I apologize for the spraeling messiness of this packet. It is a combination of 1) things to know 2) unsolved problems 3) solved problems. It is a broad survey meant to be a starting point that jogs your memory.

Review for the June 2014 Chemistry Final Exam

(The exam covers only second semester, from Jan 27 to June 6th)

Disclaimer: Studying this packet is a great start but is not a substitute for actually studying all 80 days of material. Hopefully time spent with this packet will help you find what parts of the semester you need to go back and study in depth, either from your notes or from http://genest.weebly.com

Of the 80 days we have been together this semester, the things in this packet are the ones that came up over and over.

About a third of what you need to know are specific facts. Get these from your notes.

Two thirds of what you need to know are skills. Get these by doing, redoing, and redoing one more time, all of the old homework problems that you learned to solve this semester.

UNIT 11

ACIDS AND BASES

VOCABULARY

1. acid
2. base
3. conjugate acid
4. hydrogen-ion acceptor
5. hydrogen-ion donator
6. hydronium ion
7. hydroxide ion
8. pH
9. strong, weak acid
10. strong, weak base
11. end point
12. equivalence point
13. neutralization reaction ("Acid plus base makes water plus salt")
14. titration
15. indicator colors

FOR MI II

1. $[H+][OH-] = 1x10-14$
2. $pH = -log[H)$
3. $pOH = -log[OH]$
4. $pH + pOH = 14$

1. If the concentration of [H+] is 2.33×10^{-9}, calculate the concentration of [OH-]

2. Fill in the blanks below to describe a neutralization reaction between HF and KOH.

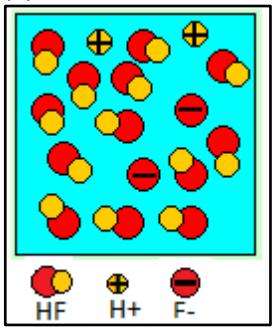
_____ + _____ → _____ + _____

3. Which compound did you just write that is considered a *salt*?

Answer: _____

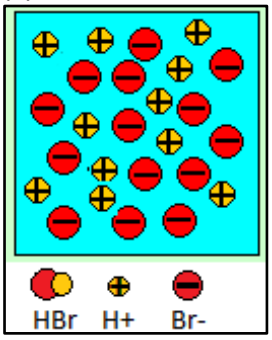
4. What is the pH of a solution that has [H+] = 4.28×10^{-12}?

1. This is
(a) an acid
(b) a base
(c) neither



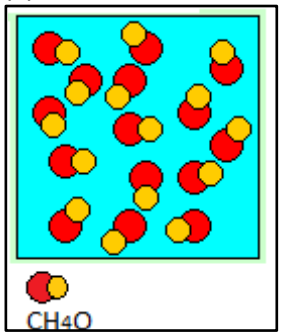
2. This is
(a) a strong electrolyte
(b) a weak electrolyte

3. This is
(a) an acid
(b) a base
(c) neither



4. This is
(a) a strong electrolyte
(b) a weak electrolyte

5. This is
(a) an acid
(b) a base
(c) neither



6. This is
(a) a strong electrolyte
(b) a weak electrolyte

5. What is the mathematical definition of pH (give the formula)?

6. What two concentrations always give $1x10^{-14}$ when multiplied together?

7. If the concentration of [H+] is $2.33x10^{-9}$, calculate the concentration of [OH-]

Start by writing an appropriate formula. Circle the unknown…	Then rearrange to get the unknown alone.	Plug in the known values and solve.

8. If the concentration of [H+] is $7.30x10^{-4}$, calculate the concentration of [OH-]

9. If the concentration of [H+] is $7.30x10^{-4}$, calculate the pH

10. If the concentration of [H+] is $2.33x10^{-9}$, calculate the pH

11. If the concentration of [OH-] is $2.33x10^{-9}$, find the [H+] and then calculate the pH (using your formula from #2 and #1)

11. Calculate the pH of a solution if its $[OH^-] = 0.000700$ M

Start by writing an appropriate formula. Circle the unknown…	Then rearrange to get the unknown alone.	Plug in the known values and solve.

