JOE PERFECT

Practice Test - Chapter 4
Reactions in Aqueous Solutions

Target 1: I can identify a substance as either an acid, base or a salt. I will also be able to determine whether an acid or base is strong or weak.

1. Circle all acids, box all bases and underline all salts.

HCl	$\boxed{KOH}$	<u>K_3PO_4</u>	$\boxed{Ca(OH)_2}$	$\boxed{NH_3}$
H_3PO_3	<u>NaCl</u>	<u>AgBr</u>	$\boxed{Zn(OH)_2}$	<u>$MgCO_3$</u>

2. Circle all of the strong acids in the list of acids below:

$HC_2H_3O_2$ HBr H_2SO_4 HNO_2 H_2CO_3

3. Circle all of the strong bases in the list of bases below:

AgOH $Fe(OH)_2$ $Fe(OH)_3$ $Ca(OH)_2$ LiOH

Target 2: I can predict whether a substance is a nonelectrolyte, strong electrolyte, or a weak electrolyte. I will also be able to predict the ions formed by electrolytes when they dissociate or ionize.

For #4-7, circle "T" for true statements and "F" for false statements.

T F 4. All strong acids and strong bases are considered strong electrolytes.

T F 5. All weak acids and weak bases are considered weak electrolytes.

T F 6. Water is a weak electrolyte. PURE H_2O is a very poor conductor.

T F 7. Aqueous salts are strong electrolytes and solid salts are ~~weak~~ non electrolytes.

8. Circle all strong electrolytes. Underline all weak electrolytes.

$H_2O(l)$	$NaCl(aq)$	$NaCl(s)$	$NaCl(g)$	$CO_2(s)$	$CO_2(g)$
$HNO_3(aq)$	$HNO_3(s)$	$HBr(aq)$	<u>$H_2CO_3(aq)$</u>	$Cl_2(g)$	$Br_2(l)$
<u>$Mg(OH)_2(aq)$</u>	$Ba(OH)_2(aq)$	<u>$NH_3(aq)$</u>	$NH_3(g)$	sugar	lead

All of the rest are nonelectrolytes.

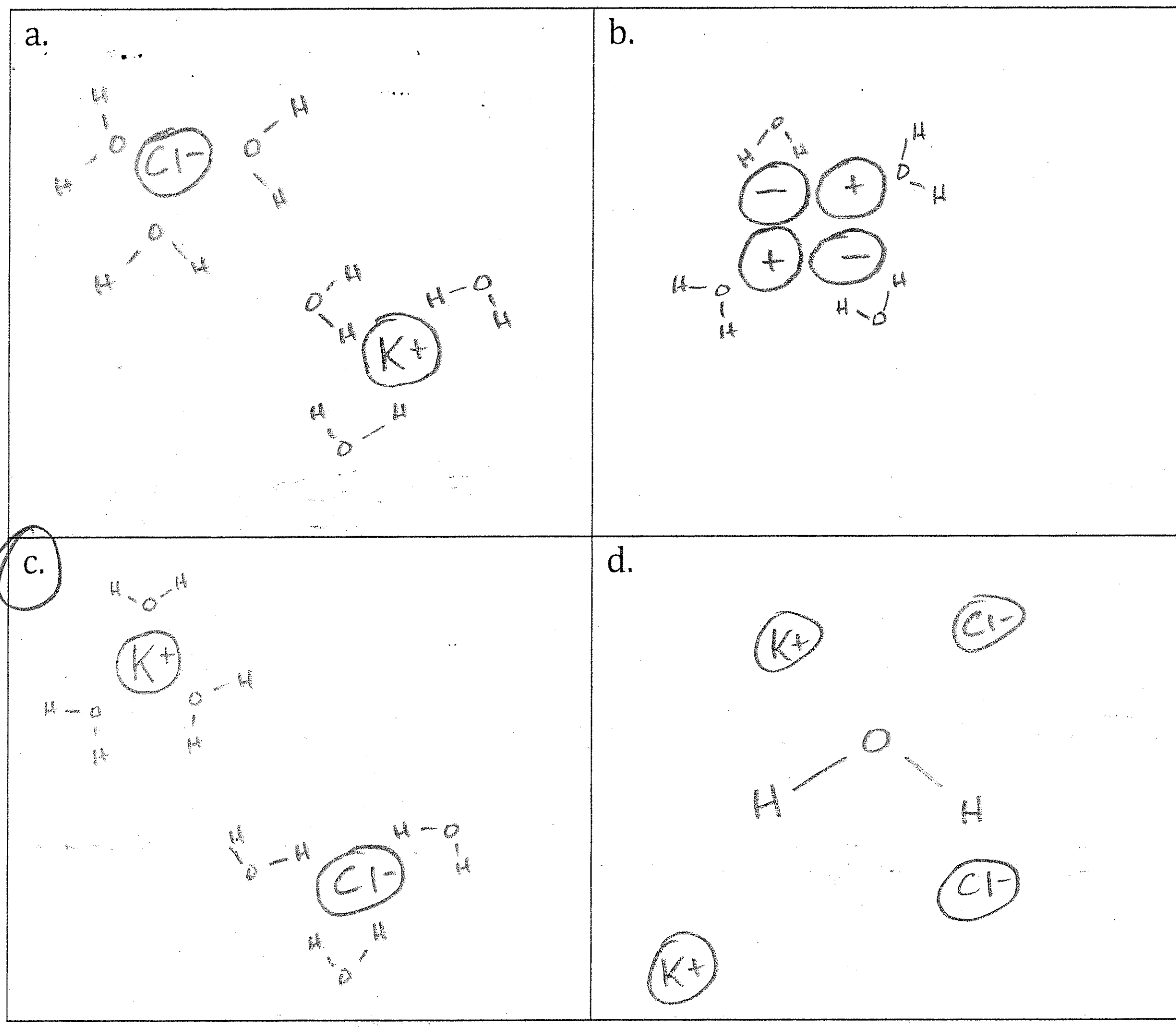
9. List the ions formed when each of the following dissolve in water:

