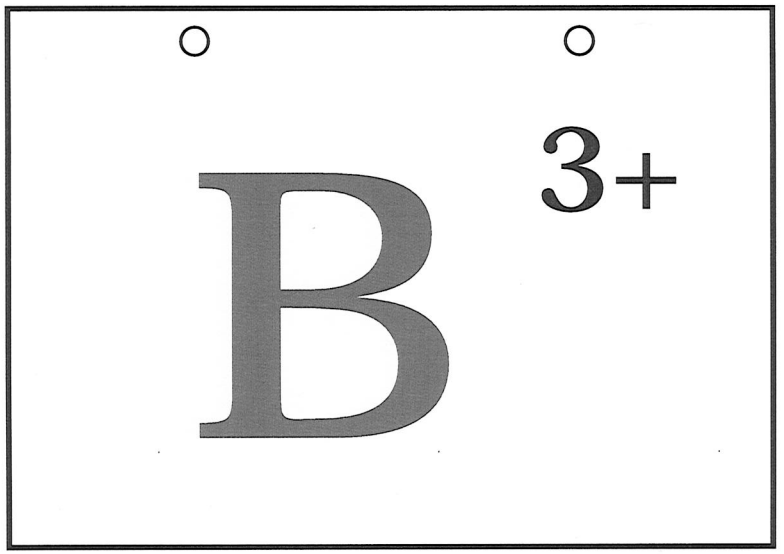
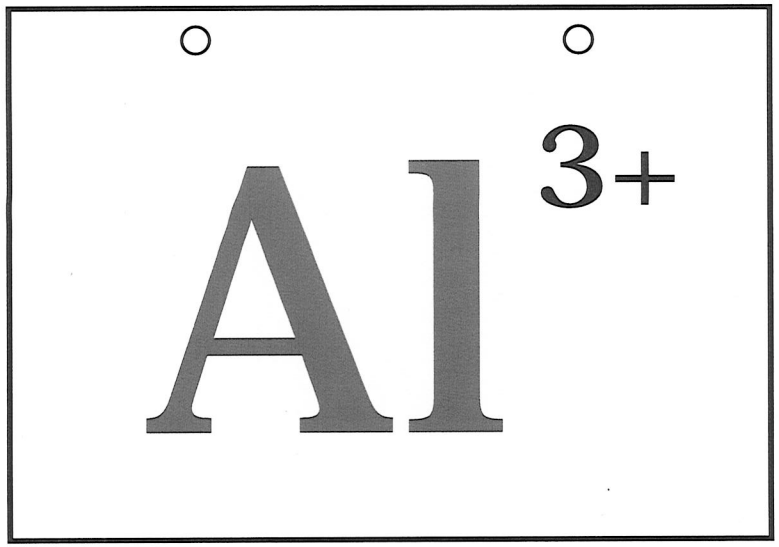
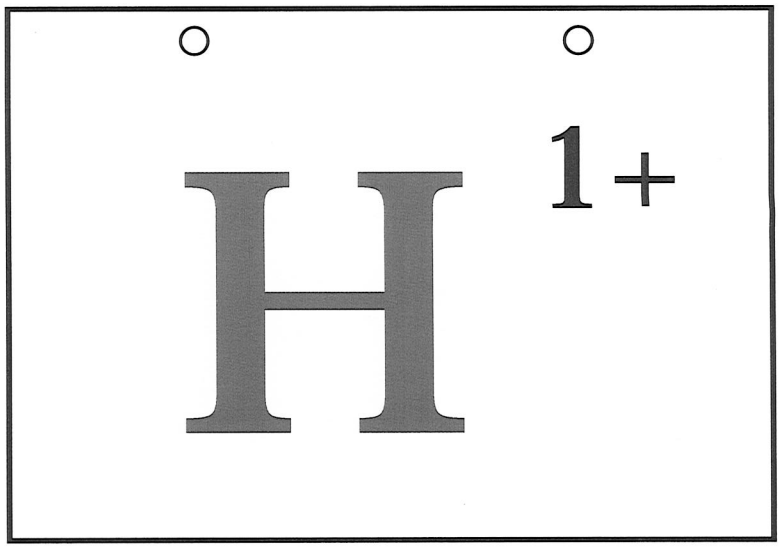
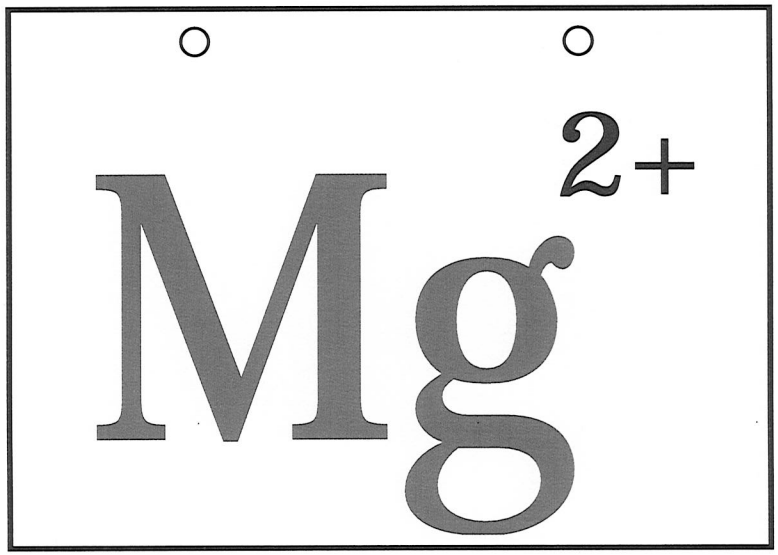
Bond with a Classmate Cards

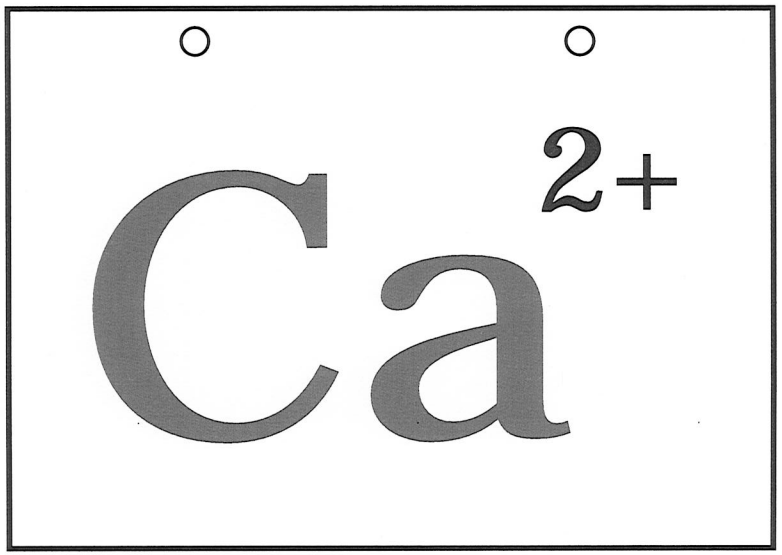
String a piece of yarn through the holes on each card to make necklaces.

