Sharyland ISD
Study Guide

Chemistry
Semester 1

Student Name: _____

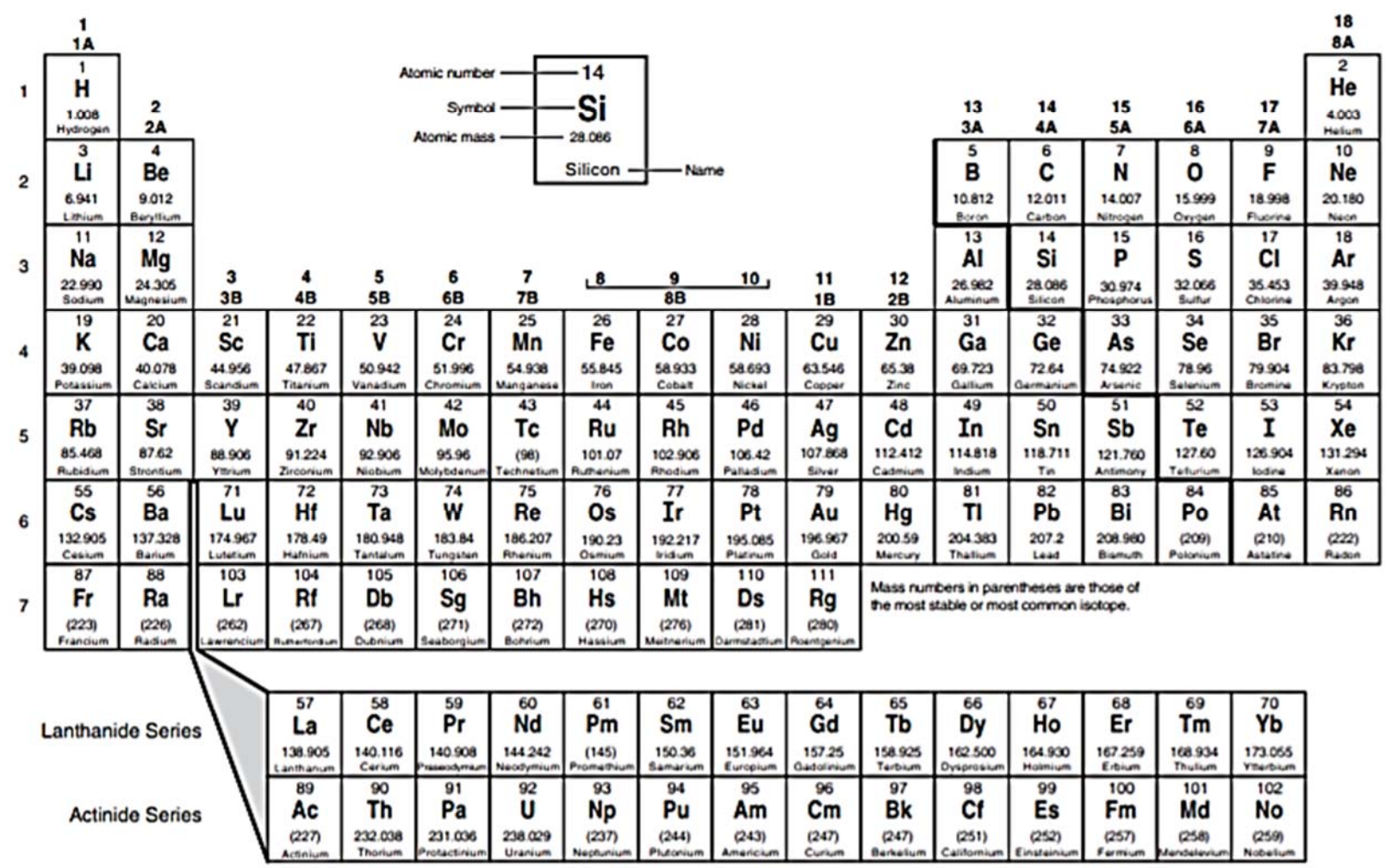
Student ID: _____

In order to be successful in passing the Biology Credit by exam it is recommended that you spend some time working and studying on this review. The following resources can help you review for the exam. This review contains vocabulary as well as practice problems.