12. Calculate the pH of a 0.025 M solution of [H+]

13. Circle the one compound that would turn litmus paper red.

(a) pure water
(b) 0.10 M $C_6H_{12}O_{6(aq)}$
(c) 0.10 M $NaCl_{(aq)}$
(d) 0.10 M $NaOH_{(aq)}$
(e) 0.10 M $H_2SO_{4(aq)}$

14. Circle the one compound that is neither an acid nor a base.

(a) 0.10 M $C_6H_{12}O_{6(aq)}$
(b) 0.10 M $H_2CO_{3(aq)}$
(c) 0.10 M $NaOH_{(aq)}$
(d) 0.10 M $H_2SO_{4(aq)}$

15. Of the following compounds, circle ONE OR MORE that are electrolytes

(a) 0.10 M $HC_2H_3O_{2(aq)}$
(b) 0.10 M $C_6H_{12}O_{6(aq)}$
(c) 0.10 M $NaCl_{(aq)}$
(d) 0.10 M $NaOH_{(aq)}$
(e) 0.10 M $H_2SO_{4(aq)}$

16. Circle the compound that would increase the concentration of hydronium in solution.

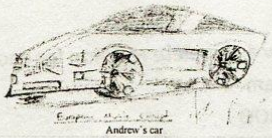
(a) pure water
(b) 0.10 M $C_6H_{12}O_{6(aq)}$
(c) 0.10 M $NaCl_{(aq)}$
(d) 0.10 M $NH_{3(aq)}$
(e) 0.10 M $HNO_{3(aq)}$

17. The formula for water is H_2O. What is the formula for hydronium?_____ (include the correct charge)

Conjugate Acids + Indicators

EHS CA3MIS+RY

Mr. Genest



Name ANSWERS ANSWERS

Date ANSWERS ANSWERS

1. In each case below for any substance on the LEFT side of the arrow, mark it as follows: circle any acid, underline any base, cross out anything that is neither an acid nor a base. (If you are stuck, look at the example on Question #10)

a. $HSO_4^- + H_2O \rightarrow SO_4^{2-} + H_3O^+$ (ACID = H+ donor; BASE = acceptor)

b. $H_2O + NH_3 \rightarrow OH^- + NH_4^+$ (acid; Base; BASE; ACID)

c. $H_3PO_4 + NH_3 \rightarrow NH_4^+ + H_2PO_4^-$ (ACID; BASE; BASE; ACID)

d. $H_2PO_4^- + H_2O \rightarrow HPO_4^{2-} + H_3O^+$ (Acid; Base; BASE; acid)

2. What color is phenolphthalein in very basic solution?

Common Acid–Base Indicators

Indicator	Approximate pH Range for Color Change	Color Change
methyl orange	3.1–4.4	red to yellow
bromthymol blue	6.0–7.6	yellow to blue ✓
phenolphthalein	8–9	colorless to pink
litmus	4.5–8.3	red to blue
bromcresol green	3.8–5.4	yellow to blue ✓
thymol blue	8.0–9.6	yellow to blue ✓

3. A sample of a solution with a pH of 10 is tested separately with phenolphthalein and litmus indicator. The colors of the indicators are as follows (choose only one letter)

   a. litmus is blue; phenolphthalein is pink
   b. litmus is red; phenolphthalein is pink
   c. litmus is blue; phenolphthalein is colorless
   d. litmus is red; phenolphthalein is colorless

4. What color is phenolphtalein in a beaker full of concentrated H_2SO_4? ACID, so pH less than 7 So it should be colorless

5. A blue solution containing an acid-base indicator was tested with a pH meter and found to have a pH of 5.5. Which of the indicators shown on the table above could be this indicator? BROMERCRESOL GREEN WOULD BE BLUE AT THIS pH

6. A solution was yellow in bromthymol blue and blue in bromcresol green. According to the table here, what could be the pH of this solution? Less than 6.0, more than 5.4. So pH should be between 5.4 and 6.0

7. Acid was added to a solution containing an indicator until the solution turned from blue to yellow. Which of the following would be the most acidic?

   a. a yellow solution containing bromthymol blue
   b. a yellow solution containing bromcresol green
   c. a yellow solution containing thymol blue

$3HCH_3COO + Al(OH)_3 \leftrightarrow Al(CH_3COO)_3 + 3HOH$

8. Complete and balance the neutralization reaction for

   a. HI neutralizing $Mg(OH)_2$

$2HI + Mg(OH)_2 \rightarrow 2HOH + MgI_2$

   b. $Al(OH)_3$ is mixed with HCH_3COO

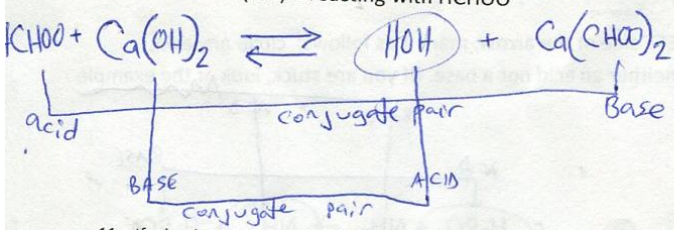
~~$\rightarrow Al(CH_3COO)_3 + HOH$~~

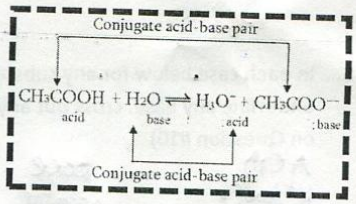
9. If NH_3 is a base, what is its conjugate acid?