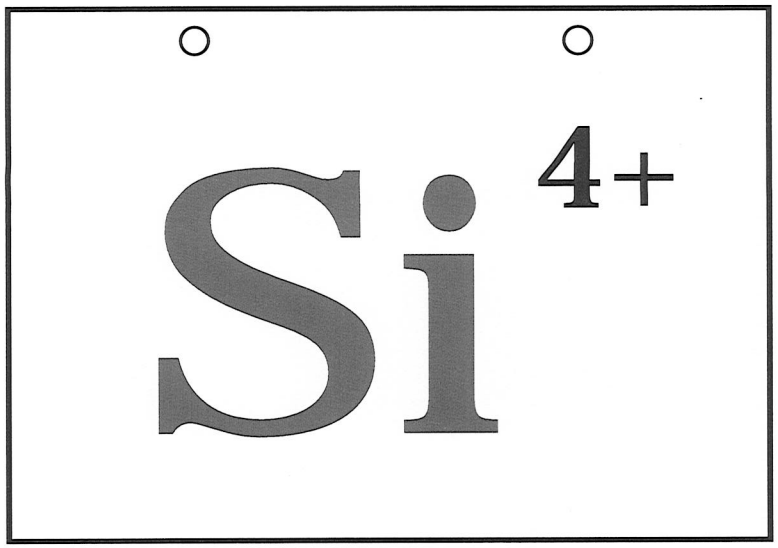


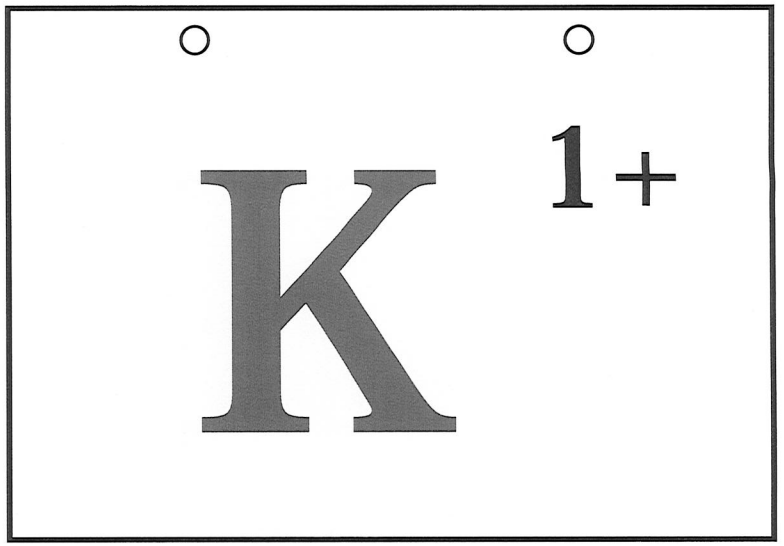


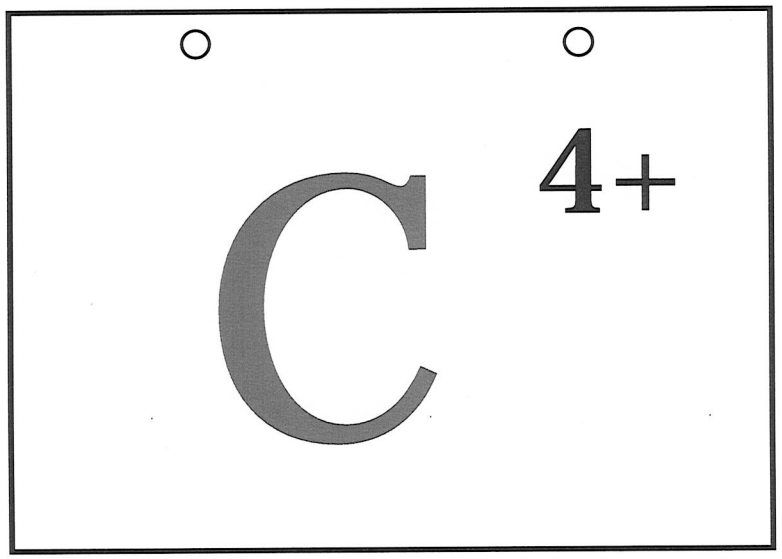


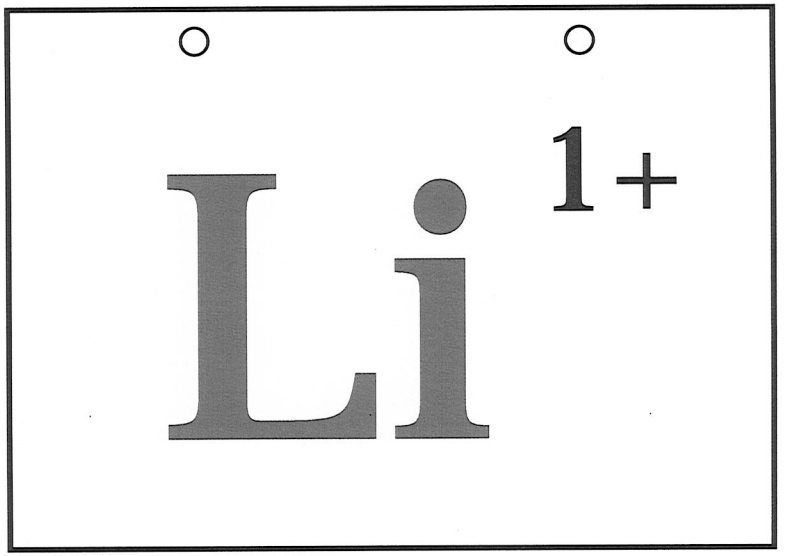

Mg^{2+}

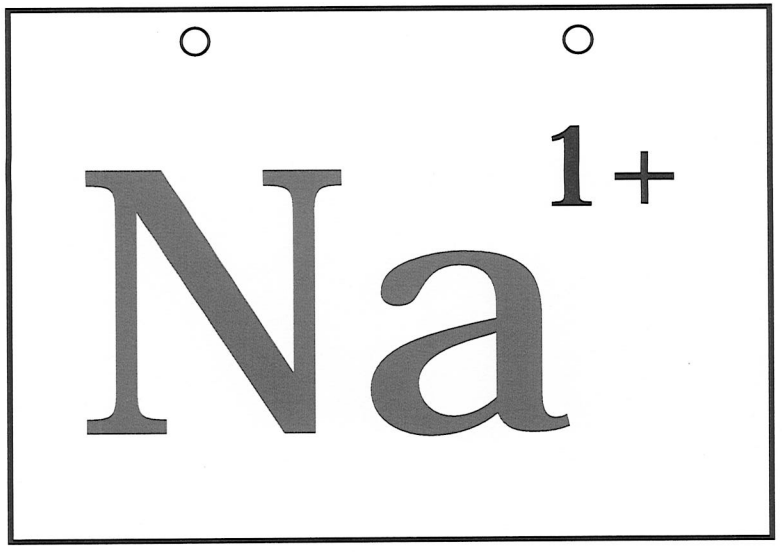

Ca^{2+}

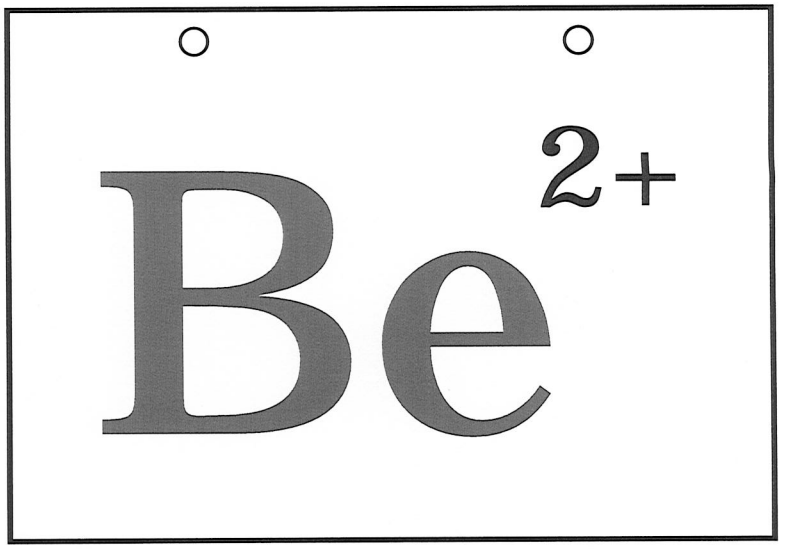

Si^{4+}

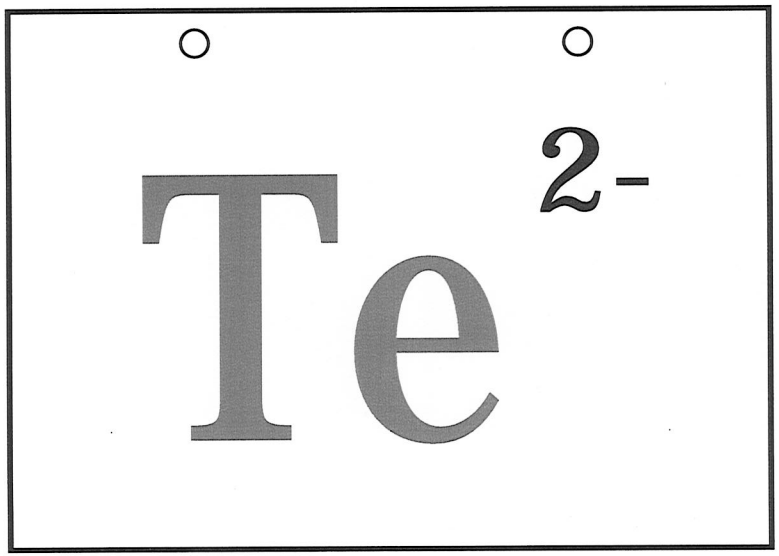

K^{1+}

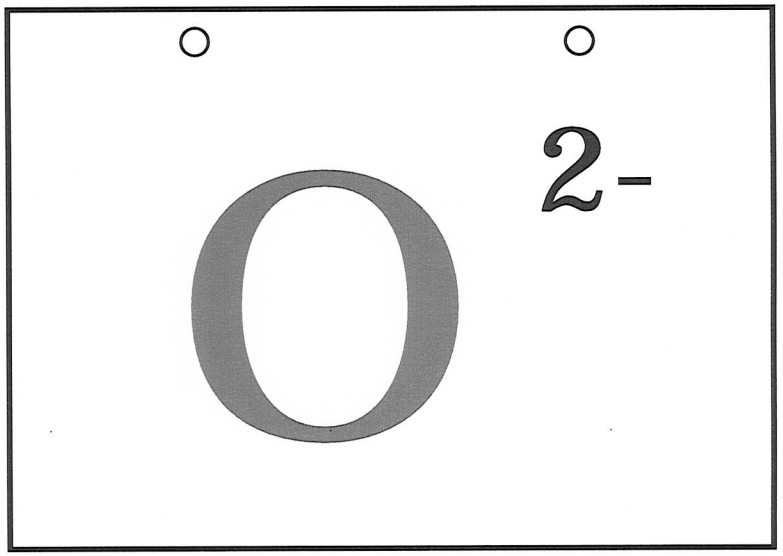

C
4+

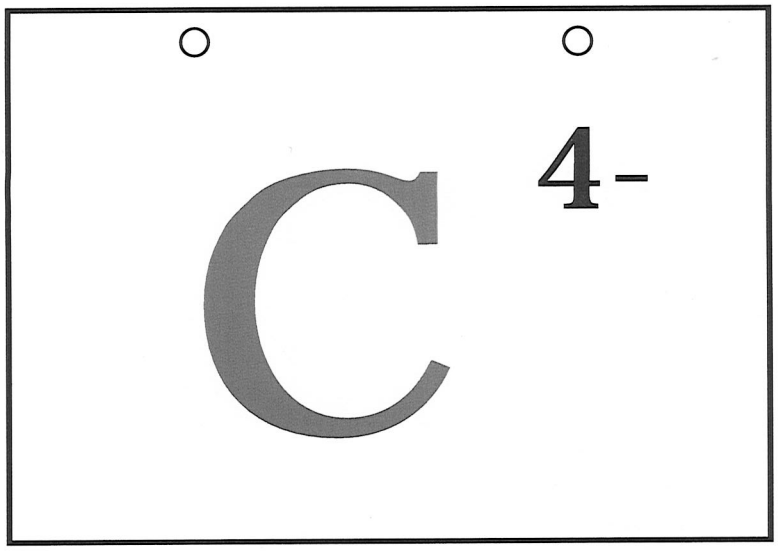

Li
1+

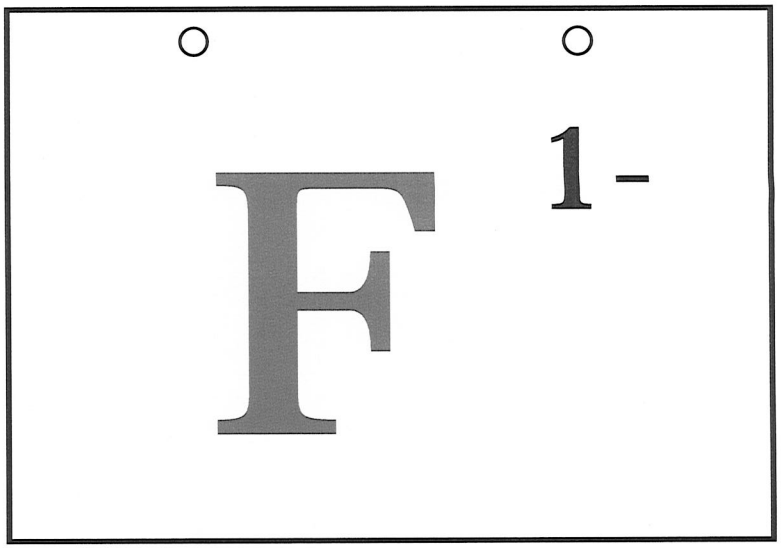

Na
1+


Be
2+


Te
2-


O
2-


C
4-


F
1-

I^{1-}

Cl^{1-}

Br^{1-}

S^{2-}

Si^{4-}

N^{3-}

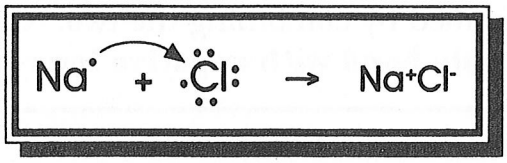
Se^{2-}

P^{3-}

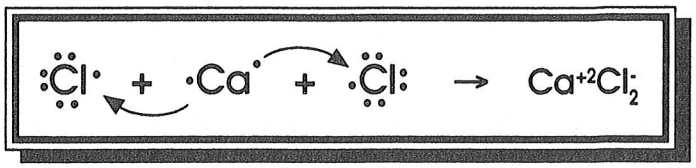
IONIC BONDING

Name _____

Ionic bonding occurs when a metal transfers one or more electrons to a nonmetal in an effort to attain a stable octet of electrons. For example, the transfer of an electron from sodium to chlorine can be depicted by a Lewis dot diagram.