- ***Textbook:*** Modern Chemistry © 2015 by Houghton Mifflin Harcourt Publishing Company (available at HS) ISBN: 978-0-544-02376-5
- ***Scientific Calculator*** – will **NOT** be provided and must bring your own on the day of the exam.
- ***Periodic Table of Elements (See Below)*** – Table will be allowed as reference on the day of the exam.
- ***Ionic Reference Sheet (See Below)*** – Sheet will be allowed as reference on the day of the exam.

****Please keep in mind that the following review has guiding questions and vocabulary that will help you get ready for the exam, however, Semester 1 covers chapters 1-7 of the book aforementioned and it would be a good idea to read and study the chapters in their entirety.**

PERIODIC TABLE OF THE ELEMENTS



IONS AND THEIR CHARGES

Cations

±1	±2	±3	±4
All Group IA	All Group 2A	Fe^{+3} iron(III)	Pb^{+4} lead(IV)
Ag^{+} silver (I)	Cu^{+2} copper(II)	Cr^{+3} chromium(III)	Sn^{+4} tin(IV)
NH_4^{+} ammonium	Fe^{+2} iron(II)	Al^{+3} aluminum	
H_3O^{+} hydronium	Hg_2^{+2} mercury(I)	Mn^{+3} manganese(III)	
Cu^{+} copper(I)	Hg^{+2} mercury(II)	Co^{+3} cobalt(III)	
	Pb^{+2} lead(II)		
	Sn^{+2} tin(II)		
	Cr^{+2} chromium(II)		
	Mn^{+2} manganese(II)		
	Co^{+2} cobalt(II)		
	Zn^{+2} zinc(II)		
	Cd^{+2} cadmium(II)		

Anions

-1	-2	-3
H^- hydride	O^{-2} oxide	PO_4^{-3} phosphate
F^- fluoride	O_2^{-2} peroxide	PO_3^{-3} phosphite
Cl^- chloride	S^{-2} sulfide	N^{-3} nitride
Br^- bromide	HPO_4^{-2} hydrogen phosphate	P^{-3} phosphide
I^- iodide	$C_2O_4^{-2}$ oxalate	
HCO_3^- hydrogen carbonate	SO_4^{-2} sulfate	
$C_2H_3O_2^-$ acetate	SO_3^{-2} sulfite	
NO_3^- nitrate	CO_3^{-2} carbonate	
NO_2^- nitrite	CrO_4^{-2} chromate	
CN^- cyanide	$Cr_2O_7^{-2}$ dichromate	
OH^- hydroxide		
MnO_4^- permanganate		
HSO_4^- hydrogen sulfate		
HSO_3^- hydrogen sulfite		
ClO_4^- perchlorate		
ClO_3^- chlorate		
ClO_2^- chlorite		
ClO^- hypochlorite		

Common Acids

Hydrochloric Acid — HCl
Sulfuric Acid — H_2SO_4
Nitric Acid — HNO_3
Acetic Acid — $HC_2H_3O_2$
Phosphoric Acid — H_3PO_4
Carbonic Acid — H_2CO_3

Chapter 1 – Matter and Change

Vocabulary

Matter	Atom	Element
Compound	Extensive Property	Intensive Property
Physical Property	Physical Change	Chemical Property
Chemical Change	Reactant	Product
Mixture	Homogeneous	Solution
Heterogeneous	Pure Substance	Group
Period	Metal	Nonmetal
Metalloid		

Questions

1. Compare the physical properties of metals, nonmetals, metalloids, and noble gases and describe where in the periodic table each of theses kinds of elements are located.

2. Suppose element X is a poor conductor of electricity and breaks when hit with a hammer. Element Z is a good conductor of electricity and heat. In what area of the periodic table does each element most likely belong?

3. Use the periodic table to wire the names of the elements that have the following symbols, and identify each as a metal, nonmetal, metalloid, or noble gas.
   a. K b. Ag c. Si d. Na e. Hg f. He

4. Use the periodic table to identify the group numbers and period numbers of the following elements:
   a. carbon, C b. argon, Ar c. chromium, Cr d. Barium, Ba

5. Identify each of the following as either a physical change or a chemical change. Explain your answers.
   a. A piece of wood is sawed in half.
   b. Milk turns sour.
   c. Melted butter solidifies in the refrigerator.

