C151-L02-W'05

Day 2:

lecture2

(1) Last time:
orientation/syllabus
scientific method
atoms, molecules, physical states and chemical properties and changes
density
metric system
unit conversion.

(2) Today
a) Electrical forces. charge.
b) density
c) temperature
d) The atom
nucleus, subatomic particles, atomic model

(3) Unit conversion:
a) How many liters (L) are in 1 m^3 of water? (1 mL = 1 cm^3) .

mL = 1 m^3 (100 cm/1 m)^3(1 mL/cm^3)(1L/10^3mL) = 1 x 10^6 mLs.

b) How many inches are in 0.2540 km? (2.54 cm = 1 in)

in = 0.2340 km x (1000 m/km) x (100 cm/m) x (1 in/2.54 cm) = 1.000 x 10^4 in

c) What is the volume (in mLs) of .25 g of ethanol (density = 0.850 g/mL)?
#mLs = (.25 g)(1mL/.850 g) = 0.29 mLs.

(4) electrical forces = like gravity; unlike charges attrract;

(5) Metric system: the standards of measurement in science. It is very convenient because the units are expressed in multiples of 10.

(International System) SI Units: m, kg, s, K, mol, A, candela

prefixes: 10^{-1} deci, 10^{-2} centi, 10^{-3} milli(m), 10^{-6} micro(u), 10^{-9} nm,

(6) conversion factors: changing from inches to m: 2.54 cm = 1 in, and 100 cm = m

(7) precision and accuracy

(8) sig figs

(9) rules for sig figs in calculations : add, subtract, multiply, divided.

The rules for addition: eg. 2.1 +.235 = 2.335 but we drop the last 2 so: 2.3
Same rule for subtraction.

Rule for multiplication: 2.30 x 1.0 = 2.3 (2 sig figs) same rule in division.

(10) density: represents the amount of mass within a give volume.

In units of kg/m^3 but in chemistry, it is usu. g/cm^3. or g/mL^3 for liquids.
Give examples of how to calculate it. And how to use it as a conversion factor.

(11) temperature:
converting from one (°c) to another (°F) or (K).

it is easiest to convert from F to C or from C to F.

F = C(1.8) + 32. or, C = (F-32)/1.8; K = C+273.15

(12) Modern atomic theory: John Dalton (1766-1844)

a) all matter is composed of tiny particles called atoms
b) all atoms of a given element are alike. Atoms of one element differ from atoms of any other element.
c) compounds are formed when atoms of different elements combine in definite ratios. (Law of definite proportions)
d) A chem reaction involves a rearrangement of atoms. No atoms are created or destroyed in a chem rxn,

Illustrate the concepts by drawing H_2, H_2O, and CH_4 in ball and stick models.

(13) Atomic components.
-atom is not indivisible. It can be broken up to yield electrons, protons and neutrons.
-electrons are (-) particles which are of very low density.
-protons are (+) ples which are very high density.
-neutrons are neutral ples of same density and mass as protons.

-nucleus = discovered by Rutherford's famous gold foil experiment
very tiny nucleus.

particle	symbol	mass	approx mass	charge	location
proton	p^+	1.007276	1	+1	nucleus
neutron	n	1.008665	1	0	nucleus
electron	e^-	0.000549	0	-1	extranuclear

note that the masses are given in "atomic mass units" (amu, or Dalton).
note that 1 amu ≈ mass of a hydrogen atom.

(14) Elements differ in their # p in the nucleus. #p = "atomic number" = Z

a) e.g. Hydrogen usually has only 1 proton in the nucleus and no neutron. (picture it).

The # e = # p for a neutral atom. So H has 1 electron.

Mass of H = 1.007276 + .000549 = 1.007825 ≈ 1

b) ISOTOPES: But sometimes H has 1 n and 1 p in its nucleus. Still Z=1. but mass is ≈2, This is called deuterium to distinguish from hydrogen-1. this is an isotope of hydrogen. Another isotope is tritium. H-3.

the atomic mass is the weighted average of the atomic mass.

eg. potassium, K, has z=19, e =19, # n = 20.

mass of K = (19)(1.007276) + 20(1.008665) + 19 (.000549)
= 19.138244+20.1733+.010431 = 39.321975

A = atomic mass number (p+n) = 39, Z = 19

In general can write: ${}_{z}^{A}E$. in general. so ${}_{19}^{39}K$.

(15) Determine the n,p and e for:

${}_{1}^{2}H$, ${}_{1}^{3}H$, ${}_{8}^{6}O$ ${}_{8}^{6}O^{2-}$

(8) What is listed in a periodic table is the average atomic mass. It is the weighted average of the various isotopes. –weighted according to the "natural abundance".

For example: hypothetical element:

3 isotopes of masses 15 (30%), 18 (25%), and 20 (45%) (expect something close to 18)

then average = 15.0(.30) + 18.0(.25) + 20.0 (.45) = 18.0

(16) What is the model of the electron component of the atom?

Danish scientist Neils Bohr. idea is that electrons orbit like planets around the sun. but orbits are limited to a few possible values. the larger the orbit the higher the energy of the electron. Energy levels.

electrons can change their energy level. by changing their orbit.

orbits have limited max number of e's: $2n^2$

electrons in a particular orbit are consisting the "shells".

how many total max # e's in the 2^{nd} shell? $= 2(2)^2 = 8$
how about the 4^{th} shell? : $= 2(4)^2 = 32$

electrons are added starting from the lowest energy level or lowest shell.

Eg. if we have carbon, C has 6 e's. The first 2 e's go to n=1 shell and next 4 go to the n=2 shell.

According to the Bohr model, how many e's are in the highest shell of phosphorus
(15 total; 2 + 8 + 5 => 5 in outermost shell)