Calcium would need two chlorine atoms to get rid of its two valence electrons.



Show the transfer of electrons in the following combinations.

1. K + F

Mg + I

3. Be + S

4. Na + O

5. Al + Br

Bond with a Classmate Name _____

When you find another ion with which you can bond, write in each symbol and charge. Then write the new compound formed by combining the two. Give the compound's name.
Remember - Positive ions can only bond with negative ions and vice versa!

+ Ion	- Ion	Compound	Name
Mg^{2+}	Cl^{1-}	$MgCl_2$	Magnesium Chloride

NH_4^+	$C_2H_3O_2^-$
NO_3^-	OH^-
CO_3^{2-}	CN^-
SO_4^{2-}	PO_4^{3-}

Acetate	Ammonium
Hydroxide	Nitrate
Cyanide	Carbonate
Phosphate	Sulfate

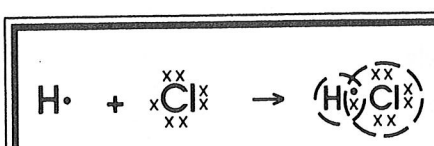
NH_4^+	$C_2H_3O_2^-$
NO_3^-	OH^-
CO_3^{2-}	CN^-
SO_4^{2-}	PO_4^{3-}

Acetate	Ammonium
Hydroxide	Nitrate
Cyanide	Carbonate
Phosphate	Sulfate

COVALENT BONDING

Name _____

Covalent bonding occurs when two or more nonmetals share electrons, attempting to attain a stable octet of electrons at least part of the time. For example:



Note that hydrogen is content with 2, not 8, electrons.

Show how covalent bonding occurs in each of the following pairs of atoms. Atoms may share one, two or three pairs of electrons.

1. H + H (H_2)

2. F + F (F_2)

3. O + O (O_2)

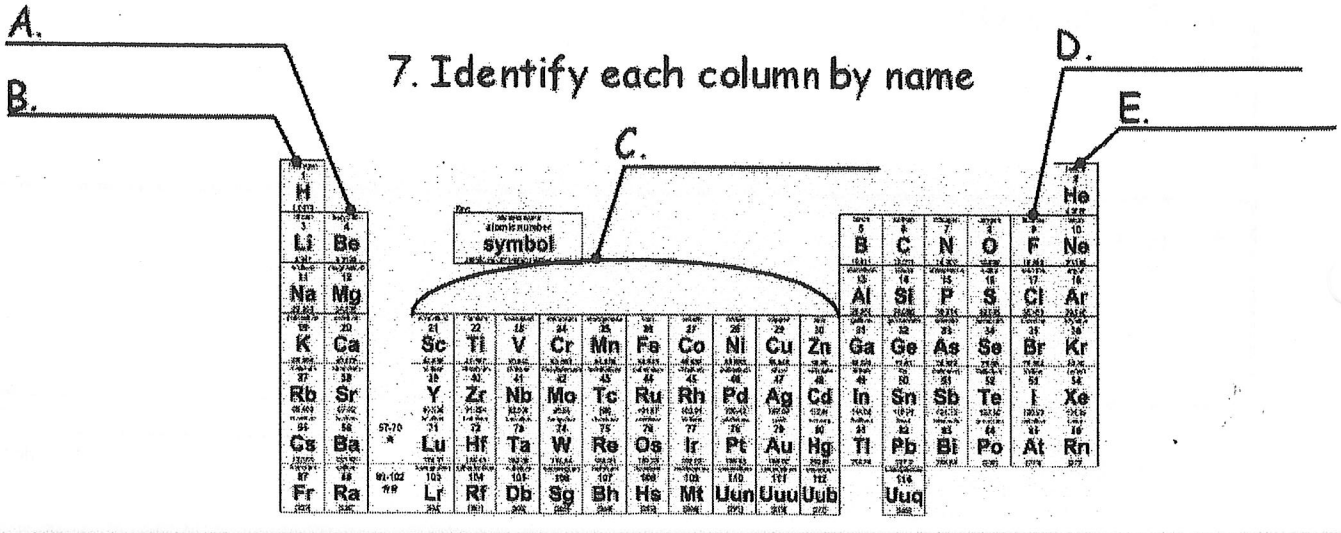
4. N + N (N_2)

5. C + O (CO_2)

6. H + O (H_2O)

PS Quiz: Ions & Bonding 6.01-6.02

1. How many valence electrons are in the following atoms:
   a. S b. Na c. Ar
2. What is the oxidation number (charge) of the following ions?
   a. Al b. F c. Mg
3. Draw and Electron Dot Diagram for Iodine.
4. When Oxygen becomes an ion does it:
   a. Gain or Lose Electrons?
   b. How Many?
   c. So what is its charge?
   d. Is it a cation or anion?
5. Label each of the following as describing an Ionic, Covalent, or Metallic Bond/Compound.
   a. Transfer/Swapping of electrons
   b. Shared pool of mobile electrons
   c. Shared pairs of electrons
   d. Conducts Electricity as a Solid
   e. Conducts electricity only when molten or in an aqueous solution
   f. Does not conduct electricity
   g. Example: NaCl
   h. Example: H_2O
   i. Example: Fe
   j. High MP & BP, Malleable, Ductile, Lustrous
   k. High MP & BP, Brittle
   l. Low MP & BP, usually gas or liquid at room temperature
   m. Metal + Nonmetal
   n. Nonmetal + Nonmetal
   o. Occurs between atoms of the same metal
6. Tell the chemical formula for the compound that forms when the following elements bond.
   a. K + O ->
   b. Mg + Cl ->
   c. Al + N ->
   d. Al + O ->
7.



TYPES OF CHEMICAL BONDS

Name _____

Classify the following compounds as ionic (metal + nonmetal), covalent (nonmetal + nonmetal) or both (compound containing a polyatomic ion).

1. $CaCl_2$ _____
2. CO_2 _____
3. H_2O _____
4. $BaSO_4$ _____
5 K_2O _____
6. NaF _____
7. Na_2CO_3 _____
8. CH_4 _____
9. SO_3 _____
10. LiBr _____
11. MgO _____
12. NH_4Cl _____
13. HCl _____
14. KI _____
15. NaOH _____
16. NO_2 _____
17. $AlPO_4$ _____
18. $FeCl_3$ _____
19. P_2O_5 _____
20. N_2O_3 _____

WRITING FORMULAS (CRISS-CROSS METHOD)

Name _____

Write the formulas of the compounds produced from the listed ions.

	Cl^-	CO_3^{-2}	OH^-	SO_4^{-2}	PO_4^{-3}	NO_3^-
Na^+						
NH_4^+						
K^+						
Ca^{+2}						
Mg^{+2}						
Zn^{+2}						
Fe^{+3}						
Al^{+3}						
Co^{+3}						
Fe^{+2}						
H^+						

VSEPR Molecule Modeling

After sketching the structural diagram, build the following molecules. <u>After you have built the molecule</u>, answer the questions for that molecule. Work as a group and help each other understand. The point of this group activity is to give each member a thorough understanding of how to draw structural diagrams and to determine VSEPR shapes. DON'T LET ANYONE ELSE DO YOUR PART AND CHEAT YOU OUT OF LEARNING!

Note: Choose carefully what color modeling piece you choose for the central atom. Only certain color center piece shapes can build certain VSEPR shapes.

1. Sketch the structural diagram for CH_4.

   Shared Pairs (around central atom): Unshared Pairs (around central atom):
   VSEPR Shape:

2. Sketch the structural diagram for NH_3.

   Shared Pairs: Unshared Pairs:
   VSEPR Shape:
   I want to see this molecule once you have it built. Be prepared to discuss/describe it! Raise your hand and I will sign off here ____.

3. Sketch the structural diagram for H_2O.

   Shared Pairs: Unshared Pairs:
   VSEPR Shape:

4. Sketch the structural diagram for BF_3.

   What is special about this molecule? It has a _____
   VSEPR Shape:

5. Sketch the structural diagram for I_2.

   Shares Pairs: Unshared Pairs:
   VSEPR Shape:

6. Sketch the structural diagram for H_2S.

   Shared Pairs: Unshared Pairs:
   VSEPR Shape: Show me, Discuss, Sign off again: _____

What is the shape of any molecule with 4 single covalent bonds?

What is the shape of any molecule with 3 single covalent bonds and 1 unshared pair?

What is the shape of any molecule with 2 double covalent bonds?

What is the shape of any molecule with 2 single covalent bonds and 2 unshared pairs?

What is the shape of any molecule with 2 single covalent bonds and one double covalent bond?

What is a coordinate covalent bond?

What is the VSEPR shape of a carbon monoxide (CO) molecule? Draw the molecule.

Covalent Bonding always occurs between a _____ and a _____.

In Covalent Bonding electrons are _____ between atoms.

Covalent Compounds, also called _____ compounds, have a _____ MP & BP, and are _____ conductors of heat and electricity.

VSEPR Theory is used to determine the _____ of molecules.

VSEPR is an acronym, which stands for _____.

Ionic Bonding always occurs between a _____ and a _____.

In Ionic Bonding electrons are _____ between atoms.

Ionic Compounds, also called _____, have a _____ MP & BP, and are good conductors of heat and electricity only when _____ or in _____.

Metallic Bonding occurs between atoms of the same _____, has a _____ MP & BP, and are _____ conductors as solids or as liquids because they have a shared _____ of mobile _____.

Which compound has a longer bond: HF or HCl? How do you know?

Which VSEPR shape has a smaller bond angle, Linear or Bent?

Which VSEPR shape has a larger bond angle, Trigonal Planer or Tetrahedral?

NAMING IONIC COMPOUNDS

Name _____

Name the following compounds using the Stock Naming System.

