You have mastered this topic when you can:

1) define these terms: **MATTER**, **PURE SUBSTANCE**, **HOMOATOMIC**, **HETEROATOMIC**, **MIXTURE**, **SUSPENSION**, **MECHANICAL MIXTURE**, **SOLUTION**, **SOLVENT**, **SOLUTE**, **AQUEOUS SOLUTION**, **DISSOCIATION**, **INTERMOLECULAR FORCE**, **SATURATED SOLUTION**, **UN-SATURATED SOLUTION**, **IONIC DISSOCIATION**, **MOLECULAR DISSOCIATION**, **IONIZATION**.
2) determine whether or not an ionic compound is ***soluble*** or has ***low solubility*** using the ***Solubility of Ionic Compounds Chart***.
3) write ***dissociation equations*** for ***ionic*** and ***molecular solutes*** when in ***aqueous solution***.

CLASSIFYING MATTER

I) **RECALL** that ***MATTER is anything that has mass and occupies space***. ***Matter*** exists in two general categories: **PURE SUBSTANCES** and **MIXTURES**.

A) ***A PURE SUBSTANCE is a form of matter composed of only one kind of particle (atom, ion, compound or molecule).***

1) **e.g.** Gold is a ***pure substance*** because it is composed of only one kind of particle, Au atoms. Sodium chloride is a ***pure substance*** because it is composed of only repeating units having the formula NaCl. Sucrose (table sugar) is a ***pure substance*** because it is composed of one kind of molecule, each having the formula $C_{12}H_{22}O_{11}$.
2) Since a ***pure substance*** is composed of many copies of the same particle, each having the same formula, every particle of a pure substance is identical and thus each particle has identical properties. This means all samples of a ***pure substance*** share the same properties.
   e.g. All samples of water (H_2O) are liquid at SATP, have a boiling point of 100°C, have a freezing point of 0°C and have a density of 1.0 g/mL. All samples of sodium chloride (NaCl) are solid at SATP, have a melting point of 801°C, and have a boiling point of 1413°C.
3) There are two kinds of ***pure substances***: **ELEMENTS** and **COMPOUNDS**. The particles in a ***pure substance*** are **HOMOATOMIC** or **HETEROATOMIC**.
   a) ***ELEMENTS are pure substances that are HOMOATOMIC. HOMOATOMIC means the particles of the sample consist of only one kind of atom.***
      e.g. $Zn_{(s)}$, $Ag_{(s)}$, $Sn_{(s)}$, $Ar_{(g)}$, $H_{2(g)}$, $O_{2(g)}$, $P_{4(s)}$, $S_{8(s)}$
   b) ***COMPOUNDS are pure substances that are HETEROATOMIC. HETEROATOMIC means the particles of the sample consist of two or more different kinds of atoms.***
      e.g. $H_2O_{(l)}$, $NaCl_{(s)}$, $C_{12}H_{22}O_{11(s)}$, $Al_2(SO_4)_{3(s)}$, $NH_4C_2H_3O_{2(s)}$, $Na_2O_{(s)}$, $CO_{2(g)}$, $H_2SO_{4(l)}$

B) ***A MIXTURE is a form of matter composed of two or more different kinds of particles (atoms, ions, compounds or molecules).***

1) **e.g.** Sugar water is a ***mixture*** because it is composed of sucrose ($C_{12}H_{22}O_{11(aq)}$) molecules mixed with water ($H_2O_{(l)}$) molecules. Air is a ***mixture*** because it is composed of many different kinds of element and compound particles including $N_{2(g)}$, $O_{2(g)}$, $H_2O_{(l\ \&\ g)}$, $CO_{2(g)}$, and $Ar_{(g)}$ mixed together. Coffee is a ***mixture*** because it is composed of the molecule $H_2O_{(l)}$ with hundreds of different substances including flavour and colour particles mixed together.
2) Since a ***mixture*** is composed of two or more different kinds of particles, and each different kind of particle has its own unique set of properties, the properties of a ***mixture*** are variable. This means that different samples of a given ***mixture*** can and often do have different properties.
   a) **e.g.** Air is a ***mixture*** that surrounds the entire earth. A sample of air from over Langley and a sample of air from over the Sahara desert are composed of the same kinds of particles ($N_{2(g)}$, $O_{2(g)}$, $H_2O_{(l\ \&\ g)}$, $CO_{2(g)}$, $Ar_{(g)}$, etc.) but in differing amounts: A sample of air from over Langley contains many more gaseous water molecules than a sample of air from over the Sahara desert. As a result a sample of air from over Langley has different properties such as being more humid than a sample of air from over the Sahara desert.
   b) **e.g.** Coffee is a common ***mixture*** consumed by people. Strong coffee has more colour, flavour, etc. particles dissolved in water than weak coffee made from the same coffee grounds.

