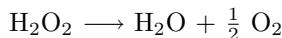


# CHM 112.009

## Additional Problems – Chapter 14

1. For the reaction



the initial concentration of  $\text{H}_2\text{O}_2$  is 0.1108 M and 12 s later the concentration is 0.1060 M. What is the initial rate of this reaction expressed in M/sec and M/min?

2. In the reaction



the rate of disappearance of A is  $-2.2 \times 10^{-4} \text{ M}\cdot\text{s}^{-1}$ . What is the:

- (a) rate of disappearance of B?
- (b) rate of formation of C?
- (c) the general rate of reaction?

3. What would be the units of  $k$  for a reaction



for which the order of the reaction was  $\frac{1}{2}$ ?

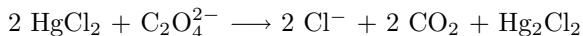
4. For the reaction



the rate law is  $\text{RATE} = k[\text{A}][\text{B}]$ . Which of the following statements is true – and why?

- (a) The value of  $k$  is independent of the initial concentrations  $[\text{A}]_0$  and  $[\text{B}]_0$ .
- (b) The unit of the rate constant,  $k$ , can be determined to be either  $\text{s}^{-1}$  or  $\text{min}^{-1}$ .

5. The following rate data was collected for the reaction



Experiment	Initial [HgCl <sub>2</sub> ] mol·L <sup>-1</sup>	Initial [C <sub>2</sub> O <sub>4</sub> <sup>2-</sup> ] mol·L <sup>-1</sup>	Initial Rate mol·L <sup>-1</sup> ·s <sup>-1</sup>
1	0.105	0.15	$1.8 \times 10^{-5}$
2	0.105	0.30	$7.1 \times 10^{-5}$
3	0.052	0.30	$3.5 \times 10^{-5}$
4	0.052	0.15	$8.9 \times 10^{-6}$

- (a) Determine the **overall** order of the reaction
- (b) Determine the value of the rate constant  $k$
- (c) What would be the initial rate of the reaction if  $[\text{HgCl}_2]_0 = 0.094 \text{ M}$  and  $[\text{C}_2\text{O}_4^{2-}]_0 = 0.19 \text{ M}$ ?
- (d) Are all four experiments needed to answer questions (a) – (c)?

6. In a reaction



the following data were obtained. What is the order of the reaction?

**Experiment 1:**  $[\text{A}]_0 = 1.512 \text{ M}$ ,  $[\text{A}]_{30\text{sec}} = 1.496 \text{ M}$

**Experiment 2:**  $[\text{A}]_0 = 2.584 \text{ M}$ ,  $[\text{A}]_{60\text{sec}} = 2.552 \text{ M}$

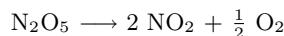
7. A first order reaction



has a rate of reaction of  $0.00250 \text{ M}\cdot\text{s}^{-1}$  when  $[A] = 0.484 \text{ M}$ .

- (a) What is the rate constant  $k$  for this reaction?
- (b) Do  $t_{\frac{3}{4}}$  and  $t_{\frac{4}{5}}$  depend on the initial concentration?

8. In the first order decomposition of dinitrogen pentoxide at 335 K



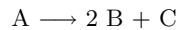
if one starts with a 2.50 g sample of  $\text{N}_2\text{O}_5$  at 335 K and, after 109 seconds only 1.50 g remains:

- (a) What is the value of the rate constant?
- (b) What is  $t_{\frac{1}{2}}$
- (c) What mass of  $\text{N}_2\text{O}_5$  will remain after 5.0 minutes?

9. The decomposition of di-tert-butyl peroxide (DTBP) is a first order reaction with a half life of 320 minutes at 135 °C and 100 minutes at 135 °C. Calculate the activation energy,  $E_a$ , for this reaction.

10. A reaction has a first order rate constant of  $4.82 \times 10^{-5} \text{ s}^{-1}$  at 25 °C and  $1.41 \times 10^{-2} \text{ s}^{-1}$  at 70 °C. Calculate the value of the rate constant at 90 °C.

11. For the reaction



the following data are obtained for  $[A]$  as a function of time:

$$t = 0 \text{ min}, [A] = 0.80 \text{ M}$$

$$t = 8 \text{ min}, [A] = 0.60 \text{ M}$$

$$t = 24 \text{ min}, [A] = 0.35 \text{ M}$$

$$t = 40 \text{ min}, [A] = 0.20 \text{ M}$$

- (a) Establish the order of the reaction
- (b) What is the value of the rate constant,  $k$
- (c) Calculate the rate of formation of B at 22 min

12. A reaction that is second order in reactant A has  $[A]_0 = 0.200 \text{ M}$ . The half life is 45.6 sec. What is  $[A]$  after 3.00 min.

13. Explain why, for the following reaction



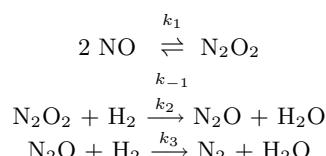
the mechanism shown below is inconsistent with the measured rate law of  $\text{RATE} = k[\text{NO}_2]^2$ .



14. Given that the proposed mechanism is consistent with the rate law  $\text{RATE} = k[\text{H}_2][\text{NO}]^2$  for the reaction



PROPOSED MECHANISM:



Which step **must** be the rate determining step?