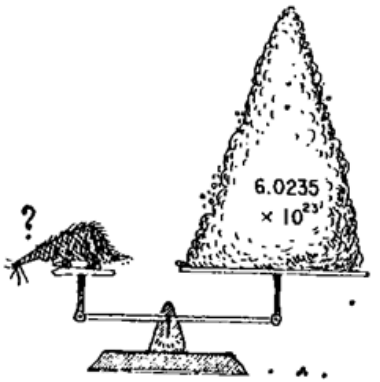
Name _____

Academic Chemistry

Chemical Quantities Notes



Unit #6 Test Date:
November 16th

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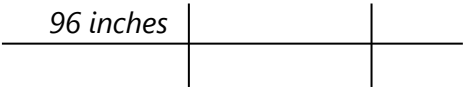
➢ **Dimensional Analysis** is a process scientists use to convert from one unit of measure to another, like ***converting inches to feet.***

Example: Convert 96 inches to feet.

1. First, write the _____.

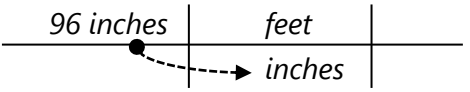
   96 inches

2. Draw in "_____"



Conversion factor = an _____ between two units of measure.

3. Bring _____ units from the given to the next bottom box. In the box above, write the _____ *you want* to convert to. You have built a *conversion factor*.



4. Insert the values for each unit that make the conversion factor *true*.

   In this case, 12 inches = 1 foot.

$$\frac{96\ inches}{12\ inches} \quad \frac{1\ \ feet}{}$$

Conversion factor
Values are EQUAL

5. Perform the math:

   - _____ units that appear both in the numerator and denominator.
   - _____ numbers on top (numerators)
   - _____ by any numbers on bottom (denominators).

$$\frac{96\ \cancel{inches}}{12\ \cancel{inches}} \quad \frac{1\ \ feet}{} = \frac{96\ x\ 1}{12} = 8\ feet$$

Chemistry fact: Mole day is celebrated every year on October 23rd.

➢ *What is a MOLE?*

A ***mole*** is _____ _____ of a pure substance. This is called _____ number. We use Avogadro's number and "mole" the same way we use *12* and "dozen". Mole is abbreviated as _____ (this does _____ mean _____).

➢ *What is Molar Mass? How do I calculate it?*

Molar mass is the _____ of 1 _____ of a compound. Its units are _____.

To calculate molar mass of an element or compound**:**

1) Make a _____ of the elements present and how many atoms of each there are.
2) Use the periodic table to determine the _____ _____of each element (round to the hundredths).
3) _____across the chart.
4) _____ up the totals.

Example: Na_2SO_4

Practice:

1) Calculate the molar mass of zinc.

2) What is the molar mass of barium nitrate?

3) You decide to electroplate your old rims on your 1977 Cadillac Eldorado with a bright silver finish and find a nickel color to be your favorite. The substance used for nickel electroplating is called nickel (II) phosphate. Determine the molar mass of nickel (II) phosphate.

➢ *How do I convert from MOLES to mass?*

1) Calculate the _____ of the compound.

2) Use the conversion factor created in step 1 in dimensional analysis to find the number of moles.

MOLES → Mass

$\frac{\text{Molar mass (g)}}{\text{1 mole}}$

Example:

What is the mass of 2.50 mol of NaCl?

Practice:

1) What is the mass of 2.32 mol of dicarbon hexahydride?

2) You need 1.70 moles of calcium hydroxide to make your magic "potion" for the traveling carnival in which you portray a magician. You have 86 grams of the powder in your apothecary's chest. Do you have enough to make your potion?

➢ *How do I convert from mass to MOLES?*

1) Calculate the _____ of the compound.

2) Use the conversion factor created in step 1 in dimensional analysis to find the number of moles.

$$\text{Mass} \rightarrow \text{MOLES}$$
$$\frac{1 \text{ mole}}{\text{Molar mass (g)}}$$

Example:

How many moles are in 74 g of potassium sulfide?

Practice:

1) How many moles are in 39 g of barium hydroxide?

2) Heading into your last lap around campus, Coach Beasley yells, "You can have 1 mole of water when you finish this lap!" However, you finish and chug 100 g of water. How many moles are in 100 g of water?

➢ *What are representative particles (a.k.a. particles)?*

A representative particle is the _____ unit of a pure substance that still holds the _____ of that substance!

