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AP Chemistry

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Period ____

Kinetics Worksheet #1.5 (2011)

Determine the rate law expression and the value for the rate constant (k) including units.

1. **A + 3 B → C**

Experiment	Initial [A]	Initial [B]	Initial Rate of Formation of C (M min^{-1})
1	0.10	0.10	1.70 x 10^{-5}
2	0.20	0.10	1.71 x 10^{-5}
3	0.10	0.20	3.41 x 10^{-5}

RATE = $k[A]^0[B]^1$

RATE = $k[B]$

$1.70 \times 10^{-5} = k[.10]$

$k = 1.7 \times 10^{-4}$

$k = 1.7 \times 10^{-4}$ min^{-1}

units

$\frac{M}{min} = k\,M$

$M \cdot \frac{1}{min} = k\,M$

$\frac{1}{min} = k$

2. **X + 5 Y → Z**

Trial	Initial [X]	Initial [Y]	Initial Rate of Formation of Z (M min^{-1})
1	1.00 x 10^{-3}	0.25 x 10^{-3}	0.26 x 10^{-9}
2	1.00 x 10^{-3}	0.50 x 10^{-3}	0.52 x 10^{-9}
3	1.00 x 10^{-3}	1.00 x 10^{-3}	1.04 x 10^{-9}
4	2.00 x 10^{-3}	1.00 x 10^{-3}	4.16 x 10^{-9}
5	3.00 x 10^{-3}	1.00 x 10^{-3}	9.36 x 10^{-9}

RATE = $k[X]^2[Y]^1$

RATE = $k[X]^2[Y]$

$.26 \times 10^{-9} = k[1.00 \times 10^{-3}]^2[.25 \times 10^{-3}]$

$k = 1.04$

$k = 1.04\ M^{-2}\ min^{-1}$

units

$\frac{M}{min} = k\,M^2 \cdot M$

$k = \frac{1}{M^2\,min} = M^{-2}\,min^{-1}$

3. **2 A + B → C**

Experiment	Initial [A]	Initial [B]	Initial Rate of Formation of C (M min^{-1})
1	1.00 x 10^{-2}	4.00 x 10^{-4}	6.00 x 10^{-3}
2	2.00 x 10^{-2}	4.00 x 10^{-4}	1.20 x 10^{-2}
3	4.00 x 10^{-2}	4.00 x 10^{-4}	2.40 x 10^{-2}
4	1.00 x 10^{-2}	8.00 x10^{-4}	6.00 x 10^{-3}

RATE = $k[A]^1[B]^0$

RATE = $k[A]$

$6.00 \times 10^{-3} = k[1.00 \times 10^{-2}]$

$k = .600$

units

$\frac{\frac{M}{min}}{M} = \frac{k \cdot M}{M}$

$k = \frac{1}{min} = min^{-1}$

$k = .600\ min^{-1}$

4. Consider the hypothetical chemical reaction where **5 X + Y → 2 Z**

How fast does X disappear compared to Y ? 5 x's faster

How fast does X disappear compared to the formation of Z ? 2.5 x's faster

How fast does Z appear compared to the disappearance of Y? 2 x's faster

5. Consider the following chemical reaction: **2 A + B → 2 C**

Experiment	Initial [A]	Initial [B]	Initial Rate of Formation of C ($M\ min^{-1}$)
1	3.0	1.0	4.6×10^{-3}

It states in the data table shown above that **C** forms at a rate of 4.6×10^{-3} M/min.

Based on that number, how fast did A disappear? BASED ON COEFFICIENTS FOR A + C
A DISAPPEARS AT SAME RATE
SO 4.6×10^{-3} M/min

How fast did B disappear?

COMPARING COEFFICIENTS OF B AND C,

$\frac{4.6 \times 10^{-3}}{2} = 2.3 \times 10^{-3}\ \frac{M}{min}$

6. Consider the combustion of H_2 in the following chemical reaction.

$2\ H_2 + O_2 \rightarrow 2\ H_2O$

(a) If H_2 is burning at a rate of 0.82 mol/s, what is the rate of consumption of oxygen?

.41 mol/sec (compare coefficients of H_2 and O_2)

(b) If H_2 is burning at a rate of 0.82 mol/s, what would be the rate of formation of water vapor?

.82 mol/sec (compare coefficients of H_2 and H_2O)

7. Consider the combustion of ethylene in the following chemical reaction.

$C_2H_4 + 3\ O_2 \rightarrow 2\ CO_2 + 2\ H_2O$

$-x \quad -3x \quad +2x \quad +2x$

If the concentration of C_2H_4 is decreasing at a rate of 0.24 M/s, what are the rates of change in the concentrations of: oxygen, carbon dioxide, and water vapor?

$x = .24$ M/sec

O_2 $(.24)(3) = .72$ M/sec

CO_2 $(.24)(2) = .48$ M/sec

H_2O $(.24)(2) = .48$ M/sec