Name:_____ Grade:_____ Date:_____

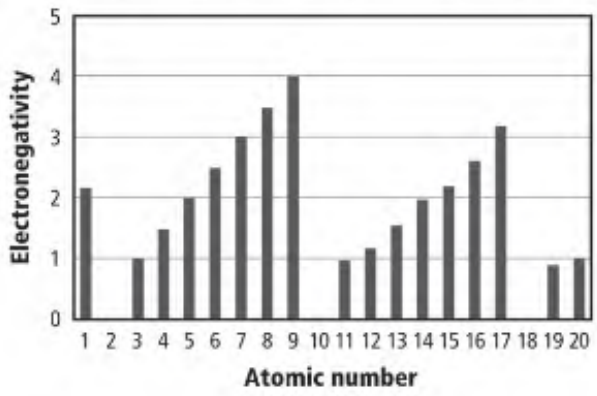
Worksheet 1

MULTIPLE CHOICE

1. The common name of SiI_4 is tetraiodosilane. What is its molecular compound name?
   - **A.** silane tetraiodide
   - **B.** silane tetraiodine
   - **C.** silicon iodide
   - **D.** silicon tetraiodide

2. Which compound contains at least one pi bond?
   - **A.** CO_2
   - **B.** $CHCl_3$
   - **C.** AsI_3
   - **D.** BeF_2

Use the graph below to answer Questions 3 and 4.



3. What is the electronegativity of the element with atomic number 14?
   - **A.** 1.5
   - **B.** 1.8
   - **C.** 2.0
   - **D.** 2.2

4. An ionic bond would form between which pairs of elements?
   - **A.** atomic number 3 and atomic number 4
   - **B.** atomic number 7 and atomic number 8
   - **C.** atomic number 4 and atomic number 18
   - **D.** atomic number 8 and atomic number 12

5. Which is the Lewis structure for silicon disulfide?
   - **A.** :S::Si::S:
   - **B.** ·S::Si::S·
   - **C.** ·S:Si:S·
   - **D.** :S̈:Si:S̈:

6. The central selenium atom in selenium hexafluoride forms an expanded octet. How many electron pairs surround the central Se atom?
   - **A.** 4
   - **B.** 5
   - **C.** 6
   - **D.** 7

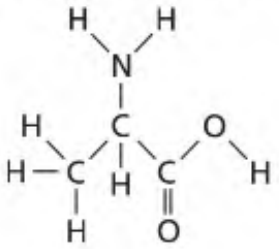
Use the table below to answer Questions 7 and 8.

Bond Dissociation Energies at 298 K

Bond	kJ/mol	Bond	kJ/mol
Cl–Cl	242	N≡N	945
C–C	345	O–H	467
C–H	416	C–O	358
C–N	305	C=O	745
H–I	299	O=O	498
H–N	391		

7. Which diatomic gas has the shortest bond between its two atoms?
   - **A.** HI
   - **B.** O_2
   - **C.** Cl_2
   - **D.** N_2

8. Approximately how much energy will it take to break all the bonds present in the molecule below?



   - **A.** 3024 kJ/mol
   - **B.** 4318 kJ/mol
   - **C.** 4621 kJ/mol
   - **D.** 5011 kJ/mol

9. Which compound does NOT have a bent molecular shape?
   - **A.** BeH_2
   - **B.** H_2S
   - **C.** H_2O
   - **D.** SeH_2

10. Which compound is nonpolar?
    - **A.** H_2S
    - **B.** CCl_4
    - **C.** SiH_3Cl
    - **D.** AsH_3

Name:_____ Grade:_____ Date:_____

Worksheet 2

1 A molecule is formed when two or more atoms form a covalent bond. According to this definition, which of these is NOT a molecule?

A NaCl

B H_2

C HCl

D NH_3

Use the table below to answer question 2.

Number of Atoms	Prefix	Number of Atoms	Prefix
1	mono-	6	hexa-
2	di-	7	hepta-
3	tri-	8	octa-
4	tetra-	9	nona-
5	penta-	10	deca-

2 The table shows some of the prefixes used to name binary covalent compounds. What name would be given to the compound PBr_5?