a) NaOH b) HCl c) HF d) K_3PO_4

Na^+ & OH^- H^+ & Cl^- H^+ & F^- K^+ & PO_4^{3-}

Target 3: I can use Coulomb's Law to help describe the interactions of ions during the dissolving process.

10. Assume that you have a potassium chloride solution. Which of the following pictures best represents this solution?



11. Which of the following ions would you expect to be most attracted to a water molecule? Justify your choice.

a. Al^{3+} b. Ba^{2+} c. H^{+} d. Cs^{+}

very small, highly charged ion!

Target 4: I can use solubility rules to predict whether a substance is classified as soluble or insoluble.

12. Place an "S" next each salt which is soluble in water. Place an "I" next each salt which is insoluble in water.

S a. KBr	I b. $MgCO_3$	S c. $AgNO_3$
I d. $PbSO_4$	S e. $Ca(C_2H_3O_2)_2$	S f. $NaBrO_3$
S g. NH_4I	I h. $Zn_3(PO_4)_2$	I i. $Fe(OH)_3$

Take some time to memorize your solubility rules.

Target 5: I can predict the products of chemical reactions (including neutralization and precipitation reactions) and write balanced molecular and net ionic equations for them. I will also be able identify spectator ions.

13. Write balanced molecular and net ionic equations for each of the following. List any spectator ions for each reaction.

a) Aqueous potassium carbonate and aqueous lead(II) nitrate are mixed.

MOLECULAR: $K_2CO_3(aq) + Pb(NO_3)_2(aq) \rightarrow PbCO_3(s) + 2KNO_3(aq)$

NET IONIC: $CO_3^{2-}(aq) + Pb^{2+}(aq) \rightarrow PbCO_3(s)$

SPECTATOR IONS: $K^+(aq)$ & $NO_3^-(aq)$

b) Aqueous ammonium phosphate and aqueous calcium sulfide are mixed.

MOLECULAR: $2(NH_4)_3PO_4(aq) + 3CaS(aq) \rightarrow Ca_3(PO_4)_2(s) + 3(NH_4)_2S(aq)$

NET IONIC: $2PO_4^{3-}(aq) + 3Ca^{2+}(aq) \rightarrow Ca_3(PO_4)_2(s)$

SPECTATOR IONS: $NH_4^+(aq)$ & $S^{2-}(aq)$

c) Nitrous acid and aqueous sodium hydroxide are mixed.

MOLECULAR: $HNO_2(aq) + NaOH(aq) \rightarrow NaNO_2(aq) + H_2O(l)$

NET IONIC: $HNO_2(aq) + OH^-(aq) \rightarrow NO_2^-(aq) + H_2O(l)$

SPECTATOR IONS: $Na^+(aq)$

NOTE: Nitrous acid is WEAK! Do not ionize! NaOH is STRONG! It will ionize 100%.

Target 6: I am able to choose which type of equation is most appropriate (molecular, ionic or net ionic) equation for specific situations.

14. Which of the following types of equations is best for determining the spectator ions in a chemical reaction?
    a. molecular equation b. ionic equation c. net ionic equation

Target 7: I can recognize reactions which produce either CO_2, H_2S, or NH_3 gases.

15. List the gases produced upon mixing the following chemicals:

    a) acetic acid and sodium hydrogen carbonate CO_2

    b) strontium hydroxide and ammonium chloride NH_3

    c) potassium sulfide and nitric acid H_2S (rotten egg smell)

16. Write a balanced net ionic equation for each of the following:

    never ionize solids

    a) 2.0 M HCl is mixed with solid sodium carbonate.