Chapter 2 – Measurements and Calculations

Vocabulary

Scientific Method	Hypothesis	Volume
Density	Dimensional Analysis	Accuracy
Precision	Significant Figures	Scientific Notation
Quantitative	Qualitative	

Questions

1. Find the density of a material, given that a 5.03 g sample occupies a volume of 3.24 mL.

2. What is the mass of a sample of material that has a volume of 55.1 cm^3 and a density of 6.72 g/cm^3?

3. A sample of a substance that has a density of 0.824 g/mL has a mass of 0.451 g. Calculate the volume of the sample.

4. State the rules governing the number of significant figures that result from each of the following operations.

    a. Addition and subtraction
    b. Multiplication and division

5. How many significant figures are in each of the following measurements?
    a. 0.4004 mL b. 6000 g c. 1.00030 km d. 400. mm

6. Calculate the sum of 6.078 g and 0.3329 g.

7. Divide 94.20 g by 3.16722 mL.

8. Write the following numbers in scientific notation.
    a. 0.0006730 b. 50000.0 c. 0.000003010

9. The following numbers are in scientific notation. Write them in standard notation.
    a. 7.050×10^3 g b. 4.00005×10^7 mg c. 2.3500×10^4 mL

Chapter 3 – Atoms: The Building Blocks of Matter

Vocabulary

Law of Conservation of Mass	Atom	Atomic Number
Isotope	Mass Number	Mole
Avogadro's Number	Molar Mass	Electron
Proton	Neutron	

Questions

1. Summarize Rutherford's model of the atom and explain how he developed this model based on the results of his famous gold-foil experiment.

2. Copy and complete the following table concerning the three isotopes of silicon, Si.

Isotope	Number of protons	Number of electrons	Number of neutrons
Si-28			
Si-29			
Si-30			

3. How many moles of atoms are there in each of the following?

   a. 6.022×10^{23} atoms Ne
   b. 3.011×10^{23} atoms Mg
   c. 3.25×10^{5} g Pb
   d. 4.50×10^{-12} g O

4. How many atoms are there in each of the following?

   a. 1. 50 mol Na b. 6.755 mol Pb c. 7.02 g Si

5. What is the mass in grams of each of the following?

   a. 3.011×10^{23} atoms F
   b. 1.50×10^{23} atoms Mg
   c. 4.50×10^{12} atoms Cl
   d. 8.42×10^{18} atoms Br
   e. 25 atoms W
   f. 1 atom Au

Chapter 4 – Arrangement of Electrons in Atoms

Vocabulary

Electromagnetic Spectrum	Wavelength	Frequency
Orbital	Quantum Number	Electron Configuration
Aufbau Principle	Pauli Exclusion Principle	Hund's Rule
Noble-gas Configuration		

Questions

1.
   a. List five examples of electromagnetic radiation.
   b. What is the speed of all forms of electromagnetic radiation in a vacuum.

2. List the colors of light in the visible spectrum in order of increasing frequency.

3. Write the orbital notation for the following elements.
   a. P b. B c. Na d. O
4. Write the electron-configuration notation of the element whose atoms contain the following number of electrons:
   a. 3 b. 6 c. 8 d. 13

5. Write the noble gas configuration notation for each of the elements listed below:
   a. Cl b. Ca c. Se

6. Identify each of the following atoms on the basis of its electron configuration:

   a. $1s^2 2s^2 2p^1$
   b. $1s^2 2s^2 2p^5$
   c. [Ne] $3s^2$
   d. [Ne] $3s^2 3p^2$
   e. [Ne] $3s^2 3p^5$
   f. [Ar]$4s^1$
   g. [Ar]$3d^6 4s^2$

Chapter 5 – The Periodic Law

Vocabulary

Periodic Table	Alkali Metals	Alkaline-Earth Metals
Transition Elements	Halogens	Noble Gases
Atomic Radius	Ion	Ionization Energy
Cation	Anion	Valence Electron
Electronegativity		

Questions

1. Describe the contributions made by the following scientists of the development of the periodic table.
    a. Dmitri Mendeleev
    b. Henry Moseley

2. What trends can be observed across the various periods within the main-group elements?

3. For each of the following groups, indicate whether electrons are more likely to be lost or gained in compound formation and give the number of such electrons typically involved.

    a. Group 1A b. Group 2A c. Group 3A d. Group 6A
    e Group 7A f. Group 8A

4. Of cesium, Cs, hafnium, Hf, and gold, Au, which element has the salles atomic radius? Explain your answer in terms of trends in the periodic table.

