PrepNet Name: Key

Full Year General Chemistry Final Exam Review

Basics of Chemistry

1. Define chemical and physical *changes*. How can you tell the difference between the two?

Definition: Chemical change - an irreversible rearrangement of atoms, changing the chemical properties + forms a new substance

Differences: Physical change - a change in the form of a substance w/o changing chemical composition.

(change in composition; no change in composition)

2. Define chemical and physical *properties*. How can you tell the difference between the two?

Definition: Chemical property - characteristic observed during a reaction, changing the chemical composition

Differences: physical property - characteristic observed w/o changing chemical composition.

3. Classify the following as physical or chemical changes:
   a. Food coloring in water physical
   b. Burning paper Chemical
   c. Cutting hair physical
   d. sunburn Chemical
   e. cooking noodles physical

4. Identify the following as pure substances, homogeneous mixtures or heterogeneous mixtures:
   a. Iron pure
   b. Tap Water homogeneous
   c. Table Salt pure
   d. Air homogeneous
   e. Chef Salad Heterogeneous

5. Please fill in the chart below:

Significant Figures Present?	
4	a. 2.102 centimeters
4	b. 0.001240 grams
2	c. 0.42 meters
5	d. 1002.4 kilograms
5	e. 134.00 liters
3	f. 1,020 seconds

6. List the Rules for Sig Figs AND include an example:

a. Multiplication/Division b. Addition/Subtraction

Operation	Multiplication	Division	Addition	Subtraction
Rule(s)	least number of sig. figs determines answer sig. figs →		looking at the decimal portion, round to the least number of placed. →	
Example	2.5 x 3.42 = 8.6	4.52 ÷ 3.980 = 1.14	3.74 + 5.1 = 8.8	9.786 − 2.5 = 7.286 → 7.3

7. Sketch particles in the three states of matter.
   a. How close are the particles and how much do they move?
   b. Label the phase changes that occur between all 3 of the phases.

	Solid	Liquid	Gas
Image	 melting → ← freezing	 evaporating → ← condensing	
Properties	Close + compact. little movement. definite volume, definite shape	more space, more movement definite volume. take shape of (container.	lots of space, lots of movement. take shape + volume of container

8. Calculations using the Law of Conservation of Mass for Reactions

$$2.0\text{ g } H_2 + ??\text{ g } O_2 \rightarrow 14.0\text{ g } H_2O$$

9. A student measures the density of water to experimentally be 1.12g/mL. Determine the student's percent error. density of water = 1g/mL

$$\left|\frac{1-1.12}{1}\right| \times 100 = 12\%$$

The Atom

10. List the three subatomic particles and list their properties (size, mass, charge, etc)

Particle	Proton	Neutron	Electron
Properties	positive mass = 1 in nucleus	Neutral (no charge) mass = 1 in nucleus	negative mass = 0 in electron cloud

11. For this Sulfur-33 isotope,
    a. Atomic number = 16
    b. Mass number = 33
    c. # of protons = 16
    d. # of electrons = 16
    e. # of neutrons = 17

12. For this Chloride Ion, (-1 in charge)
    a. Atomic number = 17
    b. Mass number = 35
    c. # of protons = 17
    d. # of electrons = 18
    e. # of neutrons = 17

13. Which of the following, a or b, represents isotopes of the same element? WHY?

a. ^{25}E ^{25}E ^{25}E b. $_{30}X$ $_{30}X$ $_{30}X$ $^{m}_{A\#}X$

Explanation: isotopes have the same atomic number, different masses (gain or lose a neutron)

14. Calculate the atomic mass of lithium is one isotope has a mass of 6.0151 amu and a percent abundance of 4.312% and a second isotope has a mass of 7.0600 amu and a percent abundance of 95.688%. PLEASE TRY AND AT LEAST LOOK UP AVERAGE ATOMIC MASS FORMULA BEFORE SAYING YOU DON'T KNOW HOW TO DO IT... ☺

$(6.0151)(.04312) + (7.0600)(0.95688) =$ **7.015 amu**

15. What are the 3 different types of nuclear radiation? What is their penetration ability?

Radiation/Symbol	Alpha α	Beta β	Gamma λ
Strength and Size	large fast high energy Short range Ejected He^{2+}	Smaller than α fast high energy Short range Ejected e^-	photons w/ higher energy. high penetration Electromagnetic

16. Complete the following Nuclear Reactions. You may have to fill in the missing atomic numbers and/or masses.

a. $^{32}_{16}S \rightarrow {}^{32}_{17}Cl + {}_{-1}e$ b. $^{14}_{5}B \rightarrow {}^{14}_{6}C + {}_{-1}e$

17. Carbon-14 has a half-life of 5,730 years. If a plant contained 24.0 g of ^{14}C when it died, how much is left after 34,380 years? (Think about how many times the atom is cut in half.)

$\frac{34,380}{5,730} = 6$ half lifes

$24 \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} =$ **0.375g**

Electrons

18. What element has the configuration $[Ne]3s^23p^4$?

Sulfur

19. What does the **3** mean in $3s^4$?

3rd energy level

20. What does the **s** mean?

S sublevel

21. What does the **4** mean?

4 electrons

22. How many valence electrons will an atom of this element have?(in # 18)

6

23. How many electrons will the atom in #18 gain **OR** lose to form an ion? Why?

gain 2 e^- ; inorder to be stable, must follow octet rule of containing outer full orbital.

