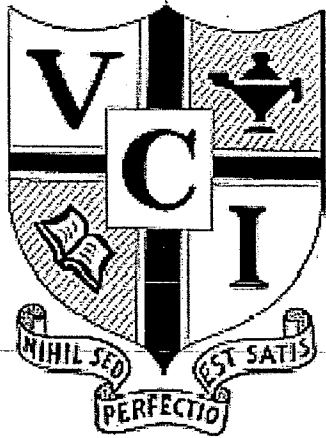


KEY

Science Notebook



30S

Chemistry

The Mole

Student Name: Key Date: _____

305 Chemistry

Chemical Reactions Molar Mass Worksheet

Calculate the molar masses of the following chemicals. Show all work.

1) $\text{Cl}_2 : 2(35.45 \text{ g/mol}) = 70.90 \text{ g/mol}$

2) $\text{KOH} : 39.10 \text{ g/mol} + 16.00 \text{ g/mol} + 1.01 \text{ g/mol} = 56.11 \text{ g/mol}$

3) $\text{BeCl}_2 : 9.01 \text{ g/mol} + 2(35.45 \text{ g/mol}) = 79.91 \text{ g/mol}$

4) $\text{FeCl}_3 : 55.85 \text{ g/mol} + 3(35.45 \text{ g/mol}) = 162.20 \text{ g/mol}$

5) $\text{BF}_3 : 10.81 \text{ g/mol} + 3(19.00 \text{ g/mol}) = 67.81 \text{ g/mol}$

6) $\text{CCl}_2\text{F}_2 : 12.01 \text{ g/mol} + 2(35.45 \text{ g/mol}) + 2(19.00 \text{ g/mol}) = 120.91 \text{ g/mol}$

7) $\text{Mg(OH)}_2 : 24.31 \text{ g/mol} + 2(16.00 \text{ g/mol} + 1.01 \text{ g/mol}) = 58.33 \text{ g/mol}$

8) $\text{UF}_6 : 238.03 \text{ g/mol} + 6(19.00 \text{ g/mol}) = 352.03 \text{ g/mol}$

9) $\text{SO}_2 : 32.06 \text{ g/mol} + 2(16.00 \text{ g/mol}) = 64.06 \text{ g/mol}$

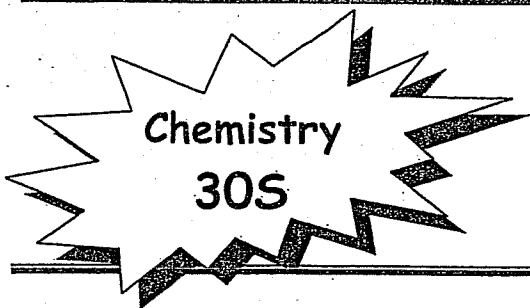
10) $\text{H}_3\text{PO}_4 : 3(1.01 \text{ g/mol}) + 30.97 \text{ g/mol} + 4(16.00 \text{ g/mol}) = 98.00 \text{ g/mol}$

11) $(\text{NH}_4)_2\text{SO}_4 : 2(14.01 \text{ g/mol} + 4(1.01 \text{ g/mol})) + 32.06 \text{ g/mol} + 4(16.00 \text{ g/mol}) = 132.16 \text{ g/mol}$

12) $\text{CH}_3\text{COOH} : 12.01 \text{ g/mol} + 3(1.01 \text{ g/mol}) + 12.01 \text{ g/mol} + 2(16.00 \text{ g/mol}) + 1.01 \text{ g/mol}$

13) $\text{Pb(NO}_3)_2 : 207.19 \text{ g/mol} + 2(14.01 \text{ g/mol} + 3(16.00 \text{ g/mol})) = 331.21 \text{ g/mol}$

14) $\text{Ga}_2(\text{SO}_4)_3 : 2(69.74 \text{ g/mol}) + 3(32.06 \text{ g/mol} + 3(16.00 \text{ g/mol})) = 379.66 \text{ g/mol}$



The Mole

Mole Calculation Worksheet

Answer the following questions in the space provided.