3) There are three kinds of ***mixtures***: **SOLUTIONS**, **SUSPENSIONS** and **MECHANICAL MIXTURES**. ***Mixtures*** are classified based on their appearance.

   a) ***SOLUTIONS are mixtures that appear as a single substance that is clear.*** **NOTE:** It is important to be aware that clear does not mean colourless: **i.e.** Apple juice is yellow in colour and is clear because one can see clearly through it.
      e.g. Apple juice, bottled water, tap water, coffee, tea, pop, iced tea from crystals, orange juice from crystals, and clean cloudless and fogless air
      i) ***Solutions*** are clear because the particles they are composed of are atoms, ions, molecules and or compounds which are small enough that light can pass by them, and thus through the ***solution*** unobstructed.
   b) ***SUSPENSIONS are mixtures that appear as a single substance that is cloudy, murky or milky.***
      e.g. milk, muddy water, blood, whipped cream, and air that is foggy, cloudy or dusty
      i) ***Suspensions*** are cloudy or murky because some of the particles they are composed of are large enough to interfere with light passing through them.
      ii) Given time, ***suspensions*** can separate as the larger more massive particles being subject to the pull of gravity and will settle at the bottom of the container as can be observe in samples of fresh squeezed orange juice, tomato juice and V-8 juice. The glass of orange juice in the above image is a suspension as evidenced by it not being clear.
   c) ***MECHANICAL MIXTURES are mixtures that have different parts that can be clearly seen.***
      e.g. granola, a bowl of mixed nuts, a child's toy box, concrete, freshly squeezed orange juice, tomato juice, V-8 juice

4) **Required Practice 1:** State whether the substances are solutions or not solutions. **{Ans. are on page 6.}**

1. Fresh-squeezed orange juice	**4.** an antique bronze dagger	**7.** humid air
2. white vinegar	**5.** a stainless steel knife	**8.** a cloud
3. apple juice	**6.** an old lead water pipe	**9.** a dirty puddle

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SOLUTIONS

I) ***A SOLUTION is a HOMOGENEOUS mixture of one or more SOLUTES dissolved in a single SOLVENT.***
   A) ***A SOLUTE is the substance dissolved in solution. A SOLVENT is the medium in which the solute is dissolved.*** See TABLE 1 below.

TABLE 1: Examples of *Solutions* and their component *Solvent* and *Solute(s)*.