24. Complete the following table.

Element	Longhand Configuration	Shorthand Notation	Lewis Dot Structure
Ca	$1s^22s^22p^63s^23p^64s^2$	$[Ar]4s^2$	Ca:
S	$1s^22s^22p^63s^23p^4$	$[Ne]3s^23p^4$	:S.
Al	$1s^22s^22p^63s^23p^1$	$[Ne]3s^23p^1$	·Al·
S^{-2}	$1s^22s^22p^63s^23p^6$	$[Ar]$	:S:

25. What happens when an "excited" electron falls back to its ground state?

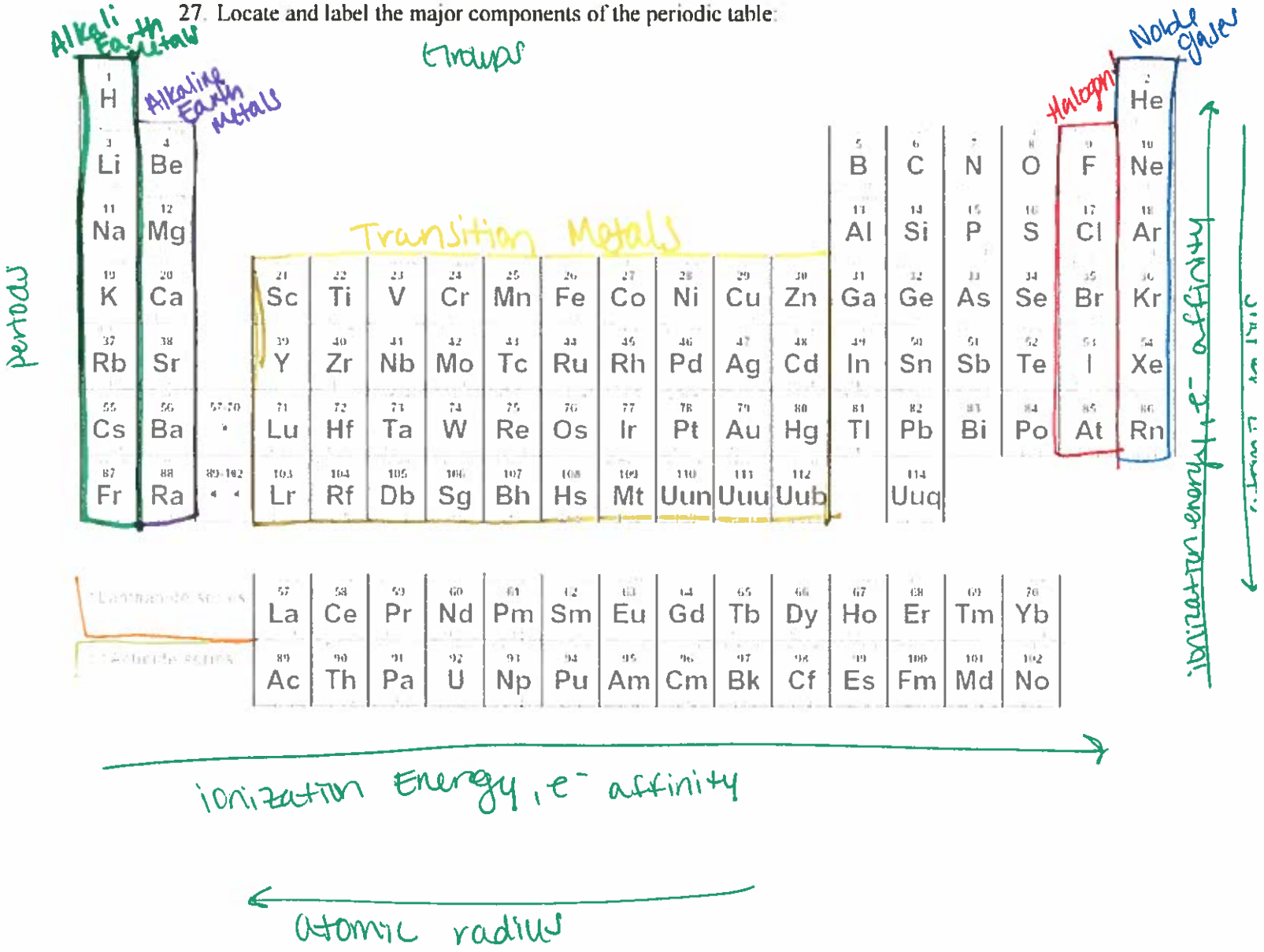
Energy is released & is visible as color.

26. What is the speed of light NO MATTER WHAT?

3.00×10^8 m/s

Periodic trends

27. Locate and label the major components of the periodic table:



Name:_____

28. Periodic Trends: Increasing or Decreasing from top to bottom or left to right? Give a short reasoning behind the trend as well.

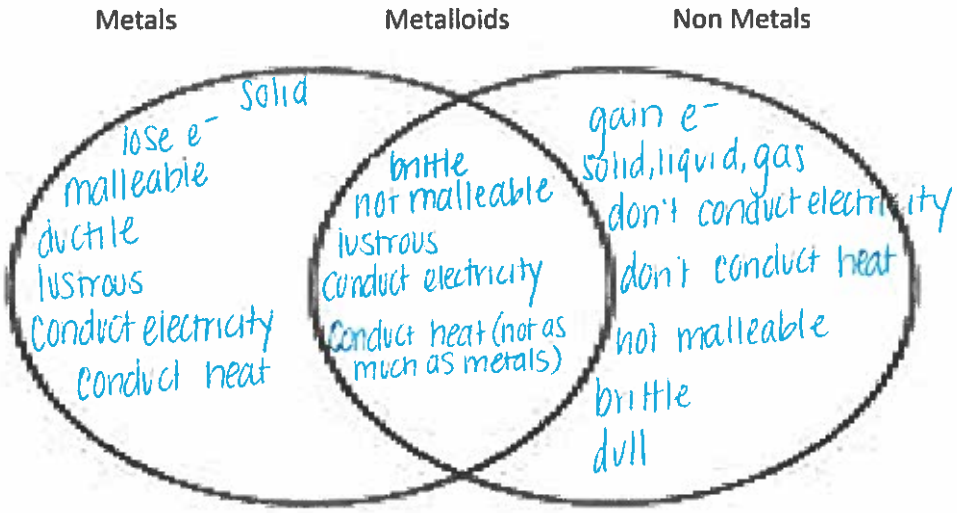
	Top to Bottom in a Group and WHY	Left to Right across a Period
electronegativity	Trend: Decreasing Why: electrons further, weaker electronegativity	Trend: Increasing Why: electrons closer, stronger electronegativity
atomic size	Trend: Increased Why: electrons further from nucleus	Trend: decreases Why: electrons closer

29. Circle One: Elements in the same (group or period) have similar physical and chemical characteristics because they have the same number of (atoms, protons, neutrons, electrons, or valence electrons).