1. $CaCO_3$ _____
2. KCl _____
3. $FeSO_4$ _____
4. $LiBr$ _____
5. $MgCl_2$ _____
6. $FeCl_3$ _____
7. $Zn_3(PO_4)_2$ _____
8. NH_4NO_3 _____
9. $Al(OH)_3$ _____
10. $CuC_2H_3O_2$ _____
11. $PbSO_3$ _____
12. $NaClO_3$ _____
13. CaC_2O_4 _____
14. Fe_2O_3 _____
15. $(NH_4)_3PO_4$ _____
16. $NaHSO_4$ _____
17. Hg_2Cl_2 _____
18. $Mg(NO_2)_2$ _____
19. $CuSO_4$ _____
20. $NaHCO_3$ _____
21. $NiBr_3$ _____
22. $Be(NO_3)_2$ _____
23. $ZnSO_4$ _____
24. $AuCl_3$ _____
25. $KMnO_4$ _____

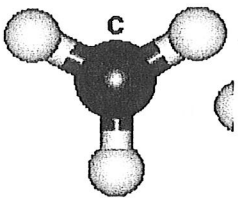
NAMING MOLECULAR COMPOUNDS

Name _____

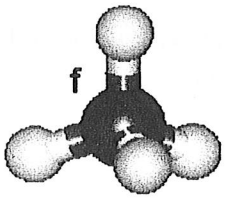
Name the following covalent compounds.

1. CO_2 _____
2. CO _____
3. SO_2 _____
4. SO_3 _____
5. N_2O _____
6. NO _____
7. N_2O_3 _____
8. NO_2 _____
9. N_2O_4 _____
10. N_2O_5 _____
11. PCl_3 _____
12. PCl_5 _____
13. NH_3 _____
14. SCl_6 _____
15. P_2O_5 _____
16. CCl_4 _____
17. SiO_2 _____
18. CS_2 _____
19. OF_2 _____
20. PBr_3 _____

VSEPR, EN, IE, Radii Quiz



1. What shape is depicted to the left?
2. What does VSEPR Theory stand for?
3. What is the shape of a CH_4 molecule?
4. What is the shape of an H_2O molecule?
5. What is the shape of an NH_3 molecule?
6. What shape is depicted to the right?



7. Which is larger, a magnesium atom or a magnesium ion?
8. Which has a longer bond length, HF or HCl?
9. Which is shorter, a double or triple covalent bond?
10. Which has a higher electronegativity, Calcium or Barium?
11. Which bond is stronger, HBr or HI?
12. Which has a larger radius, phosphorus or oxygen?
13. Which has a lower first ionization energy, carbon or nitrogen?
14. Define electronegativity.
15. Which has a smaller bond angle, a linear molecule or a pyramidal molecule?

Chemistry Quiz: Trends, Bonding, VSEPR - Page 2

16. Which type of chemical bond occurs between a metal and a nonmetal?

17. In which type of chemical bond are the atoms held together by a shared pool of mobile electrons?

18. Which type of chemical bond involves the transfer of electrons?

19. Show the bonds in a CO_2 molecule. (Include all shared and unshared electron pairs.)

20. A compound has a low MP and BP. What type of chemical bonds are probably holding this molecule together?
    a. a. Ionic b. covalent c. metallic

21. A compound has a high MP and a high BP and conducts electricity when dissolved in water. What type of chemical bonds are probably holding this molecule together?
    a. a. ionic b. covalent c. metallic

22. What is the oxidation number of Zinc?

23. List the 7 elements that form diatomic molecules. (Do not include elements above #80.)

24. Which has a bigger radius?

    Na or Mg?

25. Which has a smaller radius?

    B or Al?

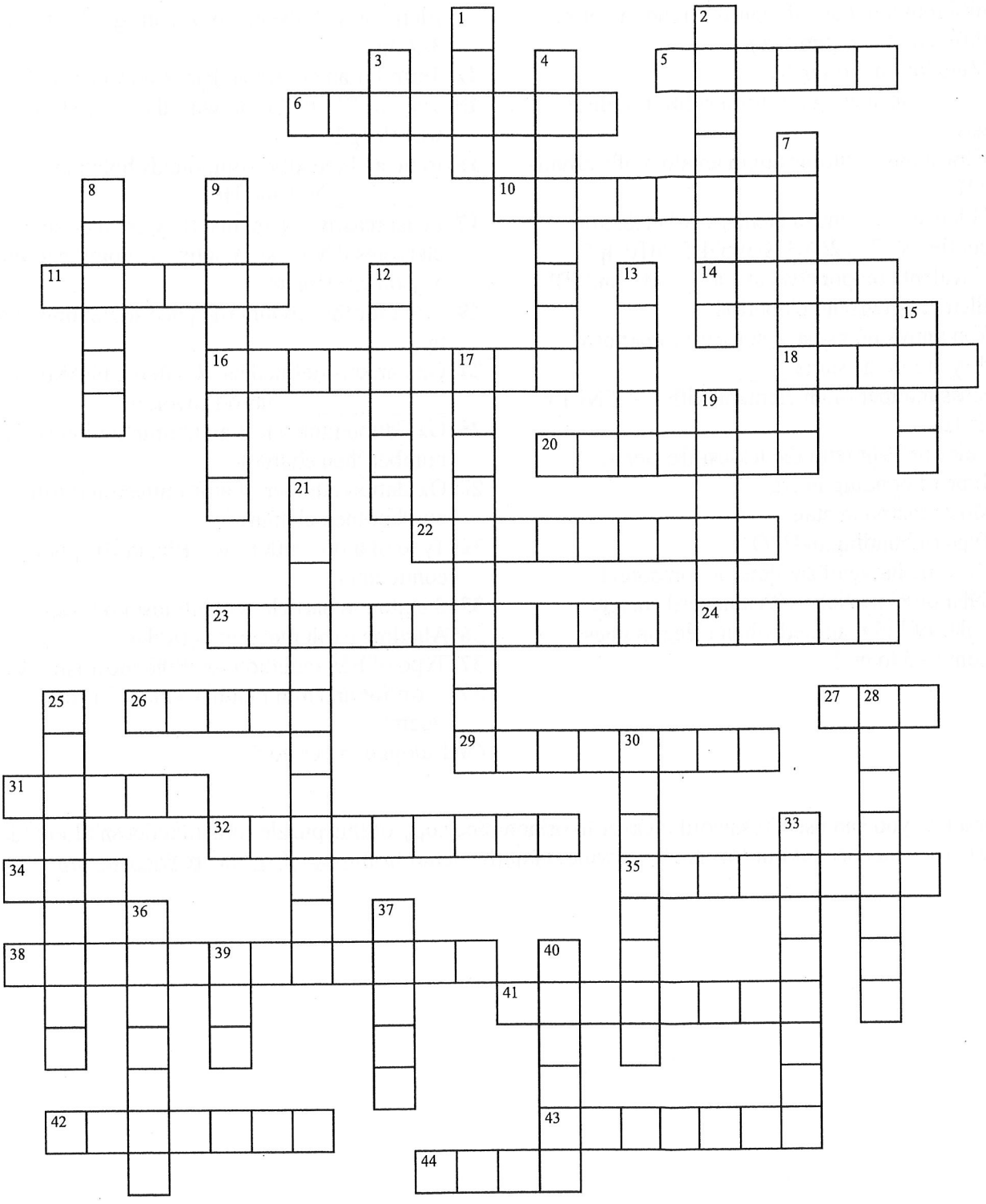
26. Which is more electronegative?

    Ca or Mg?

27. Which has a lower ionization energy?

    Ba or Sr?

Review through Bonding



ACROSS

5 In a covalent bond electrons are _____ between two atoms
6 Burning paper is this type of change
10 Overall charge of the nucleus
11 Element with electron config [Ar] 4s2 3d7
14 Term for an atom that has gained electrons
16 Term for the things you start with in a

DOWN

1 When oxygen forms an ion does it lose or gain electrons?
2 Type of change where the chemical composition of the matter does not change
3 Neutrons in a sodium-21 atom
4 Most reactive nonmetals
7 Liquids have an indefinite shape and a

chemical reaction

18 Type of bonding in NaCl

20 Term for atoms of the same element with different numbers of neutrons (and therefore different mass numbers)

22 Metalloid in group 4A

23 Change in state going from solid straight to gas

24 How many neutrons are in an atom of Carbon-14?

26 Valence electrons in element with electron config 1s2 2s2 2p6 32s 3p6 4s2 3d10 4p5

27 Covalent compounds have a ___ MP and BP

29 Element in group 5A period 4

31 You know atoms have similar properties if they are in the same _____

32 Mass number of an element with P=12 N=14 E=12

34 Color of light with the lowest frequency

35 Type of bonding in Ag

38 Most reactive metals

41 Type of bonding in H2O

42 Overall charge of an atom or compound

43 Subatomic particle with a neutral charge

44 Color of light emitted when electron goes from n=5 to n=2

_____ volume

8 Electrons release energy/light as they go to this state

9 Element with the electron config 1s2 2s2 2p6 3s2 3p5

12 Term for an atom that has lost electrons

13 Type of EM radiation with the longest wavelength

15 Ionic and metallic compounds both have a _____ MP and BP

17 Least reactive elements, they are the only elements that exist in nature uncombined with any other element

19 Term for the amount of space something take up

21 One amu is defined as 1/12th the mass of a _____ atom (2 words!)

25 Oxidation number of an aluminum ion (write number then charge)

28 Oxidation number of a bromine ion (write number then charge)

30 Type of atom with Low MP and BP, poor conductors

33 Subatomic particle with almost no mass

36 Alkaline earth metal in period 4

37 Type of EM radiation with the most energy

39 Term for an atom that has gained or lost electrons

40 Halogen in period 5

Name: _____ Class: _____ Date: _____ ID: A

Chem Review Warmup

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. Which of these elements does not exist as a diatomic molecule?
a. Ne
b. F
c. H
d. I

____ 2. How do atoms achieve noble-gas electron configurations in single covalent bonds?
a. One atom completely loses two electrons to the other atom in the bond.
b. Two atoms share two pairs of electrons.
c. Two atoms share two electrons.
d. Two atoms share one electron.