A Phosphorus tetrabromide

B Monophosphorus pentabromide

C Phosphorus pentabromide

D Phosphorus hexabromide

3 In the polyatomic ion NH_4^+, the formation of a coordinate covalent bond between nitrogen and hydrogen involves —

A hydrogen transferring a pair of electrons to nitrogen

B nitrogen transferring a pair of electrons to hydrogen

C hydrogen donating a pair of electrons to be shared with nitrogen

D nitrogen donating a pair of electrons to be shared with hydrogen

4 When hydrogen and fluorine combine, a polar covalent bond is formed. Which of these formulas is the *best* way to express this relationship?

A H – F

B $\delta^+ H - F \delta^-$

C H : F

D H : F (with lone pairs on F)

Name:_____ Grade:_____ Date:_____

Worksheet 3

5 At room temperature, iodine (I_2) is a solid and bromine (Br_2) is a liquid. These molecules have different melting points because of stronger —

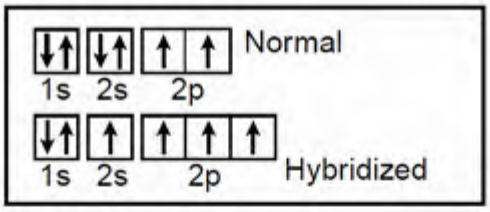
A covalent bonds in iodine

B covalent bonds in bromine

C intermolecular forces in iodine

D intermolecular forces in bromine

Use the diagram below to answer question 6.



6 The diagram shows the electron configuration of a normal carbon atom and the rearrangement of electrons to form four new identical orbits in a hybridized carbon atom. This type of hybrid orbital is called an —

A s^2 orbital

B sp orbital

C sp^2 orbital

D sp^3 orbital

7 Which of these is the chemical formula for sulfurous acid?

A H_2S

B H_2SO_3

C H_2SO_4

D H_2S

8 The bond that holds two fluorine atoms together in an F_2 molecule would be classified as nonpolar covalent because —

A both atoms are different and the difference in electronegativity is large

B both atoms are different and the difference in electronegativity is zero

C both atoms are the same and the difference in electronegativity is large

D both atoms are the same and the difference in electronegativity is zero

Name:_____ Grade:_____ Date:_____

Worksheet 4

. In what form do elements such as hydrogen, nitrogen, and oxygen normally occur?

a. as single atoms
c. as molecules containing three atoms
b. as molecules containing two atoms
d. as molecules containing four atoms

. How many electrons are shared in a double covalent bond?

a. none **b.** one **c.** two **d.** four

. Bond length is the distance between

a. two molecules of the same substance.
c. the nuclei of two attached atoms.
b. the electrons in two attached atoms.
d. the orbitals of two attached atoms.

. Which of the following relationships relating to bond length is generally correct?

a. the shorter the bond, the stronger the bond
b. the shorter the bond, the weaker the bond
c. the shorter the bond, the fewer the electrons in it
d. the shorter the bond, the lower the bond dissociation energy

. The VSEPR model is used mainly to

a. determine molecular shape.
c. determine ionic charge.
b. write resonance structures.
d. measure intermolecular distances.

. The bond angle is the angle between

a. the sigma and pi bonds in a double bond.
c. two terminal atoms and the central atom.
b. the nucleus and the bonding electrons.
d. the orbitals of a bonding atom.

. The VSEPR model is based on the idea that

a. there is always an octet of electrons around an atom in a molecule.
b. electrons are attracted to the nucleus.
c. molecules repel one another.
d. shared and unshared electron pairs repel each other as much as possible.

. The shape of a molecule whose central atom has four pairs of bonding electrons is

a. tetrahedral. **b.** trigonal planar. **c.** trigonal pyramidal. **d.** linear.

. The shape of a molecule that has two covalent single bonds and no lone pairs on the central atom is

a. tetrahedral. **b.** trigonal planar. **c.** trigonal pyramidal. **d.** linear.

