**Study Guide: Chemistry Semester 1**

If you need help answering these study guide questions, check online for the notes:

<http://msrobbinspnhs.weebly.com/> or <http://mrsgonsalves.weebly.com/>

Atomic & Molecular Structure

Standard 1

Atomic number

Atomic structure

1. Draw an atomic model of

***Carbon-13***.

In the drawing include the following:

* *Location* of nucleus & electron cloud.
* *Location* of 3 subatomic particles.
* *Amount* of each subatomic particles.
* *A note* where most of the atom’s mass is found.

1. What is **atomic number**?
2. What is atomic number for the following elements?

|  |  |
| --- | --- |
| Cr | Iron |
| Carbon | Ca |

1. How does atomic number change moving left to right across the periodic table?

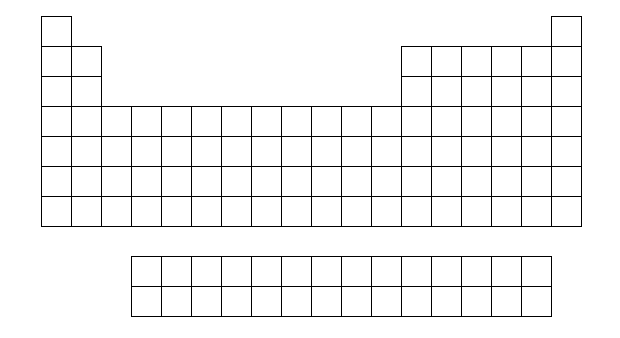
Atomic Weight (Atomic Mass)

1. What is the **atomic mass** for the following elements?

Organization of the Periodic Table

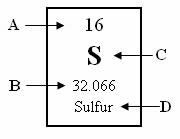
1. Identify on the periodic table below the location of

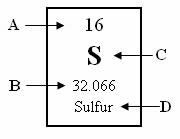
**The 3 different types of elements.**

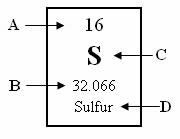


1. Where are **groups** on the periodic table?
2. Where are **periods** on the periodic table?

|  |  |
| --- | --- |
| V | Oxygen |
| Beryllium | Mn |

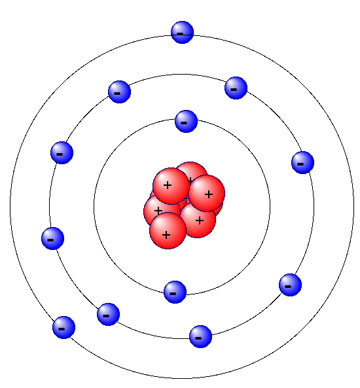


1. It was found that the periodic table was organized by increasing atomic number rather than mass. Give an example of a pair of elements where one element has a larger atomic number but a smaller atomic mass.
2. Identify the letters in the following periodic square:



Periodicity (periodic trends)

1. Atomic Radius
   * Which element has the largest atomic radius?
   * Which element has the smallest atomic radius?
2. Ionization energy
   * What is Ionization Energy?
   * Which element has the largest ionization energy?
   * Which element has the lowest ionization energy?
   * Why does ionization energy decrease moving down a group?
3. Electronegativity
   * What is Electronegativity?
   * Which element has the largest electronegativity?
   * Which element has the lowest electronegativity?
   * Why do Noble Gases tend to have no electronegativity?



Valence electrons

1. Why are alkali metals so reactive?
2. Why are halogens so reactive?
3. Identify the amount of valence electrons in each of the following:
4. How many of magnesium atom’s 12 electrons are valence electrons? Circle those electrons.

|  |  |
| --- | --- |
| Na | Phosphorus |
| Argon | He |

**Review Chemistry I: Ionic Bonding and Nomenclature**

1. Positive ions are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_. Negative ions are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. Why do chemical bonds form between atoms? (or…Why don’t atoms just stay single?)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. In an ionic bond, electrons are shared / transferred / connected between atoms. (circle one)
2. An ionic bond is a chemical bond caused by electrostatic \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_ that is formed by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons between atoms.

1. Ionic bonds form between \_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_. (metals, nonmetals, metalloids)
2. For the pairs of elements listed below, circle pairs that would likely form ionic bonds.

