Name:_____ Date:_____-_____-_____

AP Chemistry – Mr. Colling

2019 Salisbury School AP Chemistry Summer Work

Polyatomic Ions

Memorize the following polyatomic ions:

Formula	Name
OH^-	Hydroxide
NO_3^-	Nitrate
$C_2H_3O_2^-$	Acetate
CN^-	Cyanide
MnO_4^-	Permanganate
CO_3^{2-}	Carbonate
SO_4^{2-}	Sulfate
$Cr_2O_7^{2-}$	Dichromate
PO_4^{3-}	Phosphate
NH_4^+	Ammonium

Acids and Bases

Memorize the following strong acids and strong bases:

Strong Acids (7)	
HCl	Hydrochloric acid
HBr	Hydrobromic acid
HI	Hydroiodic acid
HNO_3	Nitric acid
H_2SO_4	Sulfuric acid
$HClO_3$	Chloric acid
$HClO_4$	Perchloric acid

Strong Bases (8)	
LiOH	Lithium hydroxide
NaOH	Sodium hydroxide
KOH	Potassium hydroxide
RbOH	Rubidium hydroxide
CsOH	Cesium hydroxide
$Ca(OH)_2$	Calcium hydroxide
$Sr(OH)_2$	Strontium hydroxide
$Ba(OH)_2$	Barium hydroxide

PERIODIC TABLE OF THE ELEMENTS

1																	18
1 **H** 1.008	2											13	14	15	16	17	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.30	3	4	5	6	7	8	9	10	11	12	13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.87	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.63	33 **As** 74.92	34 **Se** 78.97	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.95	43 **Tc** (97)	44 **Ru** 101.1	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 ***La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **†Ac** (227)	104 **Rf** (267)	105 **Db** (270)	106 **Sg** (271)	107 **Bh** (270)	108 **Hs** (277)	109 **Mt** (276)	110 **Ds** (281)	111 **Rg** (282)	112 **Cn** (285)	113 **Uut** (285)	114 **Fl** (289)	115 **Uup** (288)	116 **Lv** (293)	117 **Uus** (294)	118 **Uuo** (294)

*Lanthanoid Series	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.05	71 **Lu** 174.97
†Actinoid Series	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)

This is the periodic table that we will use throughout the class, and on the AP Chemistry exam.

Write the formula for the following compounds.

1. sodium sulfite

2. copper(II) nitrate

3. hydrochloric acid

4. sodium hydroxide

5. acetic acid

6. aluminum perchlorate

7. silver sulfide

8. carbonic acid

9. ammonium phosphate

10. potassium permanganate

11. lead (II) cyanide

12. calcium acetate

13. nitrous acid

14. hydroiodic acid

15. sodium bicarbonate

16. nickel (III) iodate

17. chloric acid

18. aluminum sulfite

19. phosphorous acid

20. barium hydroxide

Write the name of the following compounds.

21. $Sr(CN)_2$

22. H_3PO_4

23. $ZnSO_4$

24. $Cu(SO_3)_2$

25. H_2SO_4

26. AuOH

27. K_2CO_3

28. $NaHCO_3$

29. $HClO_2$

30. $AgNO_2$

31. HBrO

32. KOH

33. $HC_2H_3O_2$

34. $Ni(BrO_2)_3$

35. HBr

36. $NaMnO_4$

37. $HBrO_2$

38. H_3PO_4

39. $(NH_4)_2SO_4$

40. $Ni(OH)_2$

Understanding Net Ionic Equations

Balanced chemical equations, written to represent chemical reactions, are an important part of chemistry.

You do *not* need to write down physical state symbols (aq, s, ppt, L, g ... etc). In fact, it's probably best if you leave them off.

The best way to prepare for writing equations is to practice writing *lots* of equations. Many of the same equation types show up year after year on the AP Exam. When you are reading the words given in a problem, and trying to write an equation, it may be helpful to try to identify the equation as a particular type in order to help you predict the products.

Sometimes you may write overall equations in which all complete chemical formulas are shown. More often, however, equations in AP Chemistry need to be written in **net ionic** form. Net ionic is a term used for balanced equations that describe chemical reactions that occur in aqueous solution. All soluble ionic substances must be written as separated ions with the *spectator ions* left out. The spectator ions are left out of the equation because they do not change form at all during the course of the reaction and do not need to be represented in the chemical equation. All molecular substances and non-soluble compounds must be written as a molecule or formula unit (not ionized!).

