Name ____________________ Date 12/5 ________ Class ________

CHAPTER 11 STUDY GUIDE FOR CONTENT MASTERY

The Mole

Section 11.1 Measuring Matter

In your textbook, read about counting particles.

In Column B, rank the quantities from Column A from smallest to largest.

Column A	Column B
0.5 mol	1. ____________
200	2. ____________
5	3. ____________
6 000 000 000	4. ____________
6.02×10^{23}	5. ____________
dozen	6. ____________
four moles	7. ____________
gross	8. ____________
pair	9. ____________
ream	10. ____________

In your textbook, read about converting moles to particles and particles to moles.

In the boxes provided, write the conversion factor that correctly completes each problem.

11. 1.20 mol Cu $\times$ [ ] $= 7.22 \times 10^{23}$ Cu atoms

12. 9.25×10^{22} molecules CH_4 $\times$ [ ] $= 1.54 \times 10^{-1}$ mol CH_4

13. 1.54×10^{26} atoms Xe $\times$ [ ] $= 2.56 \times 10^{2}$ mol Xe

14. 3.01 mol F_2 $\times$ [ ] $= 1.81 \times 10^{24}$ molecules F_2

Name ____________________ Date __________ Class __________

CHAPTER 11 STUDY GUIDE FOR CONTENT MASTERY

Section 11.2 Mass and the Mole

In your textbook, read about the mass of a mole.

For each statement below, write *true* or *false*.

__________ 1. The isotope hydrogen-1 is the standard used for the relative scale of atomic masses.

__________ 2. The mass of an atom of helium-4 is 4 amu.

__________ 3. The mass of a mole of hydrogen atoms is 1.00×10^{23} amu.

__________ 4. The mass in grams of one mole of any pure substance is called its molar mass.

__________ 5. The atomic masses recorded on the periodic table are weighted averages of the masses of all the naturally occurring isotopes of each element.

__________ 6. The molar mass of any element is numerically equal to its atomic mass in grams.

__________ 7. The molar mass unit is mol/g.

__________ 8. If the measured mass of an element is numerically equal to its molar mass, then you have indirectly counted 6.02×10^{23} atoms of the element in the measurement.

In your textbook, read about using molar mass.

For each problem listed in Column A, select from Column B the letter of the conversion factor that is needed to solve the problem. You may need to use more than one conversion factor to solve the problem.

Column A

______ 9. Find the number of moles in 23.0 g of zinc.

______ 10. Find the mass of 5.0×10^{20} zinc atoms.

______ 11. Find the mass of 2.00 moles of zinc.

______ 12. Find the number of atoms in 7.40 g of zinc.

______ 13. Find the number of moles that contain 4.25×10^{27} zinc atoms.

______ 14. Find the number of atoms in 3.25 moles of zinc.

Column B

a. $\dfrac{65.4 \text{ g Zn}}{1 \text{ mol Zn}}$

b. $\dfrac{1 \text{ mol Zn}}{65.4 \text{ g Zn}}$

c. $\dfrac{6.02 \times 10^{23} \text{ atoms Zn}}{1 \text{ mol Zn}}$

d. $\dfrac{1 \text{ mol Zn}}{6.02 \times 10^{23} \text{ atoms Zn}}$

Name ______________________ Class ________ Date __________

TEKS
Chemistry
Lesson 8A, 8B

Lesson Check

1. **Define** State the definition of a mole.

2. **Use the Concept of a Mole** Use the concept of the mole to determine how many moles there are in 2.80×10^{24} atoms of silicon.

3. **Use the Concept of a Mole** Use the concept of the mole to calculate the number of atoms there are in 1.14 mol of sulfur trioxide (SO_3).

4. **Use the Concept of a Mole** Use the concept of the mole to find the molar mass of PCl_3.

5. **Use the Concept of a Mole** Use the concept of the mole to find the mass, in grams, of 4.52×10^{-3} mol $C_{20}H_{42}$.

6. **Use the Concept of a Mole** Use the concept of the mole to calculate the number of moles in 75.0 g of dinitrogen trioxide.