- 1) How many moles are in 15 grams of lithium? $g \rightarrow mol$

$$15g Li \times \frac{1 mol Li}{6.94g Li} = 2.16 mol Li = 2.2 mol Li$$

- 2) How many grams are in 2.4 moles of sulfur? $mol \rightarrow mass$

$$2.4 mol S \times \frac{32.06g S}{1 mol S} = 76.9g S = 77g S$$

- 3) How many moles are in 22 grams of argon? $mass \rightarrow mol$

$$22g Ar \times \frac{1 mol Ar}{39.95g Ar} = 0.550 mol Ar = 0.55 mol Ar$$

- 4) How many grams are in 88.1 moles of magnesium? $mol \rightarrow mass$

$$88.1 mol Mg \times \frac{24.31g Mg}{1 mol Mg} = 2,141.7g Mg = 2.14 \times 10^3 g Mg$$

- 5) How many moles are in 2.3 grams of phosphorus? $mass \rightarrow mol$

$$2.3g P \times \frac{1 mol P}{30.97g P} = 0.0742 mol P = 0.074 mol P$$

- 6) How many grams are in 11.9 moles of chromium? $mol \rightarrow mass$

$$11.9 mol Cr \times \frac{52.00g Cr}{1 mol Cr} = 618.8g Cr = 619g Cr$$

- 7) How many moles are in 9.8 grams of calcium? $mass \rightarrow mol$

$$9.8g Ca \times \frac{1 mol Ca}{40.08g Ca} = 0.2445 mol Ca = 0.24 mol Ca$$

- 8) How many grams are in 238 moles of arsenic? $mol \rightarrow mass$

$$238 mol As \times \frac{74.92g As}{1 mol As} = 17,830.96g As = 1.78 \times 10^4 g As$$

Student Name: _____ Date: _____

**Chemistry
30S**

The Mole

Mole Calculation Worksheet - KEY

Answer the following questions in the space provided.

- 1) How many moles are in 15 grams of lithium? ~~0.46 moles~~ *2.2 mol*
- 2) How many grams are in 2.4 moles of sulfur? **77.0 grams**
- 3) How many moles are in 22 grams of argon? **0.55 moles**
- 4) How many grams are in 88.1 moles of magnesium? **2141 grams**
2140 g
- 5) How many moles are in 2.3 grams of phosphorus? **0.074 moles**
- 6) How many grams are in 11.9 moles of chromium? **618.8 grams**
- 7) How many moles are in 9.8 grams of calcium? **0.24 moles**
- 8) How many grams are in 238 moles of arsenic? **17,826 grams**

What are the molecular weights of the following compounds? (*amu*)

- 9) NaOH **40.1 grams**
- 10) H₂O **18.0 grams**
- 11) MgCl₂ **95.3 grams**
95.2 amu
- 12) H₃PO₄ **98.0 grams**
- 13) Mn₂Se₇ **663.0 grams** *662.60 amu*
- 14) (NH₄)₂SO₄ **132.1 grams**

- 15) How many grams are in 4.5 moles of sodium fluoride, NaF? **189 grams**
- 16) How many moles are in 98.3 grams of aluminum hydroxide, Al(OH)₃?
1.26 moles
- 17) How many grams are in 0.02 moles of beryllium iodide, BeI₂? **5.2 grams**
- 18) How many moles are in 68 grams of copper (II) hydroxide, Cu(OH)₂?
0.70 moles
- 19) How many grams are in 3.3 moles of potassium sulfide, K₂S? **364.0 grams**
- 20) How many moles are in 1.2×10^3 grams of ammonia, NH₃? **70.6 moles**
70.4725 g/mol = 70. mol
- 21) How many grams are in 2.3×10^{-4} moles of calcium phosphate, Ca₃(PO₃)₂?
0.064 grams
- 22) How many moles are in 3.4×10^{-7} grams of silicon dioxide, SiO₂?
 5.66×10^{-9} moles
- 23) How many grams are in 1.11 moles of manganese sulfate, Mn₃(SO₄)₇?
929.5 grams

