# Practice Problems – Chemical Kinetics Name:

1. For the reaction given below, what is the instantaneous rate for each of the reactants and products?

3 A + 2 B 🠆 4 C

2. Given the following experimental data, find the rate law and the rate constant for the reaction:

 NO (g) + NO2 (g) + O2 (g) 🠆 N2O5 (g)

Run [NO]o , M [NO2]o , M [O2]o , M Initial Rate, Ms-1

1 0.10 M 0.10 M 0.10 M 2.1 x 10-2

2 0.20 M 0.10 M 0.10 M 4.2 x 10-2

3 0.20 M 0.30 M 0.20 M 1.26 x 10-1

4 0.10 M 0.10 M 0.20 M 2.1 x 10-2

3 The mechanism of a reaction is shown below.

HOOH + I¯ 🠆 HOI + OH¯ (slow)

HOI + I¯ 🠆 I2 + OH¯ (fast)

2OH¯ + 2H3O+ 🠆 4 H2O (fast)

a) What is the overall reaction?

b) Which compounds are intermediates?

c) Predict the rate law based on this mechanism.

d) What is the overall order of the reaction?

4. In the reaction A + 2 B → 3 C + 4 D, the initial concentration of B was

0.0443 M after 17.3 min the concentration of B was 0.0305 M. What is the average rate of disappearance (M/s) of reactant A?

5. In the reaction A + 2 B → 3 C + 4 D, the initial concentration of B was 0.0389 M after 11.9 min the concentration of B was 0.0222 M. What is the average rate of appearance (M/s) of reactant C?

6. In the reaction A + 2 B → 3 C + 4 D, the initial concentration of A was 0.0351 M after 18.3 min the concentration of A was 0.0199 M. What is the average rate of disappearance (M/s) of reactant B?

7. Hydrogen iodide decomposes to give a mixture of hydrogen and iodine:

2 HI(g) <---->H2(g) + I2(g)

Use the following data to determine whether the decomposition of HI in the gas phase is first order or second order in hydrogen iodide.

**Initial (HI) (M)          Initial Instantaneous**

**Rate of Reaction (M/s)**

Trial 1:  1.0 x 10-2 4.0 x 10-6

Trial 2: 2.0 x 10-2 1.6 x 10-5

Trial 3: 3.0 x 10-2 3.6 x 10-5

8. For the following reaction:

H2O2   +   2I-   +   2 H+  →   I2   +   2 H2O

Consider the following mechanism for this reaction:

H2O2   +   I-   →   HOI   +   OH- slow

HOI   +   I-  →   I2   +   OH-  fast

2 OH-   +   2 H+   →   2 H2O fast

a)  What species are **intermediates** in the above mechanism?  Any **catalysts?**

b)  Sketch an energy profile for the three step mechanism and clearly label the rate determining step in your diagram.

c)  What rate law would be expected if this mechanism is correct?  That is, will it be zero-order, first-order or second-order with respect to H2O2?  Zero-order, first-order or second-order with respect to I-?  Explain briefly.

d)  What rate law would be expected if the **second step** in this reaction mechanism is the **slow** step?

9. 2 A + 2 B → C + D

The following data about the reaction above were obtained from three experiments:

|  |  |  |  |
| --- | --- | --- | --- |
| Experiment | [A] | [B] | Initial Rate of Formation of C (mole.liter-1min-1) |
| 1 | 0.60 | 0.15 | 6.3x10-3 |
| 2 | 0.20 | 0.60 | 2.8x10-3 |
| 3 | 0.20 | 0.15 | 7.0x10-4 |

(a) What is the rate equation for the reaction?

(b) What is the numerical value of the rate constant k? What are its dimensions?

(c) Propose a reaction mechanism for this reaction.