**Chemistry**

**Packet#10**

***Empirical and Molecular Formulas***

***Edmodo Group Code:*** *ozm60q* (http://www.edmodo.com)

***Class Website:*** http://mrgchem.weebly.com

***Mr. Gutierrez’s email:*** gutierrezbr@elizabeth.k12.nj.us

Text Messaging Reminders: Text @aofchem to 23559



*Note: You are expected to work on this packet during the allotted class practice time.*

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| **Packet Points** |
| /35 | Completed Class Notes |
| /35 | Completed Classwork |
| /5 | **Writing Name on Every Page** |
| /25 | Handed Packet in on Time  |
| / | Homework |
| / | Followed Classroom Policies |
| / | Classwork Participation |
| / | TOTAL POINTS |

Name of Chemist:

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Period: \_\_\_\_\_\_\_\_\_\_\_

***DUE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

\*All Class Notes + Questions MUST be finished for HOMEWORK if not done in class.

**Using Chemical Formulas**

***Table of Contents***

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| 2. Molecular Formula | 14 - 22 | 248 - 249 |  |

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****Objective: SWBAT determine the empirical formula of a compound using percentage composition.**  |

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| **Class Notes** |
| **Empirical Formula**An \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a chemical formula with \_\_\_\_\_\_\_\_\_\_\_\_\_\_ showing the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ whole-number ratio of different atoms in the compound.**Calculating Empirical Formula Given PERCENTAGE Composition*****Example#1:*** Quantitative analysis shows that a compound contains 32.38% sodium, 22.65% sulfur, and 44.99% oxygen. Find the empirical formula of this compound.

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| **Steps** |  |
| 1. Convert percentage composition to mass values. |  |
| 2. Convert mass values to moles. |
| 3. Divide each mole value by the \_\_\_\_\_\_\_\_\_\_\_\_\_ number of moles. |
| 4. Round each mole ratio to the nearest \_\_\_\_\_\_\_\_\_\_\_\_\_\_ number. |
| 5. Make each rounded value as the subscript of that element. |
| FINAL ANSWER |  |

**Practice Problem**Find the empirical formula of a compound found to contain 26.56% potassium, 35.41% chromium and **the remainder oxygen.**

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| ***Summary of Steps in Your Own Words*** |

**Once you are finished, have Mr. Gutierrez check your work before continuing to the next question.** |

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****Objective: SWBAT determine the empirical formula of a compound using percentage composition.**  |

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| **Class WORK** |
| ***Class Work (Independent Practice*) Directions*:*** Finish as many questions as you can during class. Refer to your notes and ask at least three classmates before asking me for help. If you do not finish these questions in class, you must finish them for homework. Directions: Calculate the empirical formula. Make sure to SHOW ALL YOUR WORK.1. A compound is found to contain 36.58% Na, 25.41% S, and 38.11% O. What is its empirical formula?
2. What is the empirical formula of a compound that contains 32.8% chromium and 67.2% chlorine?
3. A compound is 24.7% Calcium, 1.2% Hydrogen, 14.8% Carbon, and 59.3% Oxygen. Write the empirical formula.
4. What is the empirical formula of a compound that contains 67.1% Zinc and the remaining is oxygen? Name this compound.
5. Analysis of a sample of a substance reveals that it contains 5.94% H and 94.06% O. What is its empirical formula?
6. What’s the empirical formula of a molecule containing 65.5% carbon, 5.5% hydrogen, and 29.0% oxygen?
7. What’s the empirical formula of a molecule containing 18.7% lithium, 16.3% carbon, and 65.0% oxygen?
8. Determine the empirical formula of a compound containing 63.50% silver, 8.25% nitrogen, and 28.25% oxygen.
9. Determine the empirical formula of a compound found to contain 52.11% carbon, 13.14% hydrogen, and 34.75% oxygen.
10. Chemical analysis shows that citric acid contains 37.51% carbon, 4.20% hydrogen, and 58.29% oxygen. What is the empirical formula for citric acid?
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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****Objective: SWBAT determine the empirical formula of a compound using mass composition.** |

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| **Class Notes** |
| **Empirical Formula Continued**An \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a chemical formula with \_\_\_\_\_\_\_\_\_\_\_\_\_\_ showing the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ whole-number ratio of different atoms in the compound.**Calculating Empirical Formula Given MASS Composition*****Example#1:*** Analysis of a 10.150 g sample of a compound known to contain only phosphorus and oxygen indicates a phosphorus content of 4.433 g. What is the empirical formula of this compound?