Grams/Moles Calculations – Answer Key

Given the following, find the number of moles:

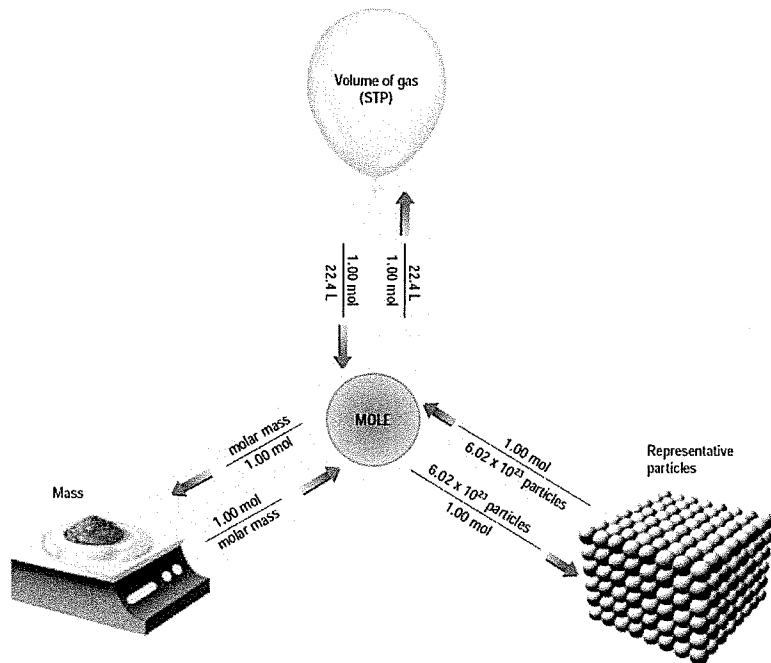
- 1) 30 grams of H_3PO_4 0.31 moles
- 2) 25 grams of HF 1.25 moles
- 3) 110 grams of NaHCO_3 1.31 moles
- 4) 1.1 grams of FeCl_3 0.0068 moles
- 5) 987 grams of $\text{Ra}(\text{OH})_2$ 3.80 moles
- * 6) 564 grams of copper ~~0.11 moles~~ $\frac{564}{63.55} = 8.87 \text{ mol Cu}$
- 7) 12.3 grams of CO_2 0.28 moles
- 8) 89 grams of $\text{Pb}(\text{CH}_3\text{COO})_4$ 0.20 moles

Given the following, find the number of grams:

- 9) 4 moles of $\text{Cu}(\text{CN})_2$ 462 grams
- 10) 5.6 moles of C_6H_6 436.8 grams
- 11) 21.3 moles of BaCO_3 4202.5 grams
- 12) 1.2 moles of $(\text{NH}_4)_3\text{PO}_3$ 159.6 grams
- 13) 9.3×10^{-3} moles of SmO 1.5 grams
- 14) 6.6 moles of ZnO 537.2 grams
- 15) 5.4 moles of K_2SO_4 941.2 grams
- 16) 88.4 moles of NI_3 ~~34679.3 grams~~ $34,892.564 \text{ g NI}_3 = 34,900 \text{ g NI}_3$

Name: Key

Date: _____



Conversion Factors:

(these factors describe what one mole of a substance can be equal to, these form the “bridges” of our dimensional analysis).

1 mole = 6.02×10^{23} atoms

1 mole = element’s atomic mass in grams (calculated the same way formula mass is calculated)

1 mole = 22.4 liters of ANY gas at STP*

*STP = standard temperature and pressure

Particle Conversion: Changing between units of Moles and Atoms

1. How many Mg atoms are in 3.24 moles of Mg?

Starting amount (moles) Conversion Factor Ending amount (atoms)

$$3.24 \text{ mol Mg} \times \frac{6.02 \times 10^{23} \text{ atoms Mg}}{1 \text{ mol Mg}} = 1.950 \times 10^{24} \text{ atoms Mg} = 1.950 \times 10^{24} \text{ atoms Mg}$$

2. 2.68×10^{24} atoms of Cu equal how many moles?

