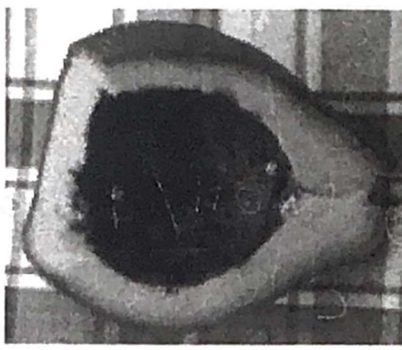
Name: KEY.
Blk:____ Date:________________

Chemistry 11
Calculating Molar Mass

Atoms are so small that in order to calculate mass, we will need a large number of them. Amedeo Avogadro **(1776 - 1856)**, a famous lawyer-turned-mathematician-physicist, concluded that **1 mole of a substance** is the number of atoms of ^{12}carbon in 12 grams of ^{12}carbon. Scientists have now calculated that the number of atoms in 12.0 grams of carbon was 6.02×10^{23} atoms. This became known as "Avogadro's Number".
Note: the picture on the left is NOT Avogadro – the picture on the right is!




HOW BIG IS A MOLE?

- **A mole of marbles spread over the Earth's surface would cover it to a depth of** 80km**!**
- **If you spent one billion dollars a day, you couldn't spend a mole of dollars in** a trillion years**!**
- **A mole of Coke cans would cover the surface of the earth to a depth of over** 450km**!**
- **If you had a mole of unpopped popcorn kernels, and spread them across the United States of America, the country would be covered in popcorn to a depth of over** 15 km**!**
- **If we were able to count atoms at the rate of 10 million per second, it would take about** 2 billion years **to count the atoms in one mole!**

Molar Mass – the amount of mass (g) per mole of substance (units are g/mol)
Molar mass is calculated by using the mass values on the Periodic Table.
Look for the atomic mass and multiply by the number of atoms in the element or compound, then add the values together. Always expressed the answer to one decimal place with the units g/mol.
For example: H_2O

$2(H) = 2(1.0) = 2.0$

$1(H) = 1(16.0) = 16.0$

$18.0\ g\ H_2O / 1\ mol$

PART B: Calculate the mass (g) for the following substances.

1. 1.5 mol of sodium phosphate Na_3PO_4

3 Na = 3(23) = 69.0
1 P = 1(31.0) 31.0
4 O = 4(16.0) 64.0
164.0 g Na_3PO_4 / 1 mol

1.5 mol	164.0 g Na_3PO_4 / 1 mol	= 250 g Na_3PO_4

2. 1.25 mol of iodine (solid → I_2

2 (I) = 2(126.9 g)
= 253.8 g / 1 mol

1.25 mol I_2	253.8 g I_2 / 1 mol	= 317 g I_2

3. 20.0 mol of phosphorus atoms (remember how to write phosphorus!)

4P = 4 (31.0) = 124.0 g P_4 / 1 mol

20.0 mol P_4	124.0 g / 1 mol	2480 g P_4

4. 0.15 mol of barium chloride dihydrate → $BaCl_2 \cdot 2H_2O$

1 Ba = 137.3
2 Cl = 71.0
4 H = 4.0
2 O 32.0
→ 244.3 g $BaCl_2 \cdot 2H_2O$

0.15 mol	244.3 g $BaCl_2$ / 1 mol	= 37 g $BaCl_2 \cdot 2H_2O$

5. 0.0020 mol of nitrogen gas ← N_2

2(N) = 2(14.0) = 28.0

0.0020 mol	28.0 g N_2 / 1 mol	= 0.056 g N_2

1. CO_2

$1(C) = 1(12.0) = 12.0$

$2(O) = 2(16.0) = 32.0$

$\frac{44.0\ g\ CO_2}{1\ mol}$

2. $SrCl_2 \cdot 4H_2O$

$1(Sr) = 87.6$

$2(Cl) = 71.0$

$8(H) = 8.0$

$4(O) = 64.0$

$\frac{230.6\ g\ SrCl_2 \cdot 4H_2O}{1\ mol}$

3. NH_4NO_3

1 N = 14.0

4 H = 4.0

1 N = 14.0

3 O = 48.0

$\frac{80.0\ g\ NH_4NO_3}{1\ mol}$

4. PbO

1 Pb = 207.2

1 O = 16.0

$\frac{223.2\ g\ PbO}{1\ mol}$

5. Chromium II sulphate → $Cr(SO_4)$

1 Cr = 52.0

1 S = 32.1

4 O = 64.0

148.1 g $CrSO_4$ / 1 mol

6. phosphoric acid → H_3PO_4

3 H = 3.0

1 P = 31.0

4 O = 64.0

$\frac{98.0\ g\ H_3PO_4}{1\ mol}$

7. zinc fluoride trihydrate

→ $ZnF_2 \cdot 3H_2O$

1 Zn = 65.4

2 F = 38.0

6 H = 6.0

3 O = 48.0

$\frac{157.4\ g\ ZnF_2 \cdot 3H_2O}{1\ mol}$

8. carbon ~~dioxide~~ trioxide

→ CO_3

1 C = 12.0 12.0

3 O = 3(16.0) = 48.0

$\frac{60.0\ g\ CO_3}{1\ mol}$

PART C: Calculate the number of moles (mol) in each of the compounds.

1. 4.8 g of aluminum ←

1 (Al) = 27.0 g / 1 mol

4.8 g	1 mol Al / 27.0 g	0.18 mol Al

2. 485 g of oxygen gas ← O_2

2 (O) = 2 (16) = 32.0 g / 1 mol

485 g	1 mol / 32.0 g	15.2 mol O_2

3. 3.0 g of silver bromide ← AgBr

1 Ag = 107.9
1 Br = 79.9
187.8 g / 1 mol

3.0 g AgBr	1 mol / 187.8 g	$1.6 \cdot 10^{-2}$ mol AgBr

4. 34.0 g of sodium phosphate ← Na_3PO_4 (from Part B #1)

164.0 g / 1 mol

34.0 g	1 mol / 164.0 g	0.207 mol Na_3PO_4

5. 100.0 g of Cobalt II Chloride hexahydrate molecules ← $CoCl_2 \cdot 6H_2O$

1 Co = 58.9
2 Cl = 71.0
129.9

12 H = 12.0
6 O = 96.0
\+ 108.0 g

= 237.9 g

100.0 g $CoCl_2 \cdot 6H_2O$	1 mol / 237.9 g	0.4203 mol $CoCl_2 \cdot 6H_2O$