Name: _____

CHEMICAL KINETICS
HONORS CHEMISTRY 2005.1.0
TEXTBOOK PG 491–528

1.List four factors which affect the rate of a chemical reaction. For each provide a brief statement describing how it affects the speed of a chemical reaction.

2. Define the term *chemical kinetics*.

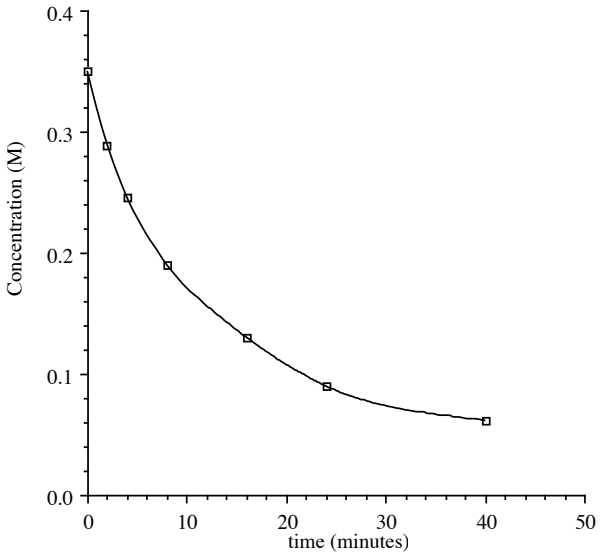
3. Define the term *reaction rate*.

4. For the following chemical reaction

$$2N_2O_{5(g)} \longrightarrow 4NO_{2(g)} + O_{2(g)}$$

write the rate equation in terms of the change in concentration of N_2O_5 with time, $\Delta[NO_2]$ with time an $\Delta[O_2]$ with time.

5. Using the plot below, define the terms *average rate*, *instantaneous rate* and *initial rate*.

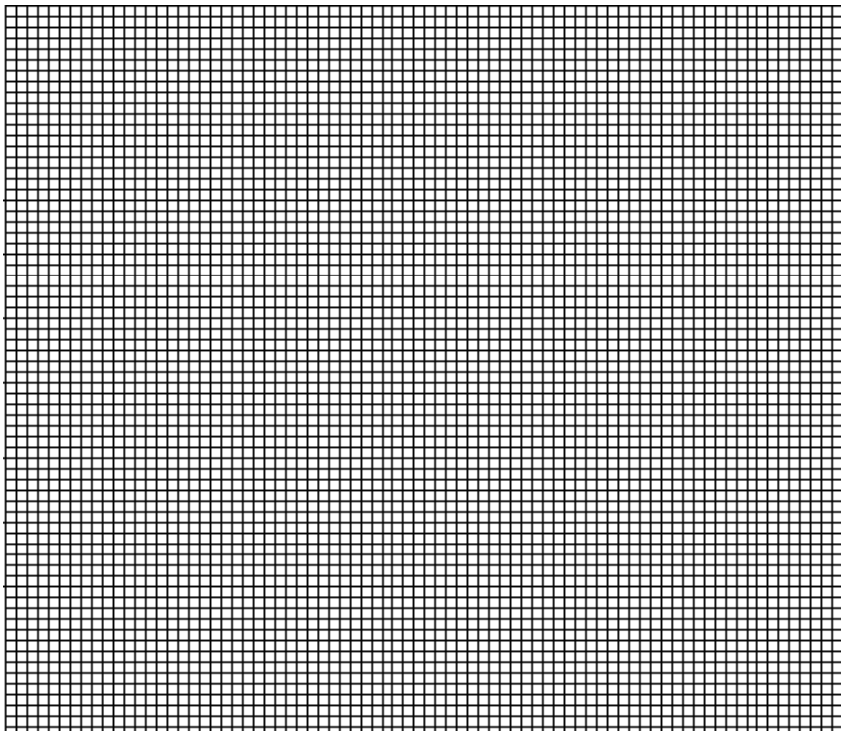


6. Given the following data for the reaction

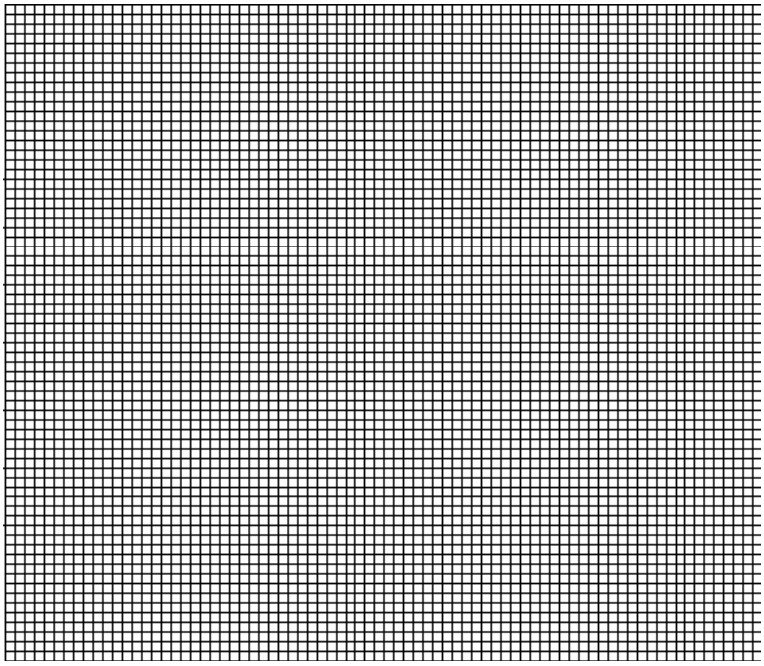
$$2NO_{2(g)} \longrightarrow 2NO_{(g)} + O_{2(g)}$$