Starting amount (atoms) Conversion Factor Ending amount (moles)

$$2.68 \times 10^{24} \text{ atoms Cu} \times \frac{1 \text{ mol Cu}}{6.02 \times 10^{23} \text{ atoms Cu}} = 4.4518 \text{ mol Cu} = 4.45 \text{ mol Cu}$$

3. How many moles are 1.505×10^{23} Na atoms?

$$1.505 \times 10^{23} \text{ atoms Na} \times \frac{1 \text{ mol Na}}{6.02 \times 10^{23} \text{ atoms Na}} = 0.2500 \text{ mol Na}$$

Mass Conversions: Converting between Grams and Moles

4. Convert 5.00 moles of carbon to grams.

Starting amount (moles) Conversion Factor Ending amount (grams)

$$5.00 \text{ mol C} \times \frac{12.01 \text{ g C}}{1 \text{ mol C}} = 60.05 \text{ g C} = 60.1 \text{ g C}$$

5. Convert 4.86×10^4 g of Mg to moles.

Starting amount (grams)

Conversion Factor

Ending amount (moles)

$$4.86 \times 10^4 \text{ g Mg} \times \frac{1 \text{ mol Mg}}{24.31 \text{ g Mg}} = 1,999.1 \text{ mol Mg} = 2.00 \times 10^3 \text{ mol Mg}$$

6. Convert 9.213 moles of Fe to grams.

Starting amount

Conversion Factor

Ending amount

$$9.213 \text{ mol Fe} \times \frac{55.85 \text{ g Fe}}{1 \text{ mol Fe}} = 514.541 \text{ g Fe} = 514.5 \text{ g Fe}$$

Volume Conversions: Converting between Volume at STP and Moles

7. What volume will 5 moles of O_2 gas occupy at STP?

Starting amount (moles)

Conversion Factor

Ending amount (Volume in L)

$$5 \text{ mol O}_2 \times \frac{22.4 \text{ L O}_2}{1 \text{ mol O}_2} = 112 \text{ L O}_2 = 100 \text{ L O}_2$$

8. A container holds 7.5 liters of CO_2 at STP, how many moles of gas is this?

$$7.5 \text{ L CO}_2 \times \frac{1 \text{ mol CO}_2}{22.4 \text{ L CO}_2} = 0.33482 \text{ mol CO}_2 = 0.33 \text{ mol CO}_2$$

9. H_2 gas at STP occupies 57L of space, how many moles of H_2 are present?

$$57 \text{ L H}_2 \times \frac{1 \text{ mol H}_2}{22.4 \text{ L H}_2} = 2.5446 \text{ mol H}_2 = 2.5 \text{ mol H}_2$$

Mixed Mole Problems (some may require more than one step)

10. Convert 84,520 mg of Ne to atoms.

mass \rightarrow mol \rightarrow atoms

$$\frac{84,520 \text{ mg}}{1000} = 84.52 \text{ g Ne}$$

$$84.52 \text{ g Ne} \times \frac{1 \text{ mol Ne}}{20.17 \text{ g Ne}} \times \frac{6.02 \times 10^{23} \text{ atoms Ne}}{1 \text{ mol Ne}} = 2.5226 \times 10^{24} \text{ atoms Ne} \\ = 2.523 \times 10^{24} \text{ atoms Ne}$$

11. How many atoms are in 45.6 grams of sulfur? mass \rightarrow mol \rightarrow atoms

$$45.6 \text{ g S} \times \frac{1 \text{ mol S}}{32.06 \text{ g S}} \times \frac{6.02 \times 10^{23} \text{ atoms S}}{1 \text{ mol S}} = 8.5624 \times 10^{23} \text{ atoms S} \\ = 8.56 \times 10^{23} \text{ atoms S}$$