Example	*Symbol*	*Pure Substance*	***Representative Particle***
potassium			
magnesium chloride			
diphosphorous pentoxide			
fluorine*		*	

***Diatomic Molecules** are _____ that only exist in nature in their "pure" form *bonded to another identical atom*. For example, fluorine ONLY exists "by itself" in nature bonded to another atom of fluorine. It is still called fluorine, but is written F_2.

The Diatomic Molecules are:

_____ _____ _____ _____ _____ _____ _____

You can use the mnemonic "Dr._____"

➢ *How do I convert from MOLES to particles?*

1) Remember : 1 mole of anything = 6.02×10^{23} _____

2) Use the above _____ _____ in dimensional analysis to calculate the number of representative particles.

3) End with the correct _____ for the compound type.

MOLES→ Particles

$\frac{6.02 \times 10^{23} \text{ (formula units, molecules, atoms)}}{1 \text{ mole}}$

Example:

How many representative particles are in 0.72 mol of Zn?

Practice:

1) How many representative particles are in 7.5 mol of sulfur dioxide?

What are the representative particles for SO_2 called?

2) How many representative particles are in 0.4 mol of potassium chloride?

What are the representative particles called?

➢ *How do I convert from particles to MOLES?*

1) Use _____ number in dimensional analysis

   to calculate the number of moles present

Particles → MOLES

$\frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ (formula units, molecules, atoms)}}$

Example:

How many moles are in 8.34×10^{24} molecules of bromine?

Practice:

1) How many moles are in 4.81×10^{24} atoms of rubidium?

2) To fill a 4 liter tank with nitrogen dioxide you need 16 moles of the gas. If you have 3.4×10^{26} molecules of nitrogen dioxide, will the tank fill?

- ***Mixed mole questions*** ask you to convert between _____

and _____. You MUST convert to _____

before converting from *particles to mass* or *mass to particles*.

How do I solve a mixed mole problem?

1) Use dimensional analysis and start with the _____.

2) Find the _____ of substances when necessary.

Practice:

1) How many atoms of sodium are you eating when you consume 1.09 g (the amount in a sausage McGriddle)?

2) How many grams in 4.29×10^{39} formula units of sodium sulfate?

3) You just inhaled 57 grams of the toxic gas carbon tetrachloride. A lethal dose is 2.26×10^{24} molecules of the gas. Are you going to die from this dose?

◆ ***Percent composition*** is the _____, by _____, of each element in a compound.

$$\% \text{ composition} = \frac{total\ mass\ of\ \_\_\_\_\_}{molar\ mass\ of\ compound} \times 100\%$$

1) Calculate the _____ _____ of the compound.

Example: CO_2 (C) 1 x 12.011 = 12.011
(O) 2 x 15.999 = 31.998 +
44.009 g/mol

2) *Look* at the calculations above. For each element, we have already calculated the _____ in the compound.

(C) 1 x 12.011 = 12.011 g/mol ← *mass of C in CO_2*
(O) 2 x 15.999 = 31.998 g/mol ← *mass of O in CO_2*

3) Using the formula, solve for % composition for each element.

$\frac{12.011}{44.009}\ x\ 100\% = 27.29\%$ C $\quad\quad$ $\frac{31.998}{44.009}\ x\ 100\% = 72.71\%$ O

Practice:

1) Find the % composition of each element in ammonium chloride.

2) What is the % composition of each element in mercury (IV) oxide?

- The ***empirical formula*** *of a compound* is the formula with the

_____ whole number _____ of elements.

How do I calculate it? … You will be given either:

a. The actual _____ of the elements in the compound **or**

b. The_____ compositions. The _____ of elements in a compound is preserved in a percentage, so we can just change the _____ from _____ to _____!

1) Use _____ of each element to determine the number of _____ of each element.

2) Divide all _____ by the _____ mole number.

3) *If whole numbers*, apply these numbers as _____ to their corresponding elements in the compound.

4) IF NOT WHOLE NUMBERS, Convert to _____ whole number ratio. *To do this: multiply results by a common number.* Apply these numbers as subscripts.

For example:

Phosphorus = 1 **x 2** = 2 Nitrogen = 1 **x 3** = 3

Oxygen = 2.5 **x 2** = 5 Chlorine = 1.33 **x 3** = 4

$P_1O_{2.5}$ → $\mathbf{P_2O_5}$ $\mathbf{N_3Cl_4}$

No ☹ Yes ☺

Example:

Determine the empirical formula for a compound that contains 40.05 g sulfur and 59.95 g oxygen.

Practice:

1) What is the empirical formula of a compound that contains 5.90 g hydrogen and 94.1 g oxygen?