Time (min)	Exp. #1 $[NO_2]$ (M)	Exp. #2 $[NO_2]$ (M)
0	0.350	0.700
2	0.289	0.492
4	0.245	0.379
8	0.190	0.258
16	0.130	0.158
24	0.090	0.115
40	0.062	0.074

Plot the data for Exp. #1 and determine the average rate of the reaction between 8 and 24 min., the instantaneous rate of the reaction at 8 minutes and the initial rate of the reaction.



7.Plot the data for Exp. #2 and determine the average rate of the reaction between 8 and 24 minutes, the instantaneous rate of the reaction at 8 minutes and the initial rate of the reaction.



i) By what factor did the initial concentration change in going from Exp #1 to Exp #2?

ii) By what factor did the initial rate change in going from Exp #1 to Exp #2?

iii)Write an equation which describes how the initial rate of the reaction depends on the initial concentration

iv) What experimental data is needed to determine the order of a chemical reaction

8. Consider the reaction

$$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$$

and the following initial rate data.

Experiment Number	P_{NO}(mmHg)	P_{H_2}(mmHg)	Initial Rate ($\frac{mmHg}{s}$)
1	400	150	0.66
2	400	300	1.34
3	150	400	0.25
4	300	400	1.03

i) Determine the reaction order for NO and H_2.

ii) Determine the overall order of the reaction.

iii) Write the specific rate law for the reaction.

iv) Determine the rate constant for the reaction (include units).

9. The following initial rate data were collected for the reaction

$$2NO_2(g) + F_2(g) \rightarrow 2NO_2F(g)$$

at 100 ˚C.

Exp.	$[NO_2]$	$[F_2]$	initial rate (M/sec)
1	0.0482 M	0.0318 M	1.90×10^{-3}
2	0.0120 M	0.0315 M	4.69×10^{-4}
3	0.0480 M	0.127 M	7.57×10^{-3}

i) Determine the reaction order for NO_2 and F_2.

ii) Determine the overall order of the reaction.

iii) Write the specific rate law for the reaction.

iv) Determine the rate constant for the reaction (include units).

10. For the reaction

$$A + 3B + C \rightarrow \text{products}$$

and the following initial rate data.

Exp. #	[A]	[B]	[C]	Rate of formation of product $\left(\frac{M}{s}\right)$
1	1.05×10^{-2}	2.50×10^{-2}	4.00×10^{-3}	1.74×10^{-4}
2	8.71×10^{-2}	2.50×10^{-2}	4.00×10^{-3}	1.19×10^{-2}
3	2.10×10^{-2}	2.10×10^{-2}	2.10×10^{-2}	1.34×10^{-3}
4	4.20×10^{-2}	2.10×10^{-2}	4.20×10^{-2}	7.58×10^{-3}

i) Determine the reaction order for A, B and C.

ii) Determine the overall order of the reaction.

iii) Write the specific rate law for the reaction.

iv) Determine the rate constant for the reaction (include units).

11. The decomposition of H_2O_2 to H_2O and O_2 follows first order kinetics with a rate constant of 0.0410 min^{-1} at a particular temperature.

$$H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$$

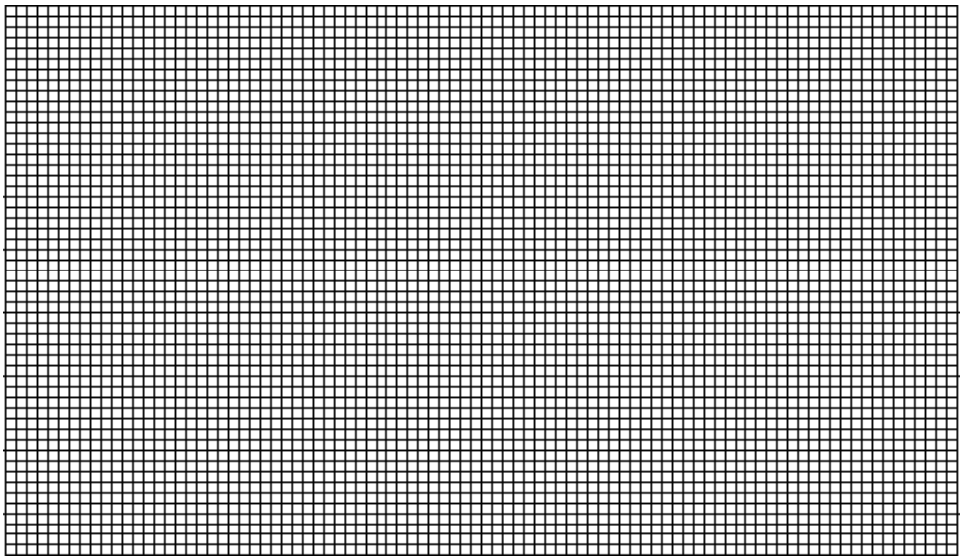
Calculate the $[H_2O_2]$ after 10 mins if $[H_2O_2]_0$ is 0.200 M.

