

Chemistry 2000 Spring 2001 Section B Assignment 1

Due: Thursday, Jan. 18, 10:50 a.m.

Note: I'm not terribly fussy about significant figures, but I will ask the marker to penalize answers which give either a ridiculously small or a ridiculously large number of digits relative to the number of significant figures of the data.

1. Calculate the mole fraction of potassium ions in a solution made by dissolving 8.0 g of potassium permanganate in 250 mL of water (measured at 20°C). The density of water at 20°C is 0.998 23 g/mL. [6 marks]
2. A 1.697 mol/L solution of acetone ($\text{CO}(\text{CH}_3)_2$) in water has a density of 0.9849 kg/L.
 - (a) Calculate the molality of this solution. [8 marks]
 - (b) Calculate the mole fraction of acetone. [4 marks]
3. Suppose that, for a reaction $\text{A} \rightarrow 2\text{B}$, the initial concentration of A is 0.400 mol/L. After 0.32 s, the concentration of A has dropped to 0.382 mol/L.
 - (a) Determine the initial rate of change of the concentration of A from this data. [2 marks]
 - (b) What is the initial rate of change of the concentration of B? [2 marks]
4. In a pair of initial rate experiments, the rate of a reaction increases by a factor of 9 when the concentration of a reactant is increased by a factor of 3, all other factors being held constant. What is the order of the reaction with respect to this reactant? Briefly explain your reasoning. [3 marks]
5. In the reaction of ozone with nitrogen monoxide forming nitrogen dioxide and oxygen, the following initial rate data have been obtained:

Experiment	[NO] ($\mu\text{mol/L}$)	[O ₃] ($\mu\text{mol/L}$)	$d[\text{NO}_2]/dt$ ($\mu\text{molL}^{-1}\text{s}^{-1}$)
1	1.00	3.00	66.0
2	1.00	6.00	132
3	1.00	9.00	198
4	2.00	9.00	396
5	3.00	9.00	594

- (a) Determine the rate law and explain your reasoning. [8 marks]
- (b) Calculate the rate constant. [2 marks]
- (c) Calculate the rate of the reaction if $[\text{NO}] = 1.30\mu\text{mol/L}$ and $[\text{O}_3] = 5.00\mu\text{mol/L}$. [2 marks]