30. Fill out the chart for each element: LDS stands for "Lewis Dot Structure"

	LDS for Neutral atom	When becoming an ion-gain or lose electrons (and #)?	Symbol for ion		LDS for Neutral atom	When becoming an ion-gain or lose electrons (and #)?	Symbol for ion
Na	Na·	lose 1	Na^+	O	:Ö:	gain 2	O^{-2}
B	·B·	lose 3	B^{+3}	S	:S:	gain 2	S^{-2}
H	H·	lose 1	H^+	Cl	:Cl:	gain 1	Cl^{-1}

31. List some properties of Metals vs. Nonmetals vs. Metalloids



Bonding:

32. Ionic bonds are formed when a metal and a nonmetal combine.

33. Metals lose electrons and form cations while nonmetals gain and electrons form anions.

34. Molecular compounds form when two nonmetals combine as they share electrons.

35. Identify the following pairs of atoms as potentially forming an ionic or molecular compound:

a. Mg and I ionic b. I and Ca ionic *based on metal/nonmetal

c. Na and Cl ionic d. Ag and S ionic

e. F and Br molecular f. C and O molecular

36. How do you know if a **Bond** is polar or nonpolar?(Please do not just use numbers...but instead talk about the "pull" of electrons.

polar - an unequal pull for electrons in a covalent bond

fluorine is more EN ∴ has stronger pull for electrons therefore a polar bond

Na → F

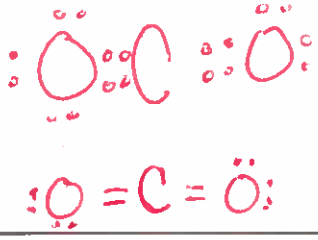
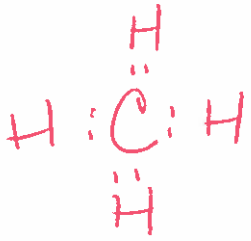
0.93 4.0

37. How do you know if a **molecule** is polar or nonpolar?

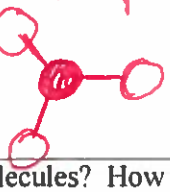
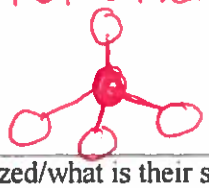
polar molecules - unequal distribution of electrons in a molecule, look for:

1) lone pairs on central atom
2) polar bonds w/ central atom (do they cancel each other out?)

38. Fill in the following chart. Be sure to show BOND polarity with arrows in the LDS.

	H_2O	CO_2	CH_4
Lewis Structures			
Shape of Molecule	Bent	Linear	tetrahedral
Contains polar bonds?	Yes	No	Yes
Is a polar molecule?	Yes	No	No

39. What are the 5 main shapes in the VSPER Theory. Draw them.

liner 	5 Main Shapes of Molecules	Trigonal pyramidal 
Bent 	Trigonal planar 	Tetrahedral 

40. What types of forces are between molecules? How are they categorized/what is their strength? Draw a concept map to help.

Strength increases ↓

London Dispersion: temporary force, weakest, exists in all molecules
Dipole-Dipole: between polar molecules (attraction between δ^+ & δ^-)
Hydrogen Bonding: type of Dipole-Dipole where H bonded to N, O, F; strongest

41. What does the term "like dissolves like" refer to? Give an example.

Polar substances will dissolve in a polar solvent & nonpolar don't.
Nonpolar substances will dissolve in a nonpolar solvent & polar will not dissolve.
Ex: Salt in water (Both are polar)

42. Fill in the following chart:	Molecular Compounds	Ionic Compounds
Combination of elements involved (metals? nonmetals?)	Nonmetal + Nonmetal	Nonmetal + metal
How is bond formed?	sharing electrons	transfer electrons metal → nonmetal
Typical state(s) at room temperature	liquid or gas (maybe brittle solid)	Solid
Melting and boiling points (Relatively high or low?)	LOW	High
Conduct electricity if dissolved in water?	Poor conductor	Good conductor

Nomenclature

43. Name: H_2O: Water and HO_2 Hydrogen dioxide
44. Name: Li_2O lithium oxide and Na_2SO_4 Sodium sulfate
45. Name: Fe_2O_3 Iron (III) oxide and $Sn_3(PO_4)_4$ Tin (IV) phosphate
46. Name: Na_2CO_3 Sodium Carbonate and CuCl Copper (I) Chloride

Write formulas for the following compounds:

47. Water H_2O
48. carbon dioxide CO_2
49. Ammonium Hydroxide $Al(OH)_3$
50. Phosphorous tetrahydride PH_3
51. dioxygen difluoride O_2F_2
52. Ammonia NH_3
53. Iron (III) hydroxide $Fe(OH)_3$
54. chromium (VI) sulfate $Cr(SO_4)_2$

Write formulas for the following ionic compounds and determine their solubility(USE YOUR SOLUBILITY RULES):

	Formula	Yes/No
55. Ca^{2+} with OH^-	$Ca(OH)_2$ Soluble in Water?	No
56. iron (II) sulfite	$FeSO_3$ Soluble in Water?	No
57. Ba^+ with OH^-	$BaOH$ Soluble in Water?	Yes
58. NH_4^+ with PO_4^{3-}	$(NH_4)_3PO_4$ Soluble in Water?	Yes
59. Strontium Sulfide	SrS Soluble in Water?	No

Chemical Reactions

65. Define what is meant by the term *chemical reaction*.
process in which the atoms of one or more substances rearrange to form one or more different substances

66. In the following chemical equation, identify the **reactants** and the **products**.
$3Ba(C_2H_3O_2)_2(aq) + 2Na_3PO_4(aq) \rightarrow Ba_3(PO_4)_2(s) + 6NaC_2H_3O_2(aq)$
Reactants products

67. In the previous chemical equation, what do the symbols *(aq)* and *(s)* stand for? What would the symbols *(l)* and *(g)* stand for in a chemical equation?
aq = aqueous l = liquid
s = solid g = gas

68. Chemical reactions can often be classified as one of five types. Write the *general form* for each type of reaction.

a. Synthesis $A + B \rightarrow AB$
b. Decomposition $AB \rightarrow A + B$
c. Single-Replacement $AB + C \rightarrow AC + B$
d. Double-Replacement $AB + CD \rightarrow AD + BC$
e. Combustion $C_xH_y + O_2 \rightarrow CO_2 + H_2O$