Moles, Molecules, and Grams Worksheet

Using your knowledge of mole calculations, do the following conversions:

1) 45 grams of $NaOH$ to moles

2) 0.90 moles of AgF to molecules

3) 4.5×10^{24} molecules of CH_4 to moles

4) 1.98 grams of $PbSO_4$ to molecules

5) 1.98 moles of $Pb(SO_4)_2$ to grams

6) 8.4×10^{23} molecules of Li_2CO_3 to grams

7) 39 grams of $NaNO_3$ to molecules

Mole Set Investigations

1. Examine the four specimens; note and record your observations. You are not expected to make any measurements yet. The samples are stamped with the letters "A" through "D" to help you make your notes easier to understand.
2. Different kinds of atoms have different masses. How can you tell that this is true from your observations thus far? Did you need to make use of the fact that each sample contained 1 mole of atoms? Which of the four samples is made of atoms with the least mass?
3. Since each sample contains the same number of atoms, a glance will tell that atoms of different elements are not all the same size. List the four samples in order according to size of their atoms. Are there any assumptions you made have needed in order to answer this question?
4. Sample "B" is noticeably less dense than the other samples in this set. In terms of the atoms the samples are made of, what are two reasons that sample "B" is the least dense? Are there any assumptions you needed to answer this question?
5. Now use a metric ruler, a balance, and a text book or other references or resources your instructor may provide. Determine the identity of the four elements in the set. Even if you believe you can identify the elements by sight, you are still asked to provide quantitative (numerical) data and a rationale based on the fact that each sample contains one mole of some element to support your logic.

Before continuing with the following challenges, be sure you correctly identified the four elements. Ask your instructor if you are uncertain.

6. Calculate the mass of one aluminum atom. Show your calculations.
7. Repeat #6 for the other three elements. Show your calculations.

Calculating Particles of Matter in Compounds

1. Examine the four specimens of compounds labeled H_2O (water), $C_{12}H_{22}O_{11}$(sugar), NaCl (table salt) and $NaHCO_3$ (baking soda). Compare the volume(s) of each substance then look at the formula(s). What can you infer about the relative amount based on the atoms in a formula?
2. Note that the formulas indicate one molecule for covalent compounds and one formula unit for ionic compounds. How many molecules or formula units are in one mole of each compound?
3. Using your knowledge of atoms in formulas, calculate the numbers of particles in each of the samples. Show your work, and indicate whether the particles are atoms or ions.

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To Catch A Mole Lab Name ______________________ Period ________

INTRODUCTION: What is a mole? Why do chemists make measurements using a unit with a silly name like "mole?" Actually, the word *mole* is derived from the word *molecule*, since the mole is used to measure quantities of molecules (or atoms!).

In this investigation, you'll get to see how a mole of a compound is determined, and learn how to measure that quantity for yourself. See if you can accurately "catch a mole!"

SAFETY: Several compounds used in this laboratory are poisons, and all are eye irritants. Goggles are required, and be sure to keep your hands away from your face and mouth and to wash your hands thoroughly after finishing the investigation.

BACKGROUND: The mole is one of the most important quantities in chemistry. It is used by chemists as a means of normalizing different compounds so that they can be compared in chemical reactions. A one-mole sample of one element or compound is likely to have a different mass than a one-mole sample of a different element or compound, but, thanks to the concept of the mole, both of those samples have exactly the same number of particles (atoms for elements and molecules or formula units for compounds).

An element's molar mass is defined as the mass in grams of one mole substance. It is equal to atomic weight listed on the periodic table. A compound's molar mass is defined as the sum of the atomic weights of each of the *atoms* in the compound.

Hydrates are ionic compounds (salts) that attract water from the atmosphere. Each formula unit of a hydrous compound combines with a certain number of water molecules, usually a relatively low integer. The convention for writing the formula for a hydrate is the formula for the compound followed by $\bullet nH_2O$ (where n is an integer representing the number of water molecules associated with each salt molecule). The molar weight of a hydrate is determined by adding the combined mass of the water molecules associated with the salt, plus the molar weight of the salt itself.

