Initial Rates Method - Worksheet

Organic Chemistry Tutor

1. The table below shows the concentration of NO with respect to time. Calculate the average rate of disappearance of NO in the first 20 seconds.

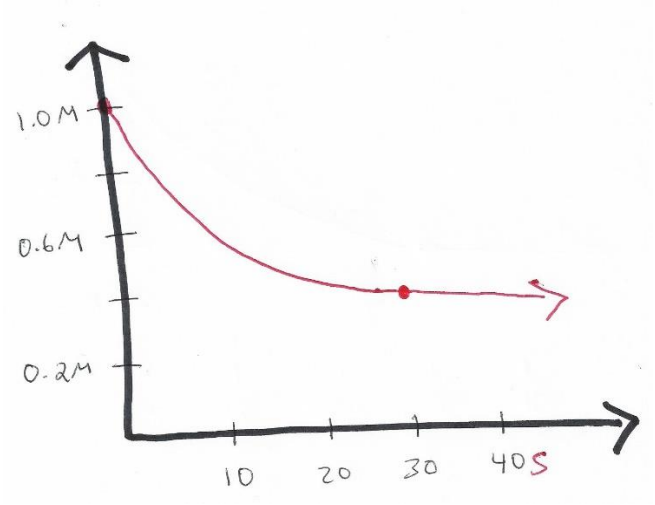
$$\mathbf{2\ NO_{(g)} + 1\ O_{2(g)} \rightarrow\ 2NO_{2(g)}}$$

[NO]	time
0.750 M	0 s
0.645 M	10 s
0.586 M	20 s
0.539 M	30 s
0.496 M	40 s

2. Dinitrogen Pentoxide decomposes into Nitrogen Dioxide and Oxygen gas as shown in the equation below. If the average rate of appearance of NO_2 is 4.6×10^{-3} mol / (L*s), what is the average rate of disappearance of N_2O_5?

$$\mathbf{2N_2O_{5(g)} \rightarrow\ 4\ NO_{2(g)} + 1\ O_{2(g)}}$$

3. The graph below shows the concentration of $[Fe^{3+}]$ with respect to time in seconds. Estimate the average rate of disappearance of Fe^{3+} in the first 30 seconds?



4. The table below shows the concentration of reactants A and B in units of M and the initial rate of reaction in units of $M*min^{-1}$. (a) Determine the rate law. (b) Calculate the value of the rate constant. (c) What will be the initial rate if [A] = 0.5 M and [B] = 0.8 M?

Trial	[A]	[B]	Initial Rate
1	0.20 M	0.20 M	0.4 M/min
2	0.20 M	0.40 M	1.6 M/min
3	0.40 M	0.20 M	0.8 M/min

5. The table below shows the concentration of reactants A, B, and C in units of M and the initial rate of reaction in units of $M*hr^{-1}$. (a) What is the rate law expression? (b) Calculate the value of the rate constant. (c) What will be the initial rate of this experiment if [A] = 0.40 M, [B] = 0.30 M, and [C] = 0.05 M?

Trial	[A]	[B]	[C]	Initial Rate
1	0.10 M	0.10 M	0.10 M	0.80 M/hr
2	0.20 M	0.10 M	0.10 M	3.20 M/hr
3	0.10 M	0.20 M	0.10 M	1.60 M/hr
4	0.10 M	0.10 M	0.20 M	0.80 M/hr

6. Consider the following rate law expression: Rate = $k[A][B]^2[C]^3$. (a) By what factor will the rate of the chemical reaction change if [C] doubles, [B] triples, and [A] quadruples? (b) If the initial rate was 0.05 M/min, what will be the new reaction rate given the changes in part (a)?

7. Consider the reaction shown below. The concentration of Hydrogen gas changed from 0.40 M to 0.28 M in 10 seconds. What is the average rate of the chemical reaction?

$$\mathbf{1\ N_{2(g)} + 3\ H_{2(g)} \rightarrow 2\ NH_{3(g)}}$$

8. Consider the reaction shown below. Which of the following statements is false?

$$\mathbf{2\ A + 5\ B \rightarrow 3\ C + 4\ D}$$

(A) The initial average rate of appearance is greatest for substance D.