. The shape of a molecule that has three single covalent bonds and one lone pair on the central atom is

a. tetrahedral. **b.** trigonal planar. **c.** trigonal pyramidal. **d.** linear.

Name:_____ Grade:_____ Date:_____

Worksheet 5

. Unequal sharing of electrons between two bonded atoms always indicates

a. a nonpolar covalent bond.
c. a polar covalent bond.
b. an ionic bond.
d. a polar molecule.

. When electronegativities of two bonded atoms differ greatly, the bond is

a. polar covalent. **b.** coordinate covalent. **c.** polar covalent. **d.** ionic.

. What is the electronegativity difference that usually is the dividing line between covalent and ionic bonds?

a. 1.0 **b.** 1.7 **c.** 2.7 **d.** 4.0

. The symbol δ^+ is placed next to which of the following?

a. the less electronegative atom in a polar covalent bond
c. a positive ion
b. the more electronegative atom in a polar covalent bond
d. the nucleus

. A nonpolar covalent bond is one in which

a. electrons are transferred.
c. electrons are shared equally.
b. electrons are shared unequally.
d. both electrons are provided by the same atom.

. Molecules containing only polar covalent bonds

a. are always polar.
c. are always ionic.
b. may or may not be polar.
d. are always nonpolar.

. What factor other than electronegativity determines whether a molecule as a whole is polar or not?

a. temperature **b.** its geometry **c.** its physical state **d.** its mass

. Which of the following correctly describes the compound water, H_2O?

a. ionic
c. polar overall, with nonpolar covalent bonds
b. nonpolar overall, with polar covalent bonds
d. polar overall, with polar covalent bonds

. Which of the following correctly describes the compound carbon tetrachloride, CCl_4?

a. ionic
c. polar overall, with nonpolar covalent bonds
b. nonpolar overall, with polar covalent bonds
d. polar overall, with polar covalent bonds

. A molecule of ammonia, NH_3, is

a. nonpolar because it is linear.
b. polar because it is linear.
c. nonpolar because there is no electronegativity difference.
d. polar because there is an electronegativity difference and the molecule is trigonal pyramidal.

Name:_____ Grade:_____ Date:_____

Worksheet 6

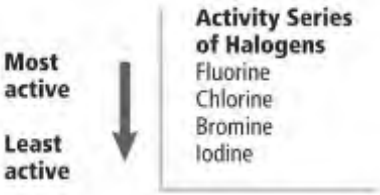
MULTIPLE CHOICE

1. What type of reaction is described by the following equation?

$Cs(s) + H_2O(l) \rightarrow CsOH(aq) + H_2(g)$

A. synthesis
B. combustion
C. decomposition
D. single-replacement

Use the figure below to answer Question 2.



2. Which reaction between halogens and halide salts will occur?

A. $F_2(g) + FeI_2(aq) \rightarrow FeF_2(aq) + I_2(l)$
B. $I_2(s) + MnBr_2(aq) \rightarrow MnI_2(aq) + Br_2(g)$
C. $Cl_2(s) + SrF_2(aq) \rightarrow SrCl_2(aq) + F_2(g)$
D. $Br_2(l) + CoCl_2(aq) \rightarrow CoBr_2(aq) + Cl_2(g)$

3. Which is the electron configuration for iron?

A. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$
B. $[Ar]3d^6$
C. $1s^2 2p^6 3p^6 3d^6$
D. $[Ar]4s^2 4d^6$

4. Which is a description of a pattern displayed by elements in the periodic table?

A. repetition of their physical properties when arranged by increasing atomic radius
B. repetition of their chemical properties when arranged by increasing atomic mass
C. periodic repetition of their properties when arranged by increasing atomic number
D. periodic repetition of their properties when arranged by increasing atomic mass

5. When moving down a group on the periodic table, which two atomic properties follow the same trend?

A. atomic radius and ionization energy
B. ionic radius and atomic radius
C. ionization energy and ionic radius
D. ionic radius and electronegativity

Use the table below to answer Questions 6 to 8.

