Name:
 Class:
 Date:

 F21 - first year for this practice, probably lots of typos and mistakes, EC for the first person to find them!

Instructions: Answer the following questions. Show ALL work for problems to receive full credit. Make sure to include proper units and significant figures for all answers.

 $[5\ {\rm pt}]$  1. Sketch a picture showing how  ${\rm BaCl}_2$  will dissolve in water. Label all IMF's present.

Should include both cation and anion each surrounded by water (in proper orientation). Also include pm and  $\delta^+\delta^-$  symbols. Label DD, ID forces

[6 pt] 2. Sketch a picture showing how  $AlCl_3$  will dissolve in water. What is the attractive force between the ions and water molecules?

Should include both cation and anion each surrounded by water (in proper orientation).

Also include  $\pm$  on cations/anions and  $\delta^+\delta^-$  symbols on water

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Opposites attract
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ID, HB should be shown



The second picture above could include the salt at the bottom as a solid showing an IB. Will redraw picture if I have time.

[6 pt] 3. Sketch a picture showing how  $HC_2H_3O_2$  will dissolve in water. What is the attractive force between the ions and water molecules?

Should include entire molecule (90% because wa) with waters forming a HB to it. Also include both cation and anion (< 10% each surrounded by water (in proper orientation). Also include  $\pm$  and  $\delta^+\delta^-$  symbols Opposites attract HB and ID should be labeled

[4 pt] 4. Sketch a picture showing how  $CH_2O$  will dissolve in water. What is the attractive force between the ions and water molecules?

This is a molecular compound, NO ions are formed, instead it dissolves because it can form HB with water.



Picture should look similar to the middle example. The example on the right shows how a similar molecule would dissolve in water.

[15 pt] 5. Complete and balance the following reactions. Include the state of the products, and any energy/heat terms where appropriate. If no reaction occurs, write NR for the products.

(a) 2 HNO<sub>3</sub>(aq) + 2 Na(s) 
$$\longrightarrow$$
 H<sub>2</sub>(g) + 2 NaNO<sub>3</sub>(aq) 5(a) \_\_\_\_\_\_  
(b) 1 Cu(s) + 2 HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>(aq)  $\longrightarrow$  NR 5(b) \_\_\_\_\_\_  
(c) 3 KOH(aq) + \_\_H<sub>3</sub>PO<sub>4</sub>(aq)  $\longrightarrow$  \_\_K<sub>3</sub>PO<sub>4</sub>(aq) + \_3 H<sub>2</sub>O(l) + Heat 5(c) \_\_\_\_\_  
(d) \_\_H<sub>2</sub>SO<sub>4</sub>(aq) + 2 NH<sub>4</sub>OH(aq)  $\longrightarrow$  \_\_(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>(aq) + 2 H<sub>2</sub>O(l) + Heat 5(d) \_\_\_\_\_

(e)  $\underline{K_2CO_3(aq)} + \underline{2} HCl(aq) \longrightarrow \underline{2} KCl(aq) + \underline{CO_2(g)} + \underline{H_2O(l)} 5(e)$ 

[8 pt] 6. Answer the following questions about acids, bases, and pH. (Recall that  $pH = -log[H^+]$ ,  $[H^+] = 10^{-pH}$ , and pH + pOH = 14). Additionally state whether the solution is (A)cidic, (B)asic, or (N)eutral

	(a) What is the pH of solution with $[H^+] = 3.8 \times 10^{-10} M?$	6(a) <b><u>9.42 - Basic</u></b>
	(b) What is the $[H^+]$ for a solution with $pH = 2.36$ ?	6(b) $4.4 \times 10^{-3}$ M - Acidic
	(c) What is the pH for a solution with $p0H = 5$ ?	6(c) <b>9 - Basic</b>
	(d) What is the pOH for a solution with $[H^+] = 3.80 \times 10^{-11} M$ ?	6(d) <b><u>3.580 - Basic</u></b>
[8 pt]	<ul> <li>7. Answer the following questions about acids, bases, and pH. (Recall that pH = and pH + pOH = 14). Additionally state whether the solution is (A)cidic, (E (a) What is the pH of solution with [H<sup>+</sup>] = 2.45 × 10<sup>-4</sup> M?</li> </ul>	-log[H <sup>+</sup> ], [H <sup>+</sup> ] = $10^{-pH}$ , B)asic, or (N)eutral 7(a) <b>3.61 - Acidic</b>
	(b) What is the $[H^+]$ for a solution with $pH = 8.5$ ?	7(b) $3.2 \times 10^{-9}$ M - Basic
	(c) What is the pH for a solution with $p0H = 12$ ?	7(c) <b><u>2 - Acidic</u></b>

