Announcements

Wednesday, February 25, 2009

Ch 6 MC is up - it's due Monday, Mar 9.

Quiz 2 is on Monday, March 9, covering the last bit of chapter 5 and chapter 6 (6.1-6.7 assigned).

Exp 14 is next week.

Discussion assignment 1 will be posted in D2L discussion boards Thursday.

Chemical composition questions involve <u>amounts</u> of substances…

How many grams Na are in 10 g NaCl? (It's <u>not</u> 5 g Na!)

<u>The mole</u>: convenient way of counting very large numbers of atoms or molecules

1 pair = 2 objects
1 dozen = 12 objects
1 mole = $\underbrace{6.022 \times 10^{23}}_{\text{Avogadro's number}}$ objects (measurement)

How many <u>dozen</u> candy bars are 173 candy bars?

$$173 \text{ candy bars} \times \frac{1 \text{ doz candy bars}}{12 \text{ candy bars}} = 14.4 \text{ doz candy bars}$$

How many moles of Al are in 1.24×10^{15} Al atoms?

$$1.24 \times 10^{15} \text{ Al atoms} \times \frac{1 \text{ mol Al}}{6.022 \times 10^{23} \text{ Al atoms}} = \boxed{2.06 \times 10^{-9} \text{ mol Al}}$$

1.24E15 ÷ 6.022E23 1.24×10^15 ÷ (6.022×10^23)

How many H_2O molecules are in 4.8 mol H_2O?

$$4.8 \text{ mol } H_2O \times \frac{6.022 \times 10^{23} \text{ } H_2O \text{ molecules}}{1 \text{ mol } H_2O} = \boxed{2.9 \times 10^{24} \text{ } H_2O \text{ molecules}}$$

Counting by mass is a way to count a large number of objects by measuring their mass.

If there are 80 nails per pound, how many nails are in 4.5 lb nails?

$$4.5 \text{ lb nails} \times \frac{80 \text{ nails}}{1 \text{ lb nails}} = 360 \text{ nails}$$

Relationship of mass and moles:

By definition, 1 mol of carbon-12 atoms has a mass of exactly 12 g

1 carbon-12 atom has a mass of 12 amu

1 mol carbon-12 atoms has a mass of 12 g

12
Mg
24.31

Atomic number = 12 (# protons)

Atomic mass = 24.31 amu

Molar mass = 24.31 g/mol
MM

there are 24.31 g Mg in 1 mol Mg

What is the mass of 17.0 mol Al? MM Al = 26.98 g/mol

$$17.0 \text{ mol Al} \times \frac{26.98 \text{ g Al}}{1 \text{ mol Al}} = \boxed{459 \text{ g Al}}$$

How many moles Si are in 248.36 g Si? (MM Si 28.09 g/mol)

$$248.36 \text{ g Si} \times \frac{1 \text{ mol Si}}{28.09 \text{ g Si}} = \boxed{8.842 \text{ mol Si}}$$

Mole calculations

number of particles $\xleftrightarrow[6.022\times10^{23}\ \text{particles/mol}]{\text{Av. \#}}$ moles $\xleftrightarrow[g/mol]{\text{Molar mass}}$ mass (g)

How many S atoms are in 8.32 g S? g S → mol S → S atoms

$$8.32\ g\ S \times \frac{1\ mol\ S}{32.07\ g\ S} \times \frac{6.022\times10^{23}\ S\ atoms}{1\ mol\ S} = \boxed{1.56\times10^{23}\ S\ atoms}$$

What is the average mass (in g) of 1 iron atom?

$$1\ atom\ Fe \times \frac{1\ mol\ Fe}{6.022\times10^{23}\ Fe\ atoms} \times \frac{55.85\ g\ Fe}{1\ mol\ Fe} = \boxed{9.274\times10^{-23}\ g}$$

Molar mass of compounds

What is the mass in g of 12.0 mol H_2O?

You must first calculate the molar mass of H_2O:

2 H = 2 (1.008 g/mol)

1 O = 1 (16.00 g/mol)

$2\times1.008 + 16.00 =$

18.016 g/mol

$$12.0\ mol\ H_2O \times \frac{18.016\ g\ H_2O}{1\ mol\ H_2O} = \boxed{216\ g\ H_2O}$$

How many mol O_2 are in 82.3 g oxygen?

Molar mass of O_2 : 2 (16.00 g/mol)

diatomic elements exist as molecules (pair of atoms)

$$82.3\ g\ O_2 \times \frac{1\ mol\ O_2}{32.00\ g\ O_2} = \boxed{2.57\ mol\ O_2}$$

Converting to elements in a formula

4.28 mol Na_2SO_4 = ? mol Na ← 1 element in formula
formula
= ? mol S
= ? mol O

First, make a conversion factor from the chemical formula itself (called a **mole ratio**):

(when making a mole ratio from a formula, always consider 1 mole of the complete formula, and use the subscripts to find moles of each element)

1 mol Na_2SO_4 contains… 2 mol Na
1 mol S
4 mol O
1 mol SO_4^{2-} ions

4.28 mol Na_2SO_4 has ? mol Na …

$$4.28 \text{ mol } Na_2SO_4 \times \frac{2 \text{ mol Na}}{1 \text{ mol } Na_2SO_4} = \boxed{8.56 \text{ mol Na}}$$

On your own:

4.28 mol Na_2SO_4 contains: ? mol S
? mol O
? Na atoms
? g Na ☆

$$4.28 \text{ mol } Na_2SO_4 \times \frac{2 \text{ mol Na}}{1 \text{ mol } Na_2SO_4} \times \frac{22.99 \text{ g Na}}{1 \text{ mol Na}} = \boxed{197 \text{ g Na}}$$