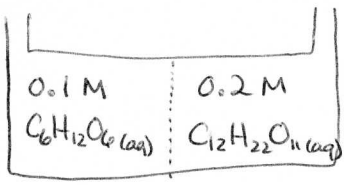
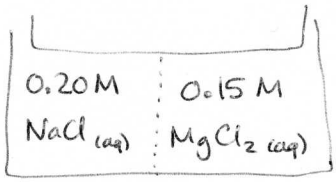
Some Review Questions for Exam 3 - Chem 30A

(Note: this selection of problems is not comprehensive!)

1. What will happen to red blood cells if they are placed in pure water? Explain.
2. What will happen to cells if they are placed in a very salty solution? Explain.
3. In the following diagrams, the two sides are separated by a semipermeable membrane. Only water can flow through this membrane. Determine the net flow of water and explain your reasoning in each case.





4. In a titration, if 38.49 mL of 0.5022 M NaOH is needed to react with 25.00 mL $H_2C_2O_4$, what is the molarity of the $H_2C_2O_4$?
5. What volume of 0.1220 M H_3PO_4 is needed to react with 15.00 mL of 0.1002 M $Ba(OH)_{2\,(aq)}$?
6. For the following reaction:

   $Al_{(s)} + HCl_{(aq)} \rightarrow AlCl_{3\,(aq)} + H_{2\,(g)}$

   a. What mass of H_2 is formed if 10.0 mL of 6.00 M HCl is reacted with excess aluminum?

   b. If the hydrogen gas is collected at 25 °C and at 727 mmHg, what volume will it occupy?
7. If the concentration of hydroxide ion is 3.1×10^{-5} M, is the solution acidic, basic, or neutral? What is the concentration of hydronium ion? What is the pH?
8. What is $[H_3O^+]$ in a solution with a pH of 4.43? What is $[OH^-]$?
9. A buffer contains HNO_2 and NO_2^{1-}.

   a. Write the equation for the reaction that will happen if HCl is added to the buffer.

   b. Write the equation for the reaction that will happen if a strong base is added to the buffer.
10. Label all acids and bases in the following reaction. Point out the conjugate acid-base pairs.

    $HPO_4^{2-} + HF \leftrightarrows H_2PO_4^{1-} + F^{1-}$

    $CO_3^{2-} + H_2O \leftrightarrows HCO_3^- + OH^-$

11. What volume of 2.00 M HCl is needed to react with 3.00 g $Ca(OH)_2$?
12. At 20°C, the solubility of NaCl in water is 35.8 g NaCl/100 mL water.

    a. What will happen if you mix 30 g NaCl in 100 mL water?

    b. What will happen if you mix 50 g NaCl in 100 mL water?

    c. What will happen if you mix 25 g NaCl in 50 mL water?
13. What mass of NaOH is in 50.0 mL of 2.00 M $NaOH_{(aq)}$?
14. A solution contains 12.3 g NaCl in 50.0 g water. Calculate the mass percent NaCl in this solution.

15. A solution contains 16.0 g H_2SO_4 in 435 mL solution. Calculate the molarity of H_2SO_4 in the solution.

16. Calculate the mass percent acetic acid ($HC_2H_3O_2$) in a solution that contains 0.100 mol acetic acid in 557 g of solution.

17. A KBr solution is 5.00% by mass KBr. What mass of solution contains 8.00 g KBr?

18. a. If you mix a certain volume of a solution with 4 times the volume of water, what happens to the concentration of the solution? (For example: mix 10 mL of solution with 40 mL water.)
b. If you dilute a solution by a factor of 10, it means the final volume is 10 times the initial volume. This would be like mixing 10 mL solution with 90 mL water. What will happen to the concentration of the solution?

19. Without doing any calculations, answer the following questions.
a. If 100 mL of 2.00 M NaOH is diluted with 100 mL of water, what is the concentration of the resulting solution?
b. If 20 mL of 1.00 M HCl is diluted to a total volume of 100 mL, what is the concentration of the resulting solution?
c. How much water would you have to add to 10 mL of 2.00 M HCl to dilute it to 0.200 M?

20. If the pOH of a solution is 9.44, what is the hydroxide ion concentration? What is the pH? Is the solution acidic or basic?

21. If the pH of a solution is 3.57, what are the concentrations of H_3O^+ and OH^-?

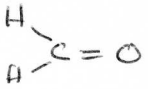
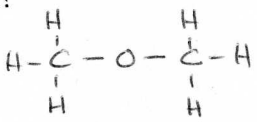
22. What is the pH of 0.040 M HNO_3?

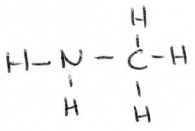
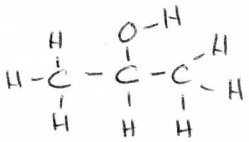
23. What is the pH of 0.20 M $Ba(OH)_2$?

24. What is a weak electrolyte?

25. Given the following substances:
a. $C_7H_{15}OH$ b. C_8H_{18} c. $CH_3CH_2NH_2$ d. CH_3CH_2F
Which would be most soluble in water? Rank the molecules in order of solubility in water (most to least soluble). Explain.
Which would have the highest boiling point? Rank from highest to lowest boiling point. Explain.

26. Which of the following compounds can hydrogen bond?

a. $CH_3CH_2CH_3$ b.  c. 

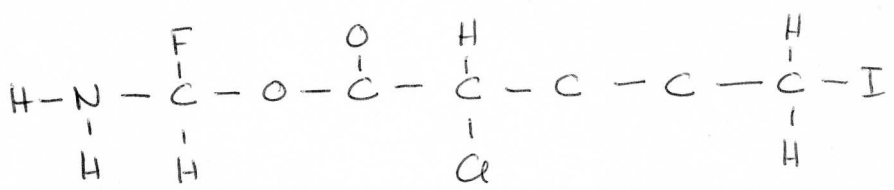
d.  e. 