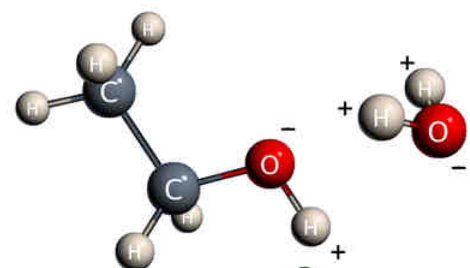
SOLUTION	SOLVENT	SOLUTE
Hydrochloric acid [Figure 3, pg.267]	Water, $H_2O_{(l)}$	$HCl_{(aq)}$
Tincture of iodine [Figure 2, pg.267]	Ethanol (**al**cohol)	$I_{2(al)}$
Air	Nitrogen gas ($N_{2(g)}$)	$O_{2(g)}$, $CO_{2(g)}$, $H_2O_{(g)}$, $Ar_{(g)}$, etc.
Tap water	Water, $H_2O_{(l)}$	$O_{2(aq)}$, $NH_2Cl_{(aq)}$ (chloramine), etc.
Iced tea	Water, $H_2O_{(l)}$	$C_{12}H_{22}O_{11(aq)}$, colour & flavour particles, etc.
Coffee	Water, $H_2O_{(l)}$	$C_8H_{10}N_4O_{2(aq)}$ (caffein), colour & flavour particles, etc.
pop	water	$CO_{2(g)}$, colour & flavour particles, etc.
Gasoline [Figure 1, pg.266]	Liquid octane	5 to 12 C atom Hydrocarbons, additives, etc.
Stainless steel [Table 4, pg.134]	$Fe_{(s)}$	$Cr_{(s)}$, $Ni_{(s)}$, $C_{(s)}$, $P_{(s)}$, $S_{(s)}$, $Si_{(s)}$
18K yellow gold [Table 4, pg.134]	$Au_{(s)}$	$Ag_{(s)}$, $Cu_{(s)}$
14K yellow gold [Table 4, pg.134]	$Au_{(s)}$	$Ag_{(s)}$, $Cu_{(s)}$
Dental Amalgam	$Ag_{(s)}$	$Hg_{(s)}$

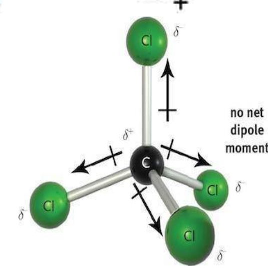
1) As **TABLE 1** above illustrates, all ***solutions*** contain a ***solvent*** and at least one ***solute***. Also, ***solutions*** exist as solids (alloys), liquids and gasses.
2) *A **solution** is a **homogeneous** mixture.* ***Homogeneous*** means that every sample of the ***solution*** contains the *same* relative amounts of ***solute*** and ***solvent particles*** spread evenly throughout each other. ***Solutions*** contain particles that are atoms, ions and or molecules, which are small enough to mix very well and are thus spread evenly throughout the ***solution***. **i.e.** When 0.1 mol of sucrose (table sugar) is dissolved in 1.0 L of water creating a sucrose ***solution***, every 1.0 mL of the ***solution*** contains the same number of sucrose molecules and the same number of water molecules, thus every 1.0 mL of the ***solution*** has the same composition and thus has the same properties.
3) ***Suspensions*** and ***mechanical mixtures*** are ***heterogeneous***. ***Heterogeneous*** means the components of the ***mixture*** are not spread evenly throughout the ***mixture***. Fresh squeezed orange juice is a ***heterogeneous mixture*** because its component parts are not at the molecular or atomic level and thus they cannot be spread evenly throughout the ***mixture*** resulting in parts of the ***mixture*** that have more pulp than others.
4) **Required Practice 2:** Classify these mixtures as heterogeneous or homogeneous. **{Ans. are on page 6.}**

1. Fresh-squeezed orange juice	**4.** an antique bronze dagger	**7.** humid air
2. white vinegar	**5.** a stainless steel knife	**8.** a cloud
3. apple juice	**6.** an old lead water pipe	**9.** a dirty puddle

B) ***SOLVENTS***

1) There are two kinds of ***solvents***: **POLAR SOLVENTS** and **NON-POLAR SOLVENTS**.
   a) All ***polar solvents*** such as water [right-hand diagram] and ethyl alcohol [left-hand diagram], have oppositely charged ends (or corners), thus they are highly attracted to each other and to ***polar solutes***. Water [right-hand diagram] is the most common ***polar solvent*** and is often referred to as the ***universal solvent***.

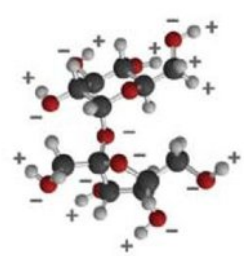




   b) All ***non-polar solvents*** such as carbon tetrachloride, ‘octane’ in gasoline and benzene, do not have oppositely charged ends, thus their attraction to each other and to the ***solute*** particles they are mixed with is very weak.

