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9/17/2013
Office Hour: Tu 5-6pm Location: Bixby Common

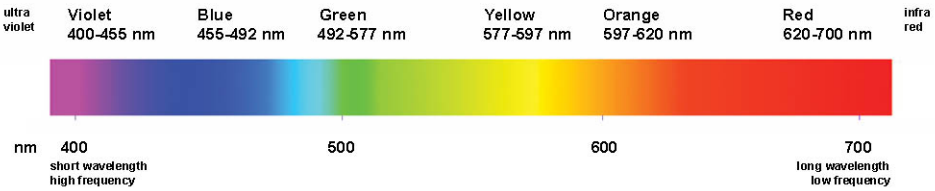
Chem 4A Scholars Worksheet 5

Blackbody Radiation, Bohr's Model, Spectroscopy, de Broglie Relation

Useful equations:

$$\lambda_{max}T = b \quad \lambda = \frac{h}{p} = \frac{h}{mv} \quad \nu = -R\infty\frac{Z^2}{n^2} \quad c = 3.00\times10^8\ m\ s^{-1}$$

$$h = 6.63\times10^{-34}\ J\ s \quad R\infty = 10973731.6m^{-1} \quad 1eV = 1.602\times10^{-19}\ J \quad m_e = 9.10\times10^{-31}\ kg$$



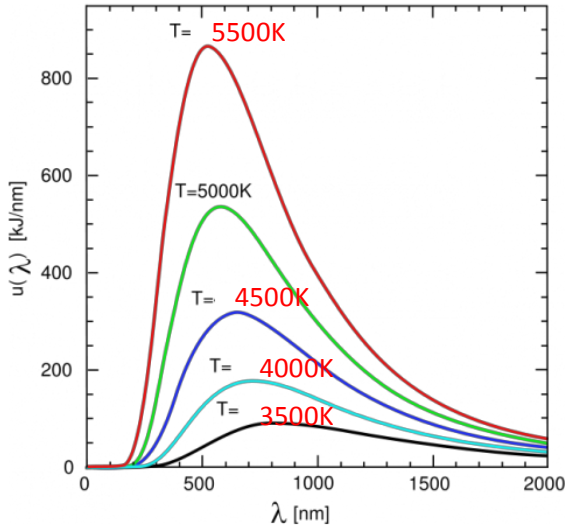
Questions:

1. *Rank the following waves from lowest energy to highest energy.(Write 1 to7 on top)*

   radio wave, microwave, X-ray, gamma ray, infrared, ultraviolet, visible

   1 2 5 7 6 3 4

2. *Fill in temparatures in the following blackbody radiation graph: 5500K,4500K,4000K,3500K*



3. *Blue Giants are a type of stars that glow blueish-white light, their maximum emission peak sit in the UV region. From the top graph, calculate the surface temperature of a star whose maximum emission is at 300nm.*

$$\lambda_{max}T = b$$

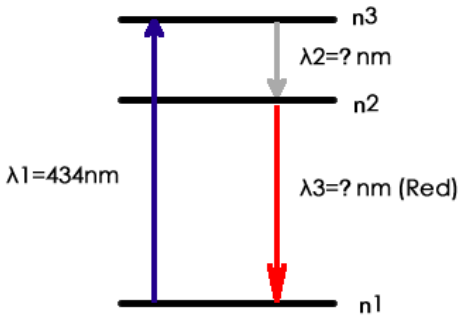
From the graph, we know that at 5000K, $\lambda_{max} = 600nm$

$$600nm \times 5000K = b \qquad b = 3,000,000nm\ K$$

At 300nm.

$$T = \frac{b}{\lambda_{max}} = \frac{3000,000}{300} = 10,000K$$

4. *Solve the following problem according the Bohr's model:*



A hydrogen atom was initially at some unknown energy level n1. The hydrogen atom absorbed a photon with wavelength of 434nm, and went to a higher energy state n3. It then went through 2 transitions and emits two photons. The second photon was red. Find the wavelength of the first photon and the second photon was red. Find the energy levels n1, n2, n3, and the wavelength of the photons.

Refer to solution 4

5. *Would you expect a photon with wavenumber of 30000 cm^{-1} to be absorbed by a hydrogen atom at ground state?*

Refer to solution 4

6. *Calculate the de Broglie wavelength of an electron whose speed is 500000 m s^{-1}.*

$$\lambda = \frac{h}{p} = \frac{h}{mv} = \frac{6.63 \times 10^{-34}\ J\ s}{9.10 \times 10^{-31}\ kg \times 500000\ m\ s^{-1}} = 1.4\ nm$$

7. *Which requires more energy? Breaking CaCl2 or Breaking CaO to ions?*

CaO because Ca and O has 2 charges. Thus it will yields a bigger Coulomb attraction.