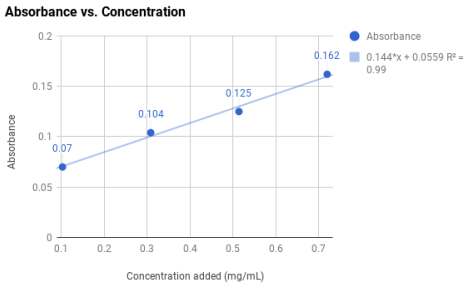
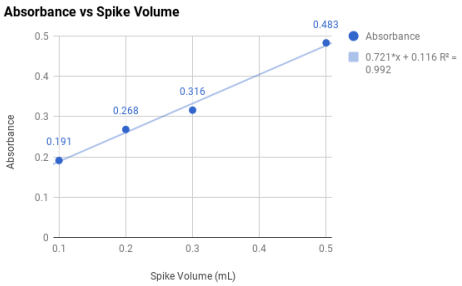
CHEM 2320 Exam 2 Review

1. Two of a local rancher's cows have recently died, and he suspects his neighbor's fertilizer runoff poisoned them. As a corn farmer, his fertilizers are composed mostly of ammonium nitrate. If ammonium nitrate has a strong absorbance close to 700 nm, which is close to that of the calcium carbonate found naturally in the stream, what type of procedure would you use to determine if the ammonium nitrate concentration were dangerous enough to injure a cow, and why is this procedure necessary?

2. After constructing a calibration curve what part of the curve corresponds to the analytical sensitivity?



(a) Absorbance vs Added Concentration



(b) Absorbance vs Added Spike

3. Using the figures above, calculate the concentration of the two unknown solutions.

4. Which of the following does the reaction rate *not* depend on?
   (a) Temperature
   (b) Catalysts
   (c) Surface area
   (d) Concentration
   (e) None of the above

5. Write an expression in terms of change in concentration for a product and for a reactant. (Hint: Use Δ notation.)

6. Given the equation $N_2 + 3\,H_2 \longrightarrow 2\,NH_3$, what is the rate of reaction in terms of a) the rate of production of NH_3 and b) the rate of consumption of H_2?

7. The reaction $X + Y \longrightarrow XY$, is second order with respect to X and first order with respect to Y. What is the overall order for the reaction?

8. What is the difference between an average rate and an instantaneous rate? Why might we want to use an initial rate instead of a rate averaged over a long interval?

9. Identify each component in the expression rate = $k[A]^x[B]^y$.

10. What are the units for the reaction rate constant, k, for the equation rate = $k[A]^{\frac{2}{5}}[B]^3$?

11. For the reaction $3\,I^-_{(aq)} + {IO_2}^-{}_{(aq)} + 4\,H^+ \longrightarrow 2\,I_{2(aq)} + 2\,H_2O$, the rate of production of H_2O was observed to be 5.0 x 10^-2 M/s. Determine the rate of consumption of I^-, ${IO_2}^-$, and H^+. Determine the rate of production of I_2. What is the rate of the reaction?

12. The following data were collected for the reaction $2\,{NO_{(g)}}^+{O_2}_{(g)} \rightleftharpoons 2\,NO_{2(g)}$:

Initial NO Concentration (mol/L)	Initial O_2 Concentration (mol/L)	Initial Rate of reaction (mol/Ls)
5.38 x 10^{-3}	5.38 x 10^{-3}	1.91 x 10^{-5}
8.07×10^{-3}	5.38×10^{-3}	4.30×10^{-5}
13.45×10^{-3}	5.38×10^{-3}	11.94×10^{-5}
8.07×10^{-3}	6.99×10^{-3}	5.59×10^{-5}
8.07×10^{-3}	9.69×10^{-3}	7.75×10^{-5}

What is the rate law for this reaction?

13. What will the rate of reaction be for an initial concentration of NO of 6.02×10^{-3} mol/L and an O_2 concentration of 8.44×10^{-3} mol/L?

14. If a reaction is second order with respect to a reactant A, what will happen to the rate of reaction if the concentration of A is doubled?

15. Write the integrated rate law for the reaction $CH_3NC_{(g)} \rightleftharpoons CH_3CN_{(g)}$ assuming it is a) zeroeth order, b) first order, and c) second order.

16. One way to determine the age of a rock is to measure the extent to which the ^{87}Rb in the rock has decayed to ^{87}Sr. Assuming this is a first-order process and that the rate constant, $k = 1.42 \times 10^{-11}$ $year^{-1}$, what fraction of the original rubidium is left after 1×10^{10} (10 billion) years?

17. Define the "mass action expression" in terms of the equilibrium constant.

18. The state of chemical equilibrium can best be described as:

    (a) Macroscopically static and microscopically dynamic
    (b) Macroscopically static and microscopically static
    (c) Macroscopically dynamic and microscopically static
    (d) Macroscopically dynamic and microscopically dynamic

19. What does a K greater than 1 say about the relative amounts of products and reactants?

20. For the reaction $A_{(g)} + 2\,B_{(g)} \rightleftharpoons C_{(g)}$, the following concentrations are measured: [A] = 0.60, [B] = 0.20, [C] = 0.55. What is the value of K for this reaction?

21. For the reaction above, what would happen to the value of K if the concentration of C were increased?

22. If the value of Q for this reaction were 25 at a time t, the reaction would be

    (a) At equilibrium, no reaction will occur

    (b) Beyond equilibrium, the reaction will proceed to the left

    (c) Before equilibrium, the reaction will proceed to the right

23. Write an expression for the reverse reaction, $C \rightleftharpoons A + 2\,B$, and calculate the corresponding equilibrium constant.

24. For the reaction $N_{2(g)} + 2\,H_{2(g)} \rightleftharpoons N_2H_{4(g)}$ in a 10.0 L reaction vessel, calculate the equilibrium concentrations of N_2 and H_2 given 1.00 starting moles N_2 and 1.50 starting moles H_2, and given $K_c = 5.0 \times 10^{-3}$.

25. State the Brønsted-Lowry definition of acids and bases.

26. What is meant by an acid-base conjugate pair?

27. What characterizes a strong acid versus a weak acid? A strong base versus a weak base? What is the leveling effect?

28. What is the ion product constant, K_w, and what is its relation to K_a and K_b?

29. For the reaction $HOCl + H_2O \rightleftharpoons H_3O^+ + OCl^-$, write the K_a expression.

30. Given a K_a of 2.9×10^{-8} for the previous reaction, calculate the equilibrium concentration of H_3O^+ assuming a starting amount of 0.30 moles HOCl in a 1.0L flask.

31. Calculate the percent dissociation for the previous problem. Is this acid strong or weak?

32. If the K_a of an unknown acid is found to be 28, is it a strong or weak acid?

33. A _____ base will have a high K_b.
    (a) Strong
    (b) Weak

34. What is the value of $p(10 \times 10^{-6})$?

35. Write a general equation for the addition of a) a strong acid and b) a strong base to water.

36. Write an expression to calculate the percent ionization of a) an acid and b) a base.

37. Calculate the pH corresponding to the ion product constant for water.

38. Given $K_a = 4.6 \times 10^{-5}$, at what pH will the solution reach equilibrium?

39. Fill in the missing entries below:

$[H^+](M)$	$[OH^-](M)$	pH	pOH	Acidic or basic?
7.7×10^{-3}				

40. Calculate the molar concentration of OH^- ions in a 7.1×10^{-2} M solution of ethylamine ($C_2H_5NH_2$)($K_b = 6.4 \times 10^{-4}$).