Name_____

PRE-TEST

Directions: Circle the letter indicating whether the following statements are either true ("T") or false ("F").

T F 1. The electron is the negative charge carrier in an atom.

T F 2. An atom can only have two valence electrons.

T F 3. A covalent bond is formed between atoms when they share electrons to complete their valence energy levels.

T F 4. Hydrogen bonds are bonds formed between hydrogen atoms.

T F 5. In the water molecule, the oxygen atom is bonded to two hydrogen atoms in the shape of a "V."

T F 6. Bohr-model diagrams can be used to show how atoms bond to one another forming molecules.

T F 7. Stable atoms always have the same number of protons as electrons.

T F 8. According to the Bohr model of the atom any number of atoms can occupy a given energy level at one time.

T F 9. One of water's special qualities is that it can dissolve almost anything.

T F 10. The water molecule is said to be a polar molecule. That is one side of the molecule is slightly more positively, and the opposite side is slightly more negatively charged due to uneven charge distribution.

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Name_____

GLOSSARY

Concentration gradient – a difference in concentration of a given particle at two points in a space

Conductivity (electrical) – the ability of a substance or solution to conduct electricity

Diffusion – net movement of particles from an area of high concentration to an area of low concentration

Ion – an atom that has gained or lost one or more electrons and as a result becomes charged

Ionic bond – a chemical bond that is the result of an attraction among positive and negative ions

Ionic compound – a compound in which the components are bonded ionically; they are generally composed of metal and non-metal ions that have formed as a result of electron transfer

Molecular compound – a compound in which the components are bonded covalently; they are composed of non–metal elements sharing electrons

Polar molecule – a molecule with one slightly positive and one slightly negative end, due to uneven charge distribution, e.g., the water molecule

Precipitate – the low solubility product of a chemical reaction that occurs in solution

Solute – the substance which dissolves

Solvent – the substance in which matter is dissolved; often this is water, but many substances can act as a solvent

Valence electrons – electrons in the energy level farthest from the nucleus of an atom

Name_____

TAPPING INTO TASTE

If you dissolve salt in water and then pour the water through a coffee filter, will the water still taste salty?

Yes, filters can remove only large particles; salt ions are too small to be removed by a coffee filter. That is why the filter works! It stops coffee grounds from passing through, but allows the dissolved coffee particles to pass

Making raw water drinkable requires removing what is floating or dissolved in it. Leaves, silt, and other solids are relatively easy to remove by filtering. Dissolved substances, like the chemicals that make water hard, are more complicated to remove.

As Ms. Kongsrude described, once the suspended particles have been removed from raw water the next step is to remove hard minerals. These are dissolved ions too small to be removed by filtering, and must be removed by causing a chemical reaction.

Water is "hard" when it contains a lot of dissolved calcium and magnesium compounds. These compounds dissolve more easily in slightly acidic water (in the same way stone statues and buildings are being dissolved away by acid rain in some parts of the world). Hard minerals can be removed by making the water less acidic. This is done by adding lime, the chemical calcium oxide. The calcium and magnesium ions react with negative ions in the water to form solid compounds (called precipitates) that settle out of the water.

Some cities and towns add fluorine to their water supply to help make our teeth stronger and more resistant to cavities. Chlorine is added to kill bacteria. Finally, before being pumped to reservoirs, the water passes through charcoal and sand filters to remove any remaining dirt, bacteria, and odour.

Check your understanding of this segment by completing the following. Use the back of the sheet if necessary.

1. What are the compounds that make water hard?

2. Where do these compounds come from?

3. Why is water described as the universal solvent?

4. Do hardness ions give water a bad odor?

5. Describe a procedure that would allow you to remove dissolved salt from water.

.

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4a Name_____

ADD SALT

Using the Glossary (Blackline Master #2), review:

- the definition of "valence energy level"
- the nature of the covalent bond

Atoms can bond in one of two ways. Some atoms share valence electrons. This forms a covalent bond with the bonded atoms called a molecule.

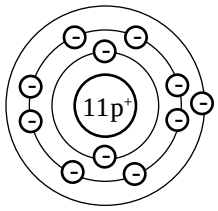
Other atoms transfer valence electrons. One atom, generally a metal, loses one or more electrons to a second atom. Losing an electron turns the metal atom into a positive ion, with the atom which gained an electron becoming a negative ion. The two ions are attracted to one another because they have opposite charges. This is an ionic bond.

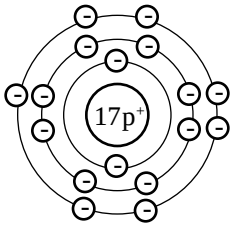
An atom which has lost or gained electrons has a charge. We call an atom with a charge an ion.

Examples

1. Using Bohr-model diagrams show the formation of an ionic bond between sodium and chlorine.

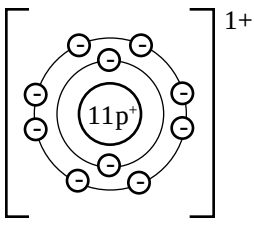
   Draw the Bohr-model diagrams of both atoms. Sodium has 11 electrons, chlorine has 17. Fill the electron energy levels starting closest to the nucleus. Remember the first energy level holds two electrons, the second and third energy levels each hold eight electrons.

