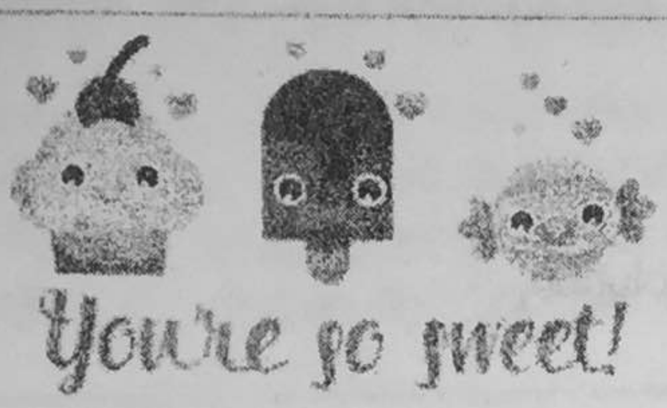
Name Key Date 2019 Period ____



Super Chemists' Unit 8
Sweet Sheet

Things to know:

*All of your vocabulary. I am not asking you to write it again, but it will be the Matching part of your test.

*How to calculate molarity and molality.

*How to calculate boiling point elevation and freezing point depression.

*How to apply Le Chatelier's Principle

*How to calculate pH, pOH, and concentrations of hydronium and hydroxide ions.

*Acid/base chemistry, conjugate acids and bases

*Neutralization reactions

*How to dilute a substance from a higher concentration to an asked molarity

*Titrations

*I would look over your notes…..

Test Breakdown

30-35 Matching

27-30 Multiple Choice Question

8-10 Short Answer

4-5 Writing and balancing chemical equations

4-5 Le Chatelier's Principle

4-5 Fill in the blank

4 Calculation

Extra Credit (Time permitting)

To receive credit for the Sweet Sheet, you MUST complete all the worksheets in this packet. ☺

Molarity Worksheet

W 331

What is the molarity of the following solutions given that:

1) 1.0 moles of potassium fluoride is dissolved to make 0.10 L of solution.

$$\frac{1.0 \text{ mole KF}}{0.10 \text{ L solu.}} = 10. \text{ M}$$

2) 1.0 grams of potassium fluoride is dissolved to make 0.10 L of solution.

$$\frac{1.0 \text{ g KF}}{58 \text{ g KF}} \left| \frac{1 \text{ mol KF}}{} \right. = 0.0172 \text{ mol KF}$$

$$\frac{0.0172 \text{ mol KF}}{.1 \text{ L}} = 0.17 \text{ M}$$

3) 1.0 grams of potassium fluoride is dissolved to make 0.10 mL of solution.

$$\frac{1.0 \text{ g KF}}{58 \text{ g KF}} \left| \frac{1 \text{ mol KF}}{} \right. = 0.0172 \text{ mol KF}$$

$$\frac{0.0172 \text{ mol}}{.00010 \text{ L}} = 170 \text{ M}$$

4) 952 grams of ammonium carbonate are dissolved to make 1750 mL of solution.

$$\frac{952 \text{ g } (NH_4)_2CO_3}{96 \text{ g } (NH_4)_2CO_3} \left| \frac{1 \text{ mol } (NH_4)CO_3}{} \right. = 9.92 \text{ mol } (NH_4)_2CO_3$$

$$\frac{9.92 \text{ mol } (NH_4)_2CO_3}{1.75 \text{ L}} = 5.67 \text{ M}$$

5) 9.82 grams of lead (IV) nitrate are dissolved to make 465 mL of solution.

$$\frac{9.82 \text{ g } Pb(NO_3)_4}{455 \text{ g } Pb(NO_3)_4} \left| \frac{1 \text{ mol } Pb(NO_3)_4}{} \right. = .0216 \text{ mol } Pb(NO_3)_4$$

$$\frac{.0216 \text{ moles } Pb(NO_3)_4}{0.465 \text{ L}} = 0.0465 \text{ M}$$

ARITY BY DILUTION

Name _____

Acids are usually acquired from chemical supply houses in concentrated form. These acids are diluted to the desired concentration by adding water. Since moles of acid before dilution = moles of acid after dilution, and moles of acid = M x V then, $M_1 \times V_1 = M_2 \times V_2$. Solve the following problems.