C) ***SOLUTES***

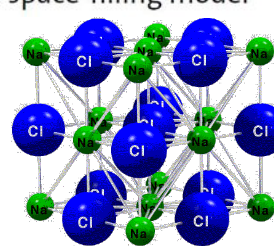
1) There are three kinds of ***solutes***: **POLAR SOLUTES**, **NON-POLAR SOLUTES**, and **IONIC SOLUTES**.
   a) All ***polar solutes*** such as sucrose (table sugar), glucose [see the diagrams below] and alcohol, have oppositely charged ends, thus they are highly attracted to each other and to the ***polar solvent*** molecules they are mixed with.



Sucrose ball-and-stick model

Sucrose space-filling model

   b) All ***non-polar solutes*** such as carbon dioxide and hydrocarbons, do not have oppositely charged ends, thus their attraction to each other and to the ***solvent*** particles they are mixed with is weak.



   c) All ***ionic solutes***, such as sodium chloride and potassium nitrate, are composed of cations and anions, which are highly attracted to each other and often times to the ***polar solvent*** they are mixed with. See the model of sodium chloride, NaCl, to the right.

II) **EXPLAINING AQUEOUS SOLUTIONS**

A) As illustrated in **TABLE 1** found on page 2 above, ***solutions*** exist in all three phases (states): solid, liquid and gas. Chemistry 11 focuses on ***solutions*** in the liquid phase having water as the ***solvent***. ***Solutions*** having water as the ***solvent*** are known as ***aqueous solutions***.

1) ***An AQUEOUS SOLUTION is a clear solution having water as the solvent.***

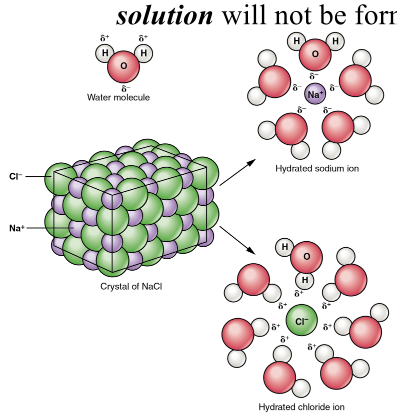
B) An ***aqueous solution*** forms as a result of the interaction between ***solute*** particles and ***solvent water molecules***. **RECALL** that the attraction between particles is called the ***intermolecular force*** [See Topic 25].

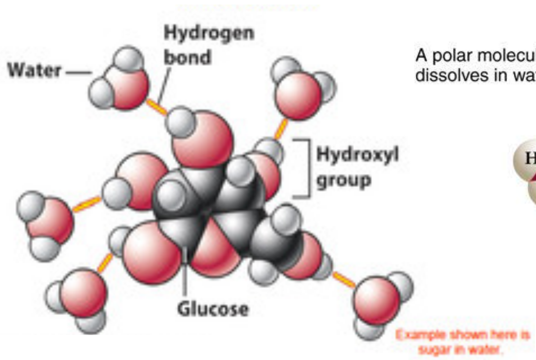
1) If the ***intermolecular force*** (the attraction between particles) between the ***solvent water molecules*** and ***solute particles*** is stronger than the ***intermolecular force*** between the ***solute particles*** or between the ***solvent particles***, the ***solute particles*** will dissolve in and spread evenly throughout the ***solvent water molecules*** and a ***solution*** will be formed. When ***solute particles*** are more attracted to the ***solvent water molecules***, they become surrounded by the ***solvent water molecules*** and become ***dissociated***, dispersed, spread evenly, throughout the ***solvent particles*** creating a ***homogeneous solution***.

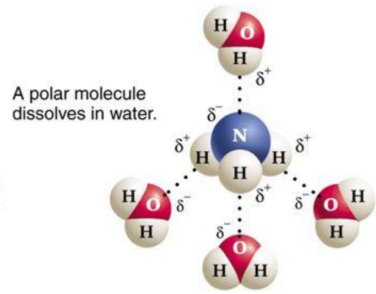
a) When a ***solute*** dissolves into a ***solvent***, its particles, atoms, ions or molecules fit within the spaces between the ***solvent water molecules***

2) If the ***intermolecular force*** (the attraction between particles) between the ***solvent water molecules*** and ***solute particles*** is weaker than the ***intermolecular force*** between the ***solute particles*** or between the ***solvent particles***, the ***solute particles*** will not interact with the ***solvent water molecules*** and thus will not dissolve in and spread evenly throughout the ***solvent water particles***. As a result, a ***solution*** will not be formed.