Solubility Rules

In first year chemistry we used a solubility chart, however, you will not be able to use one in AP Chemistry. The solubility rules that you need to memorize is quite a short list.

ALWAYS SOUBLE IF IN A COMPOUND	EXCEPT WITH
Alkali ions, NH_4^+,	No Exceptions
NO_3^-, $C_2H_3O_2^-$, ClO_4^-, ClO_3^-	No Exceptions
Cl^- , Br^- , I^-	Pb^{2+}, Ag^+
SO_4^{2-}	Pb^{2+}, Ag^+

If a compound does not fit one of the rules above, assume it is INSOLUBLE, unless you are given other information to the contrary within the problem. Non-soluble compounds must be written as a *formula unit* (not ionized). Remember, this list is just a guide, and any information given within a problem that contradicts any rules given above will be followed.

Other considerations to remember when writing chemical equations.

1. Weak acids, (any acid other than the seven strong acids you need to memorize) are mostly *NOT* ionized in solution and thus must be written as molecules. (There are weak bases, you will learn about them during the year.)
2. Strong acids and bases will be considered fully ionized in solution and thus must be written as separated ions in net ionic equations.
3. Soluble salts as memorized from the table above will exist as separated ions in solution and thus must be written as separated ions in net ionic equations, with spectator ions dropping out of the equation.
4. Solids, liquids, and gases should be written as molecules.
5. A chemical in a *saturated* solution (saturated: a solution with maximum that can be dissolved) is written in ionic form while a chemical in *suspension* (suspension: particles shaken up and floating, but not actually dissolved) should be written together as a molecule or "ionicule."
6. Know your *phantoms* – molecules that when formed as a product, will decompose into a gas and water as indicated below.
   - as a product of a double replacement reaction, H_2CO_3 decomposes into H_2O and $CO_{2(g)}$
   - as a product of a double replacement reaction, NH_4OH decomposes into H_2O and $NH_{3(g)}$

Single Replacement

- A reaction in which one element displaces another in a compound. One element is oxidized and another is reduced. In an oxidation reduction reaction, elements will change their oxidation states.
- Generic: A + BX → B + AX or Y + BX → X + BY
  - **Active metals replace less active metals or hydrogen (in acid or water).**

    The more easily oxidized metal replaces the less easily oxidized metal. You used an activity series in first year chem. You will learn more about that chart, and other methods of predicting which metal is more active than the other.

    - *Magnesium pieces are added to a solution of nickel(III) chlorate.*

    Overall Equation: $3Mg + 2Ni(ClO_4)_3 \rightarrow 2Ni + 3Mg(ClO_4)_2$ $(= 3Mg + 2Ni^{3+} + 6ClO_4^- \rightarrow 2Ni + 3Mg^{2+} + 6ClO_4^-)$

    Net Ionic Equation: $3Mg + 2Ni^{3+} \rightarrow 2Ni + 3Mg^{2+}$

    (Note that the chlorate compounds are soluble and thus the chlorate ions have been removed because they are spectators − unchanged by the reaction. The nickel and magnesium are different as reactants compared to products.)

    - *Nickel is added to hydrochloric acid.*

    Overall Equation: $Ni + 2HCl \rightarrow NiCl_2 + H_2$ $(= Ni + 2H^+ + 2Cl^- \rightarrow Ni^{2+} + 2Cl^- + H_2)$

    Net Ionic Equation: $Ni + 2H^+ \rightarrow Ni^{2+} + H_2$

    (Note that the chloride ions have been removed because nickel(II) chloride is soluble and the chloride ions are in the same form both as reactants and products, thus the chloride ions are spectators − unchanged by the reaction.)

    - *Sodium is added to water.*

    Overall Equation: $2Na + 2H_2O \rightarrow 2NaOH + H_2$

    Net Ionic Equation: $2Na + 2H_2O \rightarrow 2Na^+ + 2OH^- + H_2$

    (Remember that some metals -the alkali metals and some alkaline earth metals- can replace hydrogen in water. You may find it useful to think of water as HOH. For this equation there is no ions that are removed. Na^+ and OH^- must be included as products because those products are not ions on the reactant side.)