    $2HCl(aq) + Na_2CO_3(s) \rightarrow NaCl(aq) + CO_2(g) + H_2O(l)$ ← molecular equation

    $2H^+(aq) + Na_2CO_3(s) \rightarrow 2Na^+(aq) + CO_2(g) + H_2O(l)$ net ionic

    b) 2.0 M sodium hydroxide is mixed with 1.0 M ammonium iodide

    $NaOH(aq) + NH_4I(aq) \rightarrow NaI(aq) + NH_3(g) + H_2O(l)$ ← molecular

    $OH^-(aq) + NH_4^+(aq) \rightarrow NH_3(g) + H_2O(l)$ ← net ionic

Target 8: I can determine whether a chemical reaction involves oxidation and reduction by assigning oxidation numbers to atoms in molecules and ions.

17. List the oxidation state of the underlined element in each of the following:

    +5 a. $H\underline{N}O_3$ +5 b. $H_3\underline{P}O_4$ −2 c. $KN\underline{O}_3$

    +4 d. $\underline{C}O_2$ −1 e. $H_2\underline{O}_2$ +2 f. $\underline{Cu}(OH)_2$

18. Which 2 of the following reactions are redox reactions? In each case, identify the element being reduced and the element being oxidized.

REDOX! Reaction 1: $\overset{-4\ +1}{CH_4} + 2\,\overset{0}{O_2} \rightarrow \overset{+4\ -2}{CO_2} + 2\,\overset{+1\ -2}{H_2O}$ OXIDIZED: C REDUCED: O

Reaction 2: $3\,\overset{+1\ -2\ +1}{KOH} + \overset{+1\ +5\ -2}{H_3PO_4} \rightarrow \overset{+1\ +5\ -2}{K_3PO_4} + 3\,\overset{+1\ -2}{H_2O}$ ⇒ not redox... no change in ox. #

REDOX! Reaction 3: $\overset{0}{Mg} + \overset{0}{O_2} \rightarrow 2\,\overset{+2\ -2}{MgO}$

OXIDIZED: Mg
REDUCED: O

Target 9: I can identify the applications of redox reactions.

19. Circle all of the following which use a redox reaction.
   a. Your car engine burning gasoline.
   b. Respiration that takes place in your body.
   c. A nail rusting. $Fe + O_2 \rightarrow Fe_2O_3$
   d. The decomposition of hydrogen peroxide.
   e. Pouring hydrochloric acid into a beaker of NaOH in order to neutralize it.

All combustion, synthesis, decomp & single dis. reactions are REDOX.

Target 10: I can use the activity series to predict whether a reaction will occur when a metal is added to an aqueous solution of either a metal salt or an acid; and write the balanced molecular and net ionic equations for the reaction.

20. Circle "Yes" or "No" to indicate whether or not each of the following reactions will spontaneously occur.

Yes	No	$K_2S(aq)$	+	$Pb(s)$	→ because Pb is less reactive than K
Yes	No	$NaNO_3(aq)$	+	$Cu(s)$	→ becuz Cu is less reactive than Na
Yes	No	$NaCl(aq)$	+	$F_2(l)$	→ becuz F_2 is more reactive than Cl_2

21. Write net ionic equations for each of the following reactions.
   a) A piece of calcium is added to a solution of silver nitrate.

$Ca(s) + 2AgNO_3(aq) \rightarrow Ca(NO_3)_2(aq) + 2Ag(s)$

$Ca(s) + 2Ag^+(aq) \rightarrow Ca^{2+}(aq) + 2Ag(s)$

   b) A piece of sodium is added to a solution of iron(III) bromide.

$3Na(s) + FeBr_3(aq) \rightarrow 3NaBr(aq) + Fe(s)$

$3Na(s) + Fe^{3+}(aq) \rightarrow 3Na^+(aq) + Fe(s)$

Target 11: I can calculate molarity, solution volume, or number of moles of solute given any two of these quantities.