5. Which element is the most electronegative among C, N, O, Br, and S? Which group does it belong to?

6. For each element listed below, determine the charge of the ion that is most likely to be formed and the identity of the noble gas whose electron configuration is thus achieved.

    a. Li b. Rb c. O d. F e. Mg f. Al g. P h. S i. Br j. Ba

7. The electron configuration of argon differs from those of chlorine and by potassium by one electron each. Compare the reactivity of these three elements.

Chapter 6 – Chemical Bonding

Vocabulary

Ionic Bonding	Covalent Bonding	Polar
Polar Covalent Bond	Non Polar Covalent Bond	Molecule
Molecular Formula	Lewis Structure	Single Bond
Double Bond	Triple Bond	Ionic Compound
Metallic Bonding	VSEPR Theory	

Questions

1. As applied to covalent bonding, what is meant by an unshared or lone pair of electrons.

2. Determine the number of valence electrons in an atom of each of the following elements:
   a. H b. F c. Mg d. O e. Al f. N g. C

3. In a Lewis structure, which atom is usually the central atom?

4.
   a. In general, how do ionic and molecular compound compare in terms of melting points, boiling points, and ease of vaporization?
   b. What accounts for the observed difference in the properties of ionic and molecular compounds?
   c. Cite three physical properties of ionic compounds.

5. Draw a Lewis structure for each of the following molecules, and then use the VSEPR theory to predict the molecular geometry of each:

   a. SCl_2 b. PCl_3 c. Cl_2O d. NH_2Cl e. $SiCl_3Br$ f. CO_2

Chapter 7 – Chemical Formulas and Chemical Compounds

Vocabulary

Nomenclature	Oxidation Number (Charge)	Molar mass
Percent Composition	Empirical Formula	Molecular Formula

Questions

1. Using the periodic table, write the symbol of the ion typically formed by each of the following elements:
   a. K b. Ca c. S d. Cl e. Ba f. Br

2. Write the formula fo and indicate the charge on each of the following ions:
   a. Sodium ion
   b. Aluminum ion
   c. Chloride ion
   d. Nitride ion
   e. Iron (II) ion
   f. Iron (III) ion

3. Give the name of each of the following binary ionic compounds:
   a. KCl b. $CaBr_2$ c. Li_2O d. $MgCl_2$

4. Name the following molecular compounds:
   a. CO_2 b. CCl_4 c. PCl_5 d. SeF_6 e. As_2O_5

5. Write formulas for each of the following molecular compounds:
   a. Carbon tetrabromide
   b. Silicon dioxide
   c. Tetraphosphorus decoxide
   d. Diarsenic trisulfide

6. Write formulas for each of the following compounds:
   a. Sodium fluoride
   b. Calcium oxide
   c. Potassium sulfide
   d. Magnesium chloride
   e. Aluminum bromide
   f. Lithium nitride
   g. Iron (II) oxide

7. Determine the molar mass of the following comounds:
    a. Glucose, $C_6H_{12}O_6$ b. Calcium Acetate, $Ca(CH_3COO)_2$
    c KNO_3 d. Na_2SO_4 e. $Ca(OH)_2$ f. $(NH_4)_2SO_3$ g. $Ca_3(PO_4)_2$
    h $Al_2(CrO_4)_3$
8. Determine the percentage composition of each of the following compounds:
    a. NaCl b. $AgNO_3$ c. $Mg(OH)_2$

9. Determine the empirical formula of a compound found to contain 52.11% carbon, 13.14% hydrogen, and 34.75% oxygen.

10. What is the molecular formula of the molecule that has the empirical formula of CH_2O and a molar mass of 120.12 g/mol?

ANSWERS:

Chapter 1

1. Metals (at left and center of table) are good conductors and electrical conductors. Nonmetals (at right of table) tend to be poor conductors. Metalloids (between metal and nonmetals) are intermediate in properties and are semiconductors. Noble gases (at extreme right) are generally unreactive.