One **mole** of a substance is quantified by the following means:

1 mole	= the atomic, molecular, or formula mass of the substance in grams.
1 mole	= 6.02 x 10^{23} atoms, molecules, or formula units
1 mole	= 22.4 L of ideal gas at STP (standard temperature and pressure)
** Remember, the term atoms is used for elements, molecules for covalent compounds, and formula units for ionic compunds.*****	

MATERIALS: Electronic balances, spatulas, weighing boats

CHEMICALS: (some chemicals you might not use)

Copper Metal	Sodium Chloride	Magnesium Sulfate Heptahydrate
Zinc Metal	Ammonium Chloride	Calcium Sulfate Dihydrate
Aluminum Metal	Sodium Hydrogen Carbonate	
Tin Metal	Zinc Oxide	

PROCEDURE:

1. Receive four "Catch the Mole" cards and glue these to the correct spots pages two and three of your lab
2. Perform the calculations on the card.
3. Using the electronic balance, measure out the correct mass of substance as accurately as you can.
4. Once you have all four appropriate masses, bring those masses up to your teacher to check your work.
5. Your teacher will take care of your samples for you and then complete the conclusion questions.

Catch a Mole Card A: Element

Catch a Mole Card A:	Molar Mass Calculation
Calculation #2	
Calculation #3	

Catch a Mole Card B: Compound

Catch a Mole Card B:	Molar Mass Calculation
Calculation #2	
Calculation #3	

Catch a Mole Card C: Compound

Catch a Mole Card C:	Molar Mass Calculation
Calculation #2	
Calculation #3	

Catch a Mole Card D: Hydrate

Catch a Mole Card D:	Molar Mass Calculation
Calculation #2	
Calculation #3	

FINAL RESULTS:

List the masses of the four moles you caught. Be sure to include units and list the substance as well.

QUESTIONS:

Which would have a higher mass ? (1 mole of lead or 1 mole of iron) Explain. ______________________

____

Which would have more atoms? (1 mole of lead or 1 mole of iron) Explain. ______________________

____

Which would have a higher mass? (1.65 mole of sucrose, $C_{12}H_{22}O_{11}$ or 6.23 moles of sodium acetate) Explain.

____

Why are molar masses used to obtain a quantity of substance rather than simply counting the atoms or molecules?

____

____

How is it possible to measure out 4.5 moles of liquid water without the use of a balance? ______________

____

____

12/12

Empirical Formula Worksheet

Empirical Formula – a formula showing the smallest whole-number mole ratio.

1. Convert the grams of each element to moles.
2. To find the simplest ratio, divide each element's mole value by the smallest mole value. This will ensure a something to 1 ratio.
3. If the mole ratios are NOT all whole numbers, you must multiply a whole number in order to obtain a whole number ratio.
4. It is helpful to recognize decimal forms of common fractions and multiply by the denominator.

Ex. 2.49 is close to 2 $^{1}/_{2}$ so multiply by 2 to get 5.

1. Give the decimal forms of the following common fractions:

   a. $^{1}/_{5}$ b. $^{1}/_{4}$ c. $^{1}/_{3}$ d. $^{1}/_{2}$ e. $^{2}/_{3}$ f. $^{3}/_{4}$

2. A 15.0g sample of a compound is found to contain 8.83g sodium and 6.17g sulfur. Calculate the empirical formula of this compound.

3. Find the empirical formula of a compound that contains 53.70% iron and 46.30% sulfur.

4. Analysis of a 10.150g sample of a compound known to contain only phosphorus and oxygen indicates a phosphorus content of a 4.433g. What is the empirical formula of this compound.

5. A compound is found to contain 36.48% Na, 25.41% S, and 38.11% O. Find its empirical formula.

6. A compound is found to contain 63.52% iron and 36.48% sulfur. Find its empirical formula.

7. Qualitative analysis shows that a compound contains 32.38% sodium, 22.65% sulfur, and 44.99% oxygen. Find the empirical formula of this compound.

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

9. Analysis of a 20.0g sample of a compound containing only calcium and bromine indicates that 4.00g of calcium are present. What is the empirical formula of the compound formed?

10. A 60.00g sample of tetraethyl lead, a gasoline additive, is found to contain 38.43g lead, 17.83g carbon, and 3.74g hydrogen. Find its empirical formula.

Molecular Formulas

1. Ricinine is one of the poisonous compounds found in the castor plant. The composition of ricinine is 58.54 carbon, 4.91% hydrogen, 17.06 nitrogen, and 19.49% oxygen. Ricinine's molar mass is 164.16 g/mol. Determine the molecular formula.

