CP Chemistry

Spring Semester Final Exam Review Sheet ANSWER KEY

Directions: Read each of the following questions. Answer in the space provided. If a calculation is required, SHOW ALL WORK TO RECEIVE CREDIT FOR THE ANSWER.

The Mole and Stoichiometry

1. a. What is a chemistry mole? SI unit for a quantity

   b. What is molar mass? Mass of one mole of a substance

   c. What unit should be used for molar mass? g/mole

   d. Calculate the molar mass of calcium oxide.

$$Ca^{+2}\ O^{2-} = CaO$$

Ca = 1 x 40.1 = 40.1
O = 1 x 16 = 16
56.1 g/mol CaO

2. a. What is Avogadro's number? 6.02×10^{23} particles (molecules, atoms, formula units, etc)

   b. Use conversion factors involving the mole, Avogadro's number, and molar mass to fill in the following blanks.

$$6.02 \times 10^{23} \text{ particles} = 1 \text{ mole} = \text{molar mass}$$

3. a. How many molecules are in 2.20 moles of carbon dioxide?
   Need: molecules CO_2
   Given: 2.20 moles CO_2

$$\frac{2.20 \text{ mol } CO_2}{1} \times \frac{6.02 \times 10^{23} \text{ molecules } CO_2}{1 \text{ mol } CO_2} = \frac{1.3244 \times 10^{24} \text{ molecules}}{1} = 1.32 \times 10^{24} \text{ molecules } CO_2$$

   b. How many grams are in 3.0 moles of lithium sulfate (Li_2SO_4)?
   Need: grams Li_2SO_4
   Given: 3.0 moles Li_2SO_4

$$\frac{3.0 \text{ mol } Li_2SO_4}{1} \times \frac{109.9 \text{ g } Li_2SO_4}{1 \text{ mol } Li_2SO_4} = \frac{329.7 \text{ g}}{1} = 330 \text{ g } Li_2SO_4$$

Li = 2 x 6.9 = 13.8
S = 1 x 32.1 = 32.1
O = 4 x 16 = 64
109.9 g/mol

   c. What conversion factor was used to solve for grams from moles in 3b? $\frac{109.9 \text{ g } Li_2SO_4}{1 \text{ mol } Li_2SO_4}$

   d. Calculate the number of atoms in 80.2 g of calcium metal.

$$\frac{80.2 \text{ g Ca}}{1} \times \frac{1 \text{ mol Ca}}{40.1 \text{ g Ca}} \times \frac{6.02 \times 10^{23} \text{ atoms Ca}}{1 \text{ mol Ca}} = 1.204 \times 10^{24} = 1.20 \times 10^{24} \text{ atoms Ca}$$

Ca = 1 x 40.1 = 40.1 g/mol

4. a. What is stoichiometry? Quantitative study of reactants used up and product amounts made.
   b. Upon what chemistry law is stoichiometry based? Law of conservation of matter/mass

5. Copper (II) sulfate reacts with aluminum to form aluminum sulfate and copper metal in the following reaction:

$$3\ CuSO_4 + 2\ Al \rightarrow Al_2(SO_4)_3 + 3\ Cu$$

a. How many moles of copper will be produced from 2.00 moles of aluminum?

Need: moles Cu
Given: 2.00 moles Al

$$\frac{2.00\ \text{mol Al}}{1} \times \frac{3\ \text{mol Cu}}{2\ \text{mol Al}} = \frac{6}{2} = \boxed{3.00\ \text{mol Cu}}$$

**the mole numbers come from the coefficient in equation above

b. What is the mole ratio of aluminum to copper? $\frac{2\ \text{mol Al}}{3\ \text{mol Cu}}$ **mole = coefficient

c. What is the mole ratio of copper (II) sulfate to copper metal? $\frac{3\ \text{mol } CuSO_4}{3\ \text{mol Cu}}$ **mole = coefficient

d. Should mole ratios ever be reduced (yes or no)? NO! Explain. Mole ratios come from coefficients in a balanced chemical equation. If the mole ratio numbers change, then you are changing the coefficients that balanced the equation. Hence, the equation then becomes un-balanced if the mole coefficients are changed!

6. Write the BALANCED chemical equation for the following reaction then answer the questions below using this equation.
Lead (II) nitrate reacts with sodium iodide to produce sodium nitrate and lead (II) iodide.

$$1\ Pb(NO_3)_2 + 2\ NaI \rightarrow 2\ NaNO_3 + 1\ PbI_2$$

a. How many grams of lead (II) iodide are made from 6.00 moles of sodium iodide?