1. How much concentrated 18 M sulfuric acid is needed to prepare 250 mL of a 6.0 M solution?

$(18M)(V_1) = (6.0M)(250mL)$

$V_1 = 83.3mL$ 83.3mL

2. How much concentrated 12 M hydrochloric acid is needed to prepare 100 mL of a 2.0 M solution?

$(12M)(V_1) = (2.0)(100)$

$V_1 = 16.7mL$ 16.7mL

3. To what volume should 25 mL of 15 M nitric acid be diluted to prepare a 3.0 M solution?

$(25mL)(15M) = (3.0M)(V_2)$

125mL 125mL

4. To how much water should 50. mL of 12 M hydrochloric acid be added to produce a 4.0 M solution?

$(50mL)(12M) = (4.0)(V_2)$

$V_2 = 150mL$

100mL of H_2O 100mL of H_2O

5. To how much water should 100. mL of 18 M sulfuric acid be added to prepare a 1.5 M solution?

$(100)(18M) = (1.5M)(V_2)$

1200 mL

1100 mL of H_2O

Name _____

Worksheet: Le Chatelier's Principle

If a system at equilibrium is subjected to a Stress, the equilibrium is displaced in the direction that relieves the Stress.

- A stress is defined as any change which could affect the rate of either or both the forward and/or reverse reaction.
- When, because of an applied stress, the forward reaction is faster than the reverse reaction, the system is said to shift to the (right, left). As a result, the [products] will (increase, decrease) and the [reactants] will (increase, decrease).
- When, because of an applied stress, the reverse reaction is faster than the forward reaction, the system is said to shift to the (right, left). As a result, the [products] will (increase, decrease) and the [reactants] will (increase, decrease).

In simpler terms: If anything is added to a system at equilibrium (⇌), the system will try to consume whatever was added. If anything is removed from a system at equilibrium, the system will try to replace whatever was removed. So, the reaction is favored away from what is (added, removed) and toward what is (added, removed).

1. **In the following reaction, will the [H_2] increase or decrease when equilibrium is reestablished after these stresses are applied?**

4 moles 2 moles

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + 22\ kJ$$

$NH_3(g)$ is added ↑ *$N_2(g)$ is removed* ↑

pressure is increased ↓ *temperature is increased* ↑

less moles of gas

3 2

2. **Note reaction:** $2NO(g) + H_2(g) \rightleftharpoons N_2O(g) + H_2O(g) + 36\ kJ$

In which direction, left or right, will the equilibrium shift if the following changes are made?

NO is added	right	the system is cooled	right
H_2 is removed	left	pressure is increased	right
N_2O is added	left	H_2 is removed	left

Worksheet: Le Chatelier's Principle **Name**_____

3. In this reaction: $\underset{2}{CO_2\,(g)} + H_2\,(g) + \text{heat} \rightleftharpoons \underset{2}{CO\,(g)} + H_2O\,(g)$

a. Is heat absorbed or released by the forward reaction?

_____

b. In which direction will the equilibrium shift if these changes are made?

CO is added	left	temperature is increased	right
CO_2 is added	right	system is cooled	left
H_2 is removed	left	pressure is increased	no change
catalyst is added	* no change		

~~moles~~ moles are equal 2=2

4. In this reaction: $\underset{3}{2\,NO\,(g)} + H_2\,(g) \rightleftharpoons \underset{2}{N_2O\,(g)} + H_2O\,(g) + \text{heat}$

What will happen to the $[H_2O]$ when equilibrium is reestablished after these stresses are applied?

temperature is increased	↓
a catalyst is added	X - nothing
pressure is decreased	↓
NO is added	↑
N_2O is removed	↑

5. How would an increase in pressure affect the $[H_2]$ in the following reactions?

$\underset{3}{2\,H_2\,(g)} + O_2\,(g) \rightleftharpoons \underset{2}{2\,H_2O\,(g)}$ ↓

$\underset{4}{4\,H_2\,(g)} + Fe_3O_4\,(s) \rightleftharpoons \underset{0}{3\,Fe\,(s) + 4\,H_2O\,(l)}$ ↓