**C** and **H Na** and **F Hg** and **Ag Mg** and **S N** and **C K** and **O**

1. What is a polyatomic ion? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Circle the ionic compounds listed below.

**CaSO4 CH4 CO2 BaCl2 NH3 KNO3 LiOH**

1. How did you know which compounds in Question 8 above were ionic?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What are binary ionic compounds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Binary ionic compounds typically end with the suffix –\_\_\_\_\_.
3. A “formula unit” is the simplest or lowest \_\_\_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_\_\_\_ in an ionic compound.
4. How do each of the following atoms achieve a stable octet?

(circle gain or lose and write in a number of electrons)

O will gain / lose \_\_\_ electrons

Li will gain / lose \_\_\_ electrons

N will gain / lose \_\_\_ electrons

1. List the oxidation number (charge) for the following groups of elements.

Group 1 \_\_\_ Group 15 \_\_\_

Group 2 \_\_\_ Group 16 \_\_\_

Group 3 \_\_\_ Group 17 \_\_\_

1. List 3 physical properties of ionic compounds:

1. State: solid / liquid / gas (circle)

2. Melting Point: high / low (circle)

3. Conductor of electricity when \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Determine the total number of **atoms** in each formula listed below.

Li3PO4 \_\_\_\_ Ba(NO3)2  \_\_\_\_

1. Determine the total number of **ions** in each formula listed below.

Li3PO4  \_\_\_\_ Ba(NO3)2 \_\_\_\_

1. Which of the following compounds contains the Sn4+ ion?

a. Sn2Br

b. SnCI

c. SnI2

d. SnO2

1. Name the following compounds.

MgI2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Fe2O3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Al(NO3)3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ NH4Br \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

CuCO3  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ KHCO3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Ba(C2H3O2)2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ SnCl4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Write a formula for the following chemical compounds.

copper(I) oxide \_\_\_\_\_\_\_\_\_\_\_\_\_\_ ammonium nitrate \_\_\_\_\_\_\_\_\_\_\_\_\_\_

potassium phosphate \_\_\_\_\_\_\_\_\_\_\_\_\_\_ I ron(III) sulfide \_\_\_\_\_\_\_\_\_\_\_\_\_\_

calcium hydroxide \_\_\_\_\_\_\_\_\_\_\_\_\_\_ lead(II) iodide \_\_\_\_\_\_\_\_\_\_\_\_\_\_

aluminum sulfate \_\_\_\_\_\_\_\_\_\_\_\_\_\_ nickel(II) bromide ­­­ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Draw a Lewis Dot diagram for each the following ionic compounds.

NaF CaCl2 K2S

1. What is the oxidation number of the unknown element X in the compound MgX2?

a. 1–

b. 2–

c. 1+

d. 2+

**Review Chemistry I: Covalent Bonding and Nomenclature**

1. Why do atoms share electrons in covalent bonds with other atoms rather than remaining as single atoms?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. A molecule is a neutral group of atoms held together by \_\_\_\_\_\_ .

A. ionic bonds

B. unshared electrons

C. partial charges

D. covalent bonds

3. Compounds formed by covalent bonds usually contain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

A. halogens and oxygen

B. two or more nonmetals

C. a metal and a nonmetal

D. positive and negative ions

4. Which of the following is a molecular compound?

A. Na2O

B. AlCl3

C. SCl6

D. CuO

C C

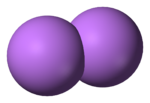
5. How do atoms form covalent double bonds?

A. One atom loses two electrons to the other atom in the bond.

B. Two atoms share two pairs of electrons.

C. Two atoms share two single electrons.

D. Two atoms share one electron.



?

?