____ 3. Why do atoms share electrons in covalent bonds?
a. to become ions and attract each other
b. to attain a noble-gas electron configuration
c. to become more polar
d. to increase their atomic numbers

____ 4. Which of the following elements can form diatomic molecules held together by triple covalent bonds?
a. carbon
b. oxygen
c. fluorine
d. nitrogen

____ 5. When one atom contributes both bonding electrons in a single covalent bond, the bond is called a(n) ____.
a. one-sided covalent bond
b. unequal covalent bond
c. coordinate covalent bond
d. ionic covalent bond

____ 6. What is the shape of a molecule with a triple bond?
a. tetrahedral
b. pyramidal
c. bent
d. linear

____ 7. A bond formed between a silicon atom and an oxygen atom is likely to be ____.
a. ionic
b. coordinate covalent
c. polar covalent
d. nonpolar covalent

____ 8. Which of the following covalent bonds is the most polar?
a. H—F
b. H—C
c. H—H
d. H—N

____ 9. Which of the forces of molecular attraction is the weakest?
a. dipole interaction
b. dispersion
c. hydrogen bond
d. single covalent bond

____ 10. What is required in order to melt a network solid?
a. breaking Van der Waals bonds
b. breaking ionic bonds
c. breaking hydrogen bonds
d. breaking covalent bonds

____ 11. When Group 2A elements form ions, they ____.
a. lose two protons
b. gain two protons
c. lose two electrons
d. gain two electrons

____ 12. Which of the following compounds contains the Mn^{3+} ion?
a. MnS
b. $MnBr_2$
c. Mn_2O_3
d. MnO

____ 13. Which of the following formulas represents an ionic compound?
a. CS_2
b. BaI_2
c. N_2O_4
d. PCl_3

____ 14. Which of the following shows correctly an ion pair and the ionic compound the two ions form?
a. Sn^{4+}, N^{3-}; Sn_4N_3
b. Cu^{2+}, O^{2-}; Cu_2O_2
c. Cr^{3+}, I^-; CrI
d. Fe^{3+}, O^{2-}; Fe_2O_3

____ 15. Which of the following compounds contains the lead(II) ion?
a. PbO
b. $PbCl_4$
c. Pb_2O
d. Pb_2S

____ 16. Which set of chemical name and chemical formula for the same compound is correct?
a. iron(II) oxide, Fe_2O_3
b. aluminum fluorate, AlF_3
c. tin(IV) bromide, $SnBr_4$
d. potassium chloride, K_2Cl_2

____ 17. Which set of chemical name and chemical formula for the same compound is correct?
a. ammonium sulfite, $(NH_4)_2S$
b. iron(III) phosphate, $FePO_4$
c. lithium carbonate, $LiCO_3$
d. magnesium dichromate, $MgCrO_4$

____ 18. Molecular compounds are usually ____.
a. composed of two or more transition elements
b. composed of positive and negative ions
c. composed of two or more nonmetallic elements
d. exceptions to the law of definite proportions

____ 19. Which of the following formulas represents a molecular compound?
a. ZnO
b. Xe
c. SO_2
d. BeF_2

____ 20. What is the correct name for the compound $CoCl_2$?
a. cobalt(I) chlorate
b. cobalt(I) chloride
c. cobalt(II) chlorate
d. cobalt(II) chloride

____ 21. What is the correct name for $Sn_3(PO_4)_2$?
a. tritin diphosphate
b. tin(II) phosphate
c. tin(III) phosphate
d. tin(IV) phosphate

Name: _____ Class: _____ Date: _____ ID: A

Chemistry Quiz: Bonding

Multiple Choice

____ 1. Which of these elements does not exist as a diatomic molecule?
a. Ne
b. F
c. H
d. I

____ 2. How do atoms achieve noble-gas electron configurations in single covalent bonds?
a. One atom completely loses two electrons to the other atom in the bond.
b. Two atoms share two pairs of electrons.
c. Two atoms share two electrons.
d. Two atoms share one electron.

____ 3. Which of the following elements can form diatomic molecules held together by triple covalent bonds?
a. carbon
b. oxygen
c. fluorine
d. nitrogen

____ 4. When one atom contributes both bonding electrons in a single covalent bond, the bond is called a(n) ____.
a. one-sided covalent bond
b. unequal covalent bond
c. coordinate covalent bond
d. ionic covalent bond

____ 5. What is the shape of a molecule with a triple bond?
a. tetrahedral
b. pyramidal
c. bent
d. linear

____ 6. A bond formed between a silicon atom and an oxygen atom is likely to be ____.
a. ionic
b. coordinate covalent
c. polar covalent
d. nonpolar covalent

____ 7. Which of the following covalent bonds is the most polar?
a. H—F
b. H—C
c. H—H
d. H—N

____ 8. Which of the forces of molecular attraction is the strongest?
a. dipole interaction
b. dispersion
c. hydrogen bond
d. single covalent bond

____ 9. What is required in order to melt a network solid?
a. breaking Van der Waals bonds
b. breaking ionic bonds
c. breaking hydrogen bonds
d. breaking covalent bonds

____ 10. When Group 2A elements form ions, they ____.
a. lose two protons
b. gain two protons
c. lose two electrons
d. gain two electrons

____ 11. Which of the following compounds contains the Mn^{3+} ion?
a. MnS
b. $MnBr_2$
c. Mn_2O_3
d. MnO

____ 12. Which of the following formulas represents an ionic compound?
a. CS_2
b. BaI_2
c. N_2O_4
d. PCl_3

____ 13. Which of the following shows correctly an ion pair and the ionic compound the two ions form?

a. $Sn^{4+}, N^{3-}; Sn_4N_3$
c. $Cr^{3+}, I^{-}; CrI$
b. $Cu^{2+}, O^{2-}; Cu_2O_2$
d. $Fe^{3+}, O^{2-}; Fe_2O_3$

____ 14. Which of the following compounds contains the lead(II) ion?

a. PbO
c. Pb_2O
b. $PbCl_4$
d. Pb_2S

____ 15. Which set of chemical name and chemical formula for the same compound is correct?

a. iron(II) oxide, Fe_2O_3
c. tin(IV) bromide, $SnBr_4$
b. aluminum fluorate, AlF_3
d. potassium chloride, K_2Cl_2

____ 16. Which set of chemical name and chemical formula for the same compound is correct?

a. ammonium sulfite, $(NH_4)_2S$
c. lithium carbonate, $LiCO_3$
b. iron(III) phosphate, $FePO_4$
d. magnesium dichromate, $MgCrO_4$

____ 17. Molecular compounds are usually ____.

a. composed of two or more transition elements
b. composed of positive and negative ions
c. composed of two or more nonmetallic elements
d. exceptions to the law of definite proportions

____ 18. Which of the following formulas represents a molecular compound?

a. ZnO
c. SO_2
b. Xe
d. BeF_2

____ 19. What is the correct name for the compound $CoCl_2$?

a. cobalt(I) chlorate
c. cobalt(II) chlorate
b. cobalt(I) chloride
d. cobalt(II) chloride

____ 20. What is the correct name for $Sn_3(PO_4)_2$?

a. tritin diphosphate
c. tin(III) phosphate
b. tin(II) phosphate
d. tin(IV) phosphate

____ 21. What is the formula for sodium sulfate?

a. $NaSO_4$
c. $Na(SO_4)_2$
b. Na_2SO_4
d. $Na_2(SO_4)_2$

____ 22. Which of the following is NOT a characteristic of most ionic compounds?

a. They are solids.
b. They have low melting points.
c. When melted, they conduct an electric current.
d. They are composed of metallic and nonmetallic elements.

____ 23. What characteristic of metals makes them good electrical conductors?

a. They have mobile valence electrons.
b. They have mobile protons.
c. They have mobile cations.
d. Their crystal structures can be rearranged easily.

____ 24. What causes dipole interactions?

a. sharing of electron pairs
b. attraction between polar molecules
c. bonding of a covalently bonded hydrogen to an unshared electron pair
d. attraction between ions

Chemistry Test 2 Review Packet **Name**_____
COMPLETE, STUDY, and TURN IN THE DAY OF THE TEST.

Goal 2.07
Atoms share electrons to become more like _____ _____

True or False: Atoms bond to become more stable.

Atoms form a mostly covalent bond if they have a _____ difference in electronegativity.

A _____ compound is one that contains covalent bonds.

List the 7 diatomic molecules.

What type of bond exists in an N_2 molecule? (select one answer for each part)

a. Polar OR nonpolar

b. Single OR double OR triple

c. Ionic bond. OR covalent bond.

Name a diatomic that forms a double covalent bond.

Name a diatomic that forms a single covalent bond.

(Remember, to determine number of bonds, count VE's, determine how many more are needed to make 8 [or 2 if it it Hydrogen] and that is the number of covalent bonds needed.)

Covalent bonding occurs between a _____ and a _____.

Which compound has the longest bond, HF or HCl?

Which of the above compounds has the stronger bond?

Which is stronger, a double or triple covalent bond? Which is longer?

Draw a Lewis Structure for Lithium, Neon, Sulfur, and Aluminum.

List and draw the 5 VSEPR shapes you are supposed to know.

Explain how bonds affect VSEPR shape versus how unshared pairs do.

Tell the shape of the following molecules:

1. H_2O
2. CH_4
3. NH_3
4. CO_2
5. CO
6. BF_3

Which VSEPR shape as the largest bond angle?

The smallest?

How do unshared pairs affect bond angles?

Identify the following as polar or nonpolar:

1. H_2O
2. NaCl
3. F_2
4. HCl
5. NO_2
6. CO_2

Water is polar. Substance B will not dissolve in water. Is substance B polar or nonpolar?

What is the general rule for solubility as it relates to polarity?

Networks solids are a special type of molecular (covalent) compound, but possess some very different properties. Describe how a network solid differs from other molecular compounds.

Give an example of a network solid.

What is the strongest type of intermolecular force?

What is the weakest?

Which type of IM force occurs between nonpolar molecules?

A compound is polar if it contains Covalent bonds and the atoms involved have different _____ values.

Goal 2.03
Name and give the chemical formula for the 4 acids you are supposed to have memorized.

Write, with charges, the following polyatomic ions: (These are the ones most likely to show up on your EOC. You should DEFINITELY recognize them easily!!!)

Nitrate

Sulfate

Carbonate

Acetate

Ammonium

List and identify the 4 state of matter symbols that can be used in chemical equations.

Write the chemical formula for the following:

Ammonium Chloride

Barium Acetate

Sodium Carbonate

Aluminum Nitrate

Disulfur Trioxide

Iron (III) Oxide

Iron (II) Oxide

Tin (IV) Chloride

Copper (I) Sulfide

Lead (II) Hydroxide

Sodium Hydride

Carbon Monoxide

Ammonium Sulfate

Zinc Chloride

Silver Iodide

Name the following compounds:

PbO

Pb_2O_3

NH_4Cl

$BaSO_4$

HCl

N_2O_5

CO_2

CO

Goal 2.06

What is the difference between a cation and an anion?

How is a cation formed?

Give the ionic charge for the following elements:

Na
F
Ne
S

O
Mg
Ba
Al
Zn
Ag
I
P

What is meant by the idea that ionic compounds are held together by electrostatic attraction?

What are the characteristics of an ionic compound?

What are the characteristics of a covalent compound?

What are the characteristics of a metallic compound?

Which type of bonding occurs between 2 nonmetals?

Which type of bond results in ions surrounded by a shared "sea" of mobile electrons?

What type of bond results between 2 atoms with a big difference in electronegativity? (>1.7)

What type of bond results between a metal and a nonmetal?

True or False: An ionic bond can occur only between a cation and an anion.