69. Using the five types of reactions listed above, classify AND balance the following equations:

a. $2Na_{(s)} + Br_{2(l)} \rightarrow 2NaBr_{(s)}$ Synthesis
b. $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$ Combustion
c. $K_2CrO_{4(aq)} + Ba(NO_3)_{2(aq)} \rightarrow BaCrO_{4(s)} + 2KNO_{3(aq)}$ Double displacement
d. $2H_2O_{(l)} \rightarrow 2H_{2(g)} + O_{2(g)}$ Decomposition
e. $2Al_{(s)} + Fe_2O_{3(s)} \rightarrow Al_2O_{3(s)} + 2Fe_{(s)}$ Single displacement
f. $2C_8H_{18(l)} + 17O_{2(g)} \rightarrow 16CO_{2(g)} + 18H_2O_{(g)}$ Combustion

70. Using the activity series, will the following reactions occur? (Yes/No)

a. $2Al\ (s) + Fe_2O_3\ (aq) \rightarrow Al_2O_3\ (aq) + 2Fe\ (s)$ Yes

b. $Zn\ (s) + 2HNO_3\ (aq) \rightarrow Zn(NO_3)_2\ (aq) + H_2\ (g)$ Yes

c. $Pb\ (s) + MgO\ (aq) \rightarrow PbO\ (aq) + Mg\ (s)$ No

71. Predict the products of the following reactions.

a. $AgNO_3\ (aq) + KCl\ (aq) \rightarrow$ $AgCl_{(s)} + KNO_{3(aq)}$

b. $2(NH_4)PO_4\ (aq) + 3CaCl_2\ (aq) \rightarrow$ $6NH_4Cl_{(aq)} + Ca_3(PO_4)_2\ (s)$

c. $NH_4NO_3\ (aq) + NaCl\ (aq) \rightarrow$ $NH_4Cl_{(aq)} + NaNO_3\ (aq)$ = NO RXN

Write the Net Ionic Equations that associated with the following reactions:

72. $2\ Na_3PO_4\ (aq) + 3\ CaCl_2\ (aq) \rightarrow 6\ NaCl\ (aq) + Ca_3(PO_4)_2\ (s)$

On Separate Sheet

73. $Mg\ (s) + 2\ HCl\ (aq) \rightarrow MgCl_2\ (aq) + H_2\ (g)$

on separate sheet

74. What is a redox reaction? What is changing? What is being exchanged?

→ A reaction that involves the transfer of electrons between chemical species.

→ Changing = oxidation numbers

→ exchanged? = electrons

The Mole

75. What information is provided by the formula for potassium chromate (K_2CrO_4)?

→ ionic compound with polyatomic ion

→ how many of each atom in compound (K: 2, Cr: 1, O: 4)

76. Determine the number of atoms or molecules in each of the following:

a. 0.250 moles of silver to particles

$$0.250\ mol \left(\frac{6.02 \times 10^{23}\ particles}{1\ mol}\right) = 1.51 \times 10^{23}\ particles\ of\ silver$$

b. 8.56×10^{-3} moles of sodium chloride to grams

$$8.56 \times 10^{-3}\ mol \left(\frac{58.439\ g\ NaCl}{1\ mol}\right) = 0.500\ g\ NaCl$$

72.

molecular: $2Na_3PO_4(aq) + 3CaCl_2(aq) \rightarrow 6NaCl(aq) + Ca_3(PO_4)_2$

Ionic: $6Na^+_{(aq)} + 2PO_4^{-3}{}_{(aq)} + 3Ca^{2+}_{(aq)} + 6Cl^-_{(aq)} \rightarrow 6Na^+_{(aq)} + 6Cl^-_{(aq)} + Ca_3(PO_4)_{2(s)}$

Net Ionic: $3Ca^{2+}_{(aq)} + 2PO_4^{-3}{}_{(aq)} \rightarrow Ca_3(PO_4)_{2(s)}$

73

molecular: $Mg_{(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$

Ionic: $Mg^{2+}_{(s)} + 2H^+_{(aq)} + 2Cl^-_{(aq)} \rightarrow Mg^{2+}_{(aq)} + 2Cl^-_{(aq)} + H^+_{2(g)}$

Net Ionic: $Mg^{2+}_{(s)} + 2H^+_{(aq)} \rightarrow Mg^{2+}_{(aq)} + H^+_{2(g)}$

c. 35.5 moles of carbon dioxide to grams

$35.5 \text{ mol } CO_2 \left(\frac{43.99 \text{ g } CO_2}{1 \text{ mol } CO_2} \right) = 1560 \text{ g } CO_2$

d. 0.425 moles of nitrogen gas to particles

$0.425 \text{ mol } N_2 \left(\frac{6.02 \times 10^{23} \text{ mc } N_2}{1 \text{ mol } N_2} \right) = 2.56 \times 10^{23} \text{ mc } N_2$

e. 25.8 grams of He gas to particles

$25.8 \text{ g He} \left(\frac{6.02 \times 10^{23} \text{ mc } N_2}{1 \text{ mol He}} \right) = 1.55 \times 10^{25} \text{ mc He}$

f. 1.24 grams of $Ca_3(PO_4)_2$ to moles

$1.24 \text{ g } Ca_3(PO_4)_2 \left(\frac{1 \text{ mol } Ca_3(PO_4)_2}{328.094 \text{ g } Ca_3(PO_4)_2} \right) = 0.00378 \text{ mol } Ca_3(PO_4)_2$

77. Determine the mass % of oxygen in each of the following:

a. sucrose ($C_{12}H_{22}O_{11}$)

C = 12 x 12.07 = 144.13
H = 22 x 1.007 = 22.154
O = 11 x 15.99 = 175.89
} 342.174

$\frac{\text{Oxygen}}{\text{total}} = \frac{175.8}{342.17} = 51.4\%$

b. Copper (II) Sulfate Pentahydrate

$CuSO_4 \cdot 5H_2O = 249.592 \text{ g/mol}$

$\frac{143.91 \text{ Oxygen}}{249.592 \text{ total}} \times 100 = 57.7\%$

78. Determine the mass of Oxygen in 12.5grams of CO_2

$CO_2 \cdot 44.0098 \text{ g/mol}$

$\frac{31.9988}{44.0098} = 72.7\%$

$.727 \times 12.5\text{g} = 9.09\text{g Oxygen}$

79. Calculate the empirical and molecular formula for a compound having 39.12% C, 8.75% H, and 52.12% O. The molar mass is 92.11 g/mol. You may use the chart below to help you formulate your thoughts.