22. What is the molarity of a solution made by dissolving 0.50 mol of $CaCl_2$ in enough water to make 250 mL of solution?
   a. 0.025 M   b. 0.050 M   c. 0.25 M   d. 0.50 M   e. 1.0 M   f. 2.0 M

$$M = \frac{mol}{L} = \frac{0.50\ mol}{0.25\ L} = 2.0\ M$$

$\rightarrow MM = 74.\ g/mole$

23. Assume 7.4 grams of $Ca(OH)_2$ is dissolved in enough water to make 500. mL of solution. The concentration of the $Ca(OH)_2$ solution is _____ molar and the concentration of the OH^- ion is ______ molar.

a. 0.20, 0.40 b. 0.30, 0.30 c. 0.60, 0.30 d. 0.30, 0.60 e. 0.40, 0.40

$$x\ \frac{mol}{L}\ Ca(OH)_2 = \frac{7.4\,g\ Ca(OH)_2}{0.500\,L}\cdot\frac{1\ mol\ Ca(OH)_2}{74\,g\ Ca(OH)_2} = \frac{0.1}{0.5} = 0.20\,M\ Ca(OH)_2$$
$$= 0.40\,M\ OH^-$$

24. How many grams of NaF would you need in order to make 5.0 liters of 0.10 M NaF?

a. 0.21 g b. 0.42 g c. 2.1 g d. 4.2 g e. 21 g

$$x\ g\ NaF = \frac{5.0\,L}{}\cdot\frac{0.10\ mol\ NaF}{1\,L\ NaF}\cdot\frac{42\,g\ NaF}{1\ mol\ NaF} = (5)(0.1)(42) = (0.5)(42) = \boxed{21}$$

Target 12: I can solve problems when making solutions by dilutions.

25. How many milliliters of 12 M NaOH would you need in order to make 2.0 liters of 0.40 M NaOH?

a. 3.4 b. 6.7 c. 34 d. 67 e. 98

$M_1 = 12\,M$
$V_1 = ?$
$M_2 = 0.40\,M$
$V_2 = 2.0\,L$

$$V_1 = \frac{M_2V_2}{M_1} = \frac{(0.40\,M)(2.0\,L)}{12\,M} = \frac{0.80}{12} = \frac{0.2}{3} = 0.067\,L$$
$= 67\,mL$

26. What volume of water should be added to 0.40 L of 6.0 M H_2SO_4 solution to produce a solution that is 2.0 M H_2SO_4?

a. 0.40 L b. 0.80 L c. 1.2 L d. 1.6 L e. 2.4 L

$M_1 = 6.0\,M$
$V_1 = 0.40\,L$
$M_2 = 2.0\,M$
$V_2 = ?$

$$V_2 = \frac{M_1V_1}{M_2} = \frac{(6.0\,M)(0.40\,L)}{2.0\,M} = \boxed{1.2\,L}$$

$\rightarrow$ Add 0.80 L of H_2O to the original 0.40 L to obtain V_2 of 1.2 L.

27. What is the final concentration of Cl^- ion when 250 mL of 0.20 M $CaCl_2$ solution is mixed with 250 mL of 0.40 M KCl solution? *(Assume additive volumes.)*

a. 0.10 M b. 0.20 M c. 0.30 M d. 0.40 M e. 0.60 M

$\rightarrow$ Add moles of Cl^- from each salt sol'n... then $\div$ by total vol. (0.50 L)

$0.20\,M\ CaCl_2 = 0.40\,M\ Cl^-$; $mol = M \times L = (0.40\,M)(0.25\,L) = 0.10\ mol\ Cl^-$
$0.40\,M\ KCl = 0.40\,M\ Cl^-$; $mol = M \times L = (0.40\,M)(0.25\,L) = 0.10\ mol\ Cl^-$
$0.20\ mol\ Cl^-$ total

$$M = \frac{mol}{L} = \frac{0.20\ mol\ Cl^-}{0.50\,L} = 0.40\,M\ Cl^-$$

$HBr + NaOH \rightarrow NaBr + H_2O$

Target 13: I can solve stoichiometry problems involving solutions.

28. What is the molarity of an aqueous HBr solution if 35.0 mL is neutralized with 70.0 mL of a 0.500 M NaOH solution?
   a. 0.250 M b. 0.500 M c. 0.750 M d. 1.00 M e. 0.100 M

$$X\ \frac{mol}{L} = \frac{0.0700\ L\ NaOH}{} \cdot \frac{0.500\ mol\ NaOH}{1\ L\ NaOH} \cdot \frac{1\ mol\ HBr}{1\ mol\ NaOH} \cdot \frac{1}{0.0350\ L\ HBr} = \{1.0\ M\}$$

Use the following to answer #29 & 30:
Assume 2.0 liters of 1.0 M $CaCl_2$ is reacted with 1.0 liter of 2.0 M $AgNO_3$ according to the reaction below:

$$CaCl_2(aq) + 2\ AgNO_3(aq) \rightarrow 2\ AgCl(s) + Ca(NO_3)_2(aq)$$

29. What is the molarity of the nitrate ion after the reaction is complete?
   a. 0.17 M b. 0.67 M c. 1.0 M d. 1.3 M e. No nitrate ion is left over!