$\underset{2}{H_2\,(g)} + Cl_2\,(g) \rightleftharpoons \underset{2}{2\,HCl\,(g)}$ NO CHANGE

Name _____ Period _____ Date _____

COLLIGATIVE PROPERTIES

PART A – CALCULATIONS (Kb of water is 0.51°C/m, Kf of water is 1.86°C/m, Kf of naphthalene is 7.00°C/m)

1. Indicate how many particles are formed when the following solutes dissolve.

SOLUTE	# OF PARTICLES	SOLUTE	# OF PARTICLES
sucrose ($C_{12}H_{22}O_{11}$)	1	magnesium chloride ($MgCl_2$)	3
sodium sulfate (Na_2SO_4)	3	methanol (CH_3OH)	1

2. When 5.0 g of $CaCl_2$ dissolves in 50.0 g of water, what is the boiling point of the solution?

GIVEN	WORK
5.0g CaCl2 111g CaCl2 = 1mol $\Delta T_b = i K_b m$ i = 3	$\frac{5.0\text{ g}}{111\text{g}} \mid \frac{1\text{mol}}{} = \frac{.045\text{ mol}}{.05}$ molality = .90 $\Delta T_b = (3)(0.51°C/m)(.9) = 1.377$ boiling pt = 100 + 1.377 = 101.38°
ANSWER:	

3. Find the freezing point of a solution containing 6.0 g benzene, C_6H_6, in 35 g of naphthalene.

GIVEN	WORK
$K_f = 7.00°C/m$ i = 1	$\frac{6\text{g}}{78\text{g}} \mid \frac{1\text{mol}}{} = \frac{.0769}{.035} = 2.20 = m$ $\Delta T_f = i k_f m = (1)(7)(2.20) = 15.4°$
ANSWER:	

4. Mrs. Smith's feet are aching at the end of a long day. At home, she dissolves 26.0 g of Epsom salt, $MgSO_4$, in 1.5 kg of water. What is the freezing point of this solution?

GIVEN	WORK
i = 2 $K_f = 1.86°C/m$	$\frac{26\text{g}}{120\text{g}} \mid \frac{1\text{mol}}{} = \frac{.217\text{ mols}}{1.5\text{kg}} = m = .144$ $\Delta T_f = (2)(1.86)(.144) = .536$ -.536°C
ANSWER:	

PART B - APPLICATIONS

5. Salt is often used to remove ice from roads and sidewalks. Explain how this process works in terms of colligative properties.

When you add the solute to the solvent, it lowers the freezing point by replacing water molecules with other molecules or ions which disrupts the freezing process.

6. Which salt, NaCl or $CaCl_2$, has a greater effect on freezing point? Explain.

$CaCl_2$ because it breaks into more ions.

Conjugate Acid Base Pairs

Name _____

Chem Worksheet 19-2

An **acid** is defined as a proton (H^+) donor while a **base** is a proton acceptor. The substance that is produced after an acid has donated its proton is called the **conjugate base** while the substance formed when a base accepts a proton is called the **conjugate acid**. The conjugate acid can donate a proton to the conjugate base, to reform the original reactants in the reverse reaction.

Acids donate protons
Bases accept protons

A proton is a hydrogen ion

$$\underset{\text{acid}}{HF} + \underset{\text{base}}{H_2O} \leftrightarrows \underset{\text{c. acid}}{H_3O^+} + \underset{\text{c. base}}{F^-}$$

In the reaction above HF is the acid and H_2O is the base. The HF has given a proton to the H_2O, forming H_3O^+ and F^-. Since the product H_3O^+ can donate a proton back to F^- it is labeled the conjugate acid, while the F^- is the conjugate base.

Example

Write an equation that shows NH_3 reacting with HCl. Label the acid, base, and conjugate acid and conjugate base.

- Write reactants and transfer a proton from the acid to the base:

$$\underset{\text{base}}{NH_3} + \underset{\text{acid}}{HCl} \leftrightarrows \underset{\text{c. acid}}{NH_4^+} + \underset{\text{c. base}}{Cl^-}$$

Rewrite each equation. Identify the acid, the base, the conjugate acid, and the conjugate base in each of the equations.