Need: g PbI_2
Given: 6.00 mol NaI

$$\frac{6.00\ \text{mol NaI}}{1} \times \frac{1\ \text{mol } PbI_2}{2\ \text{mol NaI}} \times \frac{461\ \text{g } PbI_2}{1\ \text{mol } PbI_2} = \frac{2766}{2} = 1383 = \boxed{1380\ \text{g } PbI_2\ \text{(with sig figs)}}$$

Pb = 1 x 207.2 = 207.2
I = 2 x 126.9 = 253.8
461 g/mol

b. How many moles of sodium nitrate are produced from 4 moles of NaI?

Need: mol $NaNO_3$
Given: 4 mol NaI

$$\frac{4\ \text{mol NaI}}{1} \times \frac{2\ \text{mol } NaNO_3}{2\ \text{mol NaI}} = \frac{8}{2} = \boxed{4\ \text{mol } NaNO_3\ \text{(with sig figs)}}$$

7. Calculate the mass (in grams) of ammonia (NH_3) formed when 3.75 g of nitrogen gas react with hydrogen gas according to the following equation:

$$N_2 + 3\ H_2 \rightarrow 2\ NH_3$$ **mole numbers come from coefficients

Need: g NH_3
Given: 3.75 g N_2

$$\frac{3.75\ \text{g } N_2}{1} \times \frac{1\ \text{mol } N_2}{28\ \text{g } N_2} \times \frac{2\ \text{mol } NH_3}{1\ \text{mol } N_2} \times \frac{17\ \text{g } NH_3}{1\ \text{mol } NH_3} = \frac{127.5}{28} = 4.553571 = \boxed{4.55\ \text{g } NH_3\ \text{(with sig figs)}}$$

N = 2 x 14 = 28 g/mol

N = 1 x 14 = 14
H = 3 x 1 = 3
17 g/mol

8. Use the equation below to answer the question that follows.

$$4\ NH_3 + 3\ O_2 \rightarrow 2\ N_2 + 6\ H_2O$$

How many grams of water will be produced from 51.0 g of NH_3?

Need: g H_2O

Given: 51.0 g NH_3

$$\frac{51.0\ g\ NH_3}{1} \times \frac{1\ mol\ NH_3}{17\ g\ NH_3} \times \frac{6\ mol\ H_2O}{4\ mol\ NH_3} \times \frac{18\ g\ H_2O}{1\ mol\ H_2O} = \frac{5508}{68} = \boxed{81.0\ g\ H_2O\ \text{(with sig figs)}}$$

N = 1 x 14 = 14
H = 3 x 1 = 3
17 g/mol

H = 2 x 1 = 2
O = 1 x 16 = 16
18 g/mol

9. a. What is a limiting reactant? Reactant that restricts the number of reactions that can occur because it runs out before any other reactant.

b. A candle is lit and placed in a closed jar. The candle flame burns out after a couple of minutes. What is the limiting reactant? oxygen Why? When there is no more oxygen left in the closed jar the candle will go out an its own. The fire can't continue without the oxygen (and there is still candle left aver to burn - so the candle can't be the limiting reactant if there is some left over).

10. a. What is an excess reactant? The reactant left over after the limiting reactant runs aut.

b. What would be the excess reactant in 9b? candle wax Why? There is still candle wax left that CAN burn IF there were still oxygen present.

11. Use the equation below to answer the questions that follow.

$$Cu + 2\ AgNO_3 \rightarrow Cu(NO_3)_2 + 2\ Ag$$

a. If you have 6 moles of Cu and 8 moles of $AgNO_3$, which is the limiting reactant?
You have to compare what you have of each reactant (this is GIVEN in problem) and compare to what is REQUIRED (in balanced chemical equation) for 1 reaction!

$$\frac{6\ mol\ Cu}{1} \times \frac{1\ reaction}{1\ mol\ Cu} = \frac{6}{1} = 6\ \text{reactions with Cu}$$

$$\frac{8\ mol\ AgNO_3}{1} \times \frac{1\ reaction}{2\ mol\ AgNO_3} = \frac{8}{2} = \boxed{4\ \text{reactions with } AgNO_3} \rightarrow$$

Limiting Reactant (runs out first)

**The reaction will stop after 4 reactions because there will be no more $AgNO_3$ left because it runs aut. It doesn't matter that you could do 6 reactions with copper, the $AgNO_3$ will be gone after 4 reactions!

b. What is a theoretical yield? The theoretical yield is the amount of a product produced after the limiting reactant runs out - assuming 0% error. This is calculated the way you work a problem in #7 and in part C below- the only difference is that the "given" is the amount of the limiting reactant you have (it could be in g or in moles).

c. If 4 moles of Cu and 6 moles of $AgNO_3$ react, what will be the theoretical yield (in moles) of silver?
** Before you can answer the question, you have to figure out whether Cu or $AgNO_3$ is the limiting reactant! Compare what you have (GIVEN) to what is required (in balanced equation).