3) When ***polar molecules*** are mixed with ***non-polar molecules***, the ***intermolecular forces*** (the attraction between particles) between the ***polar molecules*** are stronger than they are between the ***polar molecules*** and the ***non-polar molecules***. As a result, the ***polar solutes*** do not mix with the ***non-polar solvents*** and a ***solution*** will not be formed.







4) When an ***ionic compound*** is mixed with ***non-polar molecules***, the ***intramolecular forces*** (the attraction within particles) within the ***ionic compound*** are stronger than the ***intermolecular forces*** between the ***ionic compound's ions*** and the ***non-polar molecules***. As a result, ***ionic compounds*** do not mix with ***non-polar solvents*** and a ***solution*** will not be formed.

C) **RULE FOR DISSOLVING: *LIKE DISSOLVES LIKE***

1) ***Like dissolves like*** means that:

a) ***Polar (charged) solvents*** dissolve ***polar*** and ***ionic (charged) solutes***.

b) ***Non-polar (non-charged) solvents*** dissolve ***non-polar (non-charged) solutes***.

2) **INVESTIGATION 1:** Explaining the ***dissolving rule***.

Instructions: Answer these questions. **{Answers are on page 6 of these notes.}**

a) Consider the ionic substance potassium iodide. Explain why it will dissolve in the ***polar solvent*** water but will not dissolve in ***the non-polar solvent*** carbon tetrachloride ($CCl_{4(l)}$).

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b) Consider the non-polar substance olive oil. Explain why it will not dissolve in the ***polar solvent*** water but will dissolve in the ***non-polar solvent*** carbon tetrachloride ($CCl_{4(l)}$).

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D) ***AQUEOUS SOLUTIONS*** **ARE EITHER** ***SATURATED*** **OR** ***UNSATURATED***

1) As described above, ***solute*** particles fit within the spaces between the ***solvent water molecules***.
2) ***A SATURATED SOLUTION is a solution in which all available spaces between solvent water molecules are filled with solute particles.*** Any excess ***solute*** remains as an ***un-dissolved*** solid located at the bottom of the container the ***solution*** is stored in. **i.e.** When a child adds too much sugar to their morning bowl of cereal, a sweet 'paste' at the bottom of the bowl is often created. This sweet 'paste' is composed of primarily ***un-dissolved*** solid sugar molecules.
3) ***An unsaturated solution is a solution in which all available spaces between solvent water molecules are not filled with solute particles***. As a result, more of the ***solute particles*** can dissolve within the ***solvent water molecules***. **i.e.** When a cup of coffee or tea is not sweet enough, more sugar can be mixed with it to sweeten it.

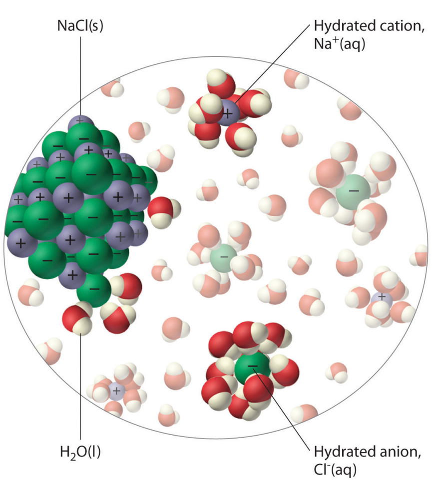
DISSOCIATION EQUATIONS

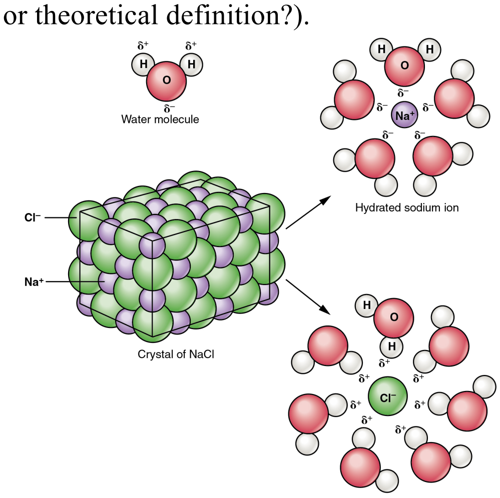
I) **RECALL** that substances are either soluble or have low solubility (see Topic 32).

