Study guide Exam 4 – Chapters 12, 14, 16, 17, 18

Know definitions – solution, solute, solvent, electrolyte, nonelectrolyte, miscible, immiscible, unsaturated, saturated, and supersaturated with respect to solutions, molarity, acid, base, Arrhenius acid and base, bronsted-lowry acid and base, conjugate acid or base, dissociation, pH, buffer, radioactivity, nuclear chemistry, radioisotope, alpha particle, beta particle, gamma ray, radioactive decay, positron, half-life, fission, fusion, chain, alkane, alkene, alkyne, monosaccharide, disaccharide, polysaccharide, starch, amino acid, protein, enzyme, triglyceride, lipid, steroid, nucleic acid, DNA, RNA.

Know effect of temperature and pressure on solubility, relationship of polarity to solubility, how to use concentration different concentration units,how to determine solubility of gases at different pressures using Henry's law, nomenclature of acids and bases, how to write acid base equations and identify conjugate acids and bases, how to differentiate between a strong and weak acid/base, calculate pH and pOH, calculation concentrations based on titration data, determine H^+ and OH^- concentrations from pH or pOH, how to write nuclear reactions and predict products of α, β, or γ decay, how to determine half-lives and percent decay for nuclear reactions.

Be able to name simple organic molecules

Sample problems

1. What are intermolecular forces?
2. What is viscosity? How does it depend on intermolecular forces?
3. Acetone evaporates more quickly than water at room temperature. What can you say about the relative strength of the intermolecular forces in the two compounds? Which is more volatile?
4. Explain what happens when a liquid boils?
5. What are dispersion forces? What can you say about the strength of dispersion forces as a function of molar mass?
6. Identify the solute and solvent in solutions composed of the following:
    a. 5.00 g sodium chloride and 50.0 gof water
    b. 145 g of sucrose and 100.0 g of water
7. Predict whether the following soluties are very soluble or slightly soluble in water
    a. O_2(a nonpolar gas)
    b. CBr_4(a nonpolar liquid)
    c. CH_3OH(a polar liquid)
    d. $AgNO_3$(an ionic solid)
8. Calculate the mass percent of solute in the following solutions
    a. 6.50 g of NaCl dissolved in 85.0 g of H_2O 7.10%
    b. 12.5 g of KNO3 dissolved in 125 g of H_2O 9.09%
9. How many grams of glucose must be added to 275 g of water to make a 25.0% solution?   91.7g
10. Calculate the mass in grams of K_2SO_4 needed to prepare 125 grams of a 2.50% solution? 3.13 g
11. Calculate the grams of a 16.3% solution of KCl needed to supply 350.0 grams of KCl? 2150 g

12. How many grams of $Na_2S_2O_3$ are present in 375 mL of a 7.50% m/v solution of $Na_2S_2O_3$? 28.1 g (This is mass/volume% we will not do one like this.)

13. Calculate the molarity of a solution prepared by dissolving 3.54 grams of KNO_3 to make 350.0 mL of solution 0.100 M

14. Calculate the volume(L) of a 2.522 M HCl required to get 15.0 grams of HCl. 0.163 L

15. Calculate the mass(g) of sodium nitrate in 2.50 L of a 3.22 M solution of $NaNO_3$. 1150 g

16. Calculate the mass(g) of silver acetate in 355 mL of a 0.415 M solutionof $AgC_3H_3O_2$. 24.6 g

17. What volume of 2.63 M NaOH is required to prepare 500.0 mL of 0.422 M NaOH? 80.2 mL

18. If 35.0 mL of a 6.34 M solution of $Ca(NO_3)_2$ is diluted to a final volume of 2.50L, what is the final concentration of the solution? 0.0888 M

19. Calculate the molarity of a 35.5% solution of calcium chloride with a density of 1.53 g/mL. 4.89 M

20. Calculate the % magnesium nitrate $(Mg(NO_3)_2)$ in a 2.53 M solution with a density of 1.14g/mL. 32.9%

21. Given the following reaction answer the questions

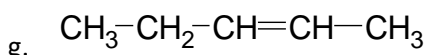$$3 \ Na_2CO_3(aq) + 2 \ AlCl_3(aq) \rightarrow Al_2(CO_3)_2(s) \ + \ 6 \ NaCl(aq)$$
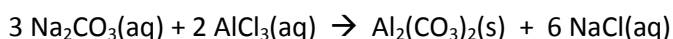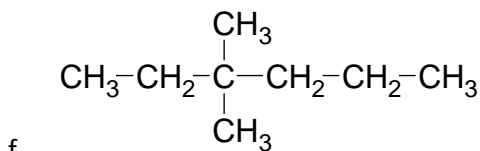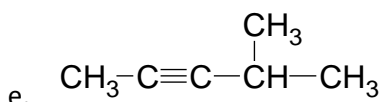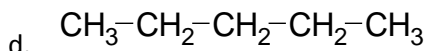
a. What volume of 0.5343 M sodium carbonate is required to completely react with 53.12 mL of a 0.9255 M solution of aluminum chloride? 138 mL

b. How many grams of aluminum carbonate will be produced by the reaction of 74.2 mL of a 2.49 M solution of sodium carbonate with excess aluminum chloride? 14.4 g

c. What volume of 0.2533 M aluminum chloride is required to completely react with 3.440 grams of sodium carbonate? 85.42 mL

22. Give the name of the following acids
    a. HCl
    b. HNO_3
    c. H_2SO_4
    d. H_3PO_4
    e. $HC_2H_3O_2$ (or CH_3CO_2H)