Physical Properties of Select Ionic Compounds

Compound	Name	State at 25°C	Soluble in Water?	Melting Point (°C)
$NaClO_3$	sodium chlorate	solid	yes	248
Na_2SO_4	sodium sulfate	solid	yes	884
$NiCl_2$	nickel(II) chloride	solid	yes	1031
$Ni(OH)_2$	nickel(II) hydroxide	solid	no	230
$AgNO_3$	silver nitrate	solid	yes	210

6. An aqueous solution of nickel(II) sulfate is mixed with aqueous sodium hydroxide. Will a visible reaction occur?

A. No, solid nickel(II) hydroxide is soluble in water.
B. No, solid sodium sulfate is soluble in water.
C. Yes, solid sodium sulfate will precipitate out of the solution.
D. Yes, solid nickel(II) hydroxide will precipitate out of the solution.

7. What happens when $AgClO_3(aq)$ and $NaNO_3(aq)$ are mixed?

A. No visible reaction occurs.
B. Solid $NaClO_3$ precipitates out of the solution.
C. NO_2 gas is released during the reaction.
D. Solid Ag metal is produced.

8. Finely ground nickel(II) hydroxide is placed in a beaker of water. It sinks to the bottom of the beaker and remains unchanged. An aqueous solution of hydrochloric acid (HCl) is then added to the beaker, and the $Ni(OH)_2$ disappears. Which equation best describes what occurred in the beaker?

A. $Ni(OH)_2(s) + HCl(aq) \rightarrow NiO(aq) + H_2(g) + HCl(aq)$
B. $Ni(OH)_2(s) + 2HCl(aq) \rightarrow NiCl_2(aq) + 2H_2O(l)$
C. $Ni(OH)_2(s) + 2H_2O(l) \rightarrow NiCl_2(aq) + 2H_2O(l)$
D. $Ni(OH)_2(s) + 2H_2O(l) \rightarrow NiCl_2(aq) + 3H_2O(l) + O_2(g)$

Name:_____ Grade:_____ Date:_____

Worksheet 7

Refer to the diagram below to answer questions 1–6.

$$Zn(s) + HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$$

1 The skeleton equation represents a chemical reaction. Which of these are the reactants?

A Zn and HCl

B $ZnCl_2$ and H_2

C HCl and $ZnCl_2$

D Zn and H_2

2 The skeleton equation for this chemical reaction violates the law of conservation of mass. Which of these is the correct balanced chemical equation?

A $2Zn(s) + HCl(aq) \longrightarrow 2ZnCl_2(aq) + H_2(g)$

B $Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + 2H_2(g)$

C $Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$

D $2Zn(s) + 2HCl(aq) \longrightarrow 2ZnCl_2(aq) + H_2(g)$

3 The chemical reaction represented by the equation would be classified as a —

A synthesis reaction

B decomposition reaction

C single-replacement reaction

D double-replacement reaction

4 HCl(aq) and $ZnCl_2$(aq) both exist as ions in aqueous solutions. Which of these is the complete ionic equation for this chemical reaction?

A $Zn(aq) + 2H^+(aq) + Cl^-(aq) \longrightarrow Zn^{2+}(aq) + Cl^-(aq) + H_2(g)$

B $Zn(s) + 2H^+(aq) + 2Cl^-(aq) \longrightarrow Zn^{2+}(aq) + 2Cl^-(aq) + H_2(g)$

C $2Zn(s) + H^+(aq) + Cl^-(aq) \longrightarrow 2Zn^{2+}(aq) + Cl^-(aq) + H_2(g)$

D $Zn(aq) + 2H^+(aq) + 2Cl^-(aq) \longrightarrow Zn^{2+}(s) + Cl^-(aq) + 2H_2(g)$