A) **Required Practice 3:** Page 138: Practice #3. **{Answers are on page 6 of these notes.}**

II) **WHEN A SUBSTANCE IS** ***SOLUBLE*** **IN WATER IT UNDERGOES THE PROCESS OF** ***DISSOCIATION***. ***DISSOCIATION is the separation of solute particles as a result of their interaction with the solvent particles.*** There are three types of ***dissociation*** that ***solutes*** experience: **IONIC DISSOCIATION**, **MOLECULAR DISSOCIATION** and **IONIZATION**.

A) ***IONIC DISSOCIATION is the separation of and dispersion of ions throughout water as a result of their interaction with water molecules*** (Is this an empirical or theoretical definition?).



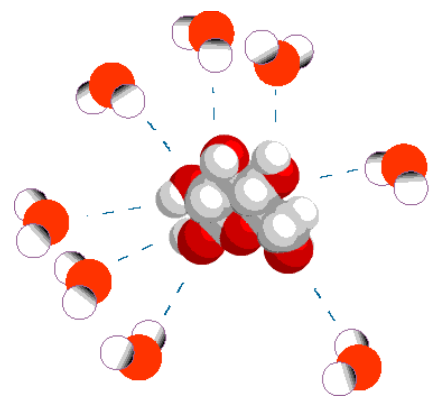


1) **Sample Problems:** Write ***dissociation equations*** for these ionic compounds.

1. $NaCl_{(s)}$ $NaCl_{(s)} \rightarrow Na^{1+}_{(aq)} + Cl^{1-}_{(aq)}$
2. $K_2CO_{3(s)}$ $K_2CO_{3(s)} \rightarrow 2K^{1+}_{(aq)} + CO_3^{2-}{}_{(aq)}$
3. $Li_3PO_{4(s)}$ $Li_3PO_{4(s)} \rightarrow 3Li^{1+}_{(aq)} + PO_4^{3-}{}_{(aq)}$

2) **NOTICE** that when an ionic compound ***dissociates***, it breaks apart resulting in the separation of every one of its ions. This often results in multiple copies of each type of ion existing in the ***solution*** as illustrated by **Sample Problems** 2 and 3.

B) ***MOLECULAR DISSOCIATION is the separation of and dispersion of individual molecules throughout water as a result of their interaction with water molecules*** (Is this an empirical or theoretical definition?). See the diagram to the right.



1) **Sample Problems:** Write dissociation equations for these molecular compounds.

1. $C_2H_5OH_{(l)}$ $C_2H_5OH_{(l)} \rightarrow C_2H_5OH_{(aq)}$
2. $C_6H_{12}O_{6(s)}$ $C_6H_{12}O_{6(s)} \rightarrow C_6H_{12}O_{6(aq)}$
3. $C_{12}H_{22}O_{11(s)}$ $C_{12}H_{22}O_{11(s)} \rightarrow C_{12}H_{22}O_{11(aq)}$

2) **NOTICE** that when a molecular compound ***dissociates***, its molecules remain intact as they separate from each other.

C) ***Ionization*** is the process of an acid ***dissociating*** in water. **RECALL** that acids are molecular compounds that when ***dissolved*** in water produce ***solutions*** that conduct electricity. A ***solution*** is only able to conduct electricity if it contains ***dissolved*** ions. This means that when acids are mixed with water they ***dissociate*** in the same manner as ionic compounds, the acid molecules break apart to form ions which then disperse, spread evenly, throughout the water. This means that ***IONIZATION is the process of an acid producing ions in solution*** (Is this an empirical or theoretical definition?).

1) **Sample Problems:** Write ***dissociation equations*** for these acids.