23. Write the formula for the conjugate base of the following acids
    a. H_2SO_3
    b. NH_4^{+1}
    c. $HC_2O_4^{-1}$
    d. H_2S
    e. H_2O

24. Write the formula for the conjugate acid of the following bases
    a. CN^{-1}
    b. HPO_4^{-2}
    c. NH_3
    d. NO_2^{-1}
    e. H_2O

25. Write equations to illustrate the acid-base reactions that can take place between the following Bronsted-Lowry acids and bases

a. Acid HClO   Base H_2O
b. Acid $HClO_4$ Base NH_3
c. Acid $H_2PO_4^{-2}$ Base OH^-
d. Acid H_3O^+ Base NH_3
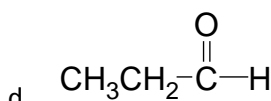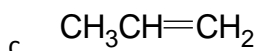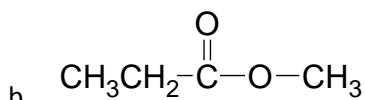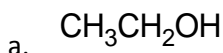e. Acid H_2O Base H_2O

26. The formula for lactic acid is preferable written as $HC_3H_4O_3$ rather than $C_3H_6O_3$. Explain why.

27. What is the purpose of a buffer and how does it function?

28. Determine the molarity of a NaOH solution if a 25.00 mL aliquot is completely neutralized by 37.34 mL a 0.9253 M solution of HCl? 1.382 M

29. A 50.00 mL sample of a vinegar solution is reacted with 41.98 mL of a 0.3854 M solution of sodium hydroxide. What is the concentration of acetic acid in the vinegar solution? 0.3236 M

30. Fill out the table below

$[H_3O^+]$	$[OH^{-1}]$	pH	pOH	Acidic or basic
1.29e-13 M	7.76 x 10^{-2} M	12.890	1.110	
6.34 x 10^{-9} M	1.58e-6	8.198	5.802	
5.01e-6	2.00e-9	5.30	8.70	
4.57e-11	2.19e-4	10.34	3.66	

31. Write balanced nuclear equations for the alpha decay of each of the following nuclides
    a. $^{200}_{84}Po$
    b. $^{152}_{64}Gd$

32. Write balanced nuclear equations for the beta decay of each of the following nuclides
    a. $^{10}_{4}Be$
    b. $^{21}_{9}F$

33. Supply the missing symbol in each of the following nuclear equations
    a. $^{34}_{14}Si \rightarrow ^{34}_{15}P + ?$
    b. $^{252}_{99}Es \rightarrow ^{248}_{97}Bk + ?$
    c. $? \rightarrow ^{230}_{92}U + ^{4}_{2}He$

34. The half-life of sodium-24 is 15.0 hr. How many grams of this nuclide in a 4.00 g sample will remain after 60.0 hr?

35. Determine the half-life of a nuclide if after 1024 hours 3.12% of the sample remains? 204 hr

36. Technetium-99 has a half-life of 6.0 hr. What percentage of the sample will remain undecayed after 36 hours? 1.56% What percentage of the sample will decay after 48 hours? 0.39%

37. Contrast the abilities of alpha, beta, and gamma radiations to penetrate a thick sheet of paper.

38. Why are the radionuclides used for diagnostic procedures usually gamma emitters?

39. What are some applications of nuclear chemistry to medicine?

40. Name the following compounds
    a. CH_4
    b. $CH_3CH_2CH_2CH_2CH_2CH_2CH_3$
    c.
$$CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_3$$

d. $CH_3-CH_2-CH_2-CH_2-CH_3$

e.
$$CH_3-C\equiv C-\underset{\underset{CH_3}{|}}{CH}-CH_3$$

f.
$$CH_3-CH_2-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_2-CH_2-CH_3$$

g. $CH_3-CH_2-CH=CH-CH_3$

41. Identify the functional groups in each of the following organic compounds

a. CH_3CH_2OH

b.
$$CH_3CH_2-\overset{\overset{O}{||}}{C}-O-CH_3$$

c. $CH_3CH=CH_2$

d.
$$CH_3CH_2-\overset{\overset{O}{||}}{C}-H$$

e. $CH_3CH_2OCH_2CH_3$

f.
$$CH_3CH_2CH_2-\overset{\overset{O}{||}}{C}-OH$$

g. $CH_3CH_2C\equiv CH$

h.
$$CH_3-\overset{\overset{O}{||}}{C}-CH_3$$
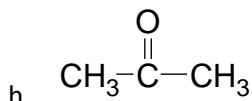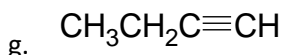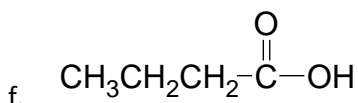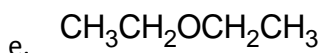
42. What is the difference between saturated and unsaturated fats? How are unsaturated fats converted into saturated fats commercially?

43. Life is dependent on four major classes of biomolecules. What are they?

44. Indicate the three types of carbohydrates. Which is the simplest?

45. What is meant by monosaccharide? By disaccharide? What are the common mono and disaccharides?

46. Discuss the similarities and differences between starch and cellulose.

47. What is meant by the primary, secondary, and tertiary structure of a protein? How are these structures maintained? (i.e. what are important intermolecular forces?)

48. What are some of the functions of proteins? What is an enzyme and what does it do?

49. What properties of molecules cause them to be classified as lipids?

50. What functions do fats have in the human body?

51. What is the role of hydrogen bonding in the structure of DNA? What are the base pairs in DNA and RNA?
52. What is meant by the terms transcription and translation is respect to nucleic acids?