NET ionic: $Cl^-(aq) + Ag^+(aq) \rightarrow AgCl(s)$ SPEC ions: Ca^{2+} & NO_3^-

→ The nitrate ion is a SPEC. ION! It did not react! It's molarity changes, though, because it is diluted upon mixing the 2 solutions!

$$M_2 = \frac{M_1V_1}{V_2} = \frac{(2.0\ M)(1.0\ L)}{3.0\ L} = \{0.67\ M\}$$

30. What is the molarity of the silver ion after the reaction is complete?
   a. 0.17 M b. 0.34 M c. 1.0 M d. 1.3 M e. No silver ion is left over!

First, determine the limiting reactant!

X mol $CaCl_2$ = M×L = (1.0 M)(2.0 L) = 2.0 moles $CaCl_2$ (excess)

X mol $AgNO_3$ = M×L = (2.0M)(1.0L) = 2.0 moles $AgNO_3$ (LR)

→ Balanced eq. says you need 2X more $AgNO_3$ than $CaCl_2$ ... you do not have this much! Ag^+ is L.R. and therefore none left.

Part II: Solve the following problems on separate sheets of paper. Please show all of your work and **circle** your final solutions.

1. Some sulfuric acid is spilled on a lab bench. It can be neutralized by sprinkling sodium bicarbonate ($NaHCO_3$) on it and then mopping it up the resulting solution. If 35.0 mL of 6.0 M sulfuric acid was spilled, what is the minimum mass of the sodium bicarbonate that can be used to neutralize the acid?

2. a) By titration, 15.0 mL of 0.1008 M sodium hydroxide is required to neutralize a 0.2053 gram sample of an organic acid. What is the molar mass of the acid? Assume the acid is monoprotic.

   b) An elemental analysis of the acid indicates that it is composed of 5.89 % H, 70.6 % C, and 23.5 % O by mass. What is its molecular formula?

3. 250.0 mL of 0.3000 M $BaCl_2$ is mixed with 500.0 mL of 0.5000 M Na_2SO_4 and a precipitate forms. How many grams of the precipitate is formed? What ions still remain in solution after the reaction? Determine the concentration (in molarity) of each remaining ion.

4. A 20.05 mL sample of vinegar ($HC_2H_3O_2$ (aq)) has a density of 1.061 g/mL. The vinegar is neutralized with 40.10 mL of 0.4100 M KOH. What is the percent by mass of acetic acid in vinegar?

5. Answer each of the following questions. In each case, use a diagram to help support your answers.
   a) Explain how water dissolves a small sample of solid sodium nitrate.
   b) Which dissolves more easily, salt or sugar? Justify your answer.
   c) Do you agree or disagree with the following statement?
      "1.0 M HCl is stronger than 0.10 M HCl."
      Justify your answer.
   d) Explain the difference between a strong, weak and nonelectrolyte.

6. Assume you had 5 aqueous chemicals (KCl, Na_2CO_3, HNO_3, HCl, $AgNO_3$) labeled 1-5. You mixed them together in all possible combinations. The results are below. Identify the chemicals. Explain how you identified each.

		$AgNO_3$	KCl	HCl	HNO_3	Na_2CO_3
		1	2	3	4	5
$AgNO_3$	1		ppt	ppt	No reaction	ppt
KCl	2			No reaction	No reaction	No reaction
HCl	3				No reaction	Bubbles
HNO_3	4					Bubbles
Na_2CO_3	5					

PART 2

① **EQUATION:** $2\,NaHCO_3(s) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2\,H_2O(l) + 2\,CO_2(g)$

$$x\text{ g } NaHCO_3 = \frac{0.0350\text{ L } H_2SO_4}{} \cdot \frac{6.0\text{ mol } H_2SO_4}{1\text{ L } H_2SO_4} \cdot \frac{2\text{ mol } NaHCO_3}{1\text{ mol } H_2SO_4} \cdot \frac{84.01\text{ g } NaHCO_3}{1\text{ mol } NaHCO_3} = 35\text{ g } NaHCO_3$$

(2) (a) We do NOT know the formula of the acid, but we do know that it is MONOPROTIC! Let's call the acid HA.

$HA + NaOH \rightarrow NaA + H_2O$; We can calculate the MOLAR MASS (g/mol) by stoichiometry.

$$X \frac{g}{mol} HA = \frac{0.2053\ g\ HA}{0.0150\ \cancel{L\ NaOH}} \cdot \frac{1\ \cancel{L}\ NaOH}{0.1008\ \cancel{mol\ NaOH}} \cdot \frac{1\ \cancel{mol\ NaOH}}{1\ mol\ HA} = 136\ g/mol\ HA$$

molarity of base

from bal. equation

(b) Assume a 100-gram sample... calculate EMPIRICAL FORMULA!

