Announcements – 10/23/00

- ***Exam #2:***
  - **We'll go over in just a moment**
  - **solution key is online**
- ***Problems for Ch. 4 are now assigned***
- **Friday: Special Quiz, Special demo!**

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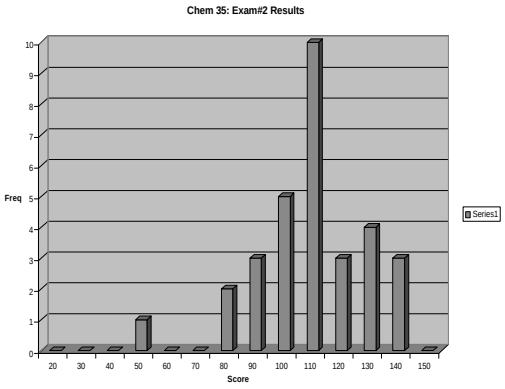
Exam #2: Results

Avg = *105/150 (70%)*

Range = 50 - 140

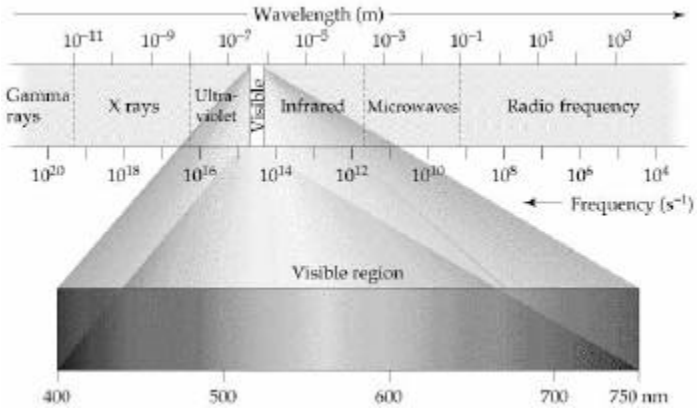
Let's take a look . . .



2

The Electromagnetic Spectrum

- The range of wavelengths and frequencies of EMR is extraordinary:



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Units of Wavelength

- The units used to express wavelength depend upon the region of the electomagnetic spectrum:

TABLE 6.1 Common Wavelength Units for Electromagnetic Radiation

Unit	Symbol	Length (m)	Type of Radiation
Angstrom	Å	10^{-10}	X ray
Nanometer	nm	10^{-9}	Ultraviolet, visible
Micrometer	µm	10^{-6}	Infrared
Millimeter	mm	10^{-3}	Infrared
Centimeter	cm	10^{-2}	Microwave
Meter	m	1	TV, radio

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Sample Problem

- Microwave ovens use EMR at a frequency of *2.45 GHz* to cook food. What is the **wavelength** of this radiation?

$c = \lambda \nu \rightarrow \lambda = c/\nu$

$$\lambda = \frac{2.9979 \times 10^{8} \text{ m/s}}{2.45 \times 10^{9} \text{ s}^{-1}}$$

$\lambda = 1.21592 \times 10^{-1}$ m

$\lambda = 0.122$ m

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Planck's Quantum Theory

- In 1900, German Physicist ***Max Planck*** proposed:

> ***"****Radiant energy may only be absorbed or emitted in discrete amounts: quanta."*

-The *energy* of each quantum could then be related to the *frequency* of the EMR:

$E = h\nu$

where: h = $6.6260755 \times 10^{-34}$ J-s (Planck's Constant)

So, the *energy* of a quantum *increases* with: -incr. ν
-decr. λ

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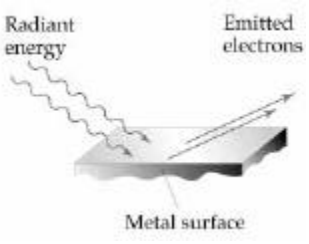
The Photoelectric Effect

- In 1905, Einstein applied this quantum theory to explain the photolectric effect:

-if EMR was absorbed as a *wave*, then the ***number*** of electrons ejected and the ***energy*** of the electrons ejected should vary only with the intensity of the light

- NUMBER of e^-: does vary with EMR intensity
- ENERGY of e^-: vary only with EMR *frequency*



AND: ***no effect*** if freq is below a threshold value!

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Einstein's Explanation

- View EMR as a collection of *particles* (called **photons**), with each photon having the following energy:

$$E = h\nu$$

  - Each photon will cause an electron to be *ejected* **IF** the energy of the photon is above a minimum (threshold) value (called the "work function" of the metal)
  - Any energy of the photon *above* that needed to eject the electron would be transferred to the electron as *kinetic energy*
  - Increased EMR intensity translates to an increase in the number of photons (thereby increasing the number of electrons ejected)

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