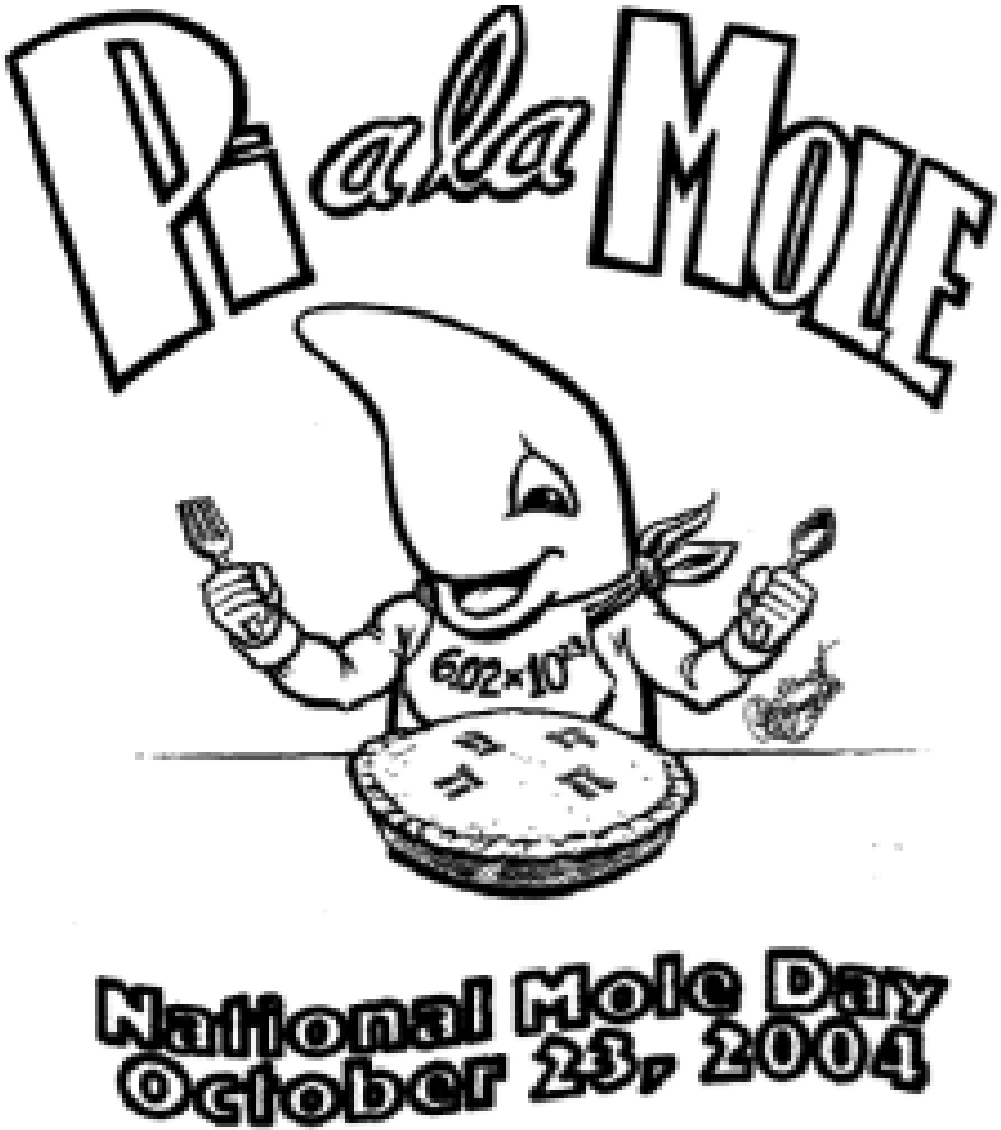
Determining Molar Mass



Significant Digits

- **Before we start, let's get something straight...**

  ...just what decimal place do we round to around here?
- **To determine this, let me enlighten you in the lost and ancient art of Sig Digs!**

In science, we take measurements and do calculations with those measurements.

But the measurements only have so much certainty.

This amount of certainty must be kept after the calculations (i.e. our measurements can not become more certain after we crunch some numbers).

So we have a system of rules...

