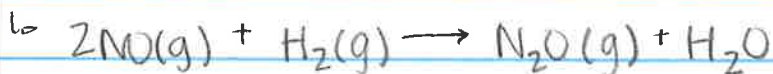


$$\text{rate} = k[\text{NO}]^{0,1 \text{ or } 2} [\text{H}_2]^{0,1 \text{ or } 2}$$

Initial [] & initial rate



Expt	$[\text{NO}]_0$	$[\text{H}_2]_0$	rate ₀
1	0.60 mol/L	0.37 mol/L	0.181 mol/L·s
2	1.00	0.37	0.503
3	0.60	0.94	0.181

Today, Jan 29th
 ↳ sections 14.7 & 14.8
 ↳ Lab tomorrow
 ↳ loggerpro does not yet work with mac OS 15.1
 ↳ next wednesday, CK1

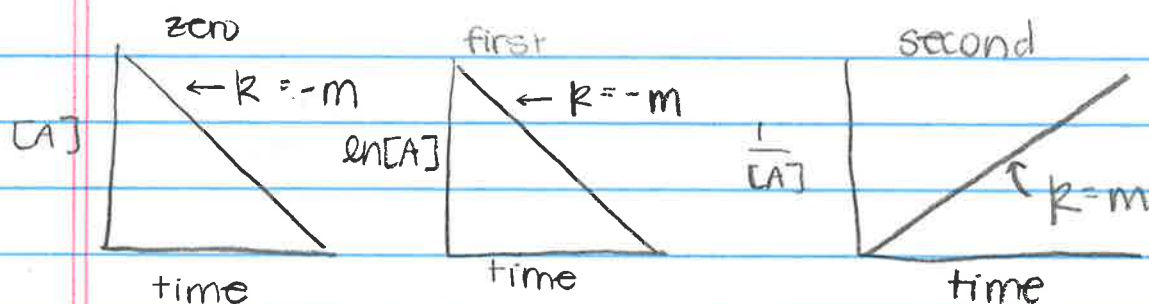
$$\text{trial 1} \rightarrow \frac{0.181}{0.503} = \frac{0.60^{0,1 \text{ or } 2}}{1.00^{0,1 \text{ or } 2}}$$

$$\text{trial 2} \rightarrow \frac{0.181}{0.181} = \frac{0.37^{0,1 \text{ or } 2}}{0.94^{0,1 \text{ or } 2}}$$

$$0.36 = 0.60^{0,1 \text{ or } 2} \rightarrow [\text{NO}]^2$$

$$\text{trial 1} \rightarrow \frac{0.181}{0.181} = \frac{0.37^{0,1 \text{ or } 2}}{0.94^{0,1 \text{ or } 2}}$$

$$\text{trial 3} \rightarrow \frac{0.181}{0.181} = \frac{0.37^{0,1 \text{ or } 2}}{0.94^{0,1 \text{ or } 2}} \rightarrow 1 = \frac{0.37^{0,1 \text{ or } 2}}{0.94^{0,1 \text{ or } 2}} \rightarrow [\text{H}_2]^0$$



$$\ln \frac{[\text{A}]_0}{[\text{A}]} = kt \rightarrow \ln \left(\frac{2.330}{0.369} \right) = k \cdot 3000 \text{ s}$$

$$\hookrightarrow k = 6.14 \times 10^{-4} \text{ s}^{-1}$$

1. What is the rate if $[\text{N}_2\text{O}_5] = 0.500 \text{ M}$?

$$\hookrightarrow \text{rate} = k[\text{N}_2\text{O}_5]^1 = 6.14 \times 10^{-4} \text{ s}^{-1} \times 0.500 \text{ mol/L} = \boxed{3.07 \times 10^{-4} \text{ mol/L}\cdot\text{s}}$$

2. How long does it take until $[\text{N}_2\text{O}_5] = 0.75 \text{ M}$?

$$\hookrightarrow \text{time conc. exp. } \ln \left(\frac{[\text{A}]_0}{[\text{A}]} \right) = kt \rightarrow \ln \left(\frac{2.330}{0.75} \right) = 6.14 \times 10^{-4} \text{ s}^{-1} \cdot t \rightarrow \boxed{t = 1815 \text{ s}}$$

3. What is the $[\text{N}_2\text{O}_5]$ after 45 min.?

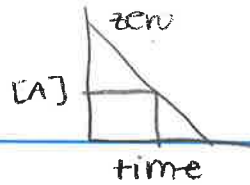
$$\hookrightarrow \frac{45 \text{ min} \times 60 \text{ s}}{1 \text{ min}} = \boxed{2700 \text{ s}} \rightarrow \ln \frac{2.330}{[\text{A}]} = 6.14 \times 10^{-4} \text{ s}^{-1} \cdot 2700$$

$$\hookrightarrow \boxed{[\text{A}] = 0.411 \text{ mol/L}}$$

4. How long does it take for 40% of N_2O_5 to react?

$$\hookrightarrow [\text{A}]_0 = 2.330 \text{ mol/L} \quad [\text{A}]_t = 0.40 \times 2.330 \text{ mol/L}$$

* use your given equation sheet to apply equations to ?'s asked!!!!