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| **Steps** |  |
| 1. Convert percentage composition to mass values. |  |
| 2. Convert mass values to moles. |  |
| 3. Divide each mole value by the \_\_\_\_\_\_\_\_\_\_\_\_\_ number of moles. |  |
| 4. Round each mole ratio to the nearest \_\_\_\_\_\_\_\_\_\_\_\_\_\_ number. |  |
| 5. Make each rounded value as the subscript of that element. |  |

**Practice Problem**Analysis of 20.0 g of a compound contains only calcium and bromine indicates that 4.00 g of calcium are present. What is the empirical formula of compound formed?

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| ***Summary of Steps in Your Own Words*** |

**Once you are finished, have Mr. Gutierrez check your work before continuing to the next question.** |

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****Objective: SWBAT determine the empirical formula of a compound using mass composition.** |

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| **Class WORK** |
| ***Class Work (Independent Practice*) Directions*:*** Finish as many questions as you can during class. Refer to your notes and ask at least three classmates before asking me for help. If you do not finish these questions in class, you must finish them for homework. Directions: Calculate the empirical formula. Make sure to SHOW ALL YOUR WORK.1. In an experiment, it was found that 11.775 g of Sn combined with 3.180 g of O. Write the empirical formula and name the compound that is formed.
2. Maryann has a sample of a compound which weighs 200 grams and contains only carbon, hydrogen, oxygen and nitrogen. By analysis, he finds that it contains 97.56 grams of carbon, 4.878 g of hydrogen, 52.03 g of oxygen and 45.53 g of nitrogen. Find its empirical formula.
3. 200.00 grams of an organic compound is known to contain 83.884 grams of carbon, 10.486 grams of oxygen and the rest is nitrogen. What is the empirical formula of the compound?
4. 300 grams of an organic sample which contains only carbon, hydrogen, and oxygen is analyzed and found to contain 145.946 grams of carbon, 24.3243 grams of hydrogen and the rest is oxygen. What is the empirical formula for the compound?
5. If 7.00 g of iron react with 3.00 g of Oxygen, what is the empirical formula of the compound formed?
6. A compound is found to have 1.121 g nitrogen, 0.161 g hydrogen, 0.480 g carbon and 0.640 g oxygen. What is its empirical formula?
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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****Objective: SWBAT determine the molecular formula of a compound given its empirical formula or percentage/mass composition.** |

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| **Class Notes** |
| **Molecular Formula**While an **empirical formula** is a chemical formula with subscripts showing the **smallest** whole-number ratio of different atoms in the compound, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the ACTUAL formula of a molecular (covalent) compound.**Relationship between Empirical Formula and Molecular Formula**

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**Calculating Molecular Formula*****Example#1:*** Analysis of a 10.150 g sample of a compound known to contain only phosphorus and oxygen indicates a phosphorus content of 4.433 g. What is the empirical formula of this compound?

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| **Steps** |  |
| 1. Find the empirical formula if percentage composition or mass composition is given. (If empirical formula is already given, skip to step 2.) |  |
| 2. Divide the **experimental formula mass** by the **empirical formula mass** to get *x*. |  |
| 3. Multiply the value of x by the subscripts of the empirical formula.  |  |
| FINAL ANSWER |  |

 **TWO TYPES of MOLECULAR FORMULA PROBLEMS**1. Given the empirical formula.
2. Given percentage or mass composition. (Calculate empirical formula FIRST.)

**Practice Problem**What is the molecular formula of the molecule that has an empirical formula of CH2O and a molar mass of 120.12 g/mol?

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| ***Summary of Steps in Your Own Words*** |

**Once you are finished, have Mr. Gutierrez check your work before continuing to the next question.** |

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****Objective: SWBAT determine the molecular formula of a compound given its empirical formula or percentage/mass composition.** |