(d) What is the  $[OH^-]$  for a solution with  $[H^+] = 3.80 \times 10^{-11}$  M? 7(d)  $2.63 \times 10^{-4}$  M - Basic

[8 pt] 8. Answer the following questions about acids, bases, and pH. (Recall that  $pH = -\log[H^+], [H^+] = 10^{-pH}$ , and pH + pOH = 14). Additionally state whether the solution is (A)cidic, (B)asic, or (N)eutral (a) What is the pH of solution with  $[H^+] = 3.5 \times 10^{-4} M$ ? 8(a) **<u>3.46 - Acidic</u>** 8(b)  $3.2 \times 10^{-10}$  M - Basic (b) What is the  $[H^+]$  for a solution with pH = 9.50? (c) What is the  $[OH^-]$  for a solution with  $[H^+] = 2.4 \times 10^{-11} M$ ?  $8(c) 4.2 \times 10^{-4} M$  - Basic (d) What is the pOH of a solution with a pH = 3.25? 8(d) **10.75 - Acidic** (e) What is the  $[H^+]$  in a solution with pOH of 5.5? 8(e)  $3.0 \times 10^{-9}$  M - Basic pH + 5.5 = 14 $[H^+] = 10^{-8.5} = 3.0 \times 10^{-9}$ 9. Fill in the missing values on the pH scale below. [5 pt]14 pН [H<sup>+</sup>] 1 Neutral Top Row = 0, 7Middle Row =  $1 \times 10^{-7}$  M, and  $1 \times 10^{-14}$  M Bottom Row = Acidic, Basic [4 pt] 10. Fill in the missing values below

	Acid	Neutral	Base
pH Scale	pH <u>&lt;</u> 7	pH <u> </u>	pH <u>&gt;</u> 7
Concentration Scale	$[{\rm H^+}] \ge 1 \times 10^{-7} {\rm M}$	$[H^+] = 1 \times 10^{-7} M$	$[{\rm H^+}] \le 1 \times 10^{-7} {\rm M}$

[5 pt] 11. Calculate the volume (in mL) of 1.25 M HCl required to neutralize 75.0 mL of 4.60 11. <u>552 mL HCl</u> M Ca(OH)<sub>2</sub>. Write a balanced equation for the reaction and show work to receive full credit. Balanced Equation: <u>2</u> HCl(aq) + <u>1</u> Ca(OH)<sub>2</sub>(aq)  $\longrightarrow$  <u>1</u> CaCl<sub>2</sub>(aq) + <u>2</u> H<sub>2</sub>O(l) + heat 75.0 mL Ca(OH)<sub>2</sub> 0.001L 4.60 mol Ca(OH)<sub>2</sub> 2 mol HCl 1 L 0.001 L 550 J

 $\frac{75.0\,\mathrm{mL}\,\mathrm{Ca(OH)}_2}{1\,\mathrm{mL}} \times \frac{4.60\,\mathrm{mol}\,\mathrm{Ca(OH)}_2}{1\,\mathrm{L}} \times \frac{2\,\mathrm{mol}\,\mathrm{HCl}}{1\,\mathrm{mol}\,\mathrm{Ca(OH)}_2} \times \frac{1\,\mathrm{L}}{1.25\,\mathrm{mol}\,\mathrm{HCl}} \frac{0.001\,\mathrm{L}}{1\,\mathrm{mL}} = 552\,\mathrm{mL}$ 

[4 pt] 12. How many grams of NaOH must you dissolve in 250. mL of water to prepare a
 7.50 M NaOH solution. Show work to support your answer.

12. 75.0 gNaOH

Solve m	$LA \longrightarrow mol$	$A \longrightarrow gA$		
$250\mathrm{mL}$	0.001 L	7.50 mol NaOH	$40.00 \mathrm{gNaOH} = 75.0 \mathrm{g}$	NaOU
	$\times \frac{1}{1}$ mL $\times$	1 L	$\times \frac{1}{1 \text{ mol NaOH}} = 75.0 \text{ g}$	NaOH

[5 pt] 13. Calculate the volume (in mL) of 3.75 M HCl required to neutralize 175.0 mL of 2.60 M Ca(OH)<sub>2</sub>. Write a balanced equation for the reaction and show work to receive full credit.

13. <u>242.7 mL HC</u>l

Balanced Equation:	<u>2</u> HC	l(aq) + 1 Ca(OH)	$_2(aq) \longrightarrow \underline{1} 0$	$CaCl_2(aq) + $	$\underline{2}$ H <sub>2</sub> O(l)	+ heat
$175.0\mathrm{mLCa(OH)}_2$	0.001L	$2.60 \mathrm{mol}\mathrm{Ca(OH)}_2$	2 mol HCl	1L	0.001 L	949 666 mI
X	$1\mathrm{mL}$	1L ×	$\overline{1 \operatorname{mol} \operatorname{Ca}(\operatorname{OH})_2}$	$\times \frac{3.75 \mathrm{mol}\mathrm{HCl}}{3.75 \mathrm{mol}\mathrm{HCl}}$	$1 \mathrm{mL}$	= 242.000 IIIL

[5 pt] 14. Calculate the Molarity of an  $H_2SO_4$  solution that requires 175.0 mL to neutralize 83.0 mL of 2.60 M NaOH soution. Write a balanced equation for the reaction and show work to receive full credit.

