AP Chemistry Kinetics Problems – Part 1

1) Determine the rate expression and rate constant for the following reaction using the given data.

$$2A + B + C \longrightarrow D + E$$

Experiment	Initial [A]	Initial [B]	Initial [C]	Initial Rate of Formation of E
1	0.20 M	0.20 M	0.20 M	$2.4 \times 10^{-6}\ M \cdot \text{min}^{-1}$
2	0.40 M	0.30 M	0.20 M	$9.6 \times 10^{-6}\ M \cdot \text{min}^{-1}$
3	0.20 M	0.30 M	0.20 M	$2.4 \times 10^{-6}\ M \cdot \text{min}^{-1}$
4	0.20 M	0.40 M	0.60 M	$7.2 \times 10^{-6}\ M \cdot \text{min}^{-1}$

2) Determine the rate expression and rate constant for the following reaction using the given data.

$$A + 2B \longrightarrow C + 2D$$

Expt.	Initial [A] (mol/L)	Initial [B] (mol/L)	Initial Rate of Formation of C ($M \cdot \text{min}^{-1}$)
1	0.10	0.10	3.0×10^{-4}
2	0.30	0.30	9.0×10^{-4}
3	0.10	0.30	3.0×10^{-4}
4	0.20	0.40	6.0×10^{-4}

3) Determine the rate expression and rate constant for the following reaction using the given data.

$$2A + B + 2C \longrightarrow D + 2E$$

Expt.	Initial [A] (M)	Initial [B] (M)	Initial [C] (M)	Initial Rate of Formation of D ($M \cdot \text{min}^{-1}$)
1	0.10	0.10	0.20	5.0×10^{-4}
2	0.20	0.30	0.20	1.5×10^{-3}
3	0.30	0.10	0.20	5.0×10^{-4}
4	0.40	0.30	0.60	4.5×10^{-3}

4) Determine the rate expression and rate constant for the following reaction using the given data.

$$A + B \longrightarrow \text{products}$$

Expt.	Initial [A] (mol/L)	Initial [B] (mol/L)	Initial Rate of Formation of C ($M \cdot \text{s}^{-1}$)
1	0.10	0.10	0.0090
2	0.20	0.20	0.072
3	0.20	0.10	0.036
4	0.20	0.30	0.11

5) Determine the rate expression and rate constant for the following reaction using the given data.

$$3A + 2B \longrightarrow 2C + D$$

Experiment	Initial [A]	Initial [B]	Initial Rate of Formation of D
1	$1.00 \times 10^{-2}\ M$	$1.00 \times 10^{-2}\ M$	$6.00 \times 10^{-3}\ M \cdot min^{-1}$
2	$2.00 \times 10^{-2}\ M$	$3.00 \times 10^{-2}\ M$	$1.44 \times 10^{-1}\ M \cdot min^{-1}$
3	$1.00 \times 10^{-2}\ M$	$2.00 \times 10^{-2}\ M$	$1.20 \times 10^{-2}\ M \cdot min^{-1}$

6) Determine the rate expression and rate constant for the following reaction using the given data.

$$2ClO_2(aq) + 2OH^-(aq) \longrightarrow ClO_3^-(aq) + ClO_2^-(aq) + H_2O(\ell)$$

Expt.	Initial $[ClO_2]$ (mol/L)	Initial $[OH^-]$ (mol/L)	Initial Rate of Formation of C ($M \cdot s^{-1}$)
1	0.012	0.012	2.07×10^{-4}
2	0.012	0.024	4.14×10^{-4}
3	0.024	0.012	8.28×10^{-4}
4	0.024	0.024	1.66×10^{-3}

On a separate sheet of paper answer the remainder of the questions below:

7) Determine the rate expression and rate constant for the following reaction using the given data.

$$(C_2H_5)_2(NH)_2 + I_2 \longrightarrow (C_2H_5)_2N_2 + 2HI$$

gives the following initial rates.

Expt.	$[(C_2H_5)_2(NH)_2]_0$ (mol/L)	$[I_2]_0$ (mol/L)	Initial Rate of Formation of $(C_2H_5)_2N_2$
1	0.015	0.015	$3.15\ M \cdot s^{-1}$
2	0.015	0.045	$9.45\ M \cdot s^{-1}$
3	0.030	0.045	$18.9\ M \cdot s^{-1}$

8) Given these data for the reaction A + B → C,

(a) write the rate-law expression.

(b) what is the value, with units, for the specific rate constant?

Expt	Initial [A] (M)	Initial [B] (M)	Initial Rate of Formation of C ($M \cdot s^{-1}$)
1	0.15	0.25	8.0×10^{-5}
2	0.30	0.25	3.2×10^{-4}
3	0.60	0.50	5.12×10^{-3}

9) Given these data for the reaction A + B -> C, write the rate-law expression. (b) What is the value, with units, for the specific rate constant?

Expt.	Initial [A] (M)	Initial [B] (M)	Initial Rate of Formation of C (M/s)
1	0.10	0.10	2.0×10^{-4}
2	0.10	0.20	8.0×10^{-4}
3	0.20	0.40	2.56×10^{-2}