  - **Active nonmetals replace less active nonmetals from their compounds in aqueous solution.**

    A halogen will replace a less electronegative (lower on the Periodic table) halogen from their binary salts.

    - *Chlorine gas is bubbled into a solution of potassium iodide.*

    Overall Equation: $Cl_2 + 2KI \rightarrow I_2 + 2KCl$ $(= Cl_2 + 2K^+ + I^- \rightarrow I_2 + 2K^+ + 2Cl^-)$

    Net Ionic Equation: $Cl_2 + 2I^- \rightarrow I_2 + 2Cl^-$

    (Note that the potassium ions have been removed because they are spectators − unchanged by the reaction.)

Double Replacement

Two compounds react to form two new compounds. No changes in oxidation numbers occur, thus DR reactions are not redox. Since the movement of electrons does not “push” the reaction, all double replacement reactions must have some other "driving force" that removes a pair of ions from solution. These ions may be removed by forming a precipitate, a gas, or molecular compound. If water forms, the double replacement reaction is an acid/base reaction. If a solid substance forms the double replacement reaction is a precipitation reaction. We can assume that all solutions are aqueous solutions, unless told otherwise.

- **Formation of a precipitate:**
  A precipitate is an insoluble substance formed during the reaction of two aqueous substances. Two ions bond together so strongly that water can not pull them apart. Knowing your solubility rules will help you write these net ionic equations.

  - *Solutions of silver nitrate and sodium sulfide are mixed (Assume a precipitate forms).*

    Overall Equation: $2AgNO_3 + Na_2S \rightarrow Ag_2S + NaNO_3$ $(= 2Ag^+ + NO_3^- + Na^+ + S^{2-} \rightarrow Ag_2S + Na^+ + NO_3^-)$

    Net Ionic Equation: $2Ag^+ + S^{2-} \rightarrow Ag_2S$

    (How do you know which substance is the precipitate? By knowing alkali and nitrate salts are soluble, the precipitate must be the silver sulfide)

- **Formation of a gas:**

  Gases may form from the decomposition of a product such as H_2CO_3 or NH_4OH.

  - *Acetic acid solution is added to a solution of sodium bicarbonate.*

    Overall Equation: $HC_2H_3O_2 + NaHCO_3 \rightarrow NaC_2H_3O_2 + (H_2CO_3 \rightharpoonup) H_2O + CO_2$

    $(= HC_2H_3O_2 + Na^+ + HCO_3^- \rightarrow Na^+ + C_2H_3O_2^- + H_2O + CO_2)$

    Net Ionic Equation: $HC_2H_3O_2 + HCO_3^- \rightarrow H_2O + CO_2$

    (Note that the acetic acid must be written as a molecule because acetic acid is a weak acid. The carbonic acid, when formed, bubbles off as carbon dioxide. You know this reaction − the classic third grade volcano trick. The sodium ions have been removed because they are spectators − unchanged by the reaction)

  - *A solution of sodium hydroxide is added to a solution of ammonium nitrate.*

    Overall Equation: $NaOH + NH_4NO_3 \rightarrow NaNO_3 + (NH_4OH \rightharpoonup) NH_3 + H_2O$

    $(= 2Na^+ + OH^- + NH_4^+ + 2NO_3^- \rightarrow Na^+ + 2NO_3^- + NH_3 + H_2O +)$

    Net Ionic Equation: $OH^- + NH_4^+ \rightarrow NH_3 + H_2O$

    (The ammonium hydroxide that is formed, bubbles off as ammonia with water in solution. The sodium and nitrate ions have been removed because they are spectators − unchanged by the reaction)

- **Formation of a molecular substance (often an acid base neutralization):**

  When a molecular substance such as water or a weak acid is formed, ions are removed from solution and the reaction happens.

Acid/Base Neutralization

Acids react with bases to produce salts and water.

One mole of hydrogen ions react with one mole of hydroxide ions to produce one mole of water. Remember which acids are strong (and thus ionize completely) and which acids are weak (should be written as a molecule). We can assume that all solutions are aqueous solutions, unless told otherwise.

