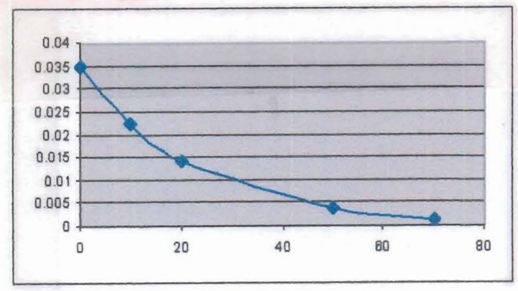
Quiz 8 **Take Home Quiz for Kinetics** **Name** Key

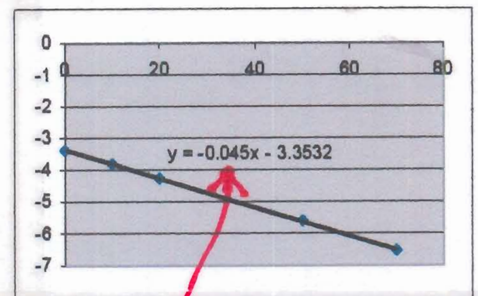
Using the following concentration-time dependence data, answer the next two questions.

Time(s)	[Reactant] (M)
0	0.0350
10	0.0223
20	0.0142
50	0.0037
70	0.0015

Zero order:



First order:



1. What is the order of reaction?

First

2. Calculate the rate constant k.

slope = $-k = \frac{(-6.5-(-3.8))}{70-10} = 0.039\ s^{-}$

or $k = 0.045\ s^{-1}$

3. Cyclobutane decomposes to form ethylene: $C_4H_8(g) \rightarrow 2C_2H_4(g)$. The rate constant for the first order reaction is $3.05 \times 10^{-2}\ s^{-1}$ at 525°C. What is the half-life in seconds?

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

$t_{1/2} = \frac{0.693}{3.05 \times 10^{-2}\ s^{-1}}$

$t_{1/2} = 22.7\ s$

4. Calculate the half-life of a first-order reaction, in seconds, if the concentration of the reactant is 0.137 M 2.4 s after the reaction starts and is 0.111 M 14.9 s after the reaction starts.

$\ln A = \ln A_0 - kt$

$\ln \frac{(.111)}{(0.137)} = -k(14.9-2.4)$

$k = 0.0168\ s^{-1}$

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

$t_{1/2} = \frac{0.693}{0.0168\ s^{-1}}$

$t_{1/2} = 41.2\ s$

5. The decomposition of formic acid is measured at several temperatures. The temperature dependence of the first-order rate constant is:

[redacted]

T(K)	k(s-1)
800	0.00027
825	0.00049
850	0.00086
875	0.00143
900	0.00234
925	0.00372

[redacted]

graph it

or

Calculate the activation energy in kJ.

$$\ln \frac{k_1}{k_2} = \frac{-Ea}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\ln\left(\frac{0.00027}{.00372}\right) = \frac{-Ea}{8.314\ J/mol\cdot K}\left(\frac{1}{800} - \frac{1}{925}\right)$$

-2.62 $\qquad$ 1.69×10^{-4}

$Ea = 128{,}953\ J$ or

$Ea = 129\ kJ$

6. The reaction rate triples when the temperature increases from 16.88°C to 39.05°C. What is the activation energy in kJ?

2.45×10^{-4}

$$\ln \frac{1}{3} = \frac{-Ea}{8.314\ J/mol}\left(\frac{1}{289.88} - \frac{1}{312.05}\right)$$

$$-1.10 = \frac{-Ea\ (2.45 \times 10^{-4})}{8.314}$$

$Ea = 37.3\ kJ$