Problem Set # 3

1. The decomposition of X is second order in X and has a rate constant of $7.02 \times 10^{-3}\ M^{-1}s^{-1}$ at a certain temperature.

a. Write the rate law. Rate = $7.02 \times 10^{-3} M^{-1} s^{-1} [X]^2$

b. What is the half-life for this reaction if the initial concentration is 0.500 M? 285 s

c. How long will it take for the concentration of X to decrease to 0.285 M when the initial concentration is 0.677 M? $t = 289$ sec

d. Draw the straight line plot of the reaction.

2. The half-life for the radioactive decay of U-238 is 4.5 billion years and is independent of initial concentration. How long will it take for 10% of the initial concentration of a U-238 to decay?

$k = 1.54 \times 10^{-10}\ yr^{-1}$ $t = 684,159,193$ yrs

3. For the reaction: $Cl_2(g) + 3F_2(g) \rightarrow 2\,ClF_3(g)$

Complete the table by adding the calculated rates for F_2 and ClF_3:

$\Delta[Cl_2]/\Delta t$	$\Delta[F_2]/\Delta t$	$\Delta[ClF_3]/\Delta t$
-0.048 M/s	-0.144 M/s	0.096 M/s

4. For the reaction: $Cl_2(g) + 3F_2(g) \rightarrow 2\,ClF_3(g)$

a. Write the rate expression for all reactants and products. $-\frac{\Delta[Cl_2]}{\Delta t} = -\frac{1}{3}\frac{\Delta[F_2]}{\Delta t} = \frac{1}{2}\frac{\Delta[ClF_3]}{\Delta t}$

b. What is the relationship between the rate of consumption of F_2 and the rate of production of ClF_3?

$-\frac{\Delta[F_2]}{\Delta t} = \frac{3}{2}\frac{\Delta[ClF_3]}{\Delta t}$

5. The following data were obtained for the reaction of NO with O_2. Concentrations are in molecules/cm^3 and rates are in molecules/cm^3.s. Find the orders with respect to NO and O_2. Find the value of the rate constant.

[NO] (molecules/cm3)	$[O_2]$ (molecules/cm3)	Initial Rate (molecules/cm^3.s)
1×10^{18}	1×10^{18}	2.0×10^{16}
2×10^{18}	1×10^{18}	2.0×10^{16}
3×10^{18}	1×10^{18}	18.0×10^{16}
1×10^{18}	3×10^{18}	6.0×10^{16}

n = 0 n = 1