	Formula	Mass
EF	$C_3H_8O_3$	92.095
MF	$C_3H_8O_3$	92.11

$39.12\,g\,C\left(\frac{1\,mol\,C}{12.011\,g\,C}\right)=3.257\,mol\,C$ $\frac{3.257}{3.257}=1(3)=3$

$8.75\,g\,H\left(\frac{1\,mol\,H}{1.008\,g\,H}\right)=8.681\,mol\,H$ $\frac{8.681}{3.257}=2.66(3)=8$

$52.12\,g\,O\left(\frac{1\,mol\,O}{15.9994\,g\,O}\right)=3.257\,mol\,O$ $\frac{3.257}{3.257}=1(3)=3$

80. Determine the volume of 64.8g of H_2 at STP.

$64.8\,g\,H_2\left(\frac{1\,mol\,H_2}{2.016\,g\,H_2}\right)=32.14\,mol\,H_2\left(\frac{22.4\,L\,H_2}{1\,mol\,H_2}\right)=$ **720. L H_2** * 3sf

81. What mass of CO_2 does 94.6 L take up?

$94.6\,L\,CO_2\left(\frac{1\,mol\,CO_2}{22.4\,CO_2}\right)=4.22\,mol\,CO_2\left(\frac{44.0098\,g\,CO_2}{1\,mol\,CO_2}\right)=$ **186 g CO_2** * 3sf

82. A student has 12grams of Oxygen gas to add to 12 grams of Iron metal. How much Iron (III) oxide can the student make? (hint, use stoichiometry and find your limiting reactant)

$3\,O_2 + 4Fe \rightarrow 2Fe_2O_3$

$12\,g\,O_2\left(\frac{1\,mol\,O_2}{31.9988\,g\,O_2}\right)=0.375\,mol\,O_2\left(\frac{2\,mol\,Fe_2O_3}{3\,mol\,O_2}\right)=0.25\,mol\,Fe_2O_3\left(\frac{159.688\,g\,Fe_2O_3}{1\,mol\,Fe_2O_3}\right)$

$=39.9=40.\,g\,Fe_2O_3$

$12\,g\,Fe\left(\frac{1\,mol\,Fe}{55.845\,g\,Fe}\right)=0.215\,mol\,Fe\left(\frac{2\,mol\,Fe_2O_3}{4\,mol\,Fe}\right)=0.107\,mol\,Fe_2O_3\left(\frac{159.688\,g\,Fe_2O_3}{1\,mol\,Fe_2O_3}\right)=$ **17 g Fe_2O_3**

* 2 sf

83. Given the reaction $S + O_2 \rightarrow SO_2$

a. How many grams of sulfur must be burned to give 100.0 g of SO2

$100.0\,g\,SO_2\left(\frac{1\,mol\,SO_2}{64.065\,g\,SO_2}\right)=1.561\,mol\,SO_2\left(\frac{1\,mol\,S}{1\,mol\,SO_2}\right)=1.561\,mol\,S\left(\frac{32.066\,g\,S}{1\,mol\,S}\right)=$ **50.05g S**

*4sf

b. how many L of oxygen will be required for the reaction in part (a) at STP?

$100.0\,g\,SO_2\left(\frac{1\,mol\,SO_2}{64.065\,g\,SO_2}\right)=1.561\,mol\,SO_2\left(\frac{1\,mol\,O_2}{1\,mol\,SO_2}\right)=1.561\,mol\,O_2\left(\frac{22.4\,L\,O_2}{1\,mol\,O_2}\right)=$ **34.97 L O_2**

*4 sf

84. For the balanced equation shown below, if the reaction of 20.7 grams of $CaCO_3$ produces 6.81 grams of CaO, what is the percent yield? $CaCO_3 \rightarrow CaO + CO2$

$20.7\,g\,CaCO_3\left(\frac{1\,mol\,CaCO_3}{100.09\,g\,CaCO_3}\right)=0.207\,mol\,CaCO_3\left(\frac{1\,mol\,CaO}{1\,mol\,CaCO_3}\right)=0.207\,mol\,CaO\left(\frac{56.077\,g\,CaO}{1\,mol\,CaO}\right)=11.6\,g$

Properties of Matter $\frac{Actual}{Theoretical}$ $\frac{6.81}{11.6}\times 100 = \boxed{58.7\%}$

85. What are the fundamental assumptions about gases based on the Kinetic Molecular Theory?
① Gases are dimensionless pts. w/ no volume
② Gases are in constant straight-line motion
③ Collisions btw gas molecules are perfectly elastic
④ Gas molecules exert no attractive forces on each other

Part 1: Gases

86. What are the standard values of pressure in atm, torr, and kPa?

1.0 atm = 101.3 kPa = 760 mmHg = 760 torr

87. What is temperature? How is it related to kinetic energy?
temperature is the measure of the average kinetic energy (or molecular motion) in a sample
Temp ↑ KE ↑ and vice versa

88. List the factors that affect gas pressure. Make sure to explain how this may increase or decrease the pressure.
Volume - inversely related (P↑ V↓ and vice versa)
Temperature - directly related (P↑ T↑ and vice versa)

89. A sample of oxygen gas has a volume of 150. mL when its pressure is 0.947 atm. What will the volume of the gas be at a pressure of 0.987 atm if temperature remains constant?
$(0.150)(0.947)=(0.987)(V_2)$ $\boxed{V_2 = 0.144\ L}$ * 3 sf

90. A sample of neon gas occupies a volume of 752 mL at 25°C. What volume will the gas occupy at 50°C if the pressure remains constant?
$\frac{0.752}{298}=\frac{V_2}{323}$ $\frac{242.896}{298}=\frac{298\,V_2}{298}$
$\boxed{V_2 = 0.815\ L}$ * 3 sf

91. The gas in an aerosol can is at a pressure of 3.00 atm at 25°C. What would the gas pressure in the can be at 52°C?
$\frac{3.00\,atm}{298}=\frac{P_2}{325}$ $\frac{975}{298}=\frac{298\,P_2}{298}$
$\boxed{P_2 = 3.3\,atm}$ * 3 sf

92. A helium filled balloon has a volume of 50.0L at 25°C and 1.08 atm. What volume will it have at 0.855 atm and 10.°C?

$P_1 = 1.08\,atm$ $P_2 = 0.855\,atm$
$V_1 = 50.0\,L$ $V_2 = ?$
$T_1 = 298\,K$ $T_2 = 283\,K$

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

$V_2 = \frac{P_1V_1T_2}{T_1P_2} = \frac{(1.08)(50.0)(283)}{(283)(0.855)} = \boxed{63\,L}$

93. How many moles of N_2 are in a flask with a volume of 0.25 L at a pressure of 300.0 kPa and a temperature of 300.0 K?

