$k = 0.037 \frac{L^2}{mol^2 \times sec} \text{ or } M^{-2}\ sec^{-1}$$

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Simple Rate Laws

Problem Seven

In experiment 1 & 2 [A] and [B] are constant and [C] goes from 0.033 to 0.066, so up by 2. The initial rate goes from 1.5×10^{-5} to 6.0×10^{-5}, so up by four. Since $2^2=4$, C is second order.

In experiment 2 & 3, [A] and [C] are constant and [B] goes from 0.025 to 0.050, so up by 2. The initial rate goes from 6.0×10^{-5} to 12.0×10^{-5}, so up by 2. Since $2^1=2$, B is first order.

In experiment 3 & 4, [B] and [C] are constant and [A] goes from 0.015 to 0.030, so up by 2. The initial rate goes from 12.0×10^{-5} to 24.0×10^{-5}, so up by 2. Since $2^1=2$, A is first order.

A=1, B=1 C=2 Rate = $k[A]^1[B]^1[C]^2$

$$k = 36.73 \ \frac{L^3}{mol^3 \times sec} \text{ or } M^{-3} \ sec^{-1}$$

Problem Eight

In experiment 4 & 2 [A] and [B] are constant and [C] goes from 1 to 2, so up by 2. The initial rate goes from $2x$ to $2x$, so up by one. Since $2^0=1$, C is zero order.

In experiment 1 & 3, [B] and [C] are constant and [A] goes from 5 to 10, so up by 2. The initial rate goes from x to $2x$, so up by 2. Since $2^1=2$, A is first order.

In experiment 1 & 2, [A] is constant (we don't need to worry about [C] since it is zero order) and [B] goes from 5 to 10, so up by 2. The initial rate goes from x to $2x$, so up by 2. Since $2^1=2$, B is first order.

A = 2, B = 1, C = zero Rate = $k[A]^2[B]^1[C]^0$ or just Rate = $k[A]^2[B]^1$

$$k = \frac{x}{0.008} \ \frac{L^2}{mol^2 \times sec} \text{ or } M^{-2} \ sec^{-1}$$

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