$$\frac{4\ mol\ Cu}{1} \times \frac{1\ reaction}{1\ mol\ Cu} = \frac{4}{1} = 4\ \text{reactions with Cu}$$

$$\frac{6\ mol\ AgNO_3}{1} \times \frac{1\ reaction}{2\ mol\ AgNO_3} = \frac{6}{2} = 3\ \text{reactions with } AgNO_3 \rightarrow$$

Limiting Reactant
use this as given for theore. yield

continued on next page

Need: mol Ag

Given: 6 mol $AgNO_3$ (the limiting reactant determines how much of the product can be made)

$$\frac{6 \text{ mol } AgNO_3}{1} \times \frac{2 \text{ mol Ag}}{2 \text{ mol } AgNO_3} = \frac{12}{2} = \boxed{6 \text{ mol Ag (with sig figs)}}$$

d. Theoretical yield can be related to the actual yield which is the mass of a product actually recovered during a lab activity

The ratio of the actual yield to the theoretical yield is called **percent yield** The mathematical formula for this would be:

$$\% \text{ yield} = \left[\frac{\text{actual yield}}{\text{theoretical yield}}\right] \times 100\%$$

12. Iron (II) sulfide reacts with hydrogen chloride to produce iron (II) chloride and hydrogen sulfide. Write the balanced chemical equation and then answer the questions below.

$$1\ FeS + 2\ HCl \rightarrow 1\ FeCl_2 + 1\ H_2S$$

a. If you start with 1144 g of FeS and 108 g HCl, which is the limiting reactant?

$$\frac{1144 \text{ g FeS}}{1} \times \frac{1 \text{ mol FeS}}{87.9 \text{ g FeS}} \times \frac{1 \text{ rxn FeS}}{1 \text{ mol FeS}} = \frac{1144}{87.9} = 13.0147 \text{ reactions with FeS}$$

Fe = 1 x 55.8 = 55.8
S = 1 x 32.1 = 32.1
87.9 g/mol FeS

$$\frac{108 \text{ g HCl}}{1} \times \frac{1 \text{ mol HCl}}{36.5 \text{ g HCl}} \times \frac{1 \text{ rxn HCl}}{2 \text{ mol HCl}} = \frac{108}{73} = \boxed{1.479 \text{ reactions with HCl}}$$

→ limiting reactant b/c it runs out 1st so use HCl's grams as the "given"

H = 1 x 1 = 1
Cl = 1 x 35.5 = 35.5
36.5 g/mol HCl

b. How many times would the reaction occur to completion? 1.48 times (with sig figs)

c. How many grams of $FeCl_2$ would be produced?

Need: g $FeCl_2$

Given: g HCl (ALWAYS START WITH THE **LIMITING REACTANT** - IT DETERMINES THE AMOUNT OF PRODUCTS MADE BECAUSE ONCE IT RUNS OUT, NO MORE PRODUCTS WILL BE MADE AND NO MORE OF EXCESS REACTANT CAN BE USED).

$$\frac{108 \text{ g HCl}}{1} \times \frac{1 \text{ mol HCl}}{36.5 \text{ g HCl}} \times \frac{1 \text{ mol } FeCl_2}{2 \text{ mol HCl}} \times \frac{126.8 \text{ g } FeCl_2}{1 \text{ mol } FeCl_2} = \frac{13694.4}{73} = 187.5945 \text{ g} = \boxed{188 \text{ g } FeCl_2 \text{ (with sig figs)}}$$

Fe = 1 x 55.8 = 55.8
Cl = 2 x 35.5 = 71
126.8 g/mol $FeCl_2$

d. What is the excess reactant? FeS (it's left over after HCl runs out)

e. How many grams of excess reactant are left over?

Need: g FeS

Given: g HCl (the limiting reactant amount)

$$\frac{108 \text{ g HCl}}{1} \times \frac{1 \text{ mol HCl}}{36.5 \text{ g HCl}} \times \frac{1 \text{ mol FeS}}{2 \text{ mol HCl}} \times \frac{87.9 \text{ g FeS}}{1 \text{ mol FeS}} = \frac{9493.2}{73} = 130.0438 = \boxed{130. \text{ g FeS (with sig figs)}}$$

H = 1 x 1 = 1
Cl = 1 x 35.5 = 35.5
36.5 g/mol HCl

Fe = 1 x 55.8 = 55.8
S = 1 x 32.1 = 32.1
87.9 g/mol FeS

13. a. What is an empirical formula? **The lowest, reduced (or simplied) versian af a chemical farmula. Ta find the empirical formula, find a number all the subscripts have in common and reduce the numbers (like you would reduce a ratia of 2:2 ta 1:1).**

b. What is the empirical formula for C_4H_8? **CH_2**
4:8 reduces to 1:2

c. What is the empirical formula for the antifreeze ethylene glycol, $C_2H_6O_2$? **CH_3O**
2:6:2 reduces to 1:3:1