1. $HCl_{(g)}$ $HCl_{(g)} \rightarrow H^{1+}_{(aq)} + Cl^{1-}_{(aq)}$
2. $HClO_{3(l)}$ $HClO_{3(l)} \rightarrow H^{1+}_{(aq)} + ClO_3^{1-}{}_{(aq)}$
3. $H_2CO_{3(l)}$ $H_2CO_{3(l)} \rightarrow H^{1+}_{(aq)} + HCO_3^{1-}{}_{(aq)}$
4. $H_3PO_{4(l)}$ $H_3PO_{4(l)} \rightarrow H^{1+}_{(aq)} + H_2PO_4^{1-}{}_{(aq)}$

2) **NOTICE** that when an acid ***dissociates***, its molecules break apart to form aqueous hydrogen ions ($H^{1+}_{(aq)}$) and a negative monatomic or polyatomic ion. **NOTICE:** As illustrated in **Sample Problems** above, acids dissociate one hydrogen ion ($H^{1+}_{(aq)}$) at a time.

D) **Required Practice 4:** Write dissociation equations for these compounds then classify the dissociation as ionic dissociation, molecular dissociation or ionization. **{Answers are on page 6 of these notes.}**

1. $BaCl_{2(s)}$	2. $HBr_{(l)}$	3. $CH_3OH_{(l)}$	4. $Fe(NO_3)_{3(s)}$	5. $NaC_2H_3O_{2(s)}$	6. $Ba(OH)_{2(s)}$
7. $AlI_{3(s)}$	8. $HF_{(g)}$	9. $SO_{3(g)}$	10. $H_2SO_{4(l)}$	11. $Sr(OH)_{2(s)}$	12. $H_3PO_{3(l)}$

ANSWERS TO THE REQUIRED PRACTICE

Required Practice 1 from page 2

1a. not a solution, it is not clear and contains chunks of orange **b.** solution, it is clear **c.** solution, it is clear **d.** solution, it is an alloy **e.** solution, it is an alloy **f.** not a solution, it is pure substance **g.** solution, it is clear **h.** not a solution, it is cloudy, not clear **i.** not a solution, it is murky, not clear

Required Practice 2 from page 3

a. Heterogeneous because its consistency is not uniform. **b.** Homogeneous because its consistency is uniform. **c.** Homogeneous because its consistency is uniform. **d.** Homogeneous because its consistency is uniform. **e.** Homogeneous because its consistency is uniform. **f.** Homogeneous because its consistency is uniform. **g.** Heterogeneous because its consistency is not uniform. **1h.** Heterogeneous because its consistency is not uniform. **1i.** Heterogeneous because its consistency is not uniform.

INVESTIGATION 1 from page 4

a. Potassium iodide will dissolve in the polar solvent water because it is composed of cations and anions that have a greater attraction for water molecules than they do themselves. Potassium iodide will not dissolve in the non-polar solvent carbon tetrachloride because it is composed of cations and anions that have a greater attraction for each other than they do the uncharged carbon tetrachloride molecules. **b.** Olive oil will dissolve in the non-polar solvent carbon tetrachloride because its molecules are non-polar and are equally attracted to the solvent carbon tetrachloride molecules. Olive oil will not dissolve in the polar solvent water because water molecules are polar and are more attracted to themselves than they are to the non-polar olive oil molecules.

Required Practice 3 from page 5

3a. soluble, $KCl_{(aq)}$ **b.** soluble, $Ca(NO_3)_{2(aq)}$ **c.** soluble, $Na_2SO_{4(aq)}$ **d.** low solubility, $AgC_2H_3O_{2(s)}$ **e.** soluble, $NH_4Br_{(aq)}$ **f.** soluble, $BaS_{(aq)}$ **g.** low solubility, $PbI_{2(s)}$ **h.** low solubility, $Ca(OH)_{2(s)}$ **i.** low solubility, $Fe(OH)_{3(s)}$ **j.** low soluble, $PbSO_{4(s)}$ **k.** low solubility, $Ca_3(PO_4)_{2(s)}$ **l.** soluble, $KMnO_{4(aq)}$ **m.** soluble, $NH_4NO_{3(aq)}$ **n.** soluble, $CoCl_{2(aq)}$ **o.** low solubility, $CaCO_{3(s)}$