- *Aqueous solutions of lithium hydroxide and hydrobromic acid are poured together.*

  Overall Equation: $LiOH + HBr \rightarrow H_2O + LiBr$ $(= Li^+ + OH^- + H^+ + Br^- \rightarrow H_2O + Li^+ + Br^-)$

  Net Ionic Equation: $OH^- + H^+ \rightarrow H_2O$

  (A strong acid will be completely ionized in solution − HBr is a strong acid. Lithium bromide is a soluble ionic compound that would be separated into ions. The ions that are unchanged as reactants and products drop out of the equation.)

- *An aqueous solutions of sulfuric acid and barium hydroxide are combined.*

  Overall Equation: $H_2SO_4 + Ba(OH)_2 \rightarrow BaSO_4 + 2H_2O$ $(= 2H^+ + SO_4^{2-} + Ba^{2+} + 2OH^- \rightarrow H_2O + Ba^{2+} + SO_4^{2-})$

  Net Ionic Equation: $H^+ + OH^- \rightarrow H_2O$

  (It's true that in the "overall reaction," 2's would show up, but then drop out of the net ionic equation.)

- **Watch out for acids or bases that should be written as a molecule, such as weak acids or weak bases and gases.**

  - *Acetic acid solution is added to a solution of sodium hydroxide.*

    Overall Equation: $HC_2H_3O_2 + NaOH \rightarrow H_2O + NaC_2H_3O_2$ $(= HC_2H_3O_2 + Na^+ + OH^- \rightarrow H_2O + Na^+ + C_2H_3O_2^-)$

    Net Ionic Equation: $HC_2H_3O_2 + OH^- \rightarrow H_2O + C_2H_3O_2^-$

    (Remember, that weak acids are mostly not ionized in solution and thus must be represented as molecules.)

  - *Hydrogen sulfide gas is bubbled through excess potassium hydroxide solution.*

    Overall Equation: $H_2S + 2KOH \rightarrow 2\ H_2O + K_2S$ $(= H_2S + 2OH^- \rightarrow 2\ H_2O + + 2K^+ + S^{2-})$

    Net Ionic Equation: $H_2S + 2OH^- \rightarrow 2\ H_2O + S^{2-}$

    (Remember, that the gas, which is also a weak acid must be written as a molecule.)

  - *A suspension of magnesium hydroxide is added to a dilute solution of hydrochloric acid.*

    Overall Equation: $Mg(OH)_2 + 2HCl \rightarrow 2H_2O + MgCl_2$ $(= Mg(OH)_2 + 2H^+ + Cl^- \rightarrow 2H_2O + Mg^{2+} + 2Cl^-)$

    Net Ionic Equation: $Mg(OH)_2 + 2H^+ \rightarrow 2H_2O + Mg^{2+}$

    (Remember, that a suspension is not actually dissolved, not ionized, and thus must be written as a formula unit − not separated.)

- **Formation of weak acids by combining a weak base with a strong acid.**

  - *Solutions of sodium fluoride and hydrobromic acid are mixed.*

    Overall Equation: $Na^+ + F^- + H^+ + Br^- \rightarrow HF + NaBr$ $(= Na^+ + F^- + H^+ + Br^- \rightarrow HF + Na^+ + Br^-)$

Net Ionic Equation: $F^- + H^+ \rightarrow HF$

(Remember that sodium bromide is soluble making the sodium and bromide ions the same as reactants and products, and thus drop out as spectators. The HF is a weak acid, thus must be represented as molecule.)

- *Solutions of potassium acetate and sulfuric acid are mixed.*

  Overall Equation: $2KC_2H_3O_2 + H_2SO_4 \rightarrow 2HC_2H_3O_2 + K_2SO_4$ (= $2K^+ + 2C_2H_3O_2^- + 2H^+ + SO_4^{2-} \rightarrow 2HC_2H_3O_2 + 2K^+ + SO_4^{2-}$)

  Net Ionic Equation: $C_2H_3O_2^- + H^+ \rightarrow HC_2H_3O_2$

  (Remember $HC_2H_3O_2$ is a weak acid, thus a molecule is formed. Sulfate and potassium ions are spectators. Again, the 2's that show up in the overall and ionic equation will drop out of the net ionic equation.)