14. a. What is a molecular formula? **The actual chemical formula (NOT reduced).**

b. The empirical formula for CO_3 was found to have a molar mass of 120 g/mol. What is the molecular formula?

$$n = \frac{\text{molar mass}}{\text{empirical formula molar mass}} = \frac{120\ g/mol}{60\ g/mol} = 2$$

$(CO_3)n$
$(CO_3)_2 = \boxed{C_2O_6}$

c. A compound has an empirical formula of CH_2 and a molar mass of 42 g/mol. What is the molecular formula?

$$n = \frac{\text{molar mass}}{\text{empirical formula molar mass}} = \frac{42\ g/mol}{14\ g/mol} = 3$$

$(CH_2)n$
$(CH_2)_3 = \boxed{C_3H_6}$

Solutions

15. a. What is a solute? **Substance being dissalved**
b. What is a solvent? **Substance daing the dissolving; the dissolving agent**

16. You have a 15% aqueous solution of sodium chloride. Identify the solute and solvent.

Solute: **sodium chlaride**

Solvent: **water – because the word "aqueous" refers ta water**

17. a. What is a polar molecule? **A molecule with positive and negative poles (ends); has appositely charged pales**

b. What is a nonpolar molecule? **A molecule WITHOUT appositely charged poles**

c. Explain the phrase "like dissalves like" to explain how a solution forms. **Substances with similar polarities will dissalve in each other. Polar solvents will dissalve polar salutes; nanpolar salvents will dissalve nanpolar solutes.**

18. a. Is water polar or nonpolar? **POLAR covalent** What types of substances can water dissolve? Explain. **Because of the "like dissolves like" rule, water can dissolve anything polar and some substances that are covalent. Cavalent means 2 nonmetals are in the compaund (the two elements are to the right of the staircase on the periodic table).**

b. Circle all of the following that WILL dissolve in water.

a. KCl — **polar like water**

b. HCl — **cavalent like water**

c. C_6H_{14}

d. $C_6H_{12}O_6$ — **covalent like water**

19. Identify three ways in which the rate at which a solution forms could be increased.

- **agitate (stir) more**
- **Increase temperature**
- **Increase surface area by pulverizing (grinding/crushing) substanc**

20. What type of solutian holds *the maximum amount* of solute in a solvent at a given temperature? **saturated**

21. What type of solution could you <u>add more solute</u> to because the solvent is holding *less than the maximum amount* of solute at a certain temperature? **unsaturated**

22. You are preparing a solution of sweet tea for a hot summer-day thirst quencher. You boil the water, add the tea bags alang with 8 cups of sugar. You then allow the solution of sweetened tea to cool in the refrigerator. What type of solution have you probably made? **supersaturated**

23. How does solubility change for gaseous solutes as temperature of a solution increases? **decreases**

24. How does solubility change for solid solutes as temperature of a solution increases? **increases**

25. a. What is a colligative property? **A physical property that depends on the amount/number of solute particles NOT the identity of the particle (not what the substance is).**

b. List three colligative properties. **Vapor pressure** and **boiling point** and **freezing point**

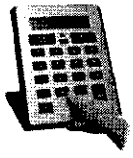
c. How is the boiling point of a solution affected by the addition of a solute? **BP elevates (increases).**
Explain your answer.
Solute interferes with the solvent's ability to vaporize into a gas during boiling; to allow more solvent to vaporize (evaporate) the temperature must be increased (elevated) causing the boiling point to elevate.

d. How is the freezing point of a solution affected by the addition of a solute? **FP depresses (lowers).**
Explain your answer.
Solute intereferes with the solvent's ability to freeze into a solid because the solvent particles have the solute particles between them (like a third wheel on a date). To allow the solvent particles to squeeze close together (like solid particles), the temperature must be decreased (depressed) causing the freezing point to depress.

26. a. What is the formula for <u>Molarity</u>? **M = $\frac{\text{moles solute}}{\text{Liter solution}}$**

b. Calculate the <u>molarity</u> of a solution containing 32.0 g of potassium chloride with a volume of 0.955 L?

Molarity = $\frac{\text{moles solute}}{\text{Liters of solution}}$ **M = $\frac{0.4289544 \text{ mol}}{0.955 \text{ L}}$ = 0.449166936 = 0.499 M (with sig figs)**



$$\frac{32.0 \text{ g KCl}}{1} \times \frac{1 \text{ mol KCl}}{74.6 \text{ g KCl}} = \frac{32}{74.6} = 0.4289544$$

K = 1 x 39.1 = 39.1
Cl = 1 x 35.5 = 35.5
74.6 g/mol KCl

c. Calculate the molarity of a solution containing 14 g of sodium sulfate dissolved in 1.6 L of solution.

Molarity = $\frac{\text{moles solute}}{\text{Liters of solution}}$ $M = \frac{0.098522167 \text{ mol}}{1.6 \text{ L}} = 0.061576355 =$ **0.062 M (with sig figs)**

$$\frac{14 \text{ g } Na_2SO_4}{1} \times \frac{1 \text{ mol } Na_2SO_4}{142.1 \text{ g } Na_2SO_4} = \frac{14}{142.1} = 0.098522167 \text{ mol } Na_2SO_4$$

Na = 2 x 23 = 46
S = 1 x 32.1 = 32.1
O = 4 x 16 = 64
142.1 g/mol Na_2SO_4

d. Calculate the volume of a 0.17 M NH_4Cl solution containing 0.17 moles of ammonium chloride.

Molarity = $\frac{\text{moles solute}}{\text{Liters of solution}}$ $\frac{0.17 \text{ mol/L}}{1} = \frac{0.17 \text{ mol}}{x} =$ **x = 1.0 L (with sig figs)**

Make into a proportion and cross-multiply to solve for x.

27. a. What is the mathematical expression for calculating percent by mass? % Mass = $\frac{\text{g solute}}{\text{g solute + g solvent}} \times 100\%$

g solution

b. What is the percent by mass of 20 g of dextrose dissolved in 200 g of water?

% Mass = $\frac{\text{g solute}}{\text{g solute + g solvent}} \times 100\%$

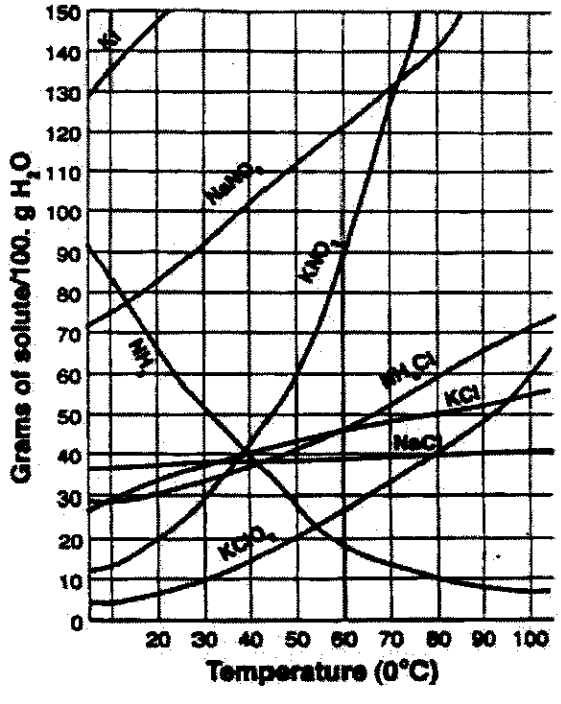
% Mass = $\frac{20 \text{ g}}{20 \text{ g} + 220 \text{ g}} = \frac{20 \text{ g}}{220 \text{ g}} \times 100\% = 9.090909 =$ **9% dextrose (with sig figs)**

c. What is the percent by mass of 35 g of sodium chloride dissolved in 150 g of water?

% Mass = $\frac{\text{g solute}}{\text{g solute + g solvent}} \times 100\%$

% Mass = $\frac{35 \text{ g}}{35 \text{ g} + 150 \text{ g}} = \frac{35 \text{ g}}{185 \text{ g}} \times 100\% = 18.918918 =$ **19% NaCl (with sig figs)**

Use the graph below to answer the questions that follow.



28. How many grams of ammonium chloride dissolve in100 g of water at 80°C? ~60 g NH_4Cl

29. If 10. g af ammanium chloride is dissolved at 80°C, how much more must be added to make a saturated salution?

@ 80°C the saturated point is 60 g (point on curve)

Problem Gives You: @ 80°C

10 g (point below curve)

50 g can be added to get point from below curve to ON the curve (the saturated point).

30. What mass of sodium nitrate will dissolve in 25 g of water at 80°C? (still using graph on previous page)
**Must use proportion because the graph is out of 100 g of water and the problem mentions 25 g water.

$$\frac{140\text{ g } NaNO_3}{100\text{ g } H_2O} = \frac{x}{25\text{ g } H_2O}$$

**NOW CROSS-MULTIPLY TO SOLVE FOR X.

$$(100\text{ g } H_2O)(x) = (140\text{ g } NaNO_3)(25\text{ g } H_2O)$$

$$\frac{(100\text{ g } H_2O)(x)}{100\text{ g } H_2O} = \frac{3500\text{ g } NaNO_3 \cdot \text{g } H_2O}{100\text{ g } H_2O}$$

$x = 35\text{ g } NaNO_3$

31. If a saturated solution of KNO_3 at 60°C is cooled to 50°C, how many grams of KNO_3 will precipitate out of solution?
Saturated @60°C = 90 g
Saturated @50°C = 60 g
30 g will NOT dissolve and will precipitate out

