CHEM 1100 Dr. Stone

Chapter 7, part I: Light, Waves, Energy, Quantized Energy levels

Fill in the blanks as you read the slides from the power point.

Slide 1: The order of increasing energy of electromagnetic radiation is

Gamma rays>_____>_____>_____>_____>

_____>radio waves.

The energy of visible light:

_____>_____>_____>_____>_____> _____>_____

Slides 2 and 3:

Electromagnetic radiation has _____oscillating fields: _____ and _____.

Most of the interactions with matter occur with the _____field.

PET scans are interactions with the _____field: _____rays.

If you break a bone, you need the _____field _____rays.

You can see colors because specialized molecules in your retina (cones) detect _____field

_____waves

Home security devices have cameras that can detect humans because they give off heat. This is the _____field and _____waves.

Heating your food in a kitchen device for 3 min is the _____field _____waves.

If you have an MRI, nuclei in your body are interacting with the _____field _____waves.

Slide 4:

Write the equation for :

speed of light in a vacuum= wavelength x frequency

Units:

_____ wavelength _____velocity _____frequency

Which wavelength A or B has a higher frequency?

Draw a wave, label amplitude, wavelength.

Slides 5 and 6:
What is the frequency of yellow-orange light from a sodium-vapor street light. (λ = 589 nm)

Slides 8 and 9:
Calculate the energy (in Joules) of one photon of red light ((λ = 685 nm)

More practice**, Slide 10** has the answers.
Calculate the energy in Joules for one photon of
(a) ultraviolet light (λ= 100 nm)

(b) visible (λ= 500 nm)

(c) infrared (λ= 6 μm)

What do the answers on slide 10 indicate about the relationship between the wavelength and energy of light?

Slide 11 has the answers to these questions:

1. Assume that a microwave oven operates at a frequency of 1.00×10^5 MHz. a) What is the wavelength of this radiation in meters?

b) What is the energy in Joules/photon?

c) What is the energy per mole of photons?

2. In the stratosphere, ultraviolet radiation with a wavelength of 220 nm can break C-Cl bonds in chlorofluorocarbons (CFCs), which can lead to stratospheric ozone depletion. Calculate the frequency and energy (in Joules) of this radiