Summary for Tutorial 2 & 3

QL
(Dated: September 26, 2008)

Keep in mind: You still need to read the lecture notes. My summary can't have everything in it. If there's an error, please email me.

I. CROSS SECTION

Cross section σ is the probability for a reaction to occur. $\sigma \approx \pi R^2$, in which R is the radius of target nucleus. The unit for σ is **barn**. $1barn = 1 \times 10^{-24} cm^2$.

II. YIELD

Yield is the total probability for a reaction to occur (for one incident particle).

$$Y = \sigma \cdot n_0 \cdot d \tag{1}$$

With n_0 the nuclei density of the target material $[particle/cm^3]$. d is the thickness of the target.

III. X-RAY INTENSITY

If we use $I(d)$ to denote the intensity after x-ray passed through the material, and use I_0 to denote the original intensity of the x-ray. We have:

$$I(d) = I_0 \cdot e^{-\mu \cdot d} \tag{2}$$

μ is the attenuation coefficient for the material and d is its thickness.

Thus the transmission ratio is $\frac{I(d)}{I_0}$, the absorption ration is $1 - \frac{I(d)}{I_0}$

IV. ABSORPTION EDGE

Absorption edge is the energy needed for ionizing electrons from inner shells. For K-edge, the energy needed is:

$$E_K = (Z-1)^2 \cdot 13.6[eV] \tag{3}$$

For L-edge:

$$E_L = (Z-\sigma_L)^2 \cdot 13.6 \cdot \frac{1}{4}[eV] \tag{4}$$

For M-edge:

$$E_M = (Z-\sigma_M)^2 \cdot 13.6 \cdot \frac{1}{9}[eV] \tag{5}$$

With Z the atomic number.

V. X-RAY ENERGY

K-series are the transitions from $n_i \geq 2$ to $n_f = 1$. The x-ray energy from these transitions is given by:

$$E_x = E_{n_i} - E_{n_f} = E_{n_i} - E_1 = (Z-1)^2 \cdot 13.6 \cdot (1 - \frac{1}{{n_i}^2})[eV] \tag{6}$$

L-series are the transitions from $n_i \geq 3$ to $n_f = 2$. The energy is:

$$E_x = E_{n_i} - E_{n_f} = E_{n_i} - E_2 = (Z-\sigma)^2 \cdot 13.6 \cdot (\frac{1}{2^2} - \frac{1}{{n_i}^2})[eV] \tag{7}$$