32. Which solute is MOST influenced by temperature? KNO_3 (it's the curve with the greatest angle that changes most).

33. Which solute is LEAST influenced by temperature? NaCl (it's the curve that is almost flat and is changing very little)

Acids and Bases

34. What is an acid according to the scientist Arrhenius? Contains H^+ or H_3O^{+1} (called hydronium)

35. a. What is a base according to the scientist Arrhenius? Contains OH^- (called hydroxide)

b. What is another term for a base? alkaline

36. Label the following as either an Arrhenius acid or base or neither.

a. CaO — neither (doesn't have H^+ ar OH^-)

b. NaOH — base (has OH^-)

c. H_2SO_4 — acid (OH^- not together but does have H^+)

d. BaOH — base (has OH^-)

37. Identify the acid, base, conjugate acid, and conjugate base in the following reaction.

$$HCl + H_2O \rightarrow H_3O^+ + Cl^-$$

Acid (donates H^+ to turn into Cl^-) | base (accepts H^+ to turn into H_3O^+) | conj. acid | conj. base

38. List four properties of acids and four properties of bases.

ACIDS	BASES
Sour	bitter
Conductive	conductive
Reacts with bases, metals, carbonates	reacts with acids
pH<7	pH>7

39. a. What type of chemical reaction occurs when an acid reacts with a base? **neutralization**

b. What are names of the two products which form when an acid reacts with a base? **Salt and water** (salt is just the name of an ionic solid)

c. Write, balance, and predict the products in the neutralization reaction between hydrofluoric and sodium hydroxide.

$$1\ HF + 1\ NaOH \rightarrow 1\ H_2O + 1\ NaF$$

d. Write, balance, and predict the products in the neutralization reaction between sulfuric acid and calcium hydroxide.

$$1\ H_2SO_4 + 1\ Ca(OH)_2 \rightarrow 2\ H_2O + 1\ CaSO_4$$

40. a. Draw and label the pH scale and the values it ranges from and label the acid range, alkaline range, and neutral range.

pH of an acid is 0 to 6.9

pH of a base is 7.1 to 14

pH of a neutral substance is 7

b. What does the pH scale measure? H^+ concentration

c. $pH = -\log [H^+]$ (fill in the mathematical expression)

d. $pH + pOH = 14$

e. The pH scale is based on powers of 10.

41. Fill in the blanks below using the information provided.

$[H^+]$	$[OH^-]$	pH	pOH	Acid, Base, or Neutral?
2.9×10^{-5} M	n/a	4.5	9.5	acid
n/a	n/a	8.4	5.6	base
n/a	6.1×10^{-4} M	10.8	3.2	base

42. Circle the pH which is more acidic in each pair AND calculate how much more acidic this pH is than the other.

a. (pH 1) or pH 3 — 3-1= 2 so 10^2 = 100 times more acidic

b. pH 6 or (pH 2) — 6-2 = 4 so 10^4 = 10000 times more acidic

c. pH 5 or (pH 4) — 5-4 = 1 so 10^1 = 10 times more acidic

Remember that pH scale is base on powers of 10!

43. Explain what happens in each test if a base is present in the solution.

a. What happens to red litmus paper? **Turns blue**

b. What happens when phenolphthalein is added? **Turns pink**

c. What happens to pH paper? **Turns blue to purple**

44. Explain what happens in each test if an acid is present in the solution.

a. What happens to blue litmus paper? **Turns red**

b. What happens when phenolphthalein is added? **No change - phenolphthalein stays clear**

c. What happens to pH paper? **Turns red to orange**

45. a. What does the term *polyprotic* mean? **More than one H^+ present**

b. What does the term *monoprotic* mean? **Only one H^+ present**

c. Is H_2S polyprotic or monoprotic? **Polyprotic - because 2 hydrogen**

d. Is HF polyprotic or monoprotic? **Monoprotic - because 1 hydrogen**

46. Compare and contrast strong acids and bases with weak acids and bases.
Strong acids and bases dissociate (split into ions/electrolytes) 100% so they are very good conductors; no K_a values
Weak acids and bases dissociate only partially (no where close to 100%) so they are poor conductors. Have K_a values.

Thermochemistry

47. a. What is heat? **A form of energy which flows from warmer regions to cooler regions.**

b. How does heat move in a system? **Warmer to coolder**

c. List three units of heat energy. Circle the SI unit.