27. a. Write the reaction for K_2CO_3 reacting with HI.
b. If this reaction produces 45.8 mL of $CO_{2\,(g)}$ at 26°C and 752 mmHg, what mass of solid potassium carbonate was used?
c. If this reaction produces 45.8 mL of $CO_{2\,(g)}$ at 26°C and 752 mmHg, what volume of 0.300 M $HI_{(aq)}$ was used?

28. Classify the following solids as molecular, ionic, metallic, or covalent network.
a. diamond b. $Fe(NO_3)_2$ c. N_2O_5 d. Ag

29. Explain what holds the particles together in each type of solid: molecular, ionic, metallic, or covalent network.

30. Which would have the higher heat of vaporization in each of the following pairs? Explain.
    a. CH_3OH or CH_3CH_3
    b. CH_3F or C_6H_{14}
31. Which would have the higher vapor pressure in each of the above pairs? Explain.
32. Which pairs would be likely to mix with each other? Explain.
    a. C_6H_6 and C_4H_{10}
    b. CO_2 and $CH_3CH_2CH_2CH_3$
    c. PCl_3 and H_2O
    d. CH_3CH_2OH and H_2O
    e. CH_3OH and oil
    f. C_6H_6 and KBr
33. Explain why water has a low vapor pressure.
34. Is it possible for water to boil at a temperature below 100°C? Explain.
35. Explain how atmospheric pressure varies with altitude. How does this relate to the boiling point of water, and why?
36. Calculate the amount of energy needed to melt 50.0 grams of ice, assuming it is at its melting point of 0°C.
37. How many grams of water can be vaporized at 100°C using 500. kJ of heat?
38. Write the overall molecular equations for each of the following:
    a. $Li_2CO_{3\,(aq)} + HNO_{3\,(aq)} \rightarrow$
    b. $H_3PO_{4\,(aq)} + NaOH_{(aq)} \rightarrow$
    c. $HCl_{(aq)} + Mg_{(s)} \rightarrow$
    d. $HI_{(aq)} + KHCO_{3\,(aq)} \rightarrow$
39. Calculate the pressure exerted by 1.00 g of $Ar_{(g)}$ in a 5.00 L container at 45°C.
40. What mass of carbon dioxide gas is present in a 45.0 L container at STP?
41. A sample of gas occupies 2.5 L at 25°C and 1.00 atm. If the pressure is changed to 967 mmHg and the temperature changes to –7°C, what is the volume of the gas sample?
42. A gas occupies 45.0 L at 2.00 atm and 25°C. What volume will it occupy at 1.00 atm and 25°C?
43. A gas mixture contains carbon dioxide at a partial pressure of 348 torr, argon at a partial pressure of 122 torr, and oxygen at a partial pressure of 259 torr. What is the total pressure of this mixture? What is the fraction of oxygen in the mixture?
44. Explain Boyle's Law, Charles' Law, and Avogadro's law at the molecular level. (Explain what the molecules are doing.)
45. 0.258 g of a gas is in a 285-mL container at 97°C and 746 mmHg. What is the molar mass of this gas?
46. In the following structure, fill in any lone pairs and multiple bonds. Then state the geometry and bond angle around each of the central atoms in this molecule.



47. For each of the following molecules or polyatomic ions, draw their Lewis structures. Determine the shape, and bond angle, draw a 3-dimensional sketch, and state whether the molecule is polar or nonpolar and why. Include resonance structures if needed.

a. CBr_4
b. CBr_2Cl_2
c. $CBrCl_3$
d. NCl_3
e. Cl_2O
f. CO_2
g. CH_2O
h. CHO_2^{1-}
i. CN^{1-}
j. ClO_3^{1-}
k. SO_4^{2-}
l. SO_3^{2-}
m. NO_3^{1-}
n. NO_2^{1-}

48. When a piece of lead metal is placed in a strong acid solution such as HCl, it reacts and bubbles form on the lead.
a. Which is more active, Pb or H? Explain.
b. Write a balanced equation for the reaction.
c. What is oxidized and what is reduced?

49. Zn is more active than Ni. Will this reaction happen? Explain.
$Ni_{(s)} + ZnCl_{2\,(aq)} \rightarrow Zn_{(s)} + NiCl_{2\,(aq)}$

50. When copper is placed in a strong acid such as HCl, no reaction occurs. Which is more active, Cu or H?

51. For the reaction:
$2\,MnO_4^- + 5\,C_2O_4^{2-} + 16\,H^+ \rightarrow 2\,Mn^{2+} + 10\,CO_2 + 8\,H_2O$
a. Determine the oxidation number of each atom in this reaction.
b. What is oxidized and what is reduced? How can you tell?
c. What is the oxidizing agent? The reducing agent? Explain.

52. Write the equation for the beta emission of ^{131}I.

53. Write the equation for the alpha emission of ^{247}Bk.

54. Fill in the atomic numbers in the following nuclear reaction. Then fill in the missing symbol.
$\_\_\_\_\_ + {}^{2}H \rightarrow {}^{99}Tc + {}^{1}n$

$K_w = 1.0 \times 10^{-14}$
$K_w = [H_3O^+][OH^-]$
ΔH_{fus} ice = 6.02 kJ/mol
ΔH_{vap} water = 40.7 kJ/mol

$M_1V_1 = M_2V_2$
$c_1V_1 = c_2V_2$

$PV = nRT$
22.4 L/mole

R = 0.08206 L•atm/K•mol
1 atm = 760 mmHg (exact)

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$