

Exam 2

MULTIPLE CHOICE (3pts each): Write the ONE letter corresponding to the correct answer on the line next to each question. The LETTER ASSOCIATED WITH THE CORRECT ANSWER MUST BE WRITTEN ON THE LINE NEXT TO THE QUESTION in order to receive full credit.

- 1.) What is the strongest type of intermolecular attractive force that can be used by the molecule NI_3 ? 1.) C
 a.) hydrogen bonding b.) dispersion forces
 c.) dipole-dipole d.) covalent bonds
- 2.) Which of the following pairs of elements would form the most ionic compound? 2.) B
 a.) As & I b.) Na & Br c.) Cu & Se d.) Sr & P
 2.0 2.5 0.9 2.8 1.9 2.4 1.0 2.1
- 3.) The most appropriate name for VO_2 would be 3.) D
 a.) vanadium oxide b.) vanadium (II) oxide
 c.) vanadium dioxide d.) vanadium (IV) oxide
- 4.) How many resonance structures would be needed to fully describe the molecule ClO_3^{1-} ? (Cl is chlorine) 4.) B
 a.) 1 b.) 3 c.) 2 d.) 4
 $\text{Cl}=\text{O}:\text{O}^-$
- 5.) How many lone pairs are there on the central atom in SeBr_4 ? 5.) B
 a.) zero b.) one c.) two d.) three
 $\text{Br}-\text{Se}(\text{Br})_3$
- 6.) How many chlorine ions are there in 0.400 moles of MgCl_2 ? 6.) D
 a.) 0.800 Cl ions b.) 2.41×10^{23} Cl ions c.) 0.400 Cl ions d.) 4.82×10^{23} Cl ions
- 7.) What is the strongest type of intermolecular attractive force that can be used by the molecule C_3H_8 ? 7.) B
 a.) hydrogen bonding b.) dispersion forces
 c.) dipole-dipole d.) covalent bonds
- 8.) What is the formal charge on nitrogen in the most stable form of NO_2^- ? 8.) A
 a.) zero b.) one c.) two d.) three
 $\text{O}=\text{N}(\text{O})^-$
- 9.) Which type of COVALENT bond is the strongest? 9.) C
 a.) single b.) double c.) triple d.) hydrogen
- 10.) Which of the following elements is most likely to violate the octet rule? 10.) A
 a.) boron b.) carbon c.) oxygen d.) nitrogen

SHORT ANSWER (10 pts each): Completely answer all of the following questions. Read all questions carefully!!! SHOW ALL WORK. If your work is in a different location, you must make a note of this in the given work area for the problem in order for the work to be considered for partial credit. Make sure to include units and report all mathematical answers to the correct number of significant figures. Write final answers in designated locations when indicated.

- 1.) Name the following compounds using the naming systems we covered in class. A table of electronegativities is provided to help you determine the correct name.

a.) TiO_2 Titanium (IV) oxide

b.) S_2Br_4 Disulfur tetrabromide

c.) K_2SO_4 Potassium sulfate

d.) $\text{Fe}(\text{OH})_2$ Iron (II) hydroxide

e.) P_2O diphosphorus monoxide

- 2.) Write the correct formulas for the following compounds/pairs of elements:

a.) Nitrogen triiodide NI_3

b.) Diarsenic hexabromide As_2Br_6

c.) Osmium (II) sulfide OsS

d.) Calcium nitrate $\text{Ca}(\text{NO}_3)_2$

e.) Sodium carbonate Na_2CO_3

3.) a.) Calculate the mass, in grams, of 0.689 mol of $\text{Mg}(\text{OH})_2$.

Answer: 40.2g

$$\text{Mg}: 24.305 \text{ g/mol} \times 1 = 24.305 \text{ g/mol}$$

$$\text{O}: 15.9994 \text{ g/mol} \times 2 = 31.9988 \text{ g/mol}$$

$$\text{H}: 1.00794 \text{ g/mol} \times 2 = 2.01588 \text{ g/mol}$$

$$\underline{58.31968 \text{ g/mol}}$$

$$0.689 \text{ mol} \left(\frac{58.31968 \text{ g}}{\text{mol}} \right)$$

$$= 40.1822595 \text{ g}$$

b.) Calculate the number of moles in 12.3mg $\text{Mg}(\text{OH})_2$. Answer: $2.11 \times 10^{-4} \text{ mol}$

$$12.3 \text{ mg} \left(\frac{1 \text{ g}}{1000 \text{ mg}} \right)$$

$$= 0.0123 \text{ g} \left(\frac{1 \text{ mol}}{58.31968 \text{ g}} \right)$$

$$= 2.109065 \times 10^{-4} \text{ mol}$$

c.) How many hydroxide ions are present in 5.73g of $\text{Mg}(\text{OH})_2$?