Name:_____ Grade:_____ Date:_____

Worksheet 8

5 Which of these is a spectator ion in this chemical reaction?

A $Cl^-(aq)$

B $H^+(aq)$

C $H_2(g)$

D $Zn^{2+}(aq)$

6 Which of these is the net ionic equation for this chemical reaction?

A $Zn(s) + 2Cl^-(aq) \longrightarrow Zn^{2+}(aq) + 2Cl^-(aq)$

B $Zn^{2+}(aq) + 2H^+(aq) \longrightarrow Zn(s) + H_2(g)$

C $2H^+(aq) + 2Cl^-(aq) \longrightarrow 2HCl(aq)$

D $Zn(s) + 2H^+(aq) \longrightarrow Zn^{2+}(aq) + H_2(g)$

7 Which of these is NOT evidence of a chemical reaction?

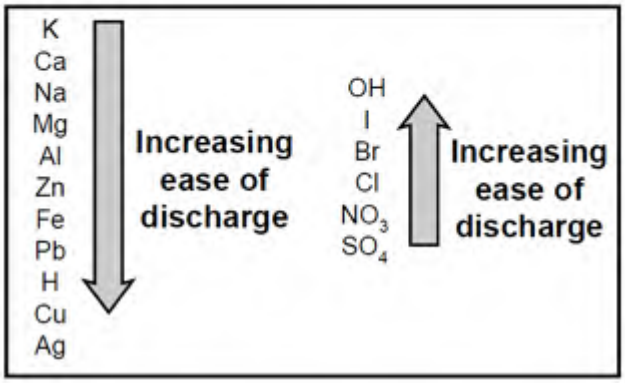
A An iron nail changes to a brownish-orange color.

B An ice cube melts into liquid water.

C An antacid tablet produces bubbles of gas when placed in water.

D A piece of zinc raises the temperature of an acid as it reacts with it.

Use the diagram below to answer question 8.



8 The diagram shows the activity series of some metals (left) and nonmetals (right). A student set up four beakers, each containing 100 mL of dilute hydrochloric acid (HCl[aq]). She added 5 g of a metal to each beaker in this order: aluminum (Al), copper (Cu), sodium (Na), and zinc (Zn). Which metal will NOT react with the acid?

A Aluminum

B Copper

C Sodium

D Zinc

Name:_____ Grade:_____ Date:_____

Worksheet 9

Circle the letter of the choice that best completes the statement or answers the question.

1. A spoonful of sodium chloride is dissolved in a liter of water. What is sodium chloride in this solution?
   a. molecule **b.** precipitate **c.** solute **d.** solvent

2. In an aqueous solution, water is the
   a. homogeneous part. **b.** precipitate. **c.** solute. **d.** solvent.

3. Compounds that produce hydrogen ions in aqueous solutions are
   a. acids. **b.** aqueous. **c.** bases. **d.** ionic compounds.

4. What type of reaction occurs between ions present in aqueous solution?
   a. decomposition **b.** double-replacement **c.** single-replacement **d.** synthesis

5. What type of ions are present in solution but are not actually involved in a chemical reaction?
   a. complete **b.** net **c.** precipitate **d.** spectator

6. If hydrochloric acid and potassium hydroxide react, what is the product of the net ionic equation for the reaction?
   a. hydrochloric acid **b.** hydrogen ions **c.** potassium chloride **d.** water

7. Which of the following gases is not commonly produced in a double-replacement reaction?
   a. carbon dioxide **b.** hydrogen cyanide **c.** hydrogen sulfide **d.** sulfur dioxide

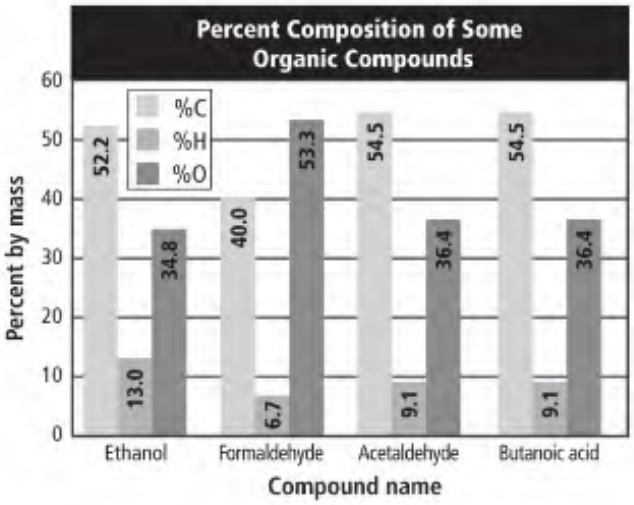
8. $H^+(aq) + Br^-(aq) + K^+(aq) + OH^-(aq) \rightarrow H_2O(l) + Br^-(aq) + K^+(aq)$ is an example of what type of chemical equation?
   a. complete ionic **b.** net ionic **c.** precipitation **d.** spectator

Name:_____ Grade:_____ Date:_____

Worksheet 10

MULTIPLE CHOICE

Use the graph below to answer Questions 1 to 4.