- **Joule**
- **calorie**
- **kilocalorie**

48. How much heat (in Joules) is needed to increase the temperature of 500. g of water from 30.0°C to 45.0°C?

$Q = mc\Delta T$

Q = ?
m = 500.
c = 4.184 J/g°C (you have to memorize this as specific heat of water)
$\Delta T = T_f - T_i$ = 45.0°C - 30.0°C = 15.0°C

Q = (500. g)(4.184 J/g°C)(15.0°C)
Q = 31 380 J = 31 400 J (with sig figs)

49. What is the specific heat of water in J/g°C? **4.184 J/g°C** In cal/g°C? **1.00 J/g°C**

50. The temperature of 55.6 g of a material decreases by 14.8°C when it loses 3080 J of heat. What is its specific heat?

Q = 3080 J
m = 55.6 g
c = ?
ΔT = 14.8°C

$Q = mc\Delta T$

$3080\ J = (55.6\ g)(x)(14.8°C)$

$\frac{3080\ J}{822.88\ g°C} = \frac{(822.88\ g°C)(x)}{822.88\ g°C}$

$3.742951585\ J/g°C = x$

3.74 J/g°C = x (with sig figs)

51. A 75.0 g sample of a metal is placed in boiling water until its temperature is 100.0°C. A calorimeter is filled with 100.0 g of water at 24.4°C. The hot metal is removed from the boiling water and placed into the water in the calarimeter. The final temperature of both the metal and water is 34.9°C. Assuming the calorimeter pravides perfect insulation, what is the specific heat af the metal? **ORGANIZE YOUR DATA!!!! ALL NUMBERS ARE COMING FROM THE PARAGRAPH ABOVE!**

<u>water</u>
m = 100.0 g
c = 4.184 J/g°C
$\Delta T = T_{final} - T_{initial} = 10.5°C$
34.9°C - 24.4°C

<u>metal</u>
m = 75.0 g
c = unknown
$\Delta T = T_{final} - T_{initial} = 65.1°C$
34.9°C-100.0°C

$Q_{water\ absorbs} = Q_{metal\ releases}$
$mc\Delta T = mc\Delta T$
$(100.0\ g)(4.184\ J/g°C)(10.5°C) = (75.0\ g)(x)(65.1°C)$
$\frac{4393.2\ J}{4882.5\ /g°C} = \frac{(4882.5\ g°C)(x)}{4882.5\ g°C}$
$0.8997849\ J/g°C = x$
0.900 J/g°C (with sig figs)

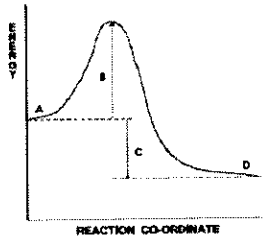
52. When the energy of the products is <u>greater than</u> the energy of the reactants the process does which of the following?
a. releases heat b. absorbs heat c. conserves heat d. none of the above

53. Bond breaking is an **endothernic** process whereas bond making is an **exothermic** process.
(Fill in the blanks with the terms *endothermic* or *exothermic*.)

54. a. If energy is a reactant, is the reaction endathermic or exathermic? **endothermic**

b. If energy is a product, is the reaction endothermic or exathermic? **exothermic**

Use the energy diagram at the right to answer the questions that follow.



55. What is represented at letter A? **reactants**
56. What is represented at letter B? **activation energy (E_a)**
57. What is represented at letter C? **change in energy (ΔE)**
58. What is represented at letter D? **products**
59. Which has more energy in the diagram: **reactants**
60. Is the process in the diagram endothermic ar exothermic? **exothermic**

Organic Chemistry

61. Which element do all arganic compounds contain? **carbon**
62. How mony bands does carbon olways make? **4**
63. Hydrocorbons bond using which type of band: ianic, covalent, or metallic? **covalent**
64. What is the general formula far alkones? C_nH_{2n+2}

65. a) If an alkane has 13 carbon atoms, how many hydrogen atoms does it have? 28 $C_{13}H_{2(13)+2}$

b) If an alkane has 22 carbon atoms, how many hydrogen atoms does it have? 46 $C_{22}H_{2(22)+2}$

Reaction Rates

66. Circle ~~all of the following~~ that DO affect reaction rates?

a. catalysts
b. surface area of reactants
c. concentration of reactants
d. reactivity of products

67. a. How does a catalyst speed up a reaction rate? Lowers activation energy so that reactants can get the energy to make the reaction occur easier – this makes the reaction faster.

b. How does an inhibitor slow a reaction rate? Increases activation energy so that reactants have a harder time getting the energy they need – this makes the reaction slower.

68. List the parts of the Collision Theory.

- particles must collide
- particles must collide with proper orientation (fit like puzzle pieces)
- particles must collide with enough energy to form the activated complex

Gases

69. What are the values for STP? Standard temp: 0°C or 273 K Standard pressure: 1 atm or 760 torr or 101.3 kPa

70. a. What is the scientific temperature scale called? Kelvin

b. How do you convert from degrees Celsius to Kelvin? K = °C + 273

c. Convert -58°C to Kelvin. K = °C + 273
K = -58 + 273
K = 215 K

71. What is absolute zero? Lowest theoretical temperature possible on Kelvin scale; Absolute Zero = 0 K = 0 Kinetic energy

72. At which of the following temperatures is there the ~~least~~ amount of movement among particles?

0°C 0°F 10 K (0 K)

73. What causes kinetic energy (particles moving) to increase? Increasing temperature because temperature is a measure of kinetic energy.

74. Is air a pure substance? No Explain. Air is a MIXTURE of gases like carbon dioxide, oxygen, nitrogen, etc.

75. A gas occupies 2.00 cm^3 at 100. K, exerting a pressure of 100. kPa. What volume would the gas occupy at 400. K if the pressure were increased to 200. kPa?

Combined Gas Law

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(100.\ kPa)(2.00\ cm^3)}{100\ K} = \frac{(200.\ kPa)(x)}{400.\ K}$$

$x = 4.00\ cm^3$

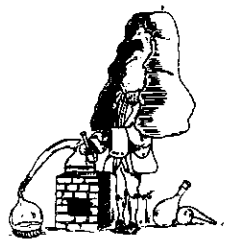
**cross multiply to solve for x

76. According to Boyle's Law, what is the relationship between pressure and volume? **Inversely proportional**

77. According to Boyle's Law, when pressure increases volume **decreases**.

78. According to Charles' Law, what is the relationship between temperature and volume? **Directly proportional**

79. According to Charles Law, if volume is increases then temperature **increases**.



80. If the pressure of a gas remains constant, the volume is directly proportional to the temperature. This is **Charles' Law**.

81. Explain why popcorn kernels "explode" when heated. Which gas law relates to this idea? Law: **Charles' Law**

Popcorn kernels contain water. As the temperature in a microwave increases, the water in the popcorn kernel turns to a gas. Since gases expand to fill their container, the water vapor "pushes" the kernel outward causing it to burst or "pop". Since temperature increases causing the volume to increase, this directly relates to Charles' Law.

82. If the pressure exerted on a 240. mL sample of hydrogen gas at constant temperature is increased from 325 mm Hg to 550. mm Hg, what will be the final volume?

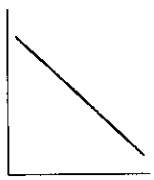
Boyle's Law

$P_1V_1 = P_2V_2$

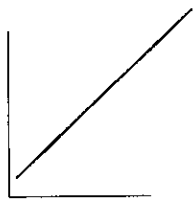
$$\frac{(325\ \text{mmHg})(240.\ \text{mL})}{550.\ \text{mmHg}} = \frac{(550.\ \text{mmHg})(x)}{550.\ \text{mmHg}}$$

x = 142 mL

83. Draw a line in the graph provided that would represent Boyle's Law and Charles' Law



Boyle's Law



Charles' Law

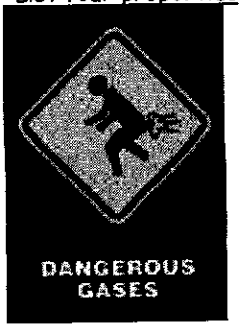
84. Explain why a balloon left in a hot car all day will be likely to burst? Which law is this? Law: **Charles' Law**

As temperature increases, the gas in the balloon begins to expand and take up more space (volume). Eventually, the balloon will not be able to expand anymore. This will cause the balloon to burst. Temperature increases and volume increases in a directly proportional relationship with exemplifies Charles' Law.

85. Explain why, on a cold day, a tire on a car looks more inflated after it has been driven for a while versus if the car has just been sitting in the driveway? Which law applies to this? **Charles' Law**

When a tire looks deflated, it means the gas particles in the tire do not have a lot of kinetic energy. When the car is driven, the friction between the tire and road creates heat that roises the temperature of the gas inside the tire. Because the temperature increases, the porticles move faster (hove more kinetic energy) making them expand outward and take up more space (volume). This increase in volume causes the tire to look more inflated. Since volume and temperature are directly related, this is Charles' Law.

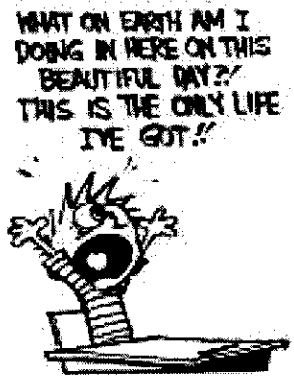
86. List four properties of gases.



a. **compressible**
b. **low densities**
c. **some are flammable**
d. **MOST are colorless, odorless, tasteless**

87. What does the Kinetic Molecular Theory (KMT) state about gas behavior?

- Gas particles do not attract or repel each other due to the fact that they are nonpolar (don't have positive and negative charges).
- Gas particles are smaller than the distances that separate them.
- Gas particles move in constant, random, straight-line motion.
- Gas particles collide in perfectly elastic callisions which means that the gas particles do not lose any kinetic energy; rather, the energy in the collisions is transferred 100% from one particle to another particle.
- Two different gases at the same temperature have the same kinetic energy (KE = temp).



Hang in there!
You're almost done for the year!
Study hard for the exam! ☺