**Exercise – Rate Law**

Answer the following questions. Be sure to show your work.

1. A first-order reaction initially proceeds at a rate of 0.500 mol/Ls. What will be the rate when half the starting material remains? When one-fourth of the starting material remains?
2. Assume the N2O(g) and O2(g) react according to the rate law

Rate = k[N2O] [O2]

How does the rate change if:  
a) the concentration of O2 is doubled?  
b) the volume of the enclosing vessel is reduced by half?

1. Assume that NO(g) and H2(g) react according to the rate law

Rate = k[NO]2 [H2]

How does the rate change if:  
a) the concentration of H2 is tripled?  
b) the concentration of NO is doubled?  
c) the volume of the enclosing vessel is reduced by half?

1. For the reaction: A + 2 B → 2 C

|  |  |  |
| --- | --- | --- |
| [A] mol/L | [B] mol/L | Rate (mol/Lmin) |
| 1.0 | 1.0 | 0.50 |
| 3.0 | 1.0 | 1.5 |
| 3.0 | 2.0 | 3.0 |

Find the rate law and calculate the value of the specific rate constant.

1. The reaction

I–(aq) + OCl–(aq) → IO–(aq) + Cl–(aq)

Was studied and the following data were obtained:

|  |  |  |  |
| --- | --- | --- | --- |
| Trial | [I–] mol/L | [OCl–] mol/L | Initial Rate (mol/L•s) |
| 1.0 | 0.12 | 0.18 | 7.91×10–2 |
| 2.0 | 0.060 | 0.18 | 3.95×10–2 |
| 3.0 | 0.24 | 0.090 | 7.91×10–2 |
| 4.0 | 0.060 | 0.090 | 1.98×10–2 |

a) What is the rate law?  
b) What is the value of the rate constant?

1. For the reaction: A + B + C → D

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Trial | [A] mol/L | [B] mol/L | [C] mol/L | Initial Rate (mol/L•min) |
| 1.0 | 1.0 | 2.0 | 0.50 | 0.35 |
| 2.0 | 2.0 | 2.0 | 0.50 | 1.40 |
| 3.0 | 2.0 | 1.0 | 0.50 | 1.40 |
| 4.0 | 1.0 | 2.0 | 1.0 | 0.70 |

Find the rate law and calculate the value of the specific rate constant.

1. For the reaction: X + Y + Z → S

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Trial | [X] mol/L | [Y] mol/L | [Z] mol/L | Initial Rate (mol/Lmin) |
| 1.0 | 0.45 | 0.20 | 0.55 | 0.66 |
| 2.0 | 1.35 | 0.20 | 0.55 | 5.94 |
| 3.0 | 0.45 | 0.60 | 0.55 | 1.98 |
| 4.0 | 0.45 | 0.60 | 1.10 | 1.98 |

Find the rate law and calculate the value of the specific rate constant.

1. The reaction CH3COCH3 + I2 → CH3COCH3 + HI is run in the presence of an excess of acid. The following data were obtained:

|  |  |  |  |
| --- | --- | --- | --- |
| Trial | Initial [I2] (mol/L) | Initial [CH3COCH3] (mol/L) | Initial Rate (mol/Ls) |
| 1.0 | 0.100 | 0.100 | 1.16× 10–7 |
| 2.0 | 0.100 | 0.0500 | 5.79× 10–8 |
| 3.0 | 0.500 | 0.0500 | 5.77× 10–8 |

* 1. What is the rate law?
  2. What is the value of the rate constant?
  3. What is the rate if the concentration of CH3COCH3 is 0.0700 mol/L and the concentration of I2 is 0.0850 mol/L
  4. What is the concentration of I2 if the concentration of CH3COCH3 is 0.0250 mol/L and the rate is 3.10× 10–8 mol/Ls?

1. For the reaction A + 2 B → C + D, the following data was collected

|  |  |  |  |
| --- | --- | --- | --- |
| Trial | Initial [A] (mol/L) | Initial [B] (mol/L) | Initial Rate (molL–1s–1) |
| 1.0 | 0.0100 | 0.0240 | 1.45× 10–4 |
| 2.0 | 0.0100 | 0.0120 | 7.25× 10–5 |
| 3.0 | 0.0200 | 0.0480 | 5.80× 10–4 |

What is the rate law?

1. For the reaction 3 A + B → 2 C + D, the following data was collected

|  |  |  |  |
| --- | --- | --- | --- |
| Trial | Initial [A] (mol/L) | Initial [B] (mol/L) | Initial Rate (molL–1h–1) |
| 1.0 | 0.0012 | 0.042 | 3.6 ×10–2 |
| 2.0 | 0.00060 | 0.084 | 3.6×10–2 |
| 3.0 | 0.00060 | 0.021 | 9.0×10–3 |

What is the rate law?

1. For the elementary reaction H2 + I2 → 2 HI
   1. Write the rate law.
   2. Find k if HI is produced at a rate of 1.0 x 10–4 mol/Lmin when [H2] = 0.025 mol/L and [I2] = 0.050 mol/L.
   3. What is the rate of production of HI if the concentration of both reactants is 0.10 mol/L and the temperature is the same as in (b)?
   4. How would the rate be affected if [H2] is doubled AND the [I2] is halved?
2. For the one step reaction A(g) + 2 B(g) ? C(g)
   1. What is the rate law?
   2. How does the rate change if
      1. [A] is doubled?
      2. [B] is tripled?
      3. The volume of the container is doubled?