$P = 300.0\,kPa$
$V = 0.25\,L$
$R = 8.314\,\frac{L \cdot kPa}{mol\,K}$
$T = 300K$

$PV = nRT$

$\frac{PV}{RT} = n = \frac{(300)(0.25)}{(8.314)(300)} = \boxed{0.030\,mol}$

94. Which gas will travel faster, chlorine or nitrogen? Why?

Nitrogen, because it has a smaller molar mass.

95. A balloon contains 0.1 moles of oxygen and 0.4 moles of nitrogen. If the balloon is at standard temperature and pressure, what is the partial pressure of the nitrogen?

20% oxygen, 80% nitrogen

$(0.80)(1.0\,atm) = \boxed{0.80\,atm}$

Part 2:Thermo

96. What is thermochemistry?

97. If 500 g of iron absorbs 22,000 cal of heat, what will be the change in temperature? (specific heat of iron = 0.11 J/g°C)

$Q = 22{,}000\,cal$
$m = 500\,g$
$C = 0.11\,J/g°C$
$\Delta T =$

$22{,}000\,cal\left(\frac{4.184\,J}{cal}\right) = 92048\,J$

$Q = mC\Delta T$

$\frac{Q}{mC} = \Delta T = \frac{(92048)}{(500)(0.11)} = \boxed{1700\,°C}$

98. A 55.0-g piece of copper wire is heated, and the temperature of the wire changes from 19.0°C to 86.0°C. The amount of heat absorbed is 343 cal. What is the specific heat of copper?

$343\,cal\left(\frac{4.184\,J}{cal}\right) = 1435\,J$

$Q = mC\Delta T$

$\frac{Q}{m\Delta T} = C = \frac{1435}{(55)(86-19)} = \boxed{0.39\,J/g°C}$

99. The specific heat capacity of graphite is 0.71 J/g°C. Calculate the energy required to raise the temperature of 750 g of graphite by 160°C.

$Q = mC\Delta T$
$= (750)(0.71)(160)$
$= \boxed{8.5 \times 10^4\,J}$

100. In a calorimetry experiment in the lab, you were able to record the following data:

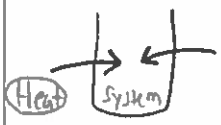
Mass of water in a calorimeter = 90.0 g
Initial temperature of water in calorimeter = 22.0 °C
Mass of unknown metal = 45.0 g
Initial temperature of hot metal = 100.0 °C
Final temperature of water after you place hot metal in calorimeter filled with water = 28.0 °C
Based on the above data, what is the Cp of the metal?

$m_w C_w \Delta T_w = -(m C \Delta T)$

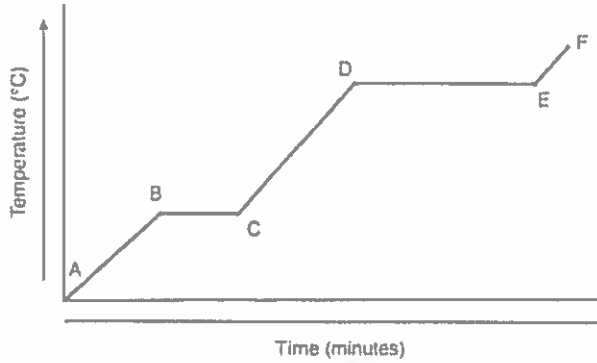
$-\frac{m_w C_w \Delta T_w}{m \Delta T} = C_{p\,metal}$

$-\frac{(90)(4.184)(28-22)}{(45)(28-100)} = 0.697\ \frac{J}{g°C}$

101. Compare endothermic vs exothermic reactions. Be sure to draw a diagram and explain what is happing to energy in terms of the system and surroundings. (also explain what it would feel like)

	Picture of System/Surroundings	How the reaction feels.	+/- ΔH
Endothermic		It feels cold	$+\Delta H$
Exothermic		It feels warm	$-\Delta H$

102. Determine the amount of energy needed to raise 12.5 grams of water from 50°C to 103°C. The specific heat of water is 4.184 J/g°C, the specific heat of steam is 2.00J/g°C, and the molar enthalpy of vaporization is 2260 J/g. Use the curve below you to help.



$Q = m C \Delta T$

$(12.5)(4.184)(100-50)$

$Q_{50-bs} = 2615\ J$

$(2260\ J/g)(12.5)$

$Q_{vap} = 28250\ J$

$Q = (12.5)(2.00)(103-100)$

$= 75\ J$

$2615 + 28250 + 75$

$= 3.1 \times 10^4\ J$

103. Using Thermodynamics,

Compound	Standard H_f^o
$N_2H_4(l)$	+50.63 kJ/mol
$H_2O(l)$	-285.83 kJ/mol
$H_2O(g)$	-241.8 kJ/mol

a. What is the formula for ΔH_{rxn}?