## 14. <u>0.617 M H<sub>2</sub>S</u>O<sub>4</sub>

15. 105.0 mL of a KOH solution with unknown molarity neutralized 78.0 mL of a 2.25 M  $\rm H_3PO_4$  solution. What is the molarity of the KOH solution? Write a balanced equation for the reaction and show work to receive full credit.

## 15. <u>5.01 M KOH</u>

16. Calculate the volume (in mL) of 8.55 M HCl required to neutralize 75.0 mL of 4.60 M  $Ca(OH)_2$ . Write a balanced equation for the reaction and show work to receive full credit.

# 16. <u>80.7 mL HCl</u>

Balanced Equation:	<u>2</u> HC	$l(aq) + \underline{1}$	$Ca(OH)_2(a)$	$aq) \longrightarrow \underline{1}$	$CaCl_2(aq) + $ _	<u>2</u> $H_2O(l)$ -	⊦ heat
$\frac{75.0\mathrm{mLCa(OH)_2}}{\times}\times$	$\frac{0.001L}{1\mathrm{mL}}$	$\times \frac{4.60 \operatorname{mol} C}{1 \operatorname{I}}$	$\frac{\text{Ca(OH)}_2}{2} \times$	$\frac{2 \operatorname{mol} \mathrm{HCl}}{1 \operatorname{mol} \mathrm{Ca}(\mathrm{OH})}$	$\frac{1 \text{ L}}{1 \text{ J}_2}  imes \frac{1 \text{ L}}{8.55 \text{ mol H}}$	$\frac{1\mathrm{mL}}{\mathrm{HCl}0.001\mathrm{L}}$	$= 80.7 \mathrm{mL}$

[10 pt] 17. Complete the following table by calculating the missing value and determining if the solution is (A)cidic, (B)asic, or (N)eutral.

Given	Calculate the	Acid/Base/Neutral			
$[{\rm H^+}] = 6.25 \times 10^{-9} \; {\rm M}$	pH= 8.204	В			
pH = 2.50	$[{\rm H}^+] = 3.2 \times 10^{-3} {\rm M}$	A			
$[{\rm OH^-}] = 1.0 \times 10^{-7} \ {\rm M}$	pH = 7.00	Ν			
pOH = 6.25	pH = 7.75	В			
Typo in F18 version $pH = 7.85$ and its Basic					

[4 pt] 18. Define Acid and Base according to Bronsted-Lowry.

(a) Acid

Proton donor (b) Base

Proton Acceptor

[10 pt] 19. Calculate the requested values below. Is the resulting solution (A)cidic, B(asic) or (N)eutral?

(a) What is the pH of solution with $[H^+] = 3.5 \times 10^{-4} M$ ?	19(a) <b><u>3.5 - Acidic</u></b>
(b) What is the $[H^+]$ for a solution with $pH = 3.5$ ?	19(b) $3.2 \times 10^{-4}$ M - Acidic
(c) What is the $[OH^-]$ for a solution with $[H^+] 2.4 \times 10^{-11} M$ ?	$19(c) \ 4.2 \times 10^{-4} \ M$ - Basic
(d) What is the pOH of a solution with a $pH = 3.25$ ?	19(d) <b>10.75 - Acidic</b>

(e) What is the  $[H^+]$  in a solution with pOH of 5.5? 19(e)  $3.2 \times 10^{-9}$  M - Basic

[9 pt] 20. Define each of the following terms, list what type of molecules have these properties and give an example compound for each.

	Definition	Class of Molecules	Example
Strong Electrolyte	Dissociates 100% into ions	Strong Acids Strong Bases Ionic (aq)	$H_2SO_4$ etc. NaOH etc. NaCl(aq) etc.
Weak Electrolyte	Dissociate $< 10\%$ into ions	Weak Acids Weak Acids	$\begin{array}{c} \mathrm{CHC}_{2}\mathrm{H}_{3}\mathrm{O}_{2} \ \mathrm{etc} \\ \mathrm{NH}_{4}\mathrm{OH} \ \mathrm{etc.} \end{array}$
Non-Electrolyte	Do not dissociate when dissolved in water	Molecular Compounds Ionic (s)	CHO etc. $PbI_2$ Etc.