2. X is probably a nonmetal on the right side of the table. Z is a metal on the left side or in the middle of the periodic table.

3.
   a. potassium, metal
   b. silver, metal
   c. silicon, metalloid
   d. sodium, metal
   e. mercury, metal
   f. helium, noble gas

4.
   a. 4A, 2 b. 8A, 3 c. 6B, 4 d. 2A, 6

5.
   a. Physical, because the wood remains wood
   b. Chemical, because the milk changes composition, as signified by the change in flavor
   c. Physical, because the butter remains buter

Chapter 2

1. 1.55 g/mL
2. 370. g
3. 0.547 mL

4.
   a. The answer must have the same number of digits to the right of the decimal point as there are in the measurement that has the fewest digits to the right of the decimal point.

   b. The answer can have no more significant figures than are in the measurement with the fewest number of significant figures.

5.
   a. four b. one c. six d. three

6. 6.411 g
7. 29.74 g/mL

8.
   a. 6.730×10^{-4} b. 5.00000×10^{4} c. 3.010×10^{-6}
9.
   a. 7050 g b. 40000500 mg c. 23500 mL

Chapter 3

1. His model had most of the mass in the nucleus. He bombarded gold atoms with positively charged particles most went straight through the atom, but some were deflected and a few bounced back.

2.

Isotope	Number of protons	Number of electrons	Number of neutrons
Si-28	14	14	14
Si-29	14	14	15
Si-30	14	14	16

3.
   a. 1.000 mol b. 0.5000 mol c. 1.57×10^{3} mol d. 2.81×10^{-13} mol

4.
   a. 9.03×10^{23} atoms b. 4.068×10^{24} atoms c. 1.50×10^{23} atoms

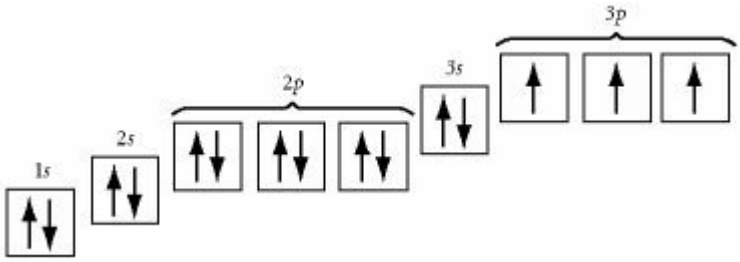
5.
   a. 9.500 g b. 6.05 g c. 2.65×10^{-10} g d. 1.12×10^{-3} g
   e 7.6×10^{-21} g f. 3×10^{-22} g

Chapter 4

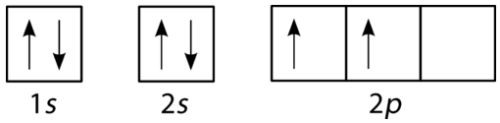
1.
   a. Examples include gamma rays, X rays, ultraviolet light, visible light, infrared light, microwaves, and radio waves.
   b. 3.00×10^{8} m/s

2. Red, orange, yellow, green, blue, and violet

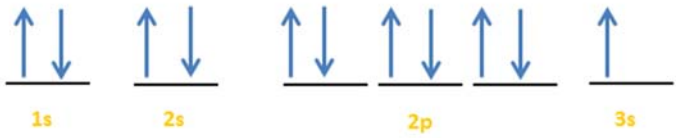
3. a.



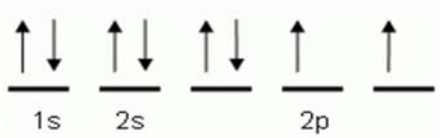
b.



c.



d.



4.

a. $1s^2 2s^1$ b. $1s^2 2s^2 2p^2$ c. $1s^2 2s^2 2p^4$ d. $1s^2 2s^2 2p^6 3s^2 3p^1$

5.

a. [Ne] $3s^2 3p^5$ b. [Ar]$4s^2$ c. [Ar]$3d^{10} 4s^2 4p^4$

6.

a. Boron b. fluorine c. magnesium d. silicon e. chlorine

f potassium g. iron

Chapter 5

1.

a. Mendeleev organized elements according to increasing atomic mass and noticed that similar properties appeared periodically.
b. Moseley discovered that nuclear charge (i.e. atomic number), not atomic mass, should be the basis for organizing the periodic table.