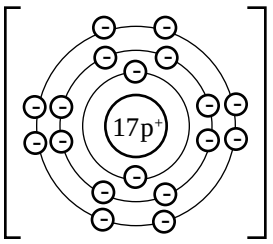
sodium atom 

chlorine atom 

You can see that sodium has a single valence electron, and chlorine has seven valence electrons. All atoms are most stable when their valence energy levels are full, or empty.

When these atoms collide, sodium becomes more stable by losing an electron. Its valence energy level is now empty. Chlorine also becomes more stable by gaining the electron – its valence energy level is now full.

sodium ion 



chloride ion

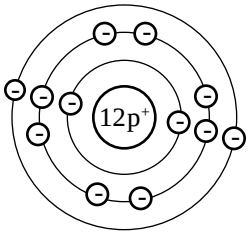
The sodium atom has become a positively charged ion, chlorine has become a negatively charged ion. Oppositely charged ions are attracted to one another – an ionic bond has formed.

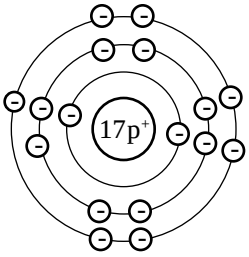
Name_____

ADD SALT

2. Predict the ratio of ions in the compound formed by magnesium and chlorine.

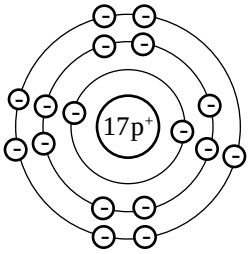
   Draw Bohr-model diagrams of the two atoms. Magnesium atoms have 12 electrons; chlorine atoms have 17 electrons.

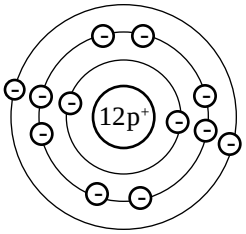
magnesium atom 

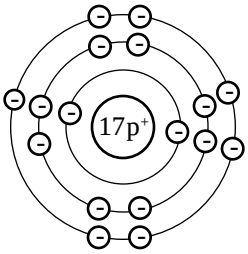


chlorine atom

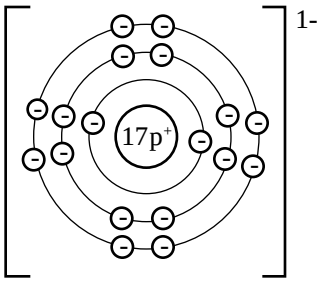
Magnesium has two valence electrons to lose, but chlorine can gain only one. So, two chlorine atoms must take one electron each from magnesium.



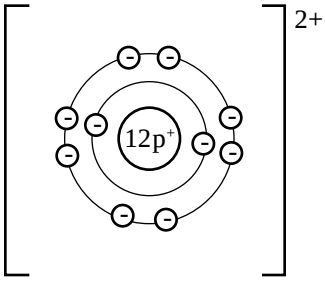




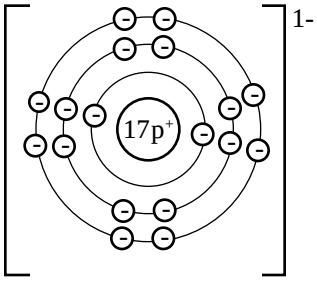
Magnesium has lost two electrons in total – it now has a charge of two positive (2+). Each chlorine atom has gained one electron, so both have a single negative charge. Two chloride ions are bonded to one magnesium ion.



chloride ion



magnesium ion



chloride ion

The ratio of ions is one magnesium ion to two chloride ions, and the formula is $MgCl_2$.

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 Name_____

ADD SALT

Check your understanding of this segment by completing the following. Use the back of the sheet if necessary.

6. What must occur for a magnesium atom to become an ion?

7. Compare a covalent bond with an ionic bond.

8. Find the number of valence electrons these atoms have by drawing Bohr-model diagrams. The total number of electrons in each atom is given.

   a. beryllium – 4 electrons
   b. oxygen – 8 electrons
   c. fluorine – 9 electrons
   d. aluminum – 13 electrons
   e. lithium – 3 electrons

9. Aluminum donates electrons when it forms ionic compounds. Does aluminum become a positive ion or a negative ion?

10. Predict the ratio of the ions when lithium reacts with oxygen to form a compound.

11. Predict the ratio of the ions when beryllium reacts with fluorine to form a compound.

12. Explain why an ionic bond will not form between lithium and beryllium.

Name_____

THE GREAT DISSOLVER

Review the structure of the water molecule and what makes it polar in your reference materials.

The polar nature of water makes it the universal solvent. Other polar molecules and charged ions attract the polar water molecules. They are surrounded by water molecules, dissolved and carried away.

Although they dissolve in the same way, ionic and molecular solutions differ. There are charged particles (the ions) in a solution made from ionic compounds. These charged particles allow for the solution to conduct electricity.