21. Identify the following substances as a (S)trong, (W)eak, or (N)on electrolyte.

(a)	HF	21(a)	WE
(b)	$SF_6$	21(b)	NE
(c)	$NaNO_3$	21(c)	SE
(d)	$\mathrm{HClO}_4$	21(d)	SE
(e)	$BaSO_4$	21(e)	NE
(f)	$H_3PO_4(aq)$	21(f)	NE
(g)	$SiCl_4(aq)$	21(g)	NE
(h)	$\rm C_6H_{12}(aq)$	21(h)	NE
(i)	$Ba(OH)_2(aq)$	21(i)	SE
(j)	AgCl(s)	21(j)	NE
(k)	$\mathrm{Fe}(\mathrm{NO}_3)_3(\mathrm{aq})$	21(k)	SE
(l)	$BaCl_2(aq)$	21(l)	SE
(m)	HCl(aq)	21(m)	SE
(n)	$\mathrm{HC}_{2}\mathrm{H}_{3}\mathrm{O}_{2}(\mathrm{aq})$	21(n)	WE
(o)	$ZnAsO_4(s)$	21(o)	SE

[4 pt] 22. Write the total ionic equation AND the net ionic equation for the following reaction:  $Ca(NO_3)_2(aq) +$  $Na_2CO_3(aq) \longrightarrow CaCO_3(s) + 2NaNO_3(aq)$ Total Ionic:  $\operatorname{Ca}^{+2}(\operatorname{aq}) + 2\operatorname{NO}_3^{-}(\operatorname{aq}) + 2\operatorname{Na}^{+}(\operatorname{aq}) + \operatorname{CO}_3^{-2}(\operatorname{aq}) \longrightarrow \operatorname{CaCO}_3(\operatorname{s}) + 2\operatorname{Na}^{+}(\operatorname{aq}) + 2\operatorname{NO}_3^{-}(\operatorname{aq})$ Net Ionic:  $Ca^{+2}(aq) + CO_3^{-2}(aq) \longrightarrow CaCO_3(s)$ [4 pt] 23. Write the total ionic equation **AND** the net ionic equation for the following reaction:  $NaCl(aq) + AgNO_3(aq) \longrightarrow NaNO_3(aq) + AgCl(s)$ Total Ionic:  $Na^+(aq) + Cl^-(aq) + Ag^+(aq)NO_3^-(aq) \longrightarrow Na^+(aq) + NO_3^-(aq) + AgCl(s)$ Net Ionic:  $Ag^+(aq) + Cl^-(aq) \longrightarrow AgCl(s)$ [5 pt] 24. Write the total ionic **AND** net ionic equations for the following reaction:  $HF(aq) + NaOH \longrightarrow NaF(aq) + H_2O(l)$ Total Ionic:  $HF(aq) + Na^+(aq) + OH^-(aq) \longrightarrow Na^+(aq) + F^-(aq) + H_{20}(l)$ Net Ionic:  $HF(aq) + OH^{-}(aq) \longrightarrow F^{-}(aq) + H_2O(l)$ [5 pt] 25. Write the total ionic **AND** net ionic equations for the following reactions:  $NH_4OH(aq) + HCl(aq) \longrightarrow NH_4Cl(aq) + H_2O(l)$ Total Ionic:  $NH_4OH(aq) + H^+(aq) + Cl^-(aq) \longrightarrow NH_4^+(aq) + Cl^-(aq) + H_{20}(l)$ Net Ionic:  $NH_4OH(aq) + H^+(aq) \longrightarrow NH_4^+(aq) + H_2O(l)$ [5 pt] 26. Write the total ionic **AND** net ionic equations for the following reaction:  $H_2SO_4(aq) + 2NaOH \longrightarrow Na_2SO_4(aq) + 2H_2O(l)$ Total Ionic :  $2H^+(aq) + SO_4^{-2}(aq) + 2Na^+(aq) + 2OH^-(aq) \longrightarrow 2Na^+(aq) + SO_4^{-2}(aq) + 2H_2O(l)$ Net Ionic :  $H^+(aq) + OH^-(aq) \longrightarrow H_2O(l)$ Coefficients should be lowest ratio (1,1,) but (2,2,2) is acceptable. [5 pt] 27. Write the total ionic **AND** net ionic equations for the following reaction:  $2Al(s) + 6HBr(aq) \longrightarrow 2AlBr_3(aq) + 3H_2(g)$ Total Ionic :  $2Al(s) + 6H^+(aq) + 6Br^-(aq) \longrightarrow 2Al^{+3}aq + 6Br^-(aq) + 3H_2(g)$ Net Ionic :  $2Al(s) + 6H^+(aq) \longrightarrow 2Al^{+3}(aq) + 3H_2(g)$