$\Delta H_{rxn} = \Delta H_{prod} - \Delta H_{react}$

b. Determine the enthalpy of this reaction. $N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2\,H_2O(l)$

$(N_2 + 2H_2O) - (O_2 + N_2H_4)$

$[2(-285.83)] - [50.63] = \boxed{-622.3\ kJ/mol}$

104. Given the following equations and ΔH^o values, determine the heat of reaction (kJ) at 298 K for the reaction:

$B_2H_6(g) + 6\,Cl_2(g) \rightarrow 2\,BCl_3(g) + 6\,HCl(g)$

$BCl_3(g) + 3\,H_2O(l) \rightarrow H_3BO_3(g) + 3\,HCl(g)$ $\Delta H^o = -112.5$ kJ

$B_2H_6(g) + 6\,H_2O(l) \rightarrow 2\,H_3BO_3(s) + 6\,H_2(g)$ $\Delta H^o = -493.4$ kJ

$1/2\,H_2(g) + 1/2\,Cl_2(g) \rightarrow HCl(g)$ $\Delta H^o = -92.3$ kJ

$2H_3BO_3 + 6HCl \rightarrow 2BCl_3 + 6H_2O$

$B_2H_6 + 6H_2O \rightarrow 2H_3BO_3 + 6H_2$

$6H_2 + 6Cl_2 \rightarrow 12HCl$ (÷6)

$2(+112.5) = 225$

$-493.4 = -493.4$

$12(-92.3) = -1107.6$

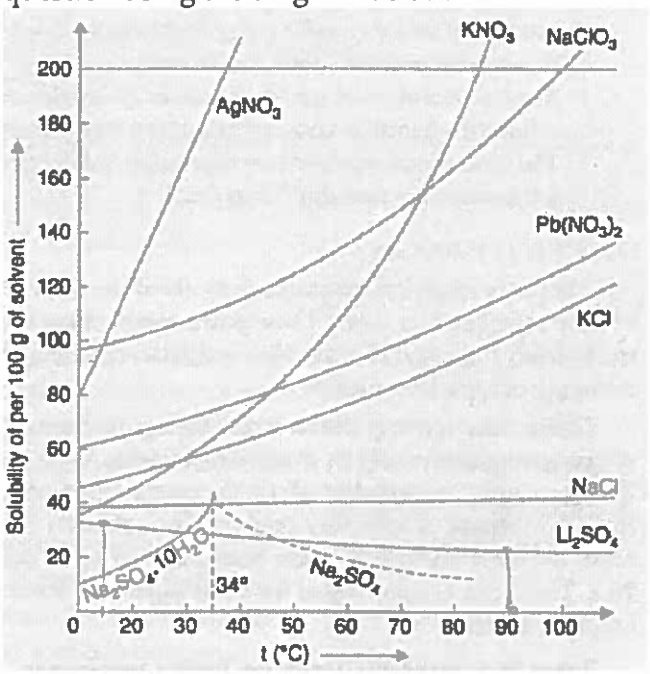
$\boxed{-1376\ kJ}$

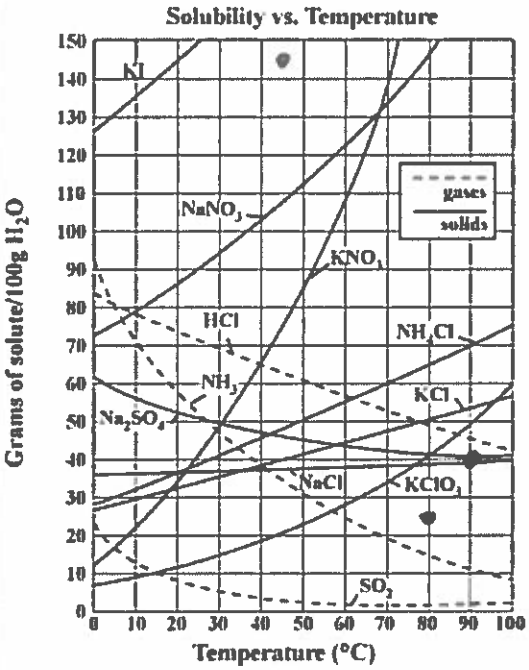
Part 3: Solutions

105. What are the formulas for the following concentrations of solutions:

Molarity $\frac{\text{moles solute}}{\text{liters solution}} = \frac{n}{V}$		Mole Fraction $\frac{\text{mol solute}}{\text{mol solute + mol solvent}} = \frac{n_A}{n_A + n_B}$
% Concentration $\frac{\text{mass solute}}{\text{mass solution}} \times 100$	Molality $\frac{\text{moles solute}}{\text{kg solvent}}$	Solubility $S = \sqrt{K_{sp}}$

106. Write in the blank letter of the choice that best completes the statement or answers the question using the diagram below.





I: In Figure 1(above), heating a saturated solution of Li_2SO_4 in 100 g of water from 10°C to 90°C would result in _____

.

a. 5 additional grams of Li_2SO_4 going into solution
b. 30 additional grams of Li_2SO_4 going into solution
c. 5 additional grams of Li_2SO_4 leaving the solution
d. no change in Li_2SO_4 concentration

II: In Figure 2(above), _____ would be unsaturated.

a. 25 g of KC1 in 100 g of water at 80°C
b. 40 g of NaCl in 100 g of water at 90°C
c. 145 g of $NaNO_3$ in 100 g of water at 45°C

107. What are the factors that affect solubility rate? Temperature, Pressure & Polarity

108. To increase the solubility of a gas increase temperature and increase pressure.

109. The solute goes into the solvent to make a solution.

110. What are colligative properties? Give the two main ones used in class with their constants and formulas(assuming that the solvent is water).

Properties of a solution that depend on the number of particles in solution.

Boiling Point elevation: $\Delta T = iK_b m$ $K_b = 0.52$

Freezing Point Depression: $\Delta T = iK_F \cdot m$ $K_F = 1.86$

111. What is the new freezing **and** boiling point of a solution where 26grams of NaCl is dissolved in 0.500L of water. $26\text{ g NaCl}\left(\frac{\text{mol}}{58.44\text{ g}}\right) = 0.44\text{ mol NaCl}$

Calculations:	Calculations:
$M = \frac{0.44\text{mol NaCl}}{0.5\text{ kg}} = 0.89$ $\Delta T_f = i K_f m$ $= (2)(1.86)(0.89)$ $= 3.31\,^\circ C$	$\Delta T_b = i K_b m$ $(2)(0.52)(0.89)$ $= 0.93\,^\circ C$
New Freezing Point: $-3.31\,^\circ C$	New Boiling Point: $100.93\,^\circ C$

112. What is the molarity when 0.5 grams of sodium chloride is dissolved to make 0.05 liters of solution.

$M = \frac{\text{mol solute}}{\text{L solution}}$ $0.5\text{g NaCl}\left(\frac{\text{mol}}{58.44\text{ g}}\right) = 0.0086\text{ mol NaCl}$ $\frac{0.0086\text{ mol NaCl}}{0.05\text{ L}} = \boxed{0.17\text{ M}}$

