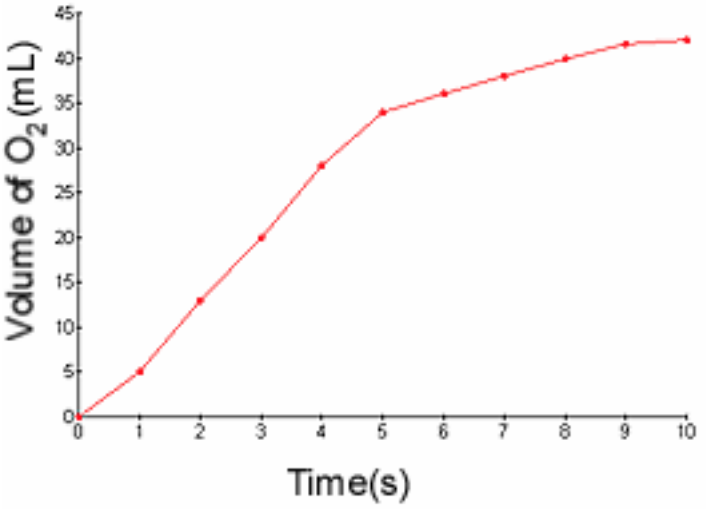
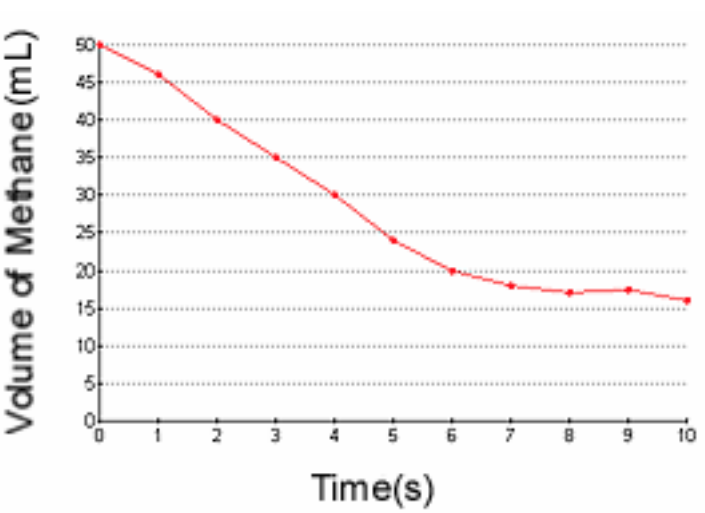
Dougherty Valley HS AP Chemistry
Kinetics – Integrated Rate Law Practice

WORKSHEET #4

Name: **Date:** **Period:** **Seat #:**

Show all work. Complete the following.





[1] Find the reaction rate of the decomposition of methane between 3 and 7 seconds. (-4.25ml/s)

[1b] Find the reaction rate of the production of oxygen gas between 2 and 6 seconds. (5.75 ml/s)

[1c] Identify the reactant and product based on the graph. Explain why

[2] How does temperature affect reaction rate?

[3] What is activation energy? Explain how a catalyst works relative to activation energy.

[4] With the given information, determine the rate law, the rate constant, and the overall reaction order. (k=2.0)

$2Mg + O_2 \rightarrow 2MgO$		**Rate = $k[Mg]_n[O_2]_m$**	
Trial	Initial [Mg] mol·L^{-1}	Initial [O_2] mol·L^{-1}	Measured Rate (M·s^{-1})
1	0.10	0.10	2.0E^{-3}
2	0.20	0.10	4.0E^{-3}
3	0.10	0.20	8.0E^{-3}

[5a] Find the half-life of a first-order reaction if the reaction constant, k, is 2.0E-3 s^{-1} (350 seconds)

[5b] Find the time when only 1% of reactant remains. (t = 2300s)

$$lnk = \frac{-E_a}{R}\left(\frac{1}{T}\right) + \ln(A) \qquad \ln\left(\frac{k_2}{k_1}\right) = \frac{E_A}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$ClO_3^- + H_2O \rightarrow ClO_4^- + H_2$

Reaction constant k (s^{-1})	Temperature (°C)
2.0E-3	25
4.0E-3	35
8.0E-3	45
1.6E-2	55

[6] Find E_a using the following information: (hint: equation can be the form of y = mx + b. Graph and solve for the slope (E_a / R) – (5.21E4 J/mol)

[7] Find the 2nd order reaction's activation energy with the given information. (1.1E4 J/mol)

K_1 = 4.0L/mol*s at 37°C	K_2 = 8.0L/mol*s at 87°C

[8] What is the rate law for this reaction?

$$NO_3\,(g) + NO_2\,(g) \rightarrow 2NO(g) + O_3\,(g)$$

	Initial Concentrations, *M*		Initial Rate, *M* s^{-1}
Expt.	**NO_3 (g)**	**NO_2(g)**	
1	0.141	0.31	0.00522
2	0.144	0.15	0.00132
3	0.283	0.16	0.00133

[a] Order in [NO_3]?