6. Which of these elements does NOT exist as a diatomic molecule?

A. P

B. Cl

C. O

D. N

7. A bond formed between a carbon atom and hydrogen atom is likely to be \_\_\_\_.

A. single, covalent

B. double, covalent

C. ionic

D. triple, covalent

8. Which of the following bonds is the most polar (i.e. has the greatest difference in electronegativity)?

A. C—C

B. H—N

C. O—H

D. H—Cl

9. Which of the following covalent bonds is the least polar?

A. H—Cl

B. H—C

C. Cl—Cl

D. H—N

10. Which is TRUE of a nonpolar covalent bond?

A. electrons are shared unequally between atoms

B. a cation is bonded to an anion

C. electrons are transferred between atoms

D. electrons are shared equally between atoms

11. Draw the Lewis dot structure for CO2  in the box

12. Describe properties that are common in typical molecular compounds.

conductor: good or poor

melting point: high or low

boiling point: high or low

net charge: neutral or charged

**#13-18** Write the NAME or FORMULA for the following molecular compounds:

13. CS2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

14. CCI4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

15. S2O6 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

16. triboron monoxide \_\_\_\_\_\_\_

17. tetraphosphorus pentoxide \_\_\_\_\_\_\_

18. arsenic trihydride \_\_\_\_\_\_\_

19. In drawing a Lewis structure, what is special about hydrogen (H2) ?

A. It achieves an octet of 8 electrons.

B. It can form up to four bonds with 8 shared electrons.

C. It can only form one double bond.

D. It can only form one single bond with no unshared electrons around it.

**For #20-25**:

-Draw the Lewis dot structures for the following compounds.

-List how many unshared pairs of electrons are in the molecule.

20. HBr unshared pairs: \_\_\_

21. NI3 unshared pairs: \_\_\_

22. N2 unshared pairs: \_\_\_

23. Cl2 unshared pairs: \_\_\_

24. SO2 unshared pairs: \_\_\_

25. CH2F2 unshared pairs: \_\_\_

**KEY Review Chemistry I: Ionic Bonding and Nomenclature**

1. Positive ions are called cations. Negative ions are called anions.
2. The formation of chemical bonds results in the formation of a more stable electron configuration (in some cases, an octet) for atoms.
3. transferred

1. An ionic bond is a chemical bond caused by electrostatic \_***attraction***\_ between \_***cations***\_\_\_ and \_\_***anions***\_\_ that is formed by \_\_***transferring***\_\_ electrons between atoms.
2. Ionic bonds always from between \_\_***metals***\_\_ and \_\_***nonmetals***\_. (metals, nonmetals, metalloids)
3. Na & F , Mg & S , K & O
4. A group of atoms with a charge
5. CaSO4, BaCl2, KNO3, LiOH
6. metal bonded to a nonmetal or metal with a polyatomic ion
7. Ionic compound consisting of only two different elements
8. –ide
9. ratio (or combination) , ions
10. O gain 2 electrons Li lose 1 electron N gain 3 electrons
11. Group 1: 1+ Group 15: 3-

Group 2: 2+ Group 16: 2-

Group 3: 3+ Group 17: 1–

1. Ionic compounds: solid, high, melted, dissolved

1. Li3PO4 : 8 atoms Ba(NO3)2 : 9 atoms
2. Li3PO4 : 4 ions Ba(NO3)2 : 3 ions
3. D. SnO2
4. MgI2 magnesium iodide Fe2O3 iron(III) oxide

Al(NO3)3 aluminum nitrate NH4Br ammonium bromide

CuCO3 copper(II) carbonate KHCO3 potassium bicarbonate

Ba(C2H3O2)2 barium acetate SnCl4 tin(IV) chloride

1. copper(I) oxide Cu2O ammonium nitrate NH4NO3

potassium phosphate K3PO4 iron(III) sulfide Fe2S3

calcium hydroxide Ca(OH)2 lead(II) iodide PbI2

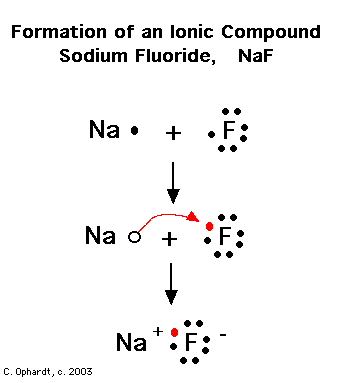
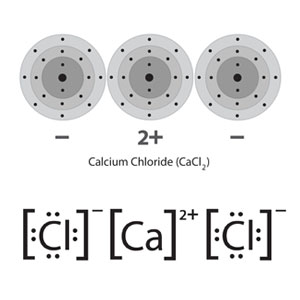
aluminum sulfate Al2(SO4)3 nickel(II) bromide NiBr2

[ ]

[ ]-

[K]+

[K]+

1. 1–

<http://hs.sharon.k12.ma.us/pages/Sharon_High_School/FACULTY_AND_STAFF/Science/6275490624862862498/Chemistry_MCAS_Exams_2004-2012>

**KEY** **Review Chemistry I Unit 6: Covalent Bonding and Nomenclature**

1. Why do atoms share electrons in covalent bonds with other atoms rather than remaining as single atoms?

Atoms form covalent bonds to **obtain more stable electron arrangements**.