113. How many moles of lithium sulfate are dissolved to make 2500 mL of a 0.4M solution.

$n = M \cdot V$
$= (0.4)(2.5\text{ L}) = \boxed{1.0\text{ mol } Li_2SO_4}$

114. When 10.00 g of acetone (d = 0.789 g/mL) in 1.55 L of an acetone-water Solution, calculate the following:

a. Molarity

$10.0\text{ g } C_3H_6O\left(\frac{\text{mol}}{58.08\text{ g}}\right) = 0.17\text{ mol } C_3H_6O$

$M = \frac{n}{V} = \frac{0.17}{1.55} = \boxed{0.11\text{ M}}$

b. % v/v (you will have to use the density for this half)

$d = \frac{0.789\text{ g}}{\text{mL}}$

$d = \frac{m}{V}$

$V = \frac{m}{d}$

$= \frac{10.0\text{ g}}{0.789\text{ g/mL}} = 12.67\text{ mL } C_3H_6O$

$\frac{0.01267\text{ L}}{1.55} \times 100 = \boxed{0.82\%}$

Acids and Bases

115. Compare Bronsted Lowry Acids and Bases to Arrhenius Acids and Bases.\

Arrhenius Acid:	Bronsted Lowry Acid:	Similarities/Differences with Acids
increases H_3O^+ concentration	proton (H^+) donor	both: solutions, scale for determining strength, exchange of protons
Arrhenius Base:	**Bronsted Lowry Base:**	**Similarities/Differences with Bases**
increase OH^- concentration	proton (H^+) acceptor	

Acids: donate H^+, low pH

Bases: accept H^+, high pH

116. Write the conjugate acid for each of the following bases:

a. HSO_4^{-1} H_2SO_4 b. HSO_3^{-1} H_2SO_3 c. H_2O H_3O^+ c. S^{-2} HS^{-1}

117. Write the conjugate base for each of the following acids:

a. H_3PO_4 $H_2PO_4^{-1}$ b. HS^{-1} S^{-2} c. HCO_3^{-1} CO_3^{-2} d. NH_3 NH_2^-

118. What is the difference between a concentrated acid/base and a dilute acid/base?

concentration: larger # of H_3O^+/OH^- molecules in solution
dilute: lower # of H_3O^+/OH^- molecules in solution

119. List some properties of acids and bases?

Acids	Bases
sour tasting low pH neutralized by bases produces electrolytes reacts w/ -metals to produce H_2 -OH bases to produce salt + H_2O	bitter tasting slippery/soapy feeling neutralized by acids produces electrolytes high pH values

120. Define pH.

- logarithm scale that ranks substances on their ability to dissociate into H_3O^+ ions
- indicates the concentration of the solution
  power of the $[H^+]$ ion

121. Answer the following:

a. The pH scale goes from 0 to 14.

b. An acidic solution has a pH between 0 and 6.

c. An alkaline solution has a pH between 8 and 14.

d. What is the most basic value on the pH scale? 14

122. If the pH is equal to 4.65, what is the pOH? What is the $[H^+]$? $[OH^-]$?

$pH + pOH = 14$

$4.65 + pOH = 14$

$pOH = 9.35$

$[H^+] = 10^{-pH}$

$= 10^{-4.65}$

$= 2.24 \times 10^{-5}$

$[H^+][OH^-] = 1.0 \times 10^{-14}$

$\frac{(2.24 \times 10^{-5})[OH^-]}{2.24 \times 10^{-5}} = \frac{1.0 \times 10^{-14}}{2.24 \times 10^{-5}}$

$[OH^-] = 4.47 \times 10^{-10}$

pOH 9.35 $[H^+]$ 2.24×10^{-5} $[OH^-]$ 4.47×10^{-10}

123. Phenolphthalein is a chemical indicator that will turn colorless in acid and pink in a base.

Name the following acids

nitrate → ate to ic

124. HNO_3 nitric acid

125. HCl hydrochloric acid

no oxygen

hydro ____ ic acid

Write the correct formula for the following:

ic to ate → sulfate SO_4^{-2}

126. sulfuric acid H_2SO_4

127. phosphoric acid H_3PO_4

ic to ate → phosphate PO_4^{-3}

128. If 25 mL of 0.25M H_2SO_4 are needed to titrate 30mL of an NaOH solution, what is the molarity of the NaOH solution? (Write a balanced chemical equation to start off)

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2HOH$

$0.025\ L\ H_2SO_4 \left(\frac{0.25\ mol\ H_2SO_4}{1\ L\ H_2SO_4}\right)\left(\frac{2\ mol\ NaOH}{1\ mol\ H_2SO_4}\right) = 0.0125\ mol\ NaOH$

$\frac{0.0125\ mol\ NaOH}{0.030\ L} = 0.42\ mol\ NaOH$

129. What is the difference between monoprotic, diprotic, and triprotic?

monoprotic - can lose 1 proton (H^+)

diprotic - can lose 2 protons (H^+)

triprotic - can lose 3 protons (H^+)

130. Answer the following parts.

a. Your chemistry teacher orders a 3.5L bottle of 18.0M H_2SO_4. She wants to make a 550mL solution that has a concentration of 0.349M. She was too busy making this review for you-she doesn't have time to do the calculation, so please be a kind student and help her out. How much of the stock solution should she take?

$$M_1V_1 = M_2V_2$$

$$18.0(V_1) = 0.349(0.550)$$

$$\frac{18.0(V_1)}{18.0} = \frac{0.19195}{18.0}$$

with 2 sf

$$V_1 = 0.010666\ L = 10.666\ mL = \boxed{11\ mL}$$

130.a.i. How what volume of a 0.264M solution of NaOH is needed to neutralize 15mL of the 0.349M H_2SO_4 solution? Hint: write a balanced equation and use STOICHIOMETRY!

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2HOH$$

$$0.015\ L\ H_2SO_4 \left(\frac{0.349\ mol\ H_2SO_4}{1\ L\ H_2SO_4}\right)\left(\frac{2\ mol\ NaOH}{1\ mol\ H_2SO_4}\right)\left(\frac{1\ L\ NaOH}{0.264\ mol\ NaOH}\right) = 0.0407\ L$$

with 2 sf

$$= 0.041\ L$$