Writing Net Ionic Equations – Single Replacement

For each problem, write the net ionic equation. Remember that on the AP exam you may only use the periodic table. No solubility chart. Assume that the reaction does occur, thus if you can recognize the single replacement reaction, you do not need to check the activity series. Look for extra information embedded in the question.

1. A strip of magnesium is added to a solution of silver nitrate.

2. Aluminum metal is dropped into an solution of zinc chloride.

3. Solid silver is dropped into an solution of gold(II) nitrate.

4. Aluminum foil is dropped into a solution of nitric acid.

5. Solid barium is added to chlorous acid.

6. Potassium metal is dropped into water.

7. Chromium(II) nitrate solution is combined with iron(III) nitrate solution.

8. Iron(II) nitrate solution is mixed with cobalt(III) chloride solution.

9. Liquid bromine is added to an aqueous sodium iodide solution.

10. Hydrogen gas is passed over hot copper(II) oxide.

11. Small chunks of solid sodium is added to water.

12. Magnesium metal is added to a dilute solution of nitric acid.

Writing Net Ionic Equations – Double Replacement

For each problem, write the net ionic equation. Remember that on the AP exam you may only use the periodic table. No solubility chart. Assume that the reaction does occur, thus if you can recognize the double replacement reaction, you should be able to infer the precipitate. Look for extra information embedded in the question.

13. Aqueous solutions of zinc sulfate and sodium phosphate are mixed.

14. Hydrofluoric acid is combined with a solution of lead (II) nitrate.

15. An aqueous solution of lead (II) acetate reacts with hydrochloric acid.

16. Solid sodium carbonate is stirred into hydrobromic acid.

17. Nitric acid is reacted with an aqueous solution of calcium acetate.

18. Hydrochloric acid is poured over powdered potassium carbonate.

19. An aqueous solution of cadmium chloride is reacted with an aqueous solution of potassium phosphate.

20. A solution of hydrofluoric acid is poured over barium carbonate crystals.

21. Hydroiodic acid is poured over potassium carbonate.

22. A solution of sodium hydroxide is poured into a solution of magnesium chloride.

Atomic and Chemical Composition

1. Complete the following table.

Symbol	Atomic #	Mass #	# of protons	# of electrons	# of neutrons	Charge
				21	24	0
	15	31		18		
C		13				
		35	17			-1
Fe^{3+}		58		23		

2. Write complete electron configurations for the following atoms.
   a. S

   b. Zr

   c. P^{3-}

   d. Cr^{2+}

3. Write noble gas notation electron configurations for the following atoms.
   a. Ge

   b. Pb

4. Bismuth subsalicylate, is the active ingredient in Pepto-Bismol which is used to treat upset stomachs. This chemical has the formula $C_7H_5BiO_4$.

    a. Calculate the percent composition of bismuth subsalicylate.

    b. If each tablet of the medication contains 262 milligrams of $C_7H_5BiO_4$ calculate the mass of bismuth in 2 tablets.

5. Determine the empirical and molecular formula of benzene which contains only carbon and hydrogen and is 7.74% hydrogen by mass. The molar mass of benzene is 78.1 g/mol.

6. 6.394 g of compound used as a drying agent is analyzed and determined to be 2.788 g phosphorus and 3.606 g oxygen. The molar mass is approximately 284 g/mol. Determine the empirical and molecular formulas of this compound. What is the name of this compound.

Stoichiometry

1. Solutions of nickel(II) chloride and potassium phosphate will react to produce a light green precipitate .
   a. Write a balanced overall chemical equation to represent this reaction.

   b. What mass of potassium phosphate in solution would be required to react completely with 0.875 g of nickel(II) chloride in solution?

   c. Calculate the theoretical mass of nickel(II) phosphate that could be produced.

   d. Convert the overall equation to the net ionic equation.

2. Gallium metal reacts with perchloric acid. *Assume that at room conditions, 24.0 L is the volume of 1.00 mole of gas.*
   a. Write both overall and net ionic balanced equations to represent this reaction.

   b. If 2.25 L of hydrogen gas were collected, what mass of gallium metal was dropped into the acid solution?