2. A molecule is a neutral group of atoms held together by \_\_\_\_\_\_ .

A. ionic bonds

B. unshared electrons

C. partial charges

**D. covalent bonds**

3. Compounds formed by covalent bonds usually contain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

A. halogens and oxygen

**B. two or more nonmetals**

C. a metal and a nonmetal

D. positive and negative ions

4. Which of the following is a molecular compound?

A. Na2O

B. AlCl3

**C. SCl6**

D. CuO

C C

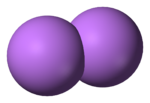
5. How do atoms form covalent double bonds?

A. One atom loses two electrons to the other atom in the bond.

**B. Two atoms share two pairs of electrons.**

C. Two atoms share two single electrons.

D. Two atoms share one electron.



6. Which of these elements does NOT exist as a diatomic molecule?

?

?

**A. P**

B. Cl

C. O

D. N

7. A bond formed between a carbon atom and hydrogen atom is likely to be \_\_\_\_.

A. polar covalent

B. dipolar

C. ionic

**D. nonpolar covalent**

8. Which of the following bonds is the most polar (i.e. has the greatest difference in electronegativity)?

A. C—C

B. H—N

**C. O—H**

D. H—Cl

9. Which of the following covalent bonds is the least polar?

A. H—Cl

B. H—C

**C. Cl—Cl**

D. H—N

10. Which is TRUE of a nonpolar covalent bond?

A. electrons are shared unequally between atoms

B. a cation is bonded to an anion

C. electrons are transferred between atoms

**D. electrons are shared equally between atoms**

11. Draw the Lewis dot structure for CO2  in the box:

http://library.thinkquest.org/C006669/media/Chem/img/lewis7e.gif

Does CO2 contain polar bonds? \_**Yes**\_ If so, how many? \_**2**\_\_

Is CO2 a polar molecule? **No** If not, explain why not. **The polar bonds are**

**arranged symmetrically and cancel out.**

12. The following molecules contain polar bonds. Which is the only nonpolar molecule?

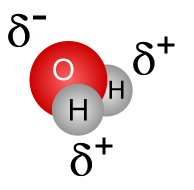
(*hint*: drawing the Lewis structures can help)

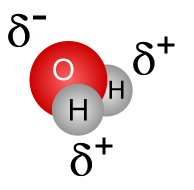
A. HCl

B. NH3

C. H2O

**D. CBr4**





water molecule

water molecule

13. Water molecules are polar because they have **polar bonds (due to different electronegativities)**

that are arranged **asymmetrically (do not cancel out).**

14. Describe properties that are common in typical molecular compounds.

conductor: good or **poor**

melting point: high or **low**

boiling point: high or **low**

net charge: **neutral** or charged

**#15-20** Write the NAME or FORMULA for the following molecular compounds:

15. CS2 **carbon disulfide**

16. CCI4 **carbon tetrachloride**

17. S2O6 **disulfur hexoxide**

18. triboron monoxide **B3O**

19. tetraphosphorus pentoxide **P4O5**

20. arsenic trihydride **AsH3**

21. In drawing a Lewis structure, what is special about hydrogen (H) ?

A. It achieves an octet of 8 electrons.

B. It can form up to four bonds with 8 shared electrons.

C. It can only form one double bond.

**D. It can only form one single bond with no unshared electrons around it.**

**For #22-27**,

-Draw the Lewis dot structures for the following compounds.

-List how many unshared pairs of electrons are in the molecule.

-Identify the molecule as polar or nonpolar by circling the correct label.

22. HBr unshared pairs: \_**3**\_

23. NI3 unshared pairs: \_**10**\_

24. N2 unshared pairs: \_**2**\_

25. Cl2 unshared pairs: \_**6**\_

26. SO2 unshared pairs: \_**6**\_

27. CH2F2 unshared pairs: \_**6**\_