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| **Class WORK** |
| ***Class Work (Independent Practice*) Directions*:*** Finish as many questions as you can during class. Refer to your notes and ask at least three classmates before asking me for help. If you do not finish these questions in class, you must finish them for homework. Directions: Calculate the empirical formula. Make sure to SHOW ALL YOUR WORK.1. A compound’s empirical formula is C3H7 and its molecular weight is 86 g/mole. Find its molecular formula.
2. A compound’s empirical formula is NO2 and its molecular weight is 46 g/mole. Find its molecular formula.
3. A compound is 58.8 % C, 9.9 % H, and 31.3 % O. If its molecular mass is 306 g/mole, what is the molecular formula?
4. What’s the empirical formula of a molecule containing 18.7% lithium, 16.3% carbon, and 65.0% oxygen?
5. Analysis if a compound reveals that it is made up of 63.50% silver, 8.25% nitrogen, and the rest oxygen. Experimentation shows that the molecular molar mass of the compound is 414 g/mol.
6. Determine the empirical formula of the compound.
7. Determine the molecular formula of the compound.
8. A compound is known to have an empirical formula of CH and a molar mass of 78.11 g/mol. What is its molecular formula? Find the molecular formula if the formula mass is 204.25 g/mol.
9. Caffeine is made of 49.48 % C, 5.19% H, 16.48% O and 28.8% N. Find the molecular mass of Caffeine if its overall molecular mass is 194.22 g/mol.
10. Hydrogen peroxide is 5.93 % H and 94.07 % O. Find the formula of hydrogen peroxide given it has an overall formula mass of 34 g/mol.
11. A strong oxidizing agent and rocket propellant has a % composition of 30.43% N and 69.57 % O. Find the molecular formula if its formula mass is 92.0 g/mol.
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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****Objective: SWBAT convert a molecular formula to an empirical formula.** |

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| **Class Notes** |
| **Molecular Formula to Empirical Formula**How to Change a Molecular Formula to an Empirical Formula in Three Steps:Step 1: Determine the molecular formula. - Step 1b: If the molecular formula is written structurally, then it must be converted to standard form (See example 3).Step 2: Divide each subscript of the molecular formula by the greatest common factor.Step 3: Write the “simplified” formula.\*If there is no whole number that all the subscripts are divisible by, then the molecular formula is the empirical formula. No further work is needed.Examples:1. Hydrogen PeroxideStep 1: Molecular Formula = H2O2Step 2: All subscripts are divisible by \_\_\_\_\_\_.Step 3: Empirical Formula = HO2. GlucoseStep 1: Molecular Formula = C6H12O6Step 2: All subscripts are divisible by \_\_\_\_\_\_\_\_.Step 3: Empirical Formula = \_\_\_\_\_\_\_\_\_\_**Practice Problem**3. Acetic AcidStep 1: Molecular Formula = CH3COOH-- Step 1b: Standard Molecular Formula = C2H4O2Step 2: All subscripts are divisible by \_\_\_\_.Step 3: Empirical Formula = \_\_\_\_\_\_\_\_\_\_. |

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****Objective: SWBAT determine the molecular formula of a compound given its empirical formula or percentage/mass composition.** |

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| **Class WORK** |
| ***Class Work (Independent Practice*) Directions*:*** Finish as many questions as you can during class. Refer to your notes and ask at least three classmates before asking me for help. If you do not finish these questions in class, you must finish them for homework. **1. Write the Empirical Formula for Each of the Following:****a. P4O6 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****b. C6H9 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****c. CH2OHCH2OH \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****d. BrCl2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****e. C6H8O6 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****f. C10H22 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****g. Cu2C2O4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****h. Hg2F2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |

Make sure Mr. Gutierrez stamps/signs this by the end of the period. You CANNOT get the stamp/signature for a day later on. It is your responsibility to remind Mr. Gutierrez. You will NOT receive a stamp if you did not follow all classroom policies or actively work on the practice problems during the allotted class time.A stamp means you received all 10 points. No stamps means you’ve received zero points. If you completed some work, I may give you partial credit based on my discretion. ***If you are absent, write the date on the day you were absent and write the word “Absent.” DO NOT LOSE THIS SHEET!!!*** (If you lose this sheet, you will lose all of your participation points. NO EXCEPTIONS.)

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| **Day of Week** | **Followed All Classroom Policies** (Respectful, on time, prepared, engaged…) | **Class work Participation** | **Homework** |
| *Monday* | /10 | /10 | /10 |
| *Tuesday* | /10 | /10 | /10 |
| *Wednesday* | /10 | /10 | /10 |
| *Thursday* | /10 | /10 | /10 |
| *Friday* | /10 | /10 | /10 |

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| **Classroom Policy Violation Codes**P = PhoneC = CursingT = TalkingL = Late to classO.T. = Off TaskH.D. = Head DownN.iP = Did not bring iPadUnp = Unprepared (no pencil, no iPad, no emergency passes, no periodic table, etc.) |

**Teacher Comments:**