12. How many moles are in 68 grams of copper (II) hydroxide, $\text{Cu}(\text{OH})_2$? mass \rightarrow mol

$$68 \text{ g Cu}(\text{OH})_2 \times \frac{1 \text{ mol Cu}(\text{OH})_2}{63.55 \text{ g} + 2(16.00 \text{ g} + 1.01 \text{ g}) \text{ Cu}(\text{OH})_2} = 0.6969 \text{ mol Cu}(\text{OH})_2 \\ = 0.70 \text{ mol Cu}(\text{OH})_2$$

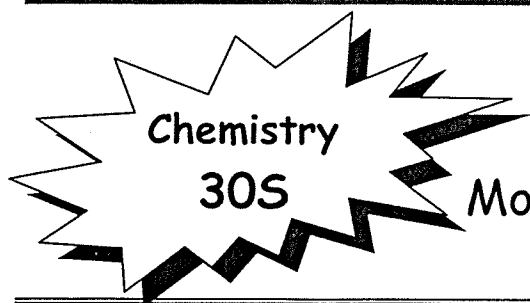
13. What is the mass of 8.944×10^{18} iron atoms in grams? atoms \rightarrow mol \rightarrow mass

$$8.944 \times 10^{18} \text{ atoms Fe} \times \frac{1 \text{ mol Fe}}{6.02 \times 10^{23} \text{ atoms Fe}} \times \frac{55.85 \text{ g Fe}}{1 \text{ mol Fe}} = 8.298 \times 10^{-4} \text{ g Fe}$$

14. How many grams are in 3.3 moles of potassium sulfide, K_2S ? mol \rightarrow mass

$$3.3 \text{ mol K}_2\text{S} \times \frac{2(39.10 \text{ g}) + 32.06 \text{ g K}_2\text{S}}{1 \text{ mol K}_2\text{S}} = 363.858 \text{ g K}_2\text{S} \\ = 360 \text{ g K}_2\text{S}$$

Student Name: _____ Date: _____



The Mole

Moles, Representative Particles and Mass Worksheet - KEY

Answer the following questions in the space provided.

- 1) How many RP are there in 24 grams of FeF_3 ? 1.28×10^{23} RP
- 2) How many RP are there in 450 grams of Na_2SO_4 ? 1.91×10^{24} RP
- 3) How many grams are there in 2.3×10^{24} atoms of silver? 421 grams
- 4) How many grams are there in 7.4×10^{23} RP of AgNO_3 ? 209 grams
- 5) How many grams are there in 7.5×10^{23} molecules of H_2SO_4 ? 122 grams
- 6) How many RP are there in 122 grams of $\text{Cu}(\text{NO}_3)_2$? 3.92×10^{23} RP
- 7) How many grams are there in 9.4×10^{25} molecules of H_2 ? 312 grams
- 8) How many RP are there in 230 grams of CoCl_2 ? 1.07×10^{24} RP
- 9) How many RP are there in 2.3 grams of NH_4SO_2 ? 1.69×10^{22} RP
- 10) How many grams are there in 3.3×10^{23} molecules of N_2I_6 ? 430 grams
- 11) How many molecules are there in 200 grams of CCl_4 ? 7.82×10^{23} molecules
- 12) How many grams are there in 1×10^{24} molecules of BCl_3 ? 195 grams
- 13) How many grams are there in 4.5×10^{22} RP of $\text{Ba}(\text{NO}_2)_2$? 17.1 grams
- 14) How many RP are there in 9.34 grams of LiCl ? 1.33×10^{23} RP
- 15) How many grams do 4.3×10^{21} RP of UF_6 weigh? 2.51 grams
- 16) How many RP are there in 230 grams of NH_4OH ? 3.96×10^{24} RP

6) iron (II) phosphate % Fe 46.8
 % P 17.3
 % O 35.8

7) beryllium nitride % Be 49.1
 % N 50.9

8) potassium cyanide % K 60.1
 % C 18.4
 % N 21.5

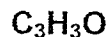
9) manganese (III) nitrate % Mn 22.8
 % N 17.4
 % O 59.8

10) lithium phosphide % Li 40.0
 % P 60.0

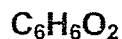
11) nickel (III) sulfate % Ni 28.9
 % S 23.7
 % O 47.3

Percent Composition and Molecular Formula Worksheet Solutions

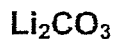
- 1) What's the empirical formula of a molecule containing 65.5% carbon, 5.5% hydrogen, and 29.0% oxygen?