2) Determine the empirical formula for a compound that contains 48.64% carbon, 8.16% hydrogen, and 43.20% oxygen.

3) While an undergraduate assistant in food chemistry, you discover a new non-nutritive sugar substitute that tastes better than maple syrup. After evaluating the substance's properties you find the substance contains 12.12% carbon, 71.72% chlorine, and 16.16% oxygen? From your learning, you know that a substance with more chlorine than carbon tends to cause cancer. Is your sugar substitute safe to eat?

- The ***molecular formula*** is the _____ of atoms of each element in a compound. In order to find the molecular formula you need to compare the _____of the compound with the mass of the _____ formula.

How do I find the molecular formula?

1) Determine the _____ of the _____ formula.

2) Find the scale. $Scale = \frac{\text{_____}}{mass\ of\ empirical\ formula}$

   Round the Scale to the nearest whole number.

3) "_____" empirical formula.

   _____ # atoms of each element by the scale from _____.

Example:

Find the molecular formula for a compound with a molar mass of 78.12 g/mol and an empirical formula of CH.

Practice:

1) Find the molecular formula for a compound with 43.64% phosphorus and 56.36% oxygen and a molar mass of 283.88 g/mol.

2) As a medical bioengineer, you encounter a compound capable of curing seasonal allergies. You know one mole has a mass of 90.04 grams. You have used mass spectrometry to surmise the substance has an empirical formula of CHO_2. Find the molecular formula of the compound.

3) Find the molecular formula for a compound with 46.68% nitrogen and 53.32% oxygen and a molar mass of 60.01 g/mol.

What did Avogadro teach his students in math class?

Solve the following problems. Use the table to determine the letter that corresponds to each answer. Fill in the blanks with the appropriate letter for each question to figure out the riddle.

1. How many grams are in 3.6 mol of Au?

2. How many atoms are in 3.6 mol of Au?

3. How many moles are in 6.4×10^{27} formula units of KCl?

4. How many moles are in 100 g of BCl_3?

5. Convert 7.82 mol $BeBr_2$ to grams.

6. Convert 399 g ZrS_2 to mol.

7. Convert 6.8×10^{20} molecules of BCl_3.

8. Convert 400 moles to atoms of Pt.

9. How many moles are in 250 g of NaBr?

10. How many molecules are in 5 moles of $C_6H_{12}O_6$?

11. How many moles are in 4×10^{23} formula units of NH_4Br?

12. How many grams are in 17.6 mol of K_3PO_3?

13. Convert 42 moles of $MgSO_3$ to formula units.

14. Convert 3 moles of Ga to grams.

A	C	I	I	I	L	L
3.01×10^{24}	2.43	3454.35	2.41×10^{26}	1320.09	10631.23	0.001

M	N	O	O	P	T	T
709.09	209.16	2.17×10^{24}	2.53×10^{25}	2.57	0.85	0.66

What did Avogadro teach his students in math class?

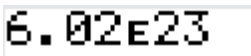
___	___	___	___	___	___	___	___	___	___	___	___	___	___
#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14

Common Polyatomic Ions List

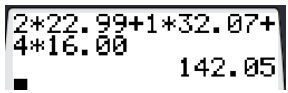
20 Common Polyatomic Ions			
acetate	$C_2H_3O_2^-$ or CH_3COO^-	hypochlorite	ClO^-
ammonium	NH_4^+	nitrate	NO_3^-
carbonate	CO_3^{2-}	nitrite	NO_2^-
chlorate	ClO_3^-	perchlorate	ClO_4^-
chlorite	ClO_2^-	permanganate	MnO_4^-
chromate	CrO_4^{2-}	phosphate	PO_4^{3-}
cyanide	CN^-	phosphite	PO_3^{3-}
dichromate	$Cr_2O_7^{2-}$	silicate	SiO_3^{2-}
hydrogen carbonate	HCO_3^-	sulfate	SO_4^{2-}
hydroxide	OH^-	sulfite	SO_3^{2-}

How to key scientific notation into a TI calculator:

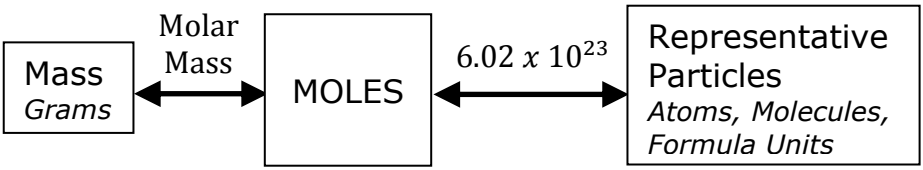
Type in 6.02 x 10^{23}: 