$$X\ mol\ H = \frac{5.89\ g\ H}{} \cdot \frac{1\ mol\ H}{1.01\ g\ H} = 5.84\ mol\ H \div 1.47 \approx 4$$

$$X\ mol\ C = \frac{70.6\ g\ C}{} \cdot \frac{1\ mol\ C}{12.0\ g\ C} = 5.88\ mol\ C \div 1.47 \approx 4$$

$$X\ mol\ O = \frac{23.5\ g\ O}{} \cdot \frac{1\ mol\ O}{16.0\ g\ O} = 1.47\ mol\ O \div 1.47 = 1$$

$$\underbrace{E.F. = C_4H_4O}_{\text{MOLAR MASS } 68\ g/mol}$$

$$\frac{MF\ (mass)}{EF\ (mass)} = \frac{136\ g/mol}{68\ g/mol} = 2 \qquad EF \times 2 = MF$$

$$C_4H_4O_1 \times 2 = C_8H_8O_2 \text{ or } HC_8H_7O_2$$

③ $BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$

$\underbrace{\begin{matrix} 0.2500\ L \\ 0.3000\ M \end{matrix}}_{0.07500\ \text{moles}}$ $\underbrace{\begin{matrix} 0.5000\ L \\ 0.5000\ M \end{matrix}}_{0.2500\ \text{moles}}$

(LIMITING REACTANT) (EXCESS REACTANT)

SPEC. IONS: Na^+ & Cl^-

NET IONIC EQUATION: $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$

0.07500 moles (L.R.) $\boxed{\text{none left}}$

0.2500 moles (excess)

Use $M_1V_1 = M_2V_2$ to calculate molarity of spectator ions!

Na^+ $M_2 = \frac{M_1V_1}{V_2} = \frac{(1.000\ M)(0.5000\ L)}{0.7500\ L} = 0.6667\ M\ Na^+$

2 x 0.5000 M

Cl^- $M_2 = \frac{M_1V_1}{V_2} = \frac{(0.6000\ M)(0.2500\ L)}{0.7500\ L} = 0.2000\ M\ Cl^-$

SO_4^-

initial moles: 0.2500 mol

− used moles: − 0.07500 mol

unreacted: 0.1750 mol

$M = \frac{mol}{L} = \frac{0.1750\ mol}{0.7500\ L} = 0.2333\ M\ SO_4^{2-}$

You must calculate the amount of excess ion!

No Ba^{2+} is left over! It is limiting reactant.

④ $HC_2H_3O_2\,(aq) + KOH\,(aq) \rightarrow KC_2H_3O_2\,(aq) + H_2O\,(l)$

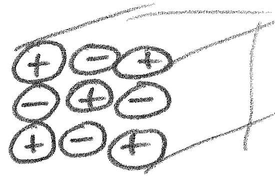
$$x\text{ g } HC_2H_3O_2 = \frac{0.04010\text{ L KOH}}{} \left| \frac{0.4100\text{ mol KOH}}{1\text{ L KOH}} \right| \frac{1\text{ mol } HC_2H_3O_2}{1\text{ mol KOH}} \left| \frac{60.04\text{ g}}{1\text{ mol } HC_2H_3O_2} \right| = 0.9871\text{ g } HC_2H_3O_2$$

$$x\text{ g vinegar} = \frac{20.05\text{ mL vinegar}}{} \left| \frac{1.061\text{ g}}{1\text{ mL}} \right| = 21.27\text{ g vinegar}$$

$$\%\,HC_2H_3O_2 = \frac{\text{Mass } HC_2H_3O_2}{\text{mass vinegar}} \times 100$$

$$\%\,HC_2H_3O_2 = \frac{0.9871\text{ g}}{21.27\text{ g}} \times 100 = 4.641\ \%$$

⑤ (a) $NaNO_3$ is ionic ...



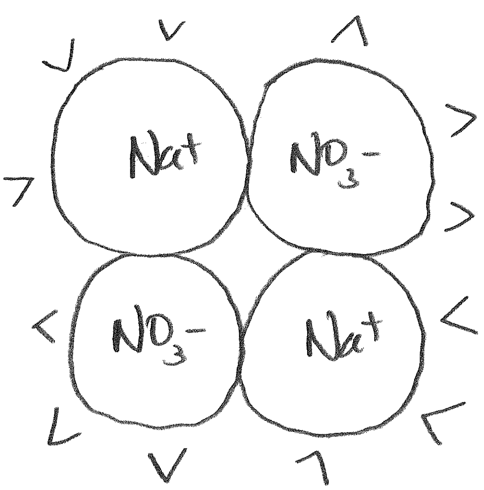
and looks something like this!