Answer: $1.18 \times 10^{23} \text{ OH}^- \text{ ions}$

$$5.73 \text{ g} \left(\frac{1 \text{ mol}}{58.31968 \text{ g}} \right)$$

$$= 0.0982516 \text{ mol } \text{Mg}(\text{OH})_2 \left(\frac{6.022 \times 10^{23} \text{ } \text{Mg}(\text{OH})_2}{\text{mol}} \right)$$

$$= 5.9167 \times 10^{22} \text{ } \text{Mg}(\text{OH})_2 \left(\frac{2 \text{ OH}^-}{1 \text{ } \text{Mg}(\text{OH})_2} \right) = 1.183342 \times 10^{23} \text{ OH}^- \text{ ions}$$

4.) What is the mass percent composition of $\text{Zn}_3(\text{PO}_4)_2$?

$$\text{Zn}: 65.39 \text{ g/mol} \times 3 = 196.17 \text{ g/mol}$$

$$\% \text{ Zn}: \underline{50.81\%}$$

$$\text{P}: 30.9738 \text{ g/mol} \times 2 = 61.9476 \text{ g/mol}$$

$$\% \text{ P}: \underline{16.04\%}$$

$$\text{O}: 15.9994 \text{ g/mol} \times 8 = 127.9952 \text{ g/mol}$$

$$\underline{386.1128 \text{ g/mol}}$$

$$\% \text{ O}: \underline{33.15\%}$$

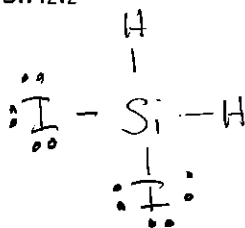
$$\text{Zn}: \frac{196.17 \text{ g/mol}}{386.1128 \text{ g/mol}} \times 100 = 50.8064\%$$

$$\text{P}: \frac{61.9476 \text{ g/mol}}{386.1128 \text{ g/mol}} \times 100 = 16.0439\%$$

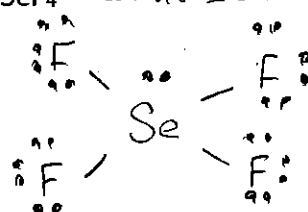
$$\text{O}: \frac{127.9952 \text{ g/mol}}{386.1128 \text{ g/mol}} \times 100 = 33.14969\%$$

5.) Draw Lewis structures for the following molecules. Include all lone pairs. Make sure to minimize formal charges. Show any non-zero formal charges. Only selenium can violate the octet rule.

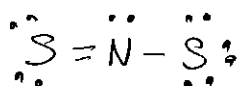
a.) SiH_2I_2



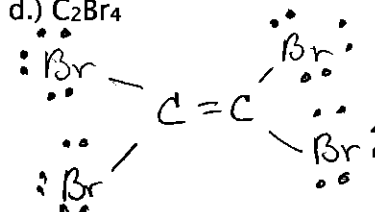
b.) SeF_4 $6 + 28 = 34$



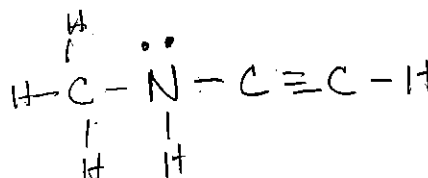
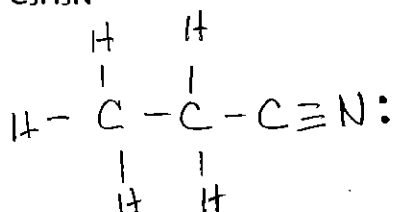
c.) NS_2^{1-}



d.) C_2Br_4



e.) $\text{C}_3\text{H}_5\text{N}$



6.) a.) Fill in the table below with the electron domain geometry, molecular geometry, and polarity for each of the listed molecules.

Molecule	Electron Domain Geometry	Molecular Geometry	Is it polar or nonpolar?
SiH_2I_2	tetrahedral	tetrahedral	polar
SeF_4	Trigonal bipyramidal	Seesaw	polar
NS_2^{1-}	Trigonal planar	bent	polar

7.) a.) Determine the empirical formula of a compound that is 55.8% carbon, 7.02% hydrogen, and 37.2% oxygen.

Assume 100g

$$55.8 \text{ g C} \left(\frac{1 \text{ mol}}{12.011 \text{ g}} \right) = \frac{4.64574 \text{ mol}}{2.325087 \text{ mol}} = 1.998 \approx 2$$

Answer: C₂H₃O

$$7.02 \text{ g H} \left(\frac{1 \text{ mol}}{1.00794 \text{ g}} \right) = \frac{6.9647 \text{ mol}}{2.325087 \text{ mol}} = 2.995 \approx 3$$

$$37.2 \text{ g O} \left(\frac{1 \text{ mol}}{15.9994 \text{ g}} \right) = \frac{2.325087 \text{ mol}}{2.325087 \text{ mol}} = 1$$

b.) If the molar mass of this compound is 129.136g/mol, what is the molecular formula?

$$2 \text{ C: } 12.011 \text{ g/mol} \times 2 = 24.022 \text{ g/mol}$$

$$3 \text{ H: } 1.00794 \text{ g/mol} \times 3 = 3.02382 \text{ g/mol}$$

$$1 \text{ O: } 15.9994 \text{ g/mol} \times 1 = 15.9994 \text{ g/mol}$$

$$\underline{\hspace{1cm}} \\ 43.04522 \text{ g/mol}$$

Answer: C₆H₉O₃

$$\frac{129.136 \text{ g/mol}}{43.04522 \text{ g/mol}} = 3$$