Should display: 

How to key molar mass into a TI calculator in ONE STEP!:

Example: Na_2SO_4 

Mole conversion chart



Atomic number — 14
Symbol — Si
Atomic mass — 28.086
Name — Silicon

	1 1A	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1	1 H 1.008 Hydrogen																	2 He 4.003 Helium
2	3 Li 6.941 Lithium	4 Be 9.012 Beryllium											5 B 10.812 Boron	6 C 12.011 Carbon	7 N 14.007 Nitrogen	8 O 15.999 Oxygen	9 F 18.998 Fluorine	10 Ne 20.180 Neon
3	11 Na 22.990 Sodium	12 Mg 24.305 Magnesium											13 Al 26.982 Aluminum	14 Si 28.086 Silicon	15 P 30.974 Phosphorus	16 S 32.066 Sulfur	17 Cl 35.453 Chlorine	18 Ar 39.948 Argon
4	19 K 39.098 Potassium	20 Ca 40.078 Calcium	21 Sc 44.956 Scandium	22 Ti 47.867 Titanium	23 V 50.942 Vanadium	24 Cr 51.996 Chromium	25 Mn 54.938 Manganese	26 Fe 55.845 Iron	27 Co 58.933 Cobalt	28 Ni 58.693 Nickel	29 Cu 63.546 Copper	30 Zn 65.38 Zinc	31 Ga 69.723 Gallium	32 Ge 72.64 Germanium	33 As 74.922 Arsenic	34 Se 78.96 Selenium	35 Br 79.904 Bromine	36 Kr 83.798 Krypton
5	37 Rb 85.468 Rubidium	38 Sr 87.62 Strontium	39 Y 88.906 Yttrium	40 Zr 91.224 Zirconium	41 Nb 92.906 Niobium	42 Mo 95.96 Molybdenum	43 Tc (98) Technetium	44 Ru 101.07 Ruthenium	45 Rh 102.906 Rhodium	46 Pd 106.42 Palladium	47 Ag 107.868 Silver	48 Cd 112.412 Cadmium	49 In 114.818 Indium	50 Sn 118.711 Tin	51 Sb 121.760 Antimony	52 Te 127.60 Tellurium	53 I 126.904 Iodine	54 Xe 131.294 Xenon
6	55 Cs 132.905 Cesium	56 Ba 137.328 Barium	71 Lu 174.967 Lutetium	72 Hf 178.49 Hafnium	73 Ta 180.948 Tantalum	74 W 183.84 Tungsten	75 Re 186.207 Rhenium	76 Os 190.23 Osmium	77 Ir 192.217 Iridium	78 Pt 195.085 Platinum	79 Au 196.967 Gold	80 Hg 200.59 Mercury	81 Tl 204.383 Thallium	82 Pb 207.2 Lead	83 Bi 208.980 Bismuth	84 Po (209) Polonium	85 At (210) Astatine	86 Rn (222) Radon
7	87 Fr (223) Francium	88 Ra (226) Radium	103 Lr (262) Lawrencium	104 Rf (267) Rutherfordium	105 Db (268) Dubnium	106 Sg (271) Seaborgium	107 Bh (272) Bohrium	108 Hs (270) Hassium	109 Mt (276) Meitnerium	110 Ds (281) Darmstadtium	111 Rg (280) Roentgenium							

Mass numbers in parentheses are those of the most stable or most common isotope.

Lanthanide Series	57 La 138.905 Lanthanum	58 Ce 140.116 Cerium	59 Pr 140.908 Praseodymium	60 Nd 144.242 Neodymium	61 Pm (145) Promethium	62 Sm 150.36 Samarium	63 Eu 151.964 Europium	64 Gd 157.25 Gadolinium	65 Tb 158.925 Terbium	66 Dy 162.500 Dysprosium	67 Ho 164.930 Holmium	68 Er 167.259 Erbium	69 Tm 168.934 Thulium	70 Yb 173.055 Ytterbium
Actinide Series	89 Ac (227) Actinium	90 Th 232.038 Thorium	91 Pa 231.036 Protactinium	92 U 238.029 Uranium	93 Np (237) Neptunium	94 Pu (244) Plutonium	95 Am (243) Americium	96 Cm (247) Curium	97 Bk (247) Berkelium	98 Cf (251) Californium	99 Es (252) Einsteinium	100 Fm (257) Fermium	101 Md (258) Mendelevium	102 No (259) Nobelium