2. Decrease in atomic size (radius), increase in ionization energy, decrease in cationic size, decrease in anionic size, increase in electronegativity.

3.

a. lost, 1 b. lost, 2 c. lost, 3 d. gained, 2 e. gained, 1
f neither lost or gained, 0

4. Gold; atomic radii decrease across a period, and god is farthest to the right in the sixth period, in which all 3 elements are found.

5. O; Group 6A

6.

a. 1^+, He b. 1^+, Kr c. 2^-, Ne d. 1^-, Ne e. 2^+, Ne
f 3^+, Ne g. 3^-, Ar h. 2^- Ar, i. 1^-, Kr j. 2^+, Xe

7. Chlorine and potassium are reactive elements, whereas argon is unreactive. Chlorine readily gains one electron to achieve the configuration of argon, and potassium readily loses one electron to achieve the argon configuration.

Chapter 6

1. A pair of electrons that is not involved in bonding but instead belongs exclusively to one atom.

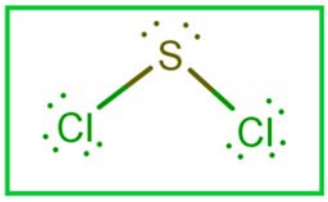
2.

a. 1 b. 7 c. 2 d. 6 e. 3 f. 5 g. 4

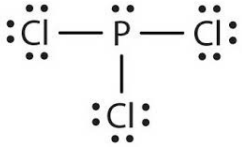
3. The least-electronegative atom is usually the central atom (except for hydrogen, which is never central). If carbon is present, however, it is usually the central atom, regardless of what other atoms are in the molecule.

4.

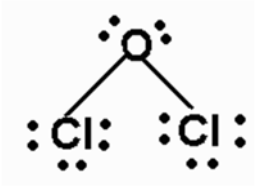
a. Ionic compounds have higher melting and boiling points than molecular compounds.
b. The differences in the properties of ionic and molecular compounds are due to differences in how strongly the compound's basic units are held together.
c. Hardness, brittleness, electrical conductivity, and molten state.

5. a. 

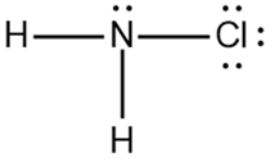
bent or angular

b. 

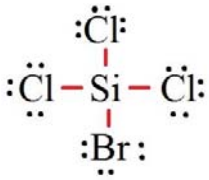
trigonal pyrimidal

c. 

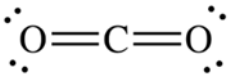
bent or angular

d 

trigonal pyramidal

e. 

tetrahedral

f. 

linear

Chapter 7

1.
   a. K^+ b. Ca^{2+} c. S^{2-} d. Cl^- e. Ba^{2+} f. Br^-
2.
   a. Na^+, 1+ b. Al^{3+}, 3+ c. Cl^-, 1- d. N^{3-}, 3- e. Fe^{2+}, 2+ f. Fe^{3+}, 3+
3.
   a. potassium chloride b. calcium bromide c. lithium oxide d. magnesium chloride
   b.
4.
   a. carbon dioxide b. carbon tetrachloride c. phosphorus pentachloride
   d selenium hexafluoride e. diarsenic pentoxide
5.
   a. CBr_4 b. SiO_2 c. P_4O_{10} d. As_2S_3
6.
   a. NaF b. CaO c. K_2S d. $MgCl_2$ e. $AlBr_3$ f. Li_3N g. FeO
7.
   a. 180.18 g/mol b. 158.18 g/mol c. 101.11 g/mol d. 142.04 g/mol
   e. 74.10 g/mol f. 116.16 g/mol g. 310.18 g/mol h. 401.96 g/mol
8.
   a. 39.33% Na, 60.66% Cl
   b. 63.50% Ag, 2.24% N, 28.24% O
   c. 41.68% Mg, 54.86% O, 3.46% H

9. C_2H_6O
10. $C_4H_8O_4$