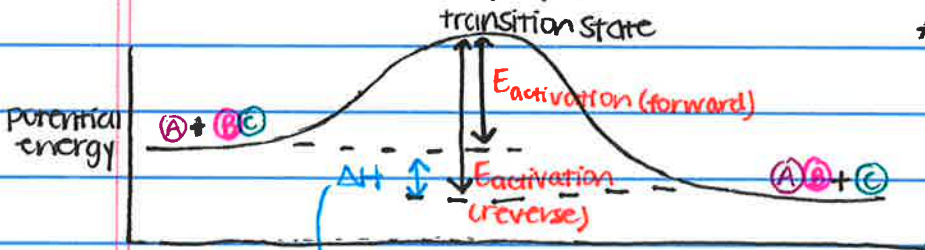
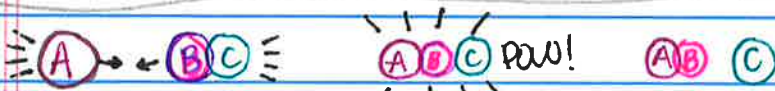
January 29th

5. What is the half-life, $t_{1/2}$?

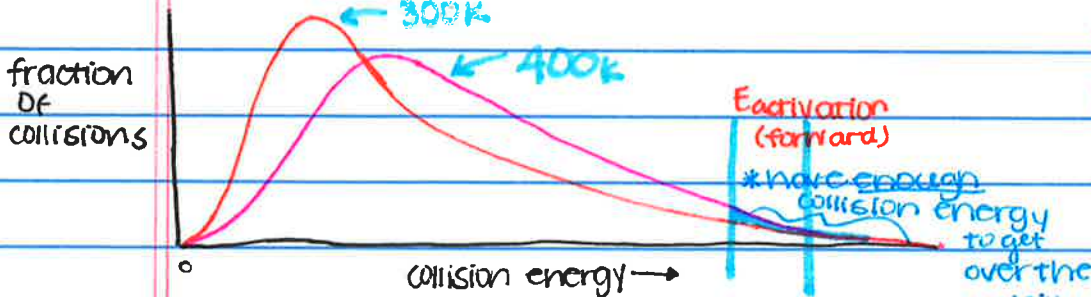
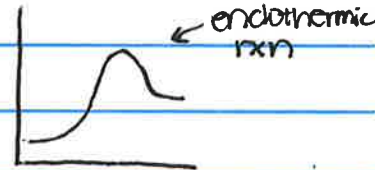
$$\ln \left(\frac{100}{50} \right) = kt$$

$$\ln 2 = 0.693 = kt$$

$$\ln 2 = \frac{0.693}{k} \quad k = \frac{0.693}{t_{1/2}}$$



* vast majority of collisions don't have enough energy to collide & react!



FOR AN EXOTHERMIC RXN?

* ↑ Temp. makes it more possible for more molecules to have ENOUGH energy to get over the hill!

rate = $k[A]^n$
 ↑ temperature causes the rxn to go faster (rate ↑), k increases

fraction w/ enough energy to overcome E_{act}

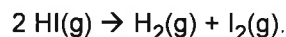
$$f = e^{-\Delta E_{act}/RT} \rightarrow e^{(-150000 \text{ J/mol}) / (8.314 \text{ J mol}^{-1} \text{ K}^{-1} * 298 \text{ K})} \rightarrow e^{-20.3} \rightarrow 7.1 \times 10^{-14}$$

* when E_{act} ↑, f ↓ * when T ↑, f ↑

Chapter 14 Number 3 (14.7 – 14.8) (Unit 1)

29 January 2020

1. The following data were presented in the previous worksheet and led to the conclusion that the best fit was for second order.



You used these data to determine the value of the rate constant with proper units. Write the rate expression (law).

Time (min)	[HI]
0	0.1000
100	0.0741
200	0.0588
300	0.0488
400	0.0417
500	0.0364

- 1a. Write the rate law. What is the rate when [HI] = 0.15 M?

- 1b. How long does it take for [HI] = 0.0600 M?

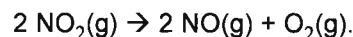
- 1c. What is [HI] after 600 min?

- 1d. What is the half-life is $[\text{HI}]_0 = 0.25 \text{ M}$?

2. A first-order reaction has a half-life of 37.0 min. How long does it take for the initial concentration of reactant, A, to decrease by 80% from its original concentration?

3. A first-order reaction decreases from 0.0500 M to 0.0400 M in 24.4 minutes. What is its half life?

4. Consider the reaction:



The rate constant increases with temperature as summarized here. Use the Arrhenius equation to calculate the energy of activation for this reaction.

Temperature	k (L/mol s)
330 K	0.77
354 K	1.8
383 K	4.7

$$\ln(k_2/k_1) = (-E_a/R)(1/T_2 - 1/T_1)$$

Questions in final exam format:

5. What is the minimum energy barrier that must be overcome for a chemical reaction to occur?
- A. activation energy B. net energy
C. potential energy D. rate limiting energy
6. If a plot of [A] vs time gives a linear plot...
- A. the reaction is first order and the slope is the rate.
B. the reaction is zero order and the slope is the rate constant.
C. the reaction is first order and the slope is the half-life.
D. the reaction is zero order and the slope is the negative rate constant.

Now try these problems from the book:

Section 14.7. (Temperature) Problems 19, 20, 82 and 90
Section 14.8. (Arrhenius equation) 21, 22, 86 – 102 even.
Practice Test, page 589, Question 11 – 12.