2. The compound borazine consists of 40.29% boron, 7.51% hydrogen, and 52.20% nitrogen. The molar mass is 80.50 g/mol. Calculate the molecular formula.

3. The composition of silver oxalate is 71.02% silver, 7.91% carbon, and 21.07% oxygen. If the molar mass of silver oxalate is 303.8 g/mol, what is the molecular formula?

4. A compound of phosphorus and sulfur contains 27.87% phosphorus and 72.13% sulfur. The molar mass of the compound is 222.3 g/mol. Calculate its molecular formula.

5. Triethylenemelamine is used in the plastics industry and as an anti-cancer drug. Its analysis is 52.93% carbon, 5.92% hydrogen, and 41.15% nitrogen. The molar mass is 204.2 g/mol. Determine the molecular formula.

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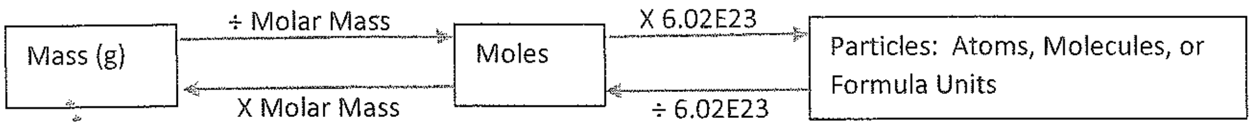
Mole Conversions – Take 2

If you just can't wrap your mind around dimensional analysis right now, memorize the graphic organizer and learn how to use it.



I have typed out generic conversions for all the possible combinations.

Mass to Moles

$$\frac{given\ mass}{1} \text{ X } \frac{1\ mol}{MM\ (g)}$$

Moles to Mass

$$\frac{given\ moles}{1} \text{ X } \frac{MM\ (g)}{1\ mol}$$

Particles to Moles

$$\frac{given\ particles}{1} \text{ X } \frac{1\ mol}{6.02E23\ particles}$$

Moles to Particles

$$\frac{given\ moles}{1} \text{ X } \frac{6.02E23\ particles}{1\ mol}$$

Mass to Particles

$$\frac{given\ mass}{1} \text{ X } \frac{1\ mol}{MM\ (g)} \text{ X } \frac{6.02E23\ Particles}{1\ mol}$$

Particles to Mass

$$\frac{given\ particles}{1} \text{ X } \frac{1\ mol}{6.02E23\ particles} \text{ X } \frac{MM\ (g)}{1\ mol}$$

MOLE CONVERSION PROBLEMS

12/16

Work these problems on your own paper. PSYW

1. **Give the weight in grams of:**

A. 1 mole of sulfur

B. 1 mole of iron

C. 1.5 moles of nitrogen

D. 0.5 moles of carbon

2. **Determine the formulas masses in amu of the following compounds:**

A. Sulfur dioxide

B. Aluminum oxide

C. Ammonia

D. Lithium oxide

E. Carbon tetrachloride

3. **Determine the number of moles in:**

A. 20.0 grams of ammonia

B. 30.0 grams of sodium chloride

C. 10.0 grams of carbon dioxide

D. 16.0 grams of nitrogen dioxide

E. 25.0 grams of glucose (C6H12O6)

4. **Calculate the number of grams in:**

A. 0.85 moles of carbon dioxide

B. 4.3 moles of nitrogen dioxide

C. 1.56 moles of sodium chloride

D. 0 25 moles of hydrochloric acid

E. 2.75 moles of potassium hydroxide

5. Calculate the number of particles in the following:

A. 5.0 moles of water

B. 3.25 moles of sodium fluoride

C. 12.75 moles of oxygen gas

D. 75.0 moles of nitric acid

E. 0.8 moles of iodine

6. Calculate the number of moles of the following:

A. 1.44E25 atoms of carbon

B. 7.22E24 molecules of caffeine

C. 2.17E25 formula units of lithium oxide

D. 4.52E24 molecules of hydrogen gas

E. 3.61E24 atoms of silver

7. Convert the given masses below into the number of representative particles:

A. 195.0 grams of cesium iodide

B. 257 grams of aluminum sulfate

C. 328 grams of sodium phosphate

D. 89.5 grams of silver nitrate

E. 125.0 grams of phosphorus pentafluoride