[b] Order in [NO_2]?

[c] Overall order?

[d] Rate Law?

[e] Value of the rate constant, k?

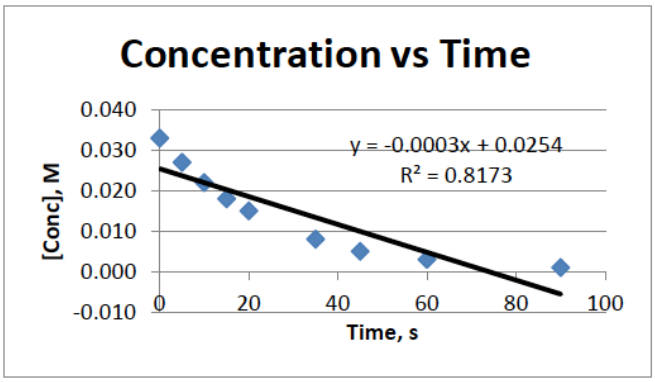
[f] Units of the rate constant, k?

[9] Kinetics

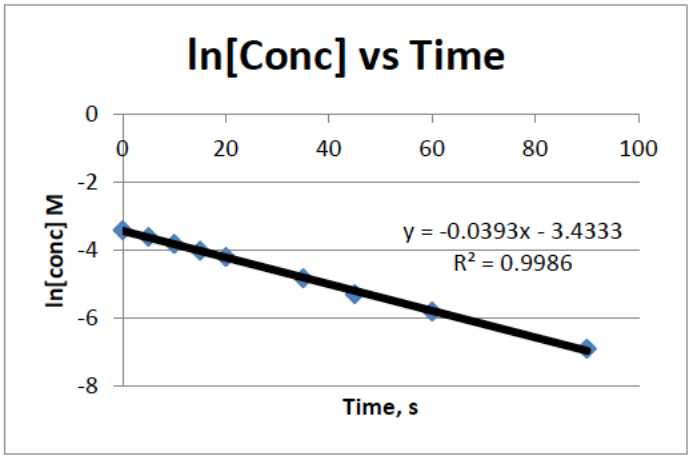
Junior Chemist had to analyze the rate at which nitropropylether decomposes at 298 K to determine the rate law. She took the raw data and made a bunch of graphs, but she doesn't know how to interpret them to determine the rate law. (Her computer drew best fit straight lines through the data and even wrote the equation for the line in the form y = mx + b where m is the slope and b is the intercept.) Please determine the rate law from the data. Explain your steps.

nitropropylether → decomposition products

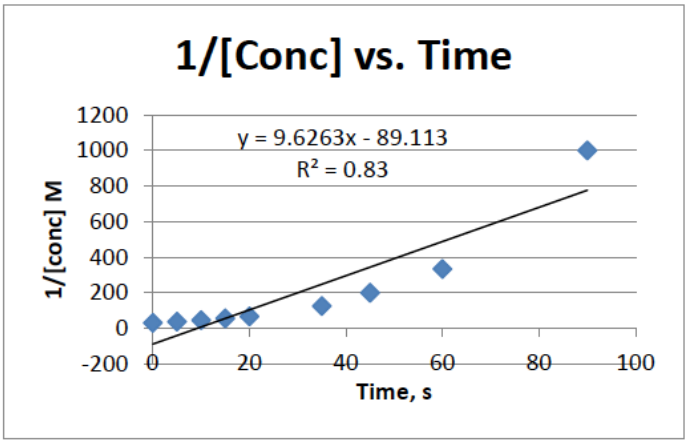
Time	[ ] M
0	0.033
5	0.027
10	0.022
15	0.018
20	0.015
35	0.008
45	0.005
60	0.003
90	0.001



Time	Ln[ ] M
0	-3.41125
5	-3.61175
10	-3.81225
15	-4.01275
20	-4.21325
35	-4.81475
45	-5.21575
60	-5.81725
90	-7.02025



Time	1 / [ ] M
0	30.30303
5	37.03072
10	45.25204
15	55.29861
20	67.57565
35	123.3157
45	184.1495
60	336.0459
90	1119.064



Order:
Rate Constant:
Units of rate constant:
Differential Rate law:
Integrated Rate Law:

[10] **Half-lives**. The decay of Pu-239 occurs with a half-life of 24,000 year. How long will it take for a bomb core, approximately 4 kg of Pu-239, to decay to 0.30 μg, which is the smallest dosage that is known to be lethal?

[11] **Effect of temperature on the rate of reaction**. It is said that all reactions proceed faster at higher temperature. **Explain** why the statement is true by describing a reaction on the atomic scale and explaining which processes are influenced by temperature and how increasing temperature affects those processes.