(B) The initial average rate of disappearance is greatest for substance B.

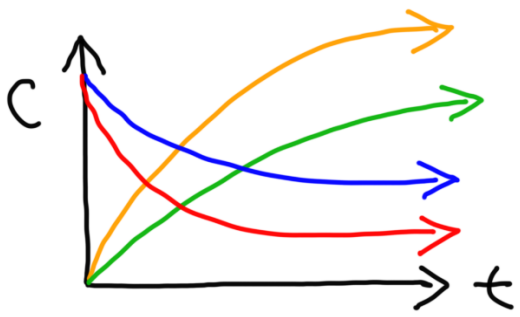
(C) The average rate of appearance of D is twice the average rate of disappearance of A.

(D) The average rate of disappearance of A is 3/2 times greater than the average rate of appearance of C.

9. A certain reaction was found to be 1st order in [A] and 2nd order in [B]. The initial rate of the reaction was found to be 0.042 M/min when [A] = 0.24 M and [B] = 0.28 M. Calculate the value of the rate constant k along with the appropriate units.

10. The graph below shows the concentration of each substance with respect to time in the reaction where Iodide reacts with Peroxydisulfate to produce elemental Iodine and Sulfate. Which curve corresponds to the Iodide ion (I^-)?

$$\mathbf{2\ I^-_{(aq)} + 1\ S_2O_8^{2-}{}_{(aq)} \rightarrow 1\ I_{2(aq)} + 2\ SO_4^{2-}{}_{(aq)}}$$



A. Red Curve
B. Green Curve
C. Blue Curve
D. Orange Curve

11. 0.150 M of NO is mixed with 0.100 M of O_2. The progress of the reaction is followed by measuring [NO] as shown in the table below. What is the concentration of O_2 100 seconds later?

$$\mathbf{2\ NO_{(g)} + 1\ O_{2(g)} \rightarrow 2\ NO_{2(g)}}$$

Time (s)	[NO]
0	0.150 M
50	0.135 M
100	0.122 M
150	0.110 M
200	0.100 M
250	0.901 M

A) 0.096 M
B) 0.092 M
C) 0.086 M
D) 0.083 M
E) 0.078 M

12. The table below shows the concentration of reactants A, B, and C in units of M and the initial rate of reaction in units of $M*hr^{-1}$. (a) What is the rate law expression? (b) Calculate the value of the rate constant? (c) What will be the initial rate of this experiment if [A] = 0.650 M, [B] = 0.840 M, and [C] = 0.730 M?

Trial	[A]	[B]	[C]	Initial Rate
1	0.450 M	0.380 M	0.270 M	2.272 x 10^-4 M/hr
2	0.900 M	0.380 M	0.270 M	9.088 x 10^-4 M/hr
3	0.735 M	0.567 M	1.080 M	5.788 x 10^-2 M/hr
4	0.900 M	1.140 M	0.270 M	2.726 x 10^-3 M/hr

Answers:

1. -8.2×10^{-3} M/s
2. -2.3×10^{-3} mol/(L*s)
3. -0.02 M/s
4a. Rate = $k[A]^1[B]^2$
4b. k = 50 M^{-2} min^{-1} or 50 L^2 mol^{-2} min^{-1}
4c. 16 M/min
5a. Rate = $k[A]^2[B]$
5b. k = 800 M^{-2} hr^{-1} or 800 L^2 mol^{-2} hr^{-1}
5c. 38.4 M/hr
6a. 288
6b. 14.4 M/min
7. 4×10^{-3} M/s
8. D
9. 2.23 M^{-2} min^{-1}
10. A
11. C
12a. Rate = $k[A]^2[B]^1[C]^3$
12b. k = 0.15 M^{-5} hr^{-1}
12c. Rate = 2.071×10^{-2} M/hr