Polar molecules have both positive and negative sides, but overall they are neutral. Since solutions made from polar molecular compounds do not have free ions, they are very poor at conducting electricity. Knowing the conductivity of a solution tells us if the solute is ionic or molecular.

Example

Problem

Use the conductivity of a solution to determine whether the solute is ionic or molecular.

Hypothesis

Solutes which are ionic will form conducting solutions; molecular substances will form non-conducting solutions. Ions must be present for electricity to flow.

Data and Analysis

Compound Dissolved in Water	Measured Conductivity	Nature of Compound
none (pure water)	very low	N / A
sodium chloride	very high	
sucrose	very low	
magnesium chloride		ionic
starch		molecular
ethanol		molecular

Check your understanding of this segment by completing the following. Use the back of the sheet if necessary.

13. Complete the chart shown above by predicting the nature of the compound or the conductivity as required.

14. Why is the conductivity of pure water tested in this experiment?

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Name_____

DISSOLVING IONIC COMPOUNDS

Kinetic molecular theory (KMT) explains why diffusion happens. KMT says that all molecules, all particles, in fact, are in constant motion. It also implies that the particles of a hot substance move more quickly than those of a cold substance.

Check your understanding of this segment by completing the following. Use the back of the sheet if necessary.

15. Why does the process of diffusion occur more quickly at higher temperatures?

16. Diffusion is sometimes described as the movement of a substance down its concentration gradient. Explain the meaning of a concentration gradient.

17. Why is diffusion useful to living cells?

18. Ms. Kongsrude spoke about diffusion and dispersion in the water treatment plant. Why do they not rely upon diffusion alone in the treatment of water?

Name_____

YOUR PERSONAL WATER

In the video "Water: The Highway of Life," listen for the benefits of providing medicines directly to the bloodstream.

Check your understanding of this segment by completing the following. Use the back of the sheet if necessary.

19. What are the two solutions used when giving medication intravenously?

20. What are some benefits of an IV (intravenous) over other methods of giving medication?

21. Why must the IV (intravenous) bags be prepared in a sterile environment?

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8a Name_____

POST-TEST

MULTIPLE CHOICE

Directions: Decide which of the choices best completes the statement or answers the question, then circle the letter that corresponds to your choice. (3 marks each)

1. An atom which gains or loses an electron is

   a. an ion
   b. a molecule
   c. a compound
   d. none of the above

2. Water's ability to dissolve most substances is mostly due to

   a. hydrogen bonds
   b. the density anomaly
   c. being a molecular compound
   d. consisting of a polar molecule

3. Table salt is a compound composed of

   a. molecules of sodium chloride
   b. sodium and chlorine crystals
   c. sodium and chlorine atoms
   d. sodium and chloride ions

4. The compound most likely responsible for "hard" water is

   a. sodium hydroxide
   b. calcium carbonate
   c. methane
   d. sucrose

5. Valence electrons

   a. form hydrogen bonds
   b. are found closest to the nucleus
   c. vary in numbers form one to eight
   d. have less energy than other electrons in the atom

Name_____

POST-TEST

LONG ANSWERS

Directions: Answer the following questions in the spaces provided. Use the back of the sheet if necessary.

1. Rain water is "soft" because it has _____.
   (3 marks)

2. How can you increase the rate of dissolving a solute in a solvent? (6 marks)

3. Describe how ionic compounds form and identify the source of the bonding force. (6 marks)

4. Domestic water supplies are labeled as "hard" or "soft" depending on the number and amount of _____ compounds _
   _____ in it. (4 marks)

5. In the water molecule two hydrogen atoms and one oxygen atom form _____
   bonds by _____. (6 marks)

6. Describe the process of sodium chloride (table salt) dissolving in water. (10 marks)

7. The _____ atoms of a molecular compound _____
   to form _____ bonds. (6 marks)

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Name_____

POST-TEST

8. A glass with a sugar cube on the bottom is carefully filled with distilled water and left undisturbed. Over a period of time the cube disappeared and the water near the top tastes sweet. The sugar molecules moved to the top of the glass by _____. How did this happen without any apparent motion in the glass? (6 marks)

9. One method for testing for dissolved substances in water is an electrical conductivity test. Explain why this works for some classes of dissolved compounds and not others. Include in your answer which class of compound forms conducting solutions and which does not. (8 marks)

10. What do we mean by "moving down the concentration gradient"? (6 marks)

11. One process used by living cells to obtain oxygen, water and nutrients and remove waste materials in solution is _____. (3 marks)

12. In humans the circulatory system is the major transportation system for nutrients and wastes. That is because blood is over 80% water and most nutrients are dissolved _ _____ and _____ compounds. (4 marks)

13. Where does the salt in ocean water come from, and why does it accumulate there? (6 marks)

Name_____

POST-TEST

14. Can water, a molecular compound, dissolve other molecular compounds? (6 marks)

15. Why is intravenous delivery of substances so effective? (5 marks)

_____

What are two common reasons for the use of intravenous delivery?

_____

_____

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