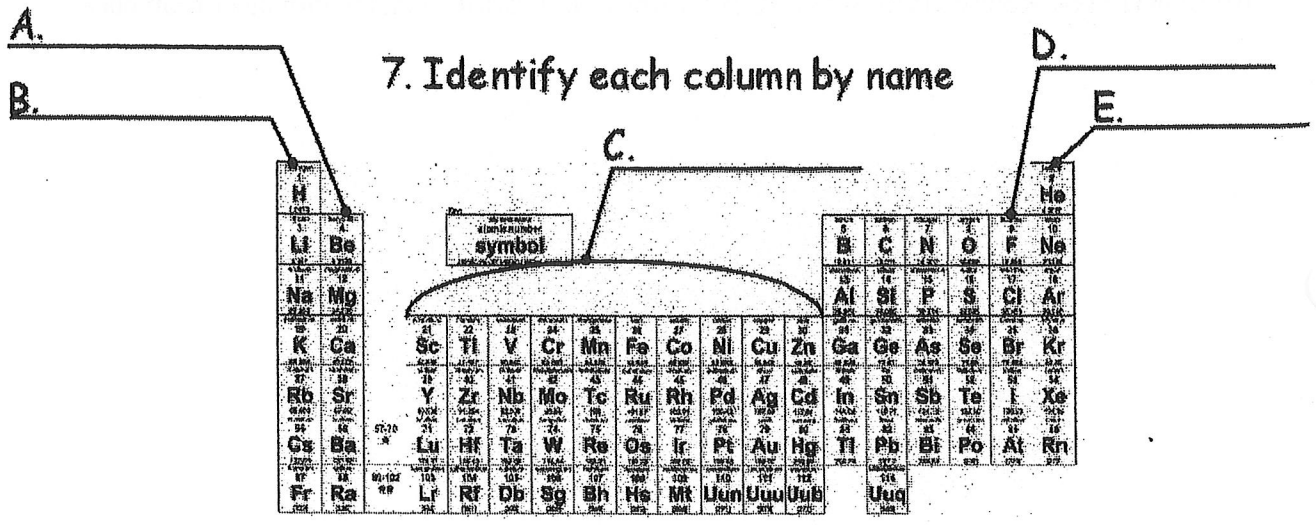
** Understand that all bonds have some ionic and some covalent character, but can usually be characterized as mostly ionic or covalent. **

Why do metallic compounds conduct electricity?

BE SURE YOU KNOW THE IONIC/COVALENT/METALLIC Graphic organizer from class!

PS Quiz: Ions & Bonding 6.01-6.02

1. How many valence electrons are in the following atoms:
   a. S b. Na c. Ar
2. What is the oxidation number (charge) of the following ions?
   a. Al b. F c. Mg
3. Draw and Electron Dot Diagram for Iodine.
4. When Oxygen becomes an ion does it:
   a. Gain or Lose Electrons?
   b. How Many?
   c. So what is its charge?
   d. Is it a cation or anion?
5. Label each of the following as describing an Ionic, Covalent, or Metallic Bond/Compound.
   a. Transfer/Swapping of electrons
   b. Shared pool of mobile electrons
   c. Shared pairs of electrons
   d. Conducts Electricity as a Solid
   e. Conducts electricity only when molten or in an aqueous solution
   f. Does not conduct electricity
   g. Example: NaCl
   h. Example: H_2O
   i. Example: Fe
   j. High MP & BP, Malleable, Ductile, Lustrous
   k. High MP & BP, Brittle
   l. Low MP & BP, usually gas or liquid at room temperature
   m. Metal + Nonmetal
   n. Nonmetal + Nonmetal
   o. Occurs between atoms of the same metal
6. Tell the chemical formula for the compound that forms when the following elements bond.
   a. K + O ->
   b. Mg + Cl ->
   c. Al + N ->
   d. Al + O ->
7.



1. Which substance will conduct electricity in both the solid phase and the liquid phase?
   A) HCl C) AgCl
   B) Ag D) H_2

2. The water solution of which of the following substances is the best conductor of electricity?
   A) $C_6H_{12}O_6$ C) KCl
   B) CO D) CO_2

3. A correct name for N_2O_3 is
   A) nitrogen oxide C) dinitrogen trioxide
   B) nitrogen (II) oxide D) nitric acid

4. Which metal will form a compound with the general formula M_2CO_3 when it combines with a carbonate ion?
   A) calcium C) aluminum
   B) lithium D) beryllium

5. What is the weakest type of intermolecular force, that occurs in nonpolar molecules.
   A) London Dispersion Forces
   B) Dipole Interactions
   C) Covalent Bonds
   D) Hydrogen Bonds

6. Which pair represents isotopes of the same element?
   A) ${}^{14}_{6}X$ and ${}^{14}_{7}X$ C) ${}^{13}_{6}X$ and ${}^{14}_{7}X$
   B) ${}^{12}_{6}X$ and ${}^{13}_{6}X$ D) ${}^{2}_{1}X$ and ${}^{4}_{2}X$

7. Compared to an atom of ${}^{12}_{6}C$, an atom of ${}^{14}_{6}C$ has
   A) more neutrons C) fewer protons
   B) fewer neutrons D) more protons

8. The element in Period 2 with the largest atomic radius is
   A) a noble gas
   B) an alkali metal
   C) a halogen
   D) an alkaline earth metal

9. An atom that contains 8 protons, 8 electrons, and 9 neutrons has
   A) a mass number of 17
   B) an atomic number of 16
   C) an atomic number of 9
   D) a mass number of 25

10. In a nonpolar covalent bond, electrons are
    A) transferred from one atom to another
    B) located in a mobile "sea" shared by many atoms
    C) shared equally by two atoms
    D) shared unequally by two atoms

11. The primary forces of attraction between water molecules in $H_2O(\ell)$ are
    A) hydrogen bonds
    B) ionic bonds
    C) van der Waals forces
    D) molecule-ion attractions

12. The table below lists the melting points of various substances.

SUBSTANCE	PHASE CHANGE (solid → liquid)	MELTING POINT (K)
chlorine	$Cl_2(s) \rightarrow Cl_2(\ell)$	172
water	$H_2O(s) \rightarrow H_2O(\ell)$	273
sodium chloride	$NaCl(s) \rightarrow NaCl(\ell)$	1073
copper	$Cu(s) \rightarrow Cu(\ell)$	1356

Based on this table, which type of substance has the highest melting point?
A) polar covalent C) nonpolar covalent
B) metallic D) ionic

13. The table below contains data for compounds *A*, *B*, *C*, and *D*.

COMPOUND	MELTING POINT (°C)	BOILING POINT (°C)	ELECTRICAL CONDUCTIVITY (State)		SOLUBILITY IN WATER
A	800.4	1413	excellent	(liquid)	good
B	1710	2230	very poor	(solid)	insoluble
C	42.5	216.3	poor	(solid)	poor
D	1083	2582	excellent	(solid)	insoluble

Which list identifies the type of bonding characteristic of each compound's solid phase?

A) *A* -ionic *B* -network *C* -molecular *D*-metallic
B) *A* -ionic *B* -network *C* -metallic *D*-molecular
C) *A* -network *B* -ionic *C* -molecular *D*-metallic
D) *A* -metallic *B* -molecular *C*-network *D*-ionic

14. What is the total number of neutrons in an atom of $^{39}_{19}K$?

A) 58
B) 20
C) 39
D) 19

15. The bonds in the compound $MgSO_4$ can be described as

A) neither ionic nor covalent
B) covalent, only
C) ionic, only
D) both ionic and covalent

16. Which ion contains the same total number of electrons as Cl^-?

A) Na^+
B) Br^-
C) S^{2-}
D) Mg^{2+}

17. Which is a property of network solids but *not* molecular solids?

A) high malleability
B) water soluble
C) electrical insulators
D) high melting points

18. An atomic mass unit is defined as exactly

A) $\frac{1}{16}$ the mass of a ^{16}O atom
B) $\frac{1}{19}$ the mass of a ^{19}F atom
C) $\frac{1}{14}$ the mass of a ^{14}N atom
D) $\frac{1}{12}$ the mass of a ^{12}C atom

19. In which compound do atoms form bonds by sharing electrons?

A) CaO
B) Na_2O
C) H_2O
D) MgO

20. What is the structure of a krypton-85 atom?

A) 36 electrons, 36 protons, and 49 neutrons
B) 36 electrons, 36 protons, and 85 neutrons
C) 49 electrons, 49 protons, and 85 neutrons
D) 49 electrons, 49 protons, and 49 neutrons

21. The elements in Period 3 all have the same number of

A) principal energy levels containing electrons
B) valence electrons
C) orbitals containing electrons
D) sublevels containing electrons

22. The correct chemical formula for iron(II) sulfide is

A) FeS
B) $FeSO_4$
C) Fe_2S_3
D) $Fe_2(SO_4)_3$

23. Which atom in the ground state has only 3 electrons in the 3*p* sublevel?

A) phosphorus
B) argon
C) aluminum
D) potassium

24. Element *X* is in Group 2 and element *Y* is in Group 17. What happens when a compound is formed between these two atoms?

A) *X* loses electrons to *Y* to form a covalent bond.
B) *X* gains electrons from *Y* to form an ionic bond.
C) *X* loses electrons to *Y* to form an ionic bond.
D) *X* gains electrons from *Y* to form a covalent bond.