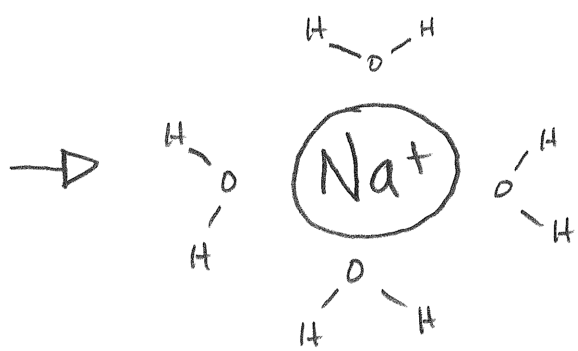
Water is a POLAR molecule which means it has a positive side and a negative side...

negative side of the water molecule

positive side of water molecule.

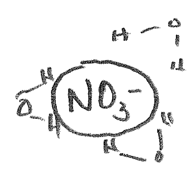
- The water molecules will orient themselves around the solid salt in such a fashion that the negative sides of the water molecules will be pointed towards the positive Na^+. The pos. side of the water molecules will be pointed towards the negative NO_3^- ions.



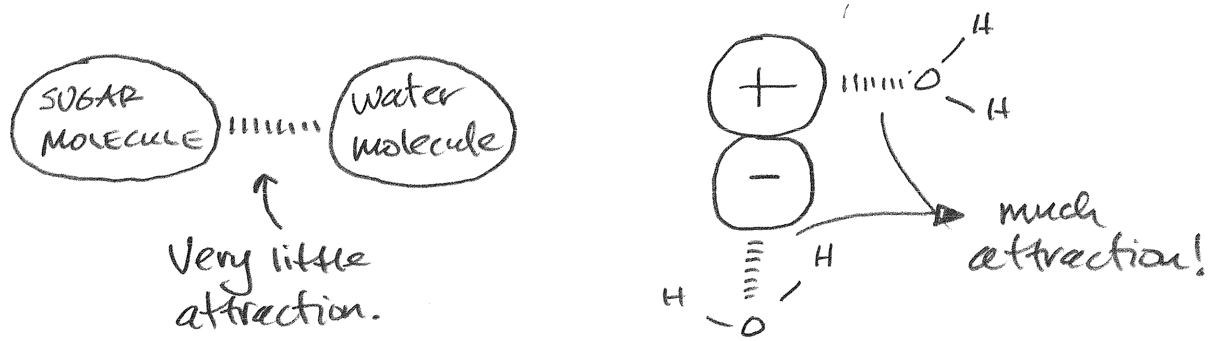


Picture of an aqueous $Na^+_{(aq)}$

- The sum of the attractions between the water molecules and ions will be greater than the ionic bonds in the salt and the salt dissolves!! :)



(b) Salts generally dissolves more readily than sugars. Salts are made up on ions (+ and −) which "feel" more attraction to water than NEUTRAL sugar molecules!

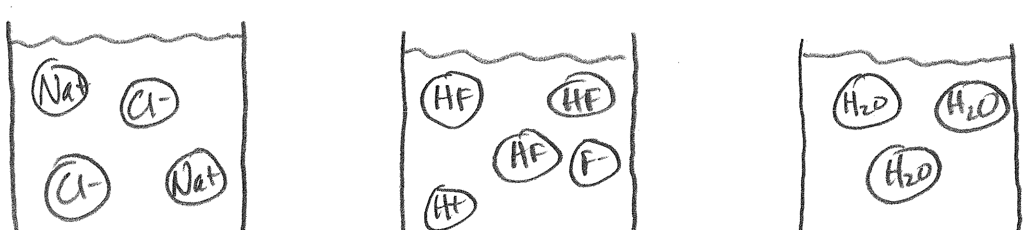


(c) DISAGREE! HCl is a strong acid independent of its concentration. HCl ionizes 100 %

$$H-Cl \xrightarrow{100\%} H^+ + Cl^-$$

(d) The difference between the 3 types of electrolytes is based upon the % it ionizes...

STRONG = 100 % WEAK < 100 % NON = 0 %



$NaCl_{(aq)}$ All ions! $HF_{(aq)}$ Some ions! $H_2O_{(l)}$ No ions!

⑥ Write reactions ...

$KCl(aq) + Na_2CO_3(aq) \rightarrow$ no rxn.
$KCl(aq) + HNO_3(aq) \rightarrow$ no rxn.
$KCl(aq) + HCl(aq) \rightarrow$ no rxn.
$KCl(aq) + AgNO_3(aq) \rightarrow$ ppt! $AgCl(s)$