3. Aluminum will cause copper to reduce from a solution of copper (II) chloride.
   a. Write a balanced net ionic chemical equation to represent this reaction.

   b. Is 5.00 g of aluminum enough aluminum to reduce all of the copper (II) ions from 750. ml of a 0.500 M solution?

   c. If 5.00 g of aluminum is more than enough, what mass would be left over? OR if 5.00 g of aluminum is not enough, what is the additional mass of aluminum that would be needed to remove all of the copper(II) ions from solution?

4. Hydrochloric acid reacts with solid magnesium hydroxide.
   a. Write a balanced overall chemical equation to represent this reaction.

   b. What volume, in milliliters, of 0.25 M hydrochloric acid solution would be required to completely react with 4.56 g of magnesium hydroxide?

   c. Convert the balanced overall equation to a net ionic equation.

5. 1.65 g of zinc is dropped into 150. ml of 0.250 M of hydrobromic acid.
    a. Write both overall and net ionic balanced chemical equations to represent this reaction.

    b. Which reactant is the limiting reactant in this chemical reaction?

    c. Calculate the theoretical mass of solid zinc bromide that should be produced.

    d. If Consuela and Pete were able to produce 3.67 g of the zinc bromide, what is their percent yield?

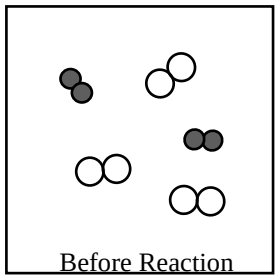
6. Eldon and Sally were preparing a sulfuric acid solution for a lab and they needed 500. ml of 0.045 M.
    a. Calculate the volume of 3.0 M solution that Eldon and Sally should measure out into the 500. ml volumetric flask.

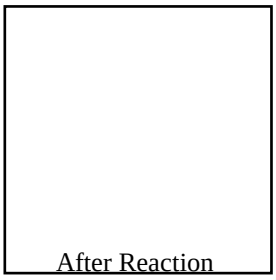
    b. What is the molarity of H^+ ions for the solution that Eldon and Sally prepared?

Particulate Diagrams

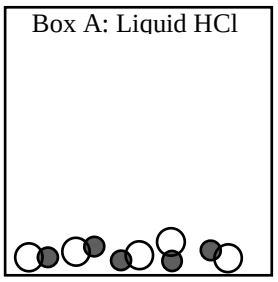
1. The picture shown to the right is a representation of a mixture of hydrogen and oxygen molecules that can be sparked to produce water. Draw a sketch that represents the resulting mixture after the reaction goes to completion.

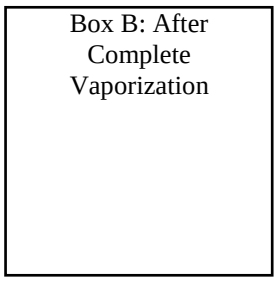
   Hint: write a balanced chemical equation first. Decide which molecule best represents oxygen and which best represents hydrogen.





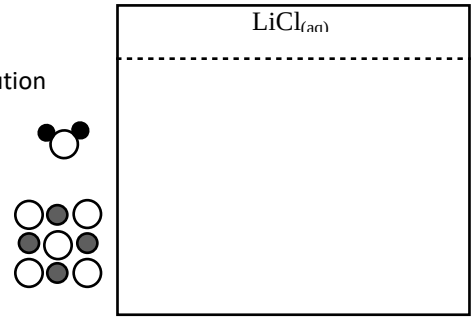
2. Draw a sketch that represents five molecules of HCl in the liquid state is shown in Box A below. In Box B, draw a representation of the five molecules of HCl after complete vaporization has occurred.





3. A solid lithium chloride crystal is represented to the left of the box below. In the box, show the interactions of the components of a lithium chloride crystal dissolved in water by making a drawing that represents the different particles present in the solution. Include only **one formula unit** of lithium chloride and at least three, but no more than five molecules of water. Your drawing must include the following details.

- identify the ions (symbol and charge)
- the proper arrangement and orientation of the particles in the solution



$N_2 + 3\ F_2 \rightarrow 2\ NF_3$

4. The picture shown to the right is a representation of a mixture of ammonia and hydrogen molecules that is a result of the completion of the reaction between N_2 and H_2 as shown in the equation above. In the box on the left, draw the particle-level representation of the reactant mixture of N_2 and H_2 that would yield the product mixture shown in the box on the right. In your drawing, represent nitrogen atoms and hydrogen atoms as shown below