Required Practice 4 from page 5

1. $BaCl_{2\,(s)} \rightarrow Ba^{2+}{}_{(aq)} + 2Cl^{1-}{}_{(aq)}$, ionic dissociation **2.** $HBr_{(l)} \rightarrow H^{1+}{}_{(aq)} + Br^{1-}{}_{(aq)}$, ionization
3. $CH_3OH_{(l)} \rightarrow CH_3OH_{(aq)}$, molecular dissociation **4.** $Fe(NO_3)_{3\,(s)} \rightarrow Fe^{3+}{}_{(aq)} + 3NO_3{}^{1-}{}_{(aq)}$, ionic dissociation
5. $NaC_2H_3O_{2\,(s)} \rightarrow Na^{1+}{}_{(aq)} + C_2H_3O_2{}^{1-}{}_{(aq)}$, ionic dissociation **6.** $Ba(OH)_{2(s)} \rightarrow Ba^{2+}{}_{(aq)} + 2OH^{1-}{}_{(aq)}$, ionic dissociation **7.** $AlI_{3(s)} \rightarrow Al^{3+}{}_{(aq)} + 3I^{1-}{}_{(aq)}$, ionic dissociation **8.** $HF_{(g)} \rightarrow H^{1+}{}_{(aq)} + F^{1-}{}_{(aq)}$, ionization
9. $SO_{3(g)} \rightarrow SO_{3(aq)}$, molecular dissociation **10.** $H_2SO_{4(l)} \rightarrow H^{1+}{}_{(aq)} + HSO_4{}^{1-}{}_{(aq)}$, ionization
11. $Sr(OH)_{2(s)} \rightarrow Sr^{2+}{}_{(aq)} + 2OH^{1-}{}_{(aq)}$, ionic dissociation **12.** $H_3PO_{3(l)} \rightarrow H^{1+}{}_{(aq)} + H_2PO_3{}^{-}{}_{(aq)}$, ionization

ASSIGNMENT

At the top of your assignment, please print **"T48 – Introducing Mixtures & Solutions", your LAST then First name, block and date**. Show all your work for questions requiring calculations; **marks will not be awarded for final answers only**. Complete these questions in the order given here. *[Marks indicated in italicized brackets.]*

1. Which of these mixtures are solutions and which are not solutions? *[4.5]*
   1. milk
   2. apple juice
   3. the gas in a helium-filled balloon
   4. pop
   5. pure water
   6. smoke-filled air
   7. silt-filled water
   8. rain water
   9. 14K gold in jewellery

2. Suppose some gasoline ran into a puddle of water.
   a. Would the gasoline dissolve in the water? What visual evidence can you use to justify your answer? *[2]*
   b. What dissolving rule did you use to predict whether the dissolving would occur? *[0.5]*
   c. Explain how the rule applies to the gasoline-water mixture? *[3]*

3. Windshield washer fluid is a mixture that contains methanol.
   a. Explain using molecular forces why methanol dissolves in water. *[2]*
   b. Draw Lewis structures of a methanol molecule and several water molecules to show the hydrogen bond interactions responsible for their ability to mix well? *[3]*
   c. Make a prediction about the relationship between the number of hydrogen bonds formed and the solubility. Explain your prediction *[2]*

4. Write dissociation equations for these solutes. *[15]*
   1. sodium fluoride
   2. sodium phosphate
   3. potassium nitrate
   4. aluminum sulphate
   5. ammonium hydrogen phosphate

5. Which of these substances will dissolve in each other. Justify your predictions. *[10]*
   1. $H_2O_{(l)}$ and $C_8H_{18(l)}$
   2. $HC_2H_3O_{2(l)}$ and $H_2O_{(l)}$
   3. $CCl_{4(l)}$ and $HCl_{(aq)}$
   4. $C_3H_7OH_{(l)}$ and $H_2O_{(l)}$
   5. $N_{2(g)}$ and $H_2O_{(l)}$

[41 marks in total]