12. Using the following data, establish that the decomposition N_2O_5 according to the reaction,

$$2N_2O_5(g) \rightarrow 2NO_2(g) + O_2(g)$$

follows first order kinetics. Determine the rate constant for the reaction.

Time (sec)	$[N_2O_5]$ (M)
0	1.50×10^{-3}
2000	1.40×10^{-3}
5000	1.27×10^{-3}
7000	1.18×10^{-3}
11000	1.03×10^{-3}
15000	9.00×10^{-4}



13. The decomposition of $NOCl(g)$

$$2NOCl(g) \rightarrow 2NO(g) + Cl_2(g)$$

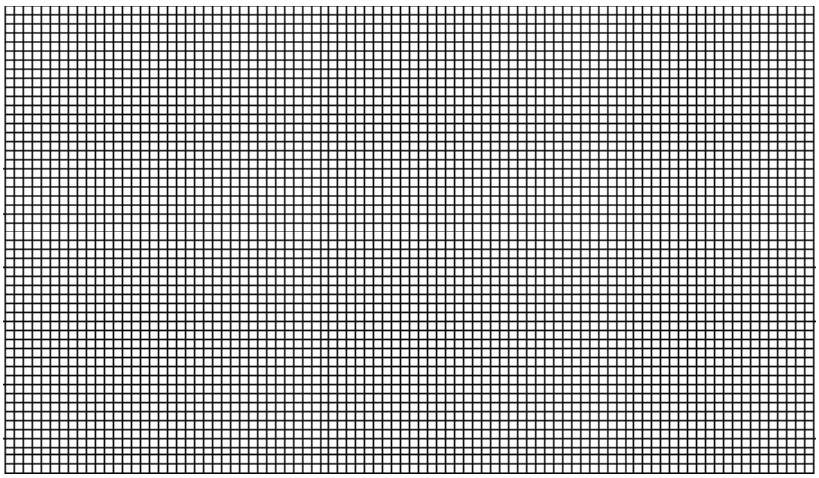
is a second order reaction with a rate constant of 0.0480 $M^{-1} \cdot sec^{-1}$ at 200 °C. In an experiment at 200 °C, the initial concentration of NOCl was 0.400 M. What is the concentration of NOCl after 15.0 min have elapsed?

14. Using the following data establish that the decomposition NO_2 according to the reaction,

$$2NO_2(g) \rightarrow 2NO(g) + O_2(g)$$

following second order kinetics. Determine the rate constant for the reaction.

Time (sec)	$[NO_2]$ (M)
0	0.0100
25	0.0088
50	0.0079
75	0.0071
100	0.0065
150	0.0055
175	0.0051
200	0.0048
250	0.0042
300	0.0038



15. Define the terms *unimolecular*, *bimolecular* and *termolecular*.

16. The reaction

$$NO_2(g) \rightarrow N_2O_4(g)$$

follows simple second order kinetics. If the $[NO_2]_0$ is 0.156 M,

i) calculate the rate constant for the reaction if it takes 1.00×10^{-3} s for the concentration of NO_2 to fall to 0.147 M.

ii) calculate the half-life for the reaction. (When the $[NO_2]_0 = 0.156$ M.)

iii) how long will it take for the $[NO_2]$ to fall to 5.00×10^{-2} M?

iv) what is the $[NO_2]$ after 1.00 s? (When $[NO_2]_0 = 0.156$ M.)

17.The reaction

$$2H_2O_2(aq) \rightarrow H_2O(aq) + O_2(g)$$

follows simple first order kinetics with a half-life of 12.4 s.

i) Calculate the rate constant for the reaction.

ii) How long will it take for the $[H_2O_2]$ to fall from 0.300 M to 0.0452 M?

18.C_4H_8 decomposes according to the following equation;

$$C_4H_8(g) \rightarrow 2C_2H_4(g)$$

the rate constant for the decomposition is 6.07 x 10^{-10} sec^{-1} at 25 °C.

i) What is the order of the reaction?

ii) How long would it take for 1.00 % of a sample of C_4H_8 to decompose at 25 °C an

iii) What is the half-life of the reaction?

19.The first-order rate constant for the reaction

$$CH_3N_2CH_3(g) \rightarrow N_2(g) + CH_3CH_3(g)$$

is 4.00 x 10^{-4} sec^{-1} at 573 K.

i) What will be the concentration of $CH_3N_2CH_3$ after 600 seconds, given that the initial concentration is 1.03 x 10^{-2} M?

ii) What is the half-life of the reaction for this initial concentration?