1. Acetaldehyde and butanoic acid must have the same
- **A.** molecular formula.
- **B.** empirical formula.
- **C.** molar mass.
- **D.** chemical properties.

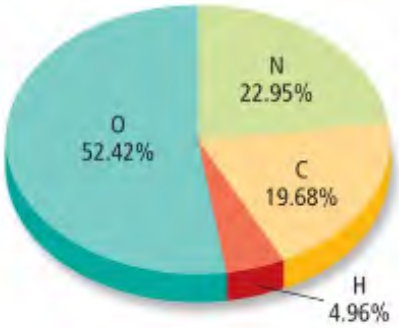
2. If the molar mass of butanoic acid is 88.1 g/mol, what is its molecular formula?
- **A.** $C_3H_4O_3$
- **B.** C_2H_4O
- **C.** $C_5H_{12}O_1$
- **D.** $C_4H_8O_2$

3. What is the empirical formula of ethanol?
- **A.** C_4HO_3
- **B.** $C_2H_6O_2$
- **C.** C_2H_6O
- **D.** $C_4H_{13}O_2$

4. The empirical formula of formaldehyde is the same as its molecular formula. How many grams are in 2.000 mol of formaldehyde?
- **A.** 30.00 g
- **B.** 60.06 g
- **C.** 182.0 g
- **D.** 200.0 g

5. Which does NOT describe a mole?
- **A.** a unit used to count particles directly
- **B.** Avogadro's number of molecules of a compound
- **C.** the number of atoms in exactly 12 g of pure C-12
- **D.** the SI unit for the amount of a substance

Use the graph below to answer Question 6.



6. What is the empirical formula for this compound?
- **A.** $C_6H_2N_6O_3$
- **B.** $C_4HN_5O_{10}$
- **C.** CH_3NO_2
- **D.** CH_5NO_3

7. Which is NOT true of molecular compounds?
- **A.** Triple bonds are stronger than single bonds.
- **B.** Electrons are shared in covalent bonds.
- **C.** All atoms have eight valence electrons when they are chemically stable.
- **D.** Lewis structures show the arrangements of electrons in covalent molecules.

8. Which type of reaction is shown below?

$$2HI + (NH_4)_2S \rightarrow H_2S + 2NH_4I$$

- **A.** synthesis
- **B.** decomposition
- **C.** single replacement
- **D.** double replacement

9. How many atoms are in 0.625 moles of Ge (atomic mass = 72.59 amu)?
- **A.** 2.73×10^{25}
- **B.** 6.99×10^{25}
- **C.** 3.76×10^{23}
- **D.** 9.63×10^{23}

10. What is the mass of one molecule of barium hexafluorosilicate ($BaSiF_6$)?
- **A.** 1.68×10^{26} g
- **B.** 2.16×10^{21} g
- **C.** 4.64×10^{-22} g
- **D.** 6.02×10^{-23} g

