2019 CHEM2C: Assignment 1

Ram Seshadri (seshadri@mrl.ucsb.edu)

Due date: April 11 2019 (in class). Keep everything brief.

1. The zeroth-order differential rate law for the reaction $A \longrightarrow$ products is:

$$-\frac{d[A]}{dt} = k[A]^0$$

   Derive the integral rate law and the expression for $t_{1/2}$.

2. The first-order differential rate law for the reaction $A \longrightarrow$ products is:

$$-\frac{d[A]}{dt} = k[A]$$

   Derive the integral rate law and the expression for $t_{1/2}$.

3. The second-order differential rate law for the reaction $A \longrightarrow$ products is:

$$-\frac{d[A]}{dt} = k[A]^2$$

   Derive the integral rate law and the expression for $t_{1/2}$.

4. P_0 is the initial investment in a compound interest account, and P is the total amount of money at time t. If continuous compounding takes place at an interest rate r, the relevant formula is:

$$P = P_0 e^{rt}$$

   (a) How long would it take for \$100.00 to become \$1000.00 if the interest rate were 10% ($r = 0.1$). *Clarification: The time is in years, and the interest rate is* per *year, so for fun, you could give the answer in years, months, and days.*

   (b) What is the interest rate required to double the money $P = 2P_0$ in 5 years? Verify that the rate is $r = ln(2)/n$ where $n = 5$ (years).

5. The decomposition of hydrogen peroxide H_2O_2 under certain conditions shows the following concentration dependence with time:

Time, t (s)	0	120	300	600	1200	1800	2400	3000	3600
$[H_2O_2]$ (M)	1.00	0.91	0.78	0.59	0.37	0.22	0.13	0.082	0.050

(a) Make suitable plots (in a program like Excel) that would allow one to verify whether the reaction is zeroth, first, or second order.

(b) Use Excel to fit a straight line to the correct *linear* plot above and calculate the slope and intercept.

(c) Use the slope to obtain the rate of reaction and verify that the intercept can be related to $[H_2O_2]$ at $t = 0$ (*viz.* that $[H_2O_2]_0 = 1.00\,\text{M}$).