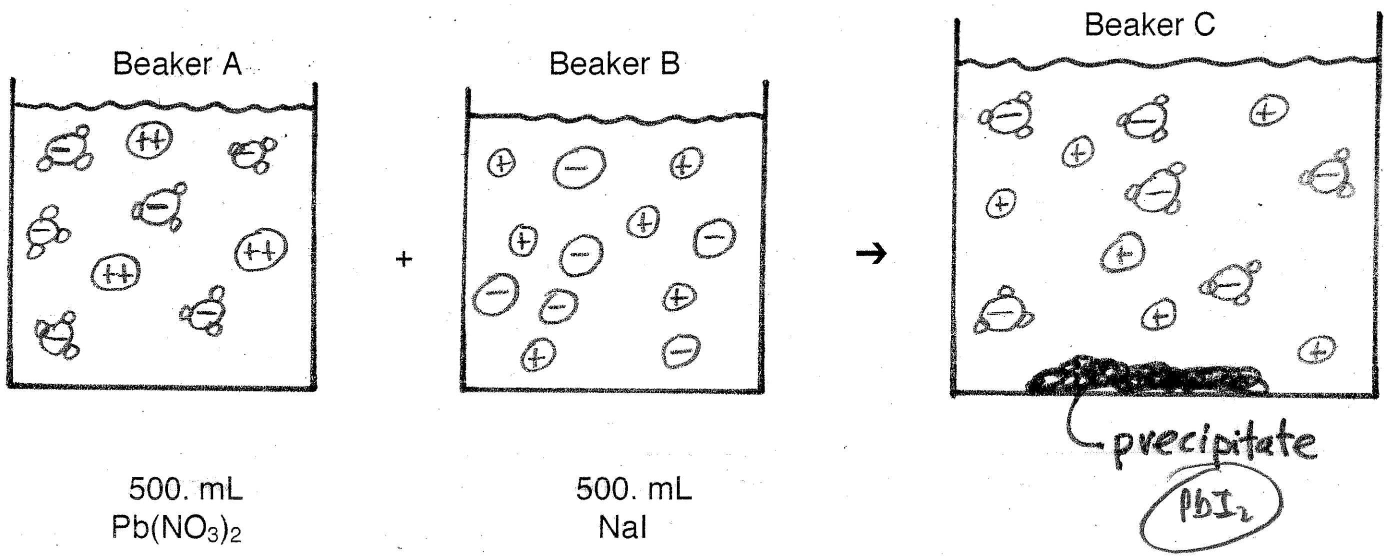
$Na_2CO_3(aq) + HNO_3(aq) \rightarrow$ CO_2 bubbles
$Na_2CO_3(aq) + HCl(aq) \rightarrow$ CO_2 bubbles
$Na_2CO_3(aq) + AgNO_3(aq) \rightarrow$ ppt! $Ag_2CO_3(s)$

$HNO_3(aq) + HCl(aq) \rightarrow$ no rxn.
$HNO_3(aq) + AgNO_3(aq) \rightarrow$ no rxn.

$HCl(aq) + AgNO_3(aq) \rightarrow$ ppt! $AgCl(s)$

1: $AgNO_3 \rightarrow$ formed 3 ppt's
2: $KCl \rightarrow$ formed 1 ppt & no bubbles
3: $HCl \rightarrow$ formed 1 ppt. & 1 bubbles
4: $HNO_3 \rightarrow$ no ppt's & 1 bubbles
5: $Na_2CO_3 \rightarrow$ 1 ppt. & 2 bubbles

7. Beaker A and beaker B each contain 500. mL of solution, as shown below. A student combines the solutions by pouring them into a larger, previously empty beaker C and observes the formation of a yellow precipitate.



500. mL $Pb(NO_3)_2$ (1.0 M)

500. mL NaI (2.0 M)

a) Write the net ionic equation for the reaction.
b) Identify the limiting reactant. Explain your choice.
c) Assume the concentration of the NaI in beaker B was 2.0 M. Also assume that the volumes are additive.
   i- Determine the concentration the $Pb(NO_3)_2$ in beaker A.
   ii- Calculate the concentration of the ions present in beaker C.

spec. ions

(a) $Pb^{2+}(aq) + 2I^-(aq) \rightarrow PbI_2(s)$

(b) Both Pb^{2+} & I^- are limiting reactants as neither are in excess. Neither of these ions are left in beaker C.

(c) i- $Pb(NO_3)_2 + \underline{\underline{2}}NaI \rightarrow PbI_2 + 2NaNO_3$

$Pb(NO_3)_2$ (1.0 M): [0.50 mol Pb^{2+}] [1 mol NO_3^-]

NaI (2.0 M): [1 mol I^-] [1 mol Na^+]

The $Pb(NO_3)_2$ is 1.0 M. You have 2X more moles of I^- than Pb^{2+}, so $Pb(NO_3)_2$ must be ½ as concentrated.

ii- You have 1.0 mol of Na^+ & NO_3^- each.

$\frac{1.0 \text{ mol}}{1.0 \text{ L}}$ = 1.0 M Na^+ & 1.0 M NO_3^-