25. Which atoms are most likely to form covalent bonds?
    A) metal atoms that share electrons
    B) nonmetal atoms that share protons
    C) nonmetal atoms that share electrons
    D) metal atoms that share protons

26. Which is the correct formula for titanium (III) oxide?
    A) TiO
    B) Ti_2O_4
    C) Ti_3O_2
    D) Ti_2O_3

27. What is the correct formula of potassium hydride?
    A) KH
    B) KH_2
    C) $K(OH)_2$
    D) KOH

28. A maximum of 6 electrons can occupy
    A) a *p* sublevel
    B) an *s* sublevel
    C) an *s* orbital
    D) a *p* orbital

29. All the isotopes of a given atom have
    A) the same mass number and the same atomic number
    B) different mass numbers and different atomic numbers
    C) different mass numbers but the same atomic number
    D) the same mass number but different atomic numbers

30. Which is the electron configuration of a neutral atom in the ground state with a total of six valence electrons?
    A) $1s^2 2s^2 2p^6$
    B) $1s^2 2s^2 2p^6 3s^2 3p^6$
    C) $1s^2 2s^2 2p^2$
    D) $1s^2 2s^2 2p^4$

31. Silicon dioxide (SiO_2) and diamonds are best described as
    A) network solids with covalent bonding
    B) molecular substances with ionic bonding
    C) molecular substances with coordinate covalent bonding
    D) network solids with ionic bonding

32. Compared to a calcium atom, the calcium ion Ca^{2+} has
    A) more protons
    B) more electrons
    C) fewer protons
    D) fewer electrons

33. Which element forms a diatomic molecule containing a triple covalent bond?
    A) O_3
    B) Cl_2
    C) H_2
    D) N_2

34. Conductivity in a metal results from the metal atoms having
    A) high ionization energy
    B) high electronegativity
    C) highly mobile electrons in the valence shell
    D) highly mobile protons in the nucleus

35. What is the VSEPR Shape of an NH_3 molecule?
    A) tetrahedral
    B) trigonal pyramidal
    C) linear
    D) trigonal planer

36. Which type of bond is present in a water molecule?
    A) electrovalent
    B) polar covalent
    C) nonpolar covalent
    D) ionic

37. Which factor distinguishes a metallic bond from an ionic bond or a covalent bond?
    A) the equal sharing of electrons
    B) the mobility of protons
    C) the mobility of electrons
    D) the unequal sharing of electrons

38. Which type of chemical bond is formed between two atoms of bromine?
    A) metallic
    B) ionic
    C) covalent
    D) hydrogen

39. Which type of bonding accounts for the relatively high boiling point of H_2O as compared with the relatively low boiling point of H_2S?
    A) hydrogen bonds
    B) van der Waals forces
    C) electrovalent bonds
    D) covalent bonds

40. What is the correct formula for ammonium carbonate?
    A) $NH_4(CO_3)_2$
    B) $(NH_4)_2(CO_3)_2$
    C) NH_4CO_3
    D) $(NH_4)_2CO_3$

41. Which formula represents sodium sulfate?
    A) Na_2SO_3
    B) $NaSO_3$
    C) $NaSO_4$
    D) Na_2SO_4

42. What is the correct name for the compound with the formula $CrPO_4$?
A) chromium (II) phosphide
B) chromium (III) phosphate
C) chromium (II) phosphate
D) chromium (III) phosphide

43. The bonding in NH_3 is most similar to the bonding in
A) H_2O C) KF
B) MgO D) NaCl

44. Which type of substance is soft, has a low melting point, and is a poor conductor of heat and electricity?
A) network solid C) ionic solid
B) molecular solid D) metallic solid

45. Which type of bond is formed when an atom of potassium transfers an electron to a bromine atom?
A) nonpolar covalent C) metallic
B) ionic D) polar covalent

46. What is the VSEPR shape of an H_2S molecule?
A) trigonal planer D) linear
B) tetrahedral E) pyramidal
C) bent

47. The correct formula for calcium phosphate is
A) $Ca_3(PO_4)_2$ C) $Ca_2(PO_4)_3$
B) $CaPO_4$ D) Ca_3P_2

48. When metals combine with nonmetals, the metallic atoms tend to
A) lose electrons and become negative ions
B) lose electrons and become positive ions
C) gain electrons and become positive ions
D) gain electrons and become negative ions

49. When a metal atom combines with a nonmetal atom, the nonmetal atom will
A) lose electrons and increase in size
B) gain electrons and decrease in size
C) gain electrons and increase in size
D) lose electrons and decrease in size

50. Which formula represents a molecular substance?
A) CaO C) CO
B) Li_2O D) Al_2O_3

51. What occurs when an atom loses an electron?
A) The atom's radius increases and the atom becomes a positive ion.
B) The atom's radius increases and the atom becomes a negative ion.
C) The atom's radius decreases and the atom becomes a positive ion.
D) The atom's radius decreases and the atom becomes a negative ion.

52. What is the total number of electrons shared in a double covalent bond between two atoms?
A) 8 C) 4
B) 1 D) 2

53. Two atoms of element *A* unite to form a molecule with the formula A_2. The bond between the atoms in the molecule is
A) ionic C) polar covalent
B) electrovalent D) nonpolar covalent

54. What type of bond exists in a molecule of hydrogen iodide?
A) a nonpolar covalent bond with an electronegativity difference between zero and 1.7
B) a polar covalent bond with an electronegativity difference of zero
C) a nonpolar covalent bond with an electronegativity difference of zero
D) polar covalent bond with an electronegativity difference between zero and 1.7

55. What is the maximum number of covalent bonds that a carbon atom can form?
A) 1 C) 3
B) 2 D) 4

56. The degree of polarity of a chemical bond in a molecule of a compound can be predicted by determining the difference in the
    A) atomic masses of the bonded atoms in a molecule of the compound
    B) electronegativities of the bonded atoms in a molecule of the compound
    C) densities of the elements in the compound
    D) melting points of the elements in the compound

57. Which element exists as a diatomic molecule at STP?
    A) argon
    B) rubidium
    C) sulfur
    D) bromine

58. As the difference in electronegativity between two atoms decreases, the tendency for the formation of covalent bonds
    A) decreases
    B) increases
    C) remains the same

59. The electrons in a bond between two iodine atoms (I_2) are shared
    A) equally, and the resulting bond is nonpolar
    B) unequally, and the resulting bond is polar
    C) unequally, and the resulting bond is nonpolar
    D) equally, and the resulting bond is polar

60. Which of the following elements has the greatest ability to attract electrons?
    A) Mg
    B) Be
    C) Li
    D) Na

61. A chemist performs the same tests on two homogeneous white crystalline solids, *A* and *B*. The results are shown in the table below.

	Solid A	Solid B
Melting Point	High, 801°C	Low, decomposes at 186°C
Solubility in H_2O (grams per 100.0 g H_2O at 0°C)	35.7	3.2
Electrical Conductivity (in aqueous solution)	Good conductor	Nonconductor

The results of these tests suggest that

A) solid *A* contains only ionic bonds and solid *B* contains only covalent bonds
B) solid *A* contains only covalent bonds and solid *B* contains only ionic bonds
C) both solids contain only ionic bonds
D) both solids contain only covalent bonds

62. What is the correct name of Fe_2O_3?

A) iron (I) oxide
B) iron (II) oxide
C) iron (III) oxide
D) iron (V) oxide

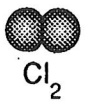
63. What is the mass number of an atom that contains 19 protons, 19 electrons, and 20 neutrons?

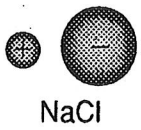
A) 20
B) 19
C) 39
D) 58

64. The correct formula for nickel (II) oxide is

A) NiO_2
B) Ni_2O
C) NiO
D) Ni_3O_2

65. Which diagram best represents a polar molecule?

A) 

C) 

B) 

D) 

66. One atom of *A* forms a coordinate covalent bond with one atom of *B*. This bond could have been formed by an atom of *B*

A) transferring two electrons to an atom of *A*
B) sharing only one electron belonging to an atom of *A*
C) sharing two electrons belonging to an atom of *A*
D) transferring only one electron to an atom of *A*

67. Which is true regarding bond length and/or strength?

A) single bonds are stronger than double bonds
B) triple bonds are shorter than single bonds
C) double bonds are shorter than triple bonds
D) polar covalent bonds are weaker than nonpolar covalent bonds

68. Which of the following elements has the smallest atomic radius?

A) cobalt
B) calcium
C) potassium
D) nickel

69. A substance that has a melting point of 1074 K conducts electricity when dissolved in water, but does *not* conduct electricity in the solid phase. The substance is most likely

A) a network solid
B) a metallic solid
C) a molecular solid
D) an ionic solid

1. The correct chemical formula for iron(II) sulfide is
   A) $FeSO_4$ C) Fe_2S_3
   B) $Fe_2(SO_4)_3$ D) FeS

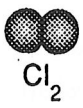
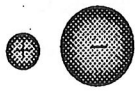
2. What is the correct formula for ammonium carbonate?
   A) NH_4CO_3 C) $NH_4(CO_3)_2$
   B) $(NH_4)_2CO_3$ D) $(NH_4)_2(CO_3)_2$

3. Which is true regarding bond length and/or strength?
   A) double bonds are shorter than triple bonds
   B) single bonds are stronger than double bonds
   C) polar covalent bonds are weaker than nonpolar covalent bonds
   D) triple bonds are shorter than single bonds

4. Which formula represents sodium sulfate?
   A) Na_2SO_4 C) Na_2SO_3
   B) $NaSO_3$ D) $NaSO_4$

5. Which ion contains the same total number of electrons as Cl^-?
   A) Mg^{2+} C) Br^-
   B) S^{2-} D) Na^+

6. Element *X* is in Group 2 and element *Y* is in Group 17. What happens when a compound is formed between these two atoms?
   A) *X* gains electrons from *Y* to form an ionic bond.
   B) *X* gains electrons from *Y* to form a covalent bond.
   C) *X* loses electrons to *Y* to form a covalent bond.
   D) *X* loses electrons to *Y* to form an ionic bond.

7. Which diagram best represents a polar molecule?
   A)  Cl_2
   C)  NaCl
   B)  H_2
   D)  HCl

8. When a metal atom combines with a nonmetal atom, the nonmetal atom will
   A) gain electrons and decrease in size
   B) lose electrons and increase in size
   C) gain electrons and increase in size
   D) lose electrons and decrease in size

9. What is the VSEPR Shape of an NH_3 molecule?
   A) trigonal pyramidal C) trigonal planer
   B) linear D) tetrahedral

10. All the isotopes of a given atom have
    A) different mass numbers but the same atomic number
    B) different mass numbers and different atomic numbers
    C) the same mass number and the same atomic number
    D) the same mass number but different atomic numbers

11. What is the correct formula of potassium hydride?
    A) KOH C) KH
    B) $K(OH)_2$ D) KH_2

12. The primary forces of attraction between water molecules in $H_2O(\ell)$ are
    A) hydrogen bonds
    B) molecule-ion attractions
    C) ionic bonds
    D) van der Waals forces

13. In which compound do atoms form bonds by sharing electrons?
    A) Na_2O C) MgO
    B) CaO D) H_2O

14. Two atoms of element *A* unite to form a molecule with the formula A_2. The bond between the atoms in the molecule is

A) nonpolar covalent
C) electrovalent
B) ionic
D) polar covalent

15. What occurs when an atom loses an electron?

A) The atom's radius increases and the atom becomes a negative ion.
B) The atom's radius decreases and the atom becomes a negative ion.
C) The atom's radius increases and the atom becomes a positive ion.
D) The atom's radius decreases and the atom becomes a positive ion.