1. $\overset{A}{HCl} + \overset{B}{NH_3} \rightarrow \overset{CA}{NH_4^+} + \overset{CB}{Cl^-}$
2. $\overset{B}{OH^-} + \overset{A}{HCN} \rightarrow \overset{CA}{H_2O} + \overset{CB}{CN^-}$
3. $\overset{B}{PO_4^{3-}} + \overset{A}{HNO_3} \rightarrow \overset{CB}{NO_3^-} + \overset{CA}{HPO_4^{2-}}$
4. $\overset{B}{HCO_3^-} + \overset{A}{HCl} \rightarrow \overset{CA}{H_2CO_3} + \overset{CB}{Cl^-}$
5. $\overset{A}{HCO_3^-} + \overset{B}{OH^-} \rightarrow \overset{CA}{H_2O} + \overset{CB}{CO_3^{2-}}$
6. $\overset{A}{NH_4^+} + \overset{B}{H_2O} \rightarrow \overset{CB}{NH_3} + \overset{CA}{H_3O^+}$
7. $\overset{B}{C_2O_4^{2-}} + \overset{A}{HC_2H_3O_2} \rightarrow \overset{CA}{HC_2O_4^-} + \overset{CB}{C_2H_3O_2^-}$
8. $\overset{B}{HPO_4^{2-}} + \overset{A}{H_2O} \rightarrow \overset{CB}{OH^-} + \overset{CA}{H_2PO_4^-}$

Fill in the following table.

	Acid	Base	Conjugate Acid	Conjugate Base	Equation
9	HNO_2	H_2O	H_3O^+	NO_2^-	$HNO_2 + H_2O \rightarrow NO_2^- + H_3O^+$
10	H_2O	F^-	HF	OH^-	$H_2O + F^- \rightarrow OH^- + HF$
11	HCN	NH_3	NH_4^+	CN^-	$NH_3 + HCN \rightarrow NH_4^+ + CN^-$
12	$HClO_3$	OH^-	H_2O	ClO_3^-	$HClO_3 + OH^- \rightarrow H_2O + ClO_3^-$
13	HSO_4^-	PO_4^{3-}	HPO_4^{2-}	SO_4^{2-}	$HSO_4^- + PO_4^{3-} \rightarrow HPO_4^{2-} + SO_4^{2-}$
14	H_2O	S^{2-}	HS^-	OH^-	$S^{2-} + H_2O \rightarrow OH^- + HS^-$
15	HCO_2H	OH^-	H_2O	CO_2H^-	$HCO_2H + OH^- \rightarrow H_2O + CO_2H^-$

16. Write an equation that shows the reaction of ammonia, NH_3 with hydrobromic acid, HBr. Label the acid, the base, the conjugate acid, and the conjugate base. $\overset{B}{NH_3} + \overset{A}{HBr_2} \rightarrow \overset{CB}{Br^-} + \overset{CA}{NH_4^+}$
17. Write an equation that shows the reaction of phosphate ion, PO_4^{3-}, reacting with hydronium ion, H_3O^+. Label the acid, the base, the conjugate acid, and the conjugate base. $\overset{B}{PO_4^{3-}} + \overset{A}{H_3O^+} \rightarrow \overset{CB}{H_2O} + \overset{CA}{HPO_4^{2-}}$
18. Write an equation that shows the reaction of hydrogen sulfide, HS^- with hydroxide ion, OH^-. Label the acid, the base, the conjugate acid, and the conjugate base. $\overset{A}{HS^-} + \overset{B}{OH^-} \rightarrow \overset{CA}{H_2O} + \overset{CB}{S^{2-}}$

Date _____

Acids & Bases Calculations Practice Worksheet

ctions: Solve the following pH calculations. Write the formula, plug numbers into formula, & give answer with ect units and significant figures.