NH_4^+

10. Using this diagram as a model, draw a complete reaction for each pair below. Label them with the arrows and all of the words shown in this diagram

Ca(OH)2 reacting with HCHOO





11. If a beaker contains 0.00000593 moles of H+ ions, in 30.0 L of water,

a. What is the [H+]?

$[H^+] = \frac{\text{moles } H^+}{\text{Liters } H^+}$

$[H^+] = \frac{0.00000593 \text{ mol}}{30.0 \text{ L}}$

$[H^+] = 1.98 \times 10^{-7} \text{ M}$

b. what is the pH?

$pH = -\log[1.98 \times 10^{-7} \text{ M}]$

$pH = 6.70$

12. If a beaker contains 4.89×10^{14} H+ ions, in 0.790 liters of water,

a. What is the [H+]?

~~concentration = $\frac{4.89 \times 10^{14} \text{ moles}}{0.790 \text{ L}}$~~

conc = 6.19

b. what is the pH?

12. If a beaker contains 4.89×10^{14} H+ ions, in 0.790 liters of water,

a. What is the [H+]?

$\frac{4.89 \times 10^{14} \text{ ions}}{} \times \frac{1 \text{ mole ions}}{6.02 \times 10^{23} \text{ ions}} = 8.12 \times 10^{-10} \text{ moles}$

$\text{concentration} = \frac{8.12 \times 10^{-10} \text{ moles}}{0.790 \text{ liters}}$

$\text{Concentration} = 1.03 \times 10^{-9} \text{ M}$

b. what is the pH?

$pH = -\log[H^+]$

$pH = -\log[1.03 \times 10^{-9}]$

$pH = 8.99$

c. find the number of H+ ions that would be in a 690.mL (units!) volume of a solution that had the same molarity you found in answer A.

$\text{Concentration} = \frac{\text{moles}}{\text{volume}}$

$\text{Moles} = (\text{conc})(\text{volume})$

$\text{moles} = (1.03 \times 10^{-9} \text{M})(0.690 \text{L})$

answer

moles = 7.11×10

13. In each case below for any substance on the LEFT side of the arrow, mark it as follows: circle any acid, underline any base, cross out anything that is neither an acid nor a base.

a. $\underline{SO_4^{2-}}$ + (H_3O^+) → HSO_4^- + H_2O

base acid

b. (NH_4^+) + $\underline{H_2PO_4^-}$ → H_3PO_4 + NH_3

acid base

ANS

Titration

CλeMis+ry: http://genest.weebly.com

Stop in for help every day at lunch and Tues, Weds., &Thurs after school!

After-hours question? Email me at home: eagenest@madison.k12.wi.us

Name_____

Period_____

Titration problems:

0.50 moles HCl / 1 L HCl

0.10 mol NaOH / 1 Liter NaOH

1. A 100.0 mL sample of 0.50 M HCl is titrated with 0.10 M NaOH. The indicator used was phenolphthalein.
   a. Write the reaction.

0.100 L

$1HCl + 1NaOH \rightarrow 1HOH + 1NaCl$

   b. Write what color phenolphthalein would be in the beginning colorless At the end pink
   c. What volume of the NaOH solution is required to reach the endpoint of the titration?

$$0.100\,L\,HCl \times \frac{0.5\,mol\,HCl}{1\,L\,HCl} \times \frac{1\,mol\,NaOH}{1\,mol\,HCl} \times \frac{1\,L\,NaOH}{0.1\,mol\,NaOH} = 0.5\,liters\,of\,NaOH$$

2. If 26.5 mL of a 0.20 M solution of NaOH is required to titrate 50.0 mL of sulfuric acid (H_2SO_4)), what is the concentration of the sulfuric acid solution? The indicator used was bromothymol blue
   a. Write the reaction.

$2NaOH + 1H_2SO_4 \rightarrow 2HOH + 1Na_2SO_4$

← these green numbers will be useful in (c)

   b. Write what color bromothymol blue would be in the beginning_____ At the end_____
   c. What ~~volume of the NaOH solution is required to reach the endpoint of the titration?~~ what is the concentration of H_2SO_4?

$$\frac{0.0265\,L\,NaOH}{0.050\,L\,H_2SO_4} \times \frac{0.20\,mol\,NaOH}{1\,L\,NaOH} \times \frac{1\,mol\,H_2SO_4}{2\,mol\,NaOH} \times \frac{1\,L\,H_2SO_4}{1\,mol\,H_2SO_4} = 0.053\,\frac{mol\,H_2SO_4}{L}$$

3. If 26.5 mL of a 0.20 M solution of NaOH is required to titrate 50.0 mL of phosphoric acid (H_3PO_4), what is the concentration of the phosphoric acid solution?

