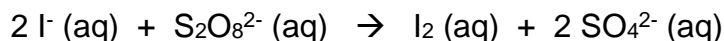


Problem Set 5 – Due by 5 p.m. Friday, Nov. 15, 2019

Please answer the following questions on a separate sheet (or sheets) of paper. Be sure to show all your work and include print-outs of any graphs you create.

1. The following reaction (called the “iodine clock reaction”) is often performed in chemistry lab courses:



Suppose that CHEM 108 students performed the series of experiments below, determining the initial rate for each.

$[\text{I}^-]_0$ (M)	$[\text{S}_2\text{O}_8^{2-}]_0$ (M)	Initial Rate (M/s)
0.080	0.040	12.5×10^{-6}
0.040	0.040	6.25×10^{-6}
0.080	0.020	6.25×10^{-6}
0.032	0.040	5.00×10^{-6}
0.060	0.030	7.00×10^{-6}

- Express the reaction rate in terms of (i) the rate of disappearance of I^- and (ii) the rate of appearance of I_2 .
 - Use the experimental results provided to determine the rate law.
 - Calculate the rate constant.
2. The decomposition of hydrogen peroxide (H_2O_2) was measured as a function of time, generating the following data:

Time (s)	$[\text{H}_2\text{O}_2]$ (M)
0	1.00
1.20×10^2	0.91
3.00×10^2	0.78
6.00×10^2	0.59
1.200×10^3	0.37
1.800×10^3	0.22
2.400×10^3	0.13
3.000×10^3	0.082
3.600×10^3	0.050

- Determine the order with respect to $[\text{H}_2\text{O}_2]$ and write the rate law.
 - Determine the rate constant.
3. A metastable form of technetium-99, $^{99\text{m}}\text{Tc}$, is the most commonly used radioactive tracer in medical imaging. It decays according to first-order kinetics, with a half-life of 6.0 hours. How much time must elapse after injection before the amount of $^{99\text{m}}\text{Tc}$ in a patient’s bloodstream drops to 1.0 % of its initial concentration?

Problems continue on back....

4. For solid lead(II) iodide in equilibrium with its ions in aqueous solution, the equilibrium constant K_c (also called the solubility product constant, K_{sp}) has a value of 8.5×10^{-9} at 25°C .
- Please write a balanced equation representing this equilibrium and an expression for K_c .
 - Please calculate ΔG° for this reaction in kJ/mol using only the information provided here. In which direction is the reaction spontaneous under standard conditions?
 - Please calculate the equilibrium concentration of each ion in moles per liter.
5. The following reaction has an equilibrium constant $K_P = 85$ at a temperature of 553 K . Suppose that, at a certain point, the pressures of H_2 and I_2 are each 0.90 atm and that of HI is 5.25 atm .



- Is the reaction at equilibrium? (Show your work and/or explain your reasoning.)
- If not, what will the pressures of H_2 , I_2 and HI be when equilibrium is reached?