1. If the pH of a solution is 10.3, what is the [H+] concentration?

$10.3 = -\log[H_3O^+]$ $[H_3O^+] = 5.01 \times 10^{-11} M$

$-10.3 = \log[H_3O^+]$

$10^{-10.3} = 10^{\log[H_3O^+]}$

2. If the [H+] is 2.1×10^{-12} M $HClO_4$, what is the pH? Is the solution ACIDIC, BASIC, or NEUTRAL?

$pH = -\log(2.1 \times 10^{-12})$ $pH = 11.7 \sim 12$ Basic

3. Calculate the pOH if the [OH–] concentration is 5.9×10^{-1} M? Is the solution ACIDIC, BASIC, or NEUTRAL?

$pOH = -\log(5.9 \times 10^{-1})$

$pOH = .23$ basic

4. What is the pH of a 0.033 M KOH solution?

$pOH = -\log[0.033]$ $pH = 14 - 1.5 = 12.5 \sim 13$

$pOH = 1.5$

5. What is the pH of an aqueous solution with a hydroxide ion concentration of 1.8×10^{-3} M?

$[OH^-]$

$pOH = -\log(1.8 \times 10^{-3})$

$pOH = 2.74$

$pH = 14 - 2.74 = 11.26 \sim 11.3$

6. What is the pH of an aqueous solution with a hydroxide ion concentration of 1.2×10^{-6} M?

$pOH = -\log(1.2 \times 10^{-6})$ $pH = 14 - 5.92 = 8.08$

$pOH = 5.92$ $pH \sim 8.1$

7. What is the hydrogen ion concentration of a solution with a pH = 8.25?

$[H_3O^+]$

$8.25 = -\log[H_3O^+]$ $-8.25 = \log[H_3O^+]$

$10^{-8.25} = 10^{\log[H_3O^+]}$

$[H_3O^+] = 5.6 \times 10^{-9} M$

8. What is the pH of a 0.235 M $Ba(OH)_2$ solution?

$pOH = -\log[2 \cdot 0.235] = .328$ $pH = 14 - .328 \sim 13.7$

Name _____ Date _____

9. Determine the concentration of [OH–] ions in an aqueous solution where the pH = 5.22.

$pOH = 14 - 5.22 = 8.78 = -\log[OH^-]$

$-8.78 = \log[OH^-]$

$10^{-8.78} = [OH^-]$

$[OH^-] = 1.66 \times 10^{-9}\ M$

10. What is the hydroxide ion concentration in an aqueous solution with a hydrogen ion concentration of 2.70×10^{-2} M?

$[H_3O^+] = 2.7 \times 10^{-2}$

$[H_3O^+][OH^-] = 1.00 \times 10^{-14}$

$\frac{(2.7 \times 10^{-2})[OH^-]}{2.7 \times 10^{-2}} = \frac{1.00 \times 10^{-14}}{2.7 \times 10^{-2}}$

$[OH^-] = 3.70 \times 10^{-13}\ M$

11. Calculate the pH of a solution that is 0.147M HCl?

$pH = -\log[.147]$

$pH = 0.832$

12. Complete the table below.

pH	$[H^+]$	$[OH^-]$	pOH	Acid / Base
3	1×10^{-3} M	1×10^{-11} M	11	acid
6	1×10^{-6} M	1×10^{-8} M	8	acid
6	1×10^{-6} M	1×10^{-8} M	8	acid
12	1×10^{-12} M	1×10^{-2} M	2	base
9.6	2.3×10^{-10} M	4.0×10^{-5} M	4.4	base
13.929	1.2×10^{-14} M	8.5×10^{-1} M	0.071	base
3.2	6.9×10^{-4} M	1.4×10^{-11} M	10.8	acid
3.7	2.0×10^{-4} M	5.1×10^{-11} M	10.3	acid

me: _____ Date: _____ Period: _____

Titrations Practice Worksheet

Find the requested quantities in the following problems:

1) Write a balanced equation for the reaction between NaOH and HCl. Use this equation to answer problems 2-4

$NaOH + HCl \rightarrow NaCl + H_2O$

2) If it takes 54 mL of 0.1 M NaOH to neutralize 125 mL of an HCl solution, what is the concentration of the HCl?

$\frac{M_A V_A}{n_B} = \frac{M_B V_B}{n_A}$ $(54mL)(.1M) = (125mL)(M_B)$

$M_B = .0432M\ HCl$

3) If it takes 25 mL of 0.05 M HCl to neutralize 345 mL of NaOH solution, what is the concentration of the NaOH solution?

$(25mL)(0.05M) = (345mL)(M_B)$

$M_B = .0036M\ NaOH$

4) A 25.0 mL sample of HCl was titrated to the endpoint with 15.0 mL of 2.0 M NaOH. What is the molarity of HCl?

$(25mL)(M_A) = (15.0mL)(2.0)$

$M_A = 1.2M\ HCl$

5) Write a balanced equation for the reaction between $Ca(OH)_2$ and HNO_3. Use this equation to answer problems 6 -8.

$Ca(OH)_2 + 2HNO_3 \longrightarrow Ca(NO_3)_2 + 2H_2O$

V_A M_A $n=2$ M_B V_B $n=1$

6) If it takes 50.0 mL of 0.5 M $Ca(OH)_2$ solution to completely neutralize 125 mL of HNO_3solution, what is the concentration of the HNO_3 solution?

$\frac{(50.0)(.5)}{1} = \frac{(125mL)(M_B)}{2}$ $\frac{25}{625} = \frac{62.5M_B}{62.5}$

$M_B = .4M\ HNO_3$

7) How many mL of 0.50 M HNO_3 is necessary to titrate 25.0 mL of 0.05 M $Ca(OH)_2$ solution to the endpoint?

$\frac{(.5M)(V_A)}{2} = \frac{(25.0mL)(.05)}{1}$

1.25

$5mL\ of\ HNO_3$

8) If it takes 75.0 mL of 1.5 M HNO_3 solution to completely neutralize 125 mL of $Ca(OH)_2$what is the concentration of the $Ca(OH)_2$ solution? $n_A = 1$

$\frac{(75.0mL)(1.5M)}{2} = \frac{(125mL)(M_B)}{1}$

$M_B = .45\ M\ Ca(OH)_2$

Chemistry: *pH and pOH calculations*

Part 1: *Fill in the missing information in the table below.*

pH	$[H_3O^{1+}]$	pOH	$[OH^{1-}]$	ACID or BASE?
3.78	1.66×10^{-4} M	10.22	6.03×10^{-11} M	Acid
3.41	3.89×10^{-4} M	10.59	2.57×10^{-11} M	Acid
8.81	1.55×10^{-9} M	5.19	6.46×10^{-6} M	Base
8.69	2.04×10^{-9} M	5.31	4.88×10^{-6} M	Base
8.46	3.47×10^{-9} M	5.54	2.88×10^{-6} M	Base
12.1	8.45×10^{-13} M	1.90	1.26×10^{-2} M	Base
11.86	1.38×10^{-12} M	2.14	7.24×10^{-3} M	Base
3.40	3.98×10^{-4} M	10.6	2.31×10^{-11} M	Acid
10.91	1.23×10^{-11} M	3.09	8.13×10^{-4} M	Base
5.13	7.49×10^{-6} M	8.87	1.35×10^{-9} M	Acid
4.06	8.71×10^{-5} M	9.94	1.15×10^{-10} M	Acid
6.41	3.89×10^{-7} M	7.59	2.57×10^{-8} M	Acid
4.16	6.92×10^{-5} M	9.84	1.45×10^{-10} M	Acid
0.98	1.06×10^{-1} M	13.0	1.00×10^{-13} M	Acid
10.18	6.61×10^{-11} M	3.82	1.51×10^{-4} M	Base
7.93	1.17×10^{-8} M	6.07	8.53×10^{-7} M	Base
7.05	8.91×10^{-8} M	6.95	1.12×10^{-7} M	~Base
9.33	4.73×10^{-10} M	4.67	2.14×10^{-5} M	Base
12.67	2.14×10^{-13} M	1.33	4.68×10^{-2} M	Base
12.0	1.0×10^{-12} M	2.01	9.87×10^{-3} M	Base
11.68	2.09×10^{-12} M	2.32	4.79×10^{-3} M	Base
7.04	9.22×10^{-8} M	6.96	1.10×10^{-7} M	~Base
1.76	1.74×10^{-2} M	12.24	5.75×10^{-13} M	Acid
2.70	2.00×10^{-3} M	11.3	5.39×10^{-12} M	Acid