$3NaOH + H_3PO_4 \rightarrow 3HOH + Na_3PO_4$

$$\frac{0.0265\,L\,NaOH}{0.0500\,L\,H_3PO_4} \times \frac{0.20\,mol\,NaOH}{1\,L\,NaOH} \times \frac{1\,mol\,H_3PO_4}{3\,mol\,NaOH} = 0.035\,\frac{mol\,H_3PO_4}{L}$$

Review:

4. Calculate the hydrogen ion concentration and the hydroxide ion concentration for the following pH values.

	$[H^+]$	$[OH^-]$
a. pH = 1.04	$0.091 \frac{mol}{L}$	$1.099 \times 10^{-13} \frac{mol}{L}$
b. pH = 13.1	$7.94 \times 10^{-14} \frac{mol}{L}$	$0.126 \frac{mol}{L}$

5. What volume of 0.200 M hydrochloric acid solution is needed to neutralize 25.0 mL of 0.150 M sodium hydroxide solution?

$$0.025\ L\ NaOH \times \left(\frac{.150\ mol\ NaOH}{1\ L\ NaOH}\right) \times \left(\frac{1\ mol\ HCl}{1\ mol\ NaOH}\right) \times \left(\frac{1\ L\ HCl}{.200\ mol\ HCl}\right) = 0.019\ L\ HCl$$

15. Write a balanced chemical equation for each reaction

$Mg + H_2SO_4 \rightarrow$ $MgSO_4 + H_2$

$H_3PO_4 + 3NaOH \rightarrow$ $3HOH + Na_3PO_4$

22. What would be the **pH** of each of the following:

a) 0.0010 M HCl — pH = 3

b) 0.0010 M HNO_3 — pH = 3

c) 0.010 M NaOH — pH = 12 ← because $\frac{1.0 \times 10^{-14}}{0.01} = 1 \times 10^{-12}$

d)pure water — pH = 7

f) 0.000000000001M HCl — pH = 12

12

Metal with Acid
Remembering that Acid + Metal → hydrogen gas + salt, fill in the missing substances for each reaction below

6. $HBr + Na \rightarrow H_2 + NaBr$

7. $HNO_3 + Mg \rightarrow H_2 + Mg(NO_3)_2$

8. $2H_3PO_4 + 3Ca \rightarrow 3H_2 + Ca_3(PO_4)_2$

9. We have three equations which we have been using in this chapter. :

Write the equation you have memorized that describes what number you get when you multiply the molarity of H+ by the molarity of OH-	Write the equation you have memorized that describes how H+ molarity is related to pH	Write the equation that you have been using since March to relate moles of solute, volume of solution, and molarity of a solution.
$[OH^-][H^+] = 1 \times 10^{-14}$	$pH = -\log[H^+]$	$\text{Concentration} = \frac{\text{moles}}{\text{Volume}}$

volume units must be LITERS

10. If a solution contains 4.115 moles of HNO_3 dissolved to make 788 mL of solution, what is the molarity?

0.788L

$\text{Concentration} = \frac{\text{moles}}{\text{Volume}}$ $\quad \text{concentration} = \frac{4.115 \text{ moles}}{0.788 L}$

$\text{Concentration} = 5.22 M$

11. If 335 mL of a 0.20 M solution of $Ca(OH)_2$ is required to titrate 450.0 mL of HBr, what is the concentration of the acid solution?

$$\frac{.335 L\ Ca(OH)_2}{.450 L\ HBr} \times \frac{0.20 \text{ mol } Ca(OH)_2}{1 L\ Ca(OH)_2} \times \frac{2 \text{ mol HBr}}{1 \text{ mol } Ca(OH)_2} = 0.30 \frac{mol}{L}$$

12. If 3.59 mL of a 0.040 M solution of $Ca(OH)_2$ is required to titrate 840.0 mL of HBr, what is the concentration of the acid solution?

$$\frac{0.00359 L\ Ca(OH)_2}{0.8400 L\ HBr} \times \frac{0.040 \text{ mol } Ca(OH)_2}{1 L\ Ca(OH)_2} \times \frac{2 \text{ mol HBr}}{1 \text{ mol } Ca(OH)_2} = 3.4 \times 10^{-4}$$