16. Which atoms are most likely to form covalent bonds?

A) metal atoms that share electrons
B) nonmetal atoms that share protons
C) nonmetal atoms that share electrons
D) metal atoms that share protons

17. What is the weakest type of intermolecular force, that occurs in nonpolar molecules.

A) Covalent Bonds
B) London Dispersion Forces
C) Hydrogen Bonds
D) Dipole Interactions

18. Which metal will form a compound with the general formula M_2CO_3 when it combines with a carbonate ion?

A) beryllium
C) aluminum
B) calcium
D) lithium

19. What is the maximum number of covalent bonds that a carbon atom can form?

A) 1
C) 3
B) 2
D) 4

20. Which atom in the ground state has only 3 electrons in the 3*p* sublevel?

A) phosphorus
C) potassium
B) argon
D) aluminum

21. The correct formula for calcium phosphate is

A) $Ca_3(PO_4)_2$
C) $CaPO_4$
B) Ca_3P_2
D) $Ca_2(PO_4)_3$

22. A correct name for N_2O_3 is

A) nitrogen oxide
C) dinitrogen trioxide
B) nitrogen (II) oxide
D) nitric acid

23. Which substance will conduct electricity in both the solid phase and the liquid phase?

A) AgCl
C) Ag
B) HCl
D) H_2

24. A substance that has a melting point of 1074 K conducts electricity when dissolved in water, but does *not* conduct electricity in the solid phase. The substance is most likely

A) a molecular solid
C) a network solid
B) an ionic solid
D) a metallic solid

25. Which type of chemical bond is formed between two atoms of bromine?

A) metallic
C) covalent
B) ionic
D) hydrogen

26. Silicon dioxide (SiO_2) and diamonds are best described as

A) network solids with covalent bonding
B) network solids with ionic bonding
C) molecular substances with ionic bonding
D) molecular substances with coordinate covalent bonding

27. When metals combine with nonmetals, the metallic atoms tend to

A) gain electrons and become positive ions
B) lose electrons and become negative ions
C) lose electrons and become positive ions
D) gain electrons and become negative ions

28. What is the total number of neutrons in an atom of $^{39}_{19}K$?

A) 58
C) 39
B) 20
D) 19

29. Which of the following elements has the smallest atomic radius?

A) potassium C) cobalt

B) nickel D) calcium

30. The table below lists the melting points of various substances.

SUBSTANCE	PHASE CHANGE (solid → liquid)	MELTING POINT (K)
chlorine	$Cl_2(s) \rightarrow Cl_2(\ell)$	172
water	$H_2O(s) \rightarrow H_2O(\ell)$	273
sodium chloride	$NaCl(s) \rightarrow NaCl(\ell)$	1073
copper	$Cu(s) \rightarrow Cu(\ell)$	1356

Based on this table, which type of substance has the highest melting point?

A) ionic C) polar covalent

B) metallic D) nonpolar covalent

31. Which formula represents a molecular substance?

A) CO C) Li_2O

B) Al_2O_3 D) CaO

32. A chemist performs the same tests on two homogeneous white crystalline solids, *A* and *B*. The results are shown in the table below.

	Solid A	**Solid B**
Melting Point	High, 801°C	Low, decomposes at 186°C
Solubility in H_2O (grams per 100.0 g H_2O at 0°C)	35.7	3.2
Electrical Conductivity (in aqueous solution)	Good conductor	Nonconductor

The results of these tests suggest that

A) both solids contain only ionic bonds

B) solid *A* contains only ionic bonds and solid *B* contains only covalent bonds

C) both solids contain only covalent bonds

D) solid *A* contains only covalent bonds and solid *B* contains only ionic bonds

33. The table below contains data for compounds *A*, *B*, *C*, and *D*.

COMPOUND	MELTING POINT (°C)	BOILING POINT (°C)	ELECTRICAL CONDUCTIVITY (State)		SOLUBILITY IN WATER
A	800.4	1413	excellent	(liquid)	good
B	1710	2230	very poor	(solid)	insoluble
C	42.5	216.3	poor	(solid)	poor
D	1083	2582	excellent	(solid)	insoluble

Which list identifies the type of bonding characteristic of each compound's solid phase?

A) *A* -ionic *B* -network *C* -molecular *D*-metallic
B) *A* -network *B* -ionic *C* -molecular *D*-metallic
C) *A* -ionic *B* -network *C* -metallic *D*-molecular
D) *A* -metallic *B* -molecular *C*-network *D*-ionic

34. Which pair represents isotopes of the same element?

A) ${}^{12}_{6}X$ and ${}^{13}_{6}X$
B) ${}^{13}_{6}X$ and ${}^{14}_{7}X$
C) ${}^{2}_{1}X$ and ${}^{4}_{2}X$
D) ${}^{14}_{6}X$ and ${}^{14}_{7}X$

35. What is the mass number of an atom that contains 19 protons, 19 electrons, and 20 neutrons?

A) 20
B) 19
C) 58
D) 39

36. Compared to a calcium atom, the calcium ion Ca^{2+} has

A) fewer electrons
B) more protons
C) fewer protons
D) more electrons

37. An atomic mass unit is defined as exactly

A) $\frac{1}{12}$ the mass of a ${}^{12}C$ atom
B) $\frac{1}{14}$ the mass of a ${}^{14}N$ atom
C) $\frac{1}{19}$ the mass of a ${}^{19}F$ atom
D) $\frac{1}{16}$ the mass of a ${}^{16}O$ atom

38. The correct formula for nickel (II) oxide is

A) NiO
B) Ni_2O
C) NiO_2
D) Ni_3O_2

39. What is the total number of electrons shared in a double covalent bond between two atoms?

A) 8
B) 1
C) 2
D) 4

40. Which type of bond is formed when an atom of potassium transfers an electron to a bromine atom?

A) nonpolar covalent
B) ionic
C) metallic
D) polar covalent

41. The element in Period 2 with the largest atomic radius is

A) a halogen
B) a noble gas
C) an alkali metal
D) an alkaline earth metal

42. Which is the electron configuration of a neutral atom in the ground state with a total of six valence electrons?

A) $1s^2 2s^2 2p^6$
B) $1s^2 2s^2 2p^6 3s^2 3p^6$
C) $1s^2 2s^2 2p^4$
D) $1s^2 2s^2 2p^2$

43. The bonds in the compound $MgSO_4$ can be described as

A) both ionic and covalent
B) neither ionic nor covalent
C) ionic, only
D) covalent, only

44. What type of bond exists in a molecule of hydrogen iodide?
    A) a polar covalent bond with an electronegativity difference of zero
    B) a nonpolar covalent bond with an electronegativity difference of zero
    C) a nonpolar covalent bond with an electronegativity difference between zero and 1.7
    D) polar covalent bond with an electronegativity difference between zero and 1.7

45. Which element exists as a diatomic molecule at STP?
    A) argon
    B) rubidium
    C) bromine
    D) sulfur

46. What is the correct name of Fe_2O_3?
    A) iron (I) oxide
    B) iron (II) oxide
    C) iron (III) oxide
    D) iron (V) oxide

47. What is the structure of a krypton-85 atom?
    A) 49 electrons, 49 protons, and 85 neutrons
    B) 36 electrons, 36 protons, and 49 neutrons
    C) 49 electrons, 49 protons, and 49 neutrons
    D) 36 electrons, 36 protons, and 85 neutrons

48. The bonding in NH_3 is most similar to the bonding in
    A) H_2O
    B) NaCl
    C) KF
    D) MgO

49. Which is a property of network solids but *not* molecular solids?
    A) high malleability
    B) high melting points
    C) water soluble
    D) electrical insulators

50. Which is the correct formula for titanium (III) oxide?
    A) Ti_2O_4
    B) Ti_2O_3
    C) Ti_3O_2
    D) TiO

51. Which type of bonding accounts for the relatively high boiling point of H_2O as compared with the relatively low boiling point of H_2S?
    A) hydrogen bonds
    B) van der Waals forces
    C) covalent bonds
    D) electrovalent bonds

52. Which element forms a diatomic molecule containing a triple covalent bond?
    A) Cl_2
    B) H_2
    C) O_3
    D) N_2

53. In a nonpolar covalent bond, electrons are
    A) shared unequally by two atoms
    B) transferred from one atom to another
    C) shared equally by two atoms
    D) located in a mobile "sea" shared by many atoms

54. What is the correct name for the compound with the formula $CrPO_4$?
    A) chromium (II) phosphate
    B) chromium (III) phosphate
    C) chromium (II) phosphide
    D) chromium (III) phosphide

55. Compared to an atom of $^{12}_{6}C$, an atom of $^{14}_{6}C$ has
    A) fewer protons
    B) fewer neutrons
    C) more protons
    D) more neutrons

56. The degree of polarity of a chemical bond in a molecule of a compound can be predicted by determining the difference in the
    A) atomic masses of the bonded atoms in a molecule of the compound
    B) electronegativities of the bonded atoms in a molecule of the compound
    C) densities of the elements in the compound
    D) melting points of the elements in the compound

57. Which type of bond is present in a water molecule?
    A) electrovalent
    B) ionic
    C) nonpolar covalent
    D) polar covalent

58. Which of the following elements has the greatest ability to attract electrons?
    A) Mg
    B) Li
    C) Be
    D) Na

59. One atom of *A* forms a coordinate covalent bond with one atom of *B*. This bond could have been formed by an atom of *B*
    A) transferring only one electron to an atom of *A*
    B) sharing two electrons belonging to an atom of *A*
    C) transferring two electrons to an atom of *A*
    D) sharing only one electron belonging to an atom of *A*

60. Conductivity in a metal results from the metal atoms having
    A) highly mobile electrons in the valence shell
    B) high ionization energy
    C) high electronegativity
    D) highly mobile protons in the nucleus

61. A maximum of 6 electrons can occupy
    A) an *s* sublevel
    B) a *p* sublevel
    C) a *p* orbital
    D) an *s* orbital

62. The water solution of which of the following substances is the best conductor of electricity?
    A) *CO*
    B) $C_6H_{12}O_6$
    C) KCl
    D) CO_2

63. An atom that contains 8 protons, 8 electrons, and 9 neutrons has
    A) an atomic number of 9
    B) an atomic number of 16
    C) a mass number of 25
    D) a mass number of 17

64. As the difference in electronegativity between two atoms decreases, the tendency for the formation of covalent bonds
    A) decreases
    B) increases
    C) remains the same

65. The elements in Period 3 all have the same number of
    A) orbitals containing electrons
    B) principal energy levels containing electrons
    C) valence electrons
    D) sublevels containing electrons

66. Which type of substance is soft, has a low melting point, and is a poor conductor of heat and electricity?
    A) ionic solid
    B) network solid
    C) molecular solid
    D) metallic solid

67. Which factor distinguishes a metallic bond from an ionic bond or a covalent bond?
    A) the mobility of protons
    B) the equal sharing of electrons
    C) the unequal sharing of electrons
    D) the mobility of electrons

68. The electrons in a bond between two iodine atoms (I_2) are shared
    A) unequally, and the resulting bond is polar
    B) unequally, and the resulting bond is nonpolar
    C) equally, and the resulting bond is nonpolar
    D) equally, and the resulting bond is polar

69. What is the VSEPR shape of an H_2S molecule?
    A) pyramidal
    B) tetrahedral
    C) linear
    D) trigonal planer
    E) bent