- 2) If the molar mass of the compound in problem 1 is 110 grams/mole, what's the molecular formula?



-
- 3) What's the empirical formula of a molecule containing 18.7% lithium, 16.3% carbon, and 65.0% oxygen?



- 4) If the molar mass of the compound in problem 3 is 73.8 grams/mole, what's the molecular formula?

Li_2CO_3 (In this case, the molecular and empirical formulas are the same, a frequent occurrence for inorganic compounds)

Student Name: _____ Date: _____

30S Chemistry Hydrates Worksheet Key

Answers each question in the space provided.

- 1) How is a hydrate different from other chemical compounds?
It has water molecules loosely attached to it. These water molecules can typically be removed through heating (a process called "dehydration". Hydrates usually involve ionic compounds with transition metals as the cation.
- 2) Define the following terms:
 - anhydrate
A molecule which has no water molecules attached to it. This term is usually only used when describing chemicals which have specifically had their water molecules removed during heating – in these cases, the word "anhydrate" is added to the name.
 - dehydration
The process of removing water from a hydrate, usually through applied heat.
- 3) Name the following compounds:
 - a) $\text{FeCl}_3 \cdot 6 \text{H}_2\text{O}$ iron (III) chloride hexahydrate
 - b) $\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$ copper (II) sulfate pentahydrate
- 4) Write the formulas for the following compounds:
 - a) barium chloride dihydrate $\text{BaCl}_2 \cdot 2 \text{H}_2\text{O}$
 - b) magnesium sulfate heptahydrate $\text{MgSO}_4 \cdot 7 \text{H}_2\text{O}$

Ionic Hydrate Worksheet

Name the following hydrates:

$\text{CaCl}_2 \cdot 8 \text{H}_2\text{O}$ Calcium chloride octahydrate

$\text{FeSO}_4 \cdot 6 \text{H}_2\text{O}$ iron^(II) sulfate hexahydrate

$\text{LiOH} \cdot \text{H}_2\text{O}$ lithium hydroxide monohydrate

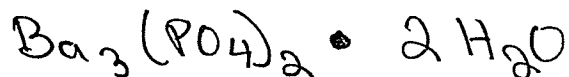
$\text{PbCl}_2 \cdot 3 \text{H}_2\text{O}$ lead^(II) chloride trihydrate

$\text{Li}_2\text{CrO}_4 \cdot 5 \text{H}_2\text{O}$ lithium chromate pentahydrate

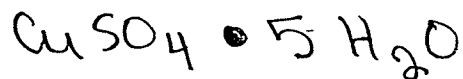
$\text{Na}_2\text{SO}_4 \cdot 10 \text{H}_2\text{O}$ sodium sulfate decahydrate

Write the formulas for the following hydrates:

Barium Phosphate dihydrate



Copper(II)sulfate pentahydrate



Cobalt^(II) chloride hexahydrate



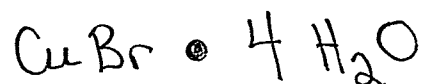
Magnesium sulfate heptahydrate



Nickel (II) sulfate hexahydrate



Copper (I) Bromide tetrahydrate



Naming Hydrates

Write the correct numerical prefix for each of the numbers in the table

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

Complete each of the following sentences by filling in the appropriate word or phrase from the list below.

Cation, hydrates, degree of hydration, anhydrous, anion

1. Ionic compounds that absorb water into their solid structures form substances called hydrates
2. A compound that is completely dry or "water-free" is called anhydrous
3. When naming an ionic substance, the name of the cation comes first, followed by the name of the anion
4. The prefix in the name of a hydrate indicates the degree of hydration