Rule 1: Determining Sig-Digs

Rule:	Example:
i) All nonzero integers are significant.	421.1 → 4 SD
ii) Leading zeros are never significant.	0.0034 2 → 3 SD
iii) Captive zeros are always significant.	2.05 → 3 SD
iv) Trailing zeros in a decimal number are significant.	25.0 → 3 SD

ex) Determine the number of Sig-Digs.

a) 0.002541

b) 45.204

c) 1.02501

d) 1.00

e) 1.25×10^5

Rule 2: Adding/Subtracting

When adding or subtracting, your answer must have the same number of sig-digs after the decimal as the lowest number of sig-digs after the decimal in the question.

ex) 1.25 + 2.0 = 3.25 ← we must round this to 3.3

2 SD 1 SD should be 1 SD

ex) 5.502 - 5.25 =

3 2

ex) 150.0 + 0.05 =

Rule 3: Multiplying/Dividing

When multiplying or dividing, the total number of sig-digs in the final answer must be the same as the smallest total sig-digs in the question.

ex) 1.5 x 6.35 = 9.525 ← round to 9.5

2 SD 3 SD should be 2 SD

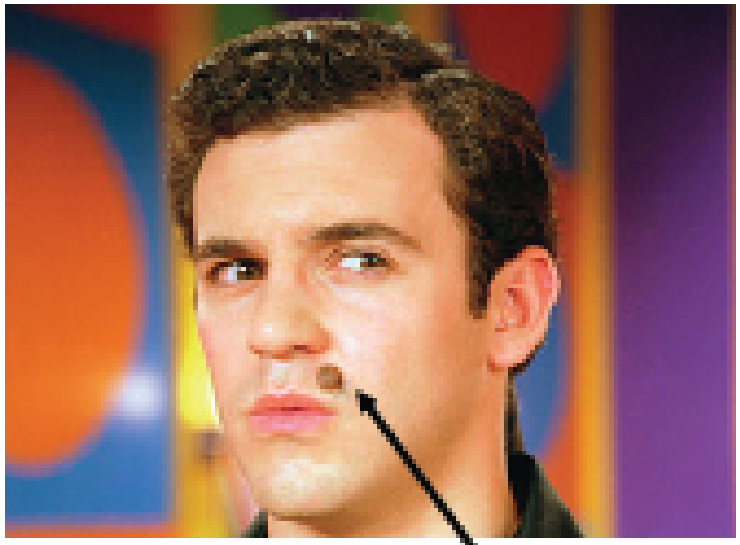
ex) 7.89 / 2.75

ex) 0.0005 x 1258.5

Counting Atoms

Since individual atoms or molecules are too small to be counted individually, chemists use moles to represent the amount of a pure substance.

A mole is like a dozen, a more convenient way of counting large sums. A dozen eggs represents 12 eggs, while a mole represents 6.02×10^{23} eggs.



To convert from grams to moles, we use this molar mass and our knowledge of fractions OR this equation.

$$n = \frac{m}{M}$$

Where:

n = # of moles

m = mass of substance (in grams)

M = molar mass of substance (in g/mol)

ex) How many moles are present in 15.0 g of pure silver?

The molar mass of silver is 107.87 g/mol.

ex) A silicon chip used in an integrated circuit of a microchip has a mass of 5.68 mg. How many silicon atoms are present in this chip?

Step 1: Convert to grams.

Step 2: Convert to moles.

Step 3: Use Avogadro's Number to convert to number of atoms.

ex) Cobalt is added to steel to improve its resistance to corrosion. Calculate both the number of moles in a sample of cobalt containing 5.00×10^{20} atoms and the mass of the sample.

Calculating Molar Masses

A chemical compound is made of more than one element. To determine the molar mass of a compound, we must add the molar masses of its elements.

ex) Determine the molar mass of $H_2O_{(l)}$

H - 2 x (1.01 g/mol)
O - 1 x (16.00 g/mol)

total = 18.02 g/mol

There are two atoms of hydrogen and one of oxygen. So we add the mass of two hydrogen atoms to the mass of one oxygen atom.

ex) Jugalone, a dye known for centuries, is produced from the husks of black walnuts. It is also a natural herbicide (weed killer) that kills off competitive plants around the tree. The formula for jugalone is C H O (aq).

a) Calculate the molar mass of jugalone.

b) A sample of 1.56×10^{-2} g of pure jugalone was extracted. How many moles does this represent?