Name:_____ Grade:_____ Date:_____

Worksheet 11

1 How many moles of nitrogen atoms are contained in one mole of $Ba(NO_3)_2$?

A 1

B 2

C 6

D 9

2 The molecular formula of a compound is X_6Y_3. What is the empirical formula for this compound?

A X_6Y

B XY_3

C X_2Y

D XY_2

3 Zinc is used as a coating on iron and steel to prevent corrosion. What is the mass, in grams, of 0.0650 mol Zn?

A 3.25 g

B 3.90 g

C 3.94 g

D 4.25 g

4 Mole is to atom as gram is to —

A amu

B mass

C molecule

D particle

5 What is the total number of atoms contained in 2.00 moles of helium?

A 15.999

B 32.0

C 6.02×10^{23}

D 1.20×10^{24}

6 A compound has the formula $MgSO_4 \cdot 7H_2O$. Its chemical name is —

A aqueous magnesium sulfate

B magnesium sulfate pentahydrate

C magnesium sulfate heptahydrate

D magnesium sulfate decahydrate

Name:_____ Grade:_____ Date:_____

Worksheet 12

7 Indium (In) is a relatively rare element that never occurs as a free metal. It is usually found in a compound that contains 70.48% In and 29.52% S. What is the empirical formula for this compound?

A InS

B In_2S_3

C In_3S_5

D In_6S_9

8 A student measures 10.0 g of hydrated sodium carbonate ($Na_2CO_3 \cdot xH_2O$) and places it in a crucible. After heating, 3.7 g of anhydrous sodium carbonate (Na_2CO_3) remains. What is the formula for the hydrate?

A $Na_2CO_3 \cdot 2H2O$

B $Na_2CO_3 \cdot 5H2O$

C $Na_2CO_3 \cdot 8H_2O$

D $Na_2CO_3 \cdot 10H_2O$

9 Potassium nitrate, also known as saltpeter, is used in matches. What is the percent by mass of potassium (K) in potassium nitrate (KNO_3)?

A 38.67%

B 45.94%

C 55.71%

D 56.58 %

10 Baking soda is the common name for sodium hydrogen carbonate ($NaHCO_3$). What is the mass in grams of 2.75 moles of sodium hydrogen carbonate?

A 63.2 g

B 84 g

C 210 g

D 231 g

11 A mole of $^{12}_{6}C$ atoms will have a total mass of —

A 12 kg

B 12 g

C 12 amu

D 6 amu

Name:_____ Grade:_____ Date:_____

Worksheet 13

. Which information about a compound can you use to begin to determine the empirical and molecular formulas of the compound?

a. mass of the compound
c. percent composition of the compound
b. number of elements in the compound
d. volume of the compound

. You have determined that a compound is composed of 0.300 moles of carbon and 0.600 moles of oxygen. What must you do to determine the mole ratio of the elements in the empirical formula of the compound?

a. Multiply each mole value by 0.300 mol.
c. Divide each mole value by 0.300 mol.
b. Multiply each mole value by 0.600 mol.
d. Divide each mole value by 0.600 mol.

. The mole ratio of carbon to hydrogen to oxygen in a compound is 1 mol C : 2 mol H : 1 mol O. What is the empirical formula of the compound?

a. CHO **b.** CH_2O **c.** C_2HO_2 **d.** $C_2H_2O_2$

. You calculate the mole ratio of oxygen to aluminum in a compound to be 1.5 mol O : 1 mol Al. What should you do to determine the mole ratio in the empirical formula of the compound?

a. Multiply each mole value by 1.5.
c. Divide each mole value by 1.5.
b. Multiply each mole value by 2.
d. Divide each mole value by 2.

. What is the relationship between the molecular formula and the empirical formula of a compound?

a. (molecular formula)(empirical formula) = n
b. molecular formula = $\frac{\text{empirical formula}}{n}$
c. molecular formula = (empirical formula)n
d. molecular formula = $\frac{n}{\text{empirical formula}}$

. You know that the empirical formula of a compound has a molar mass of 30.0 g/mol. The experimental molar mass of this compound is 60.0 g/mol. What must you do to determine the value of n in the relationship between the molecular formula and the empirical formula?

a. Add 30.0 g/mol and 60.0 g/mol.
c. Divide 60.0 g/mol by 30.0 g/mol.
b. Divide 30.0 g/mol by 60.0 g/mol.
d. Multiply 30.0 g/mol by 60.0 g/mol.

. You know that the experimental molar mass of a compound is three times the molar mass of its empirical formula. If the compound's empirical formula is NO_2, what is its molecular formula?

a. NO_2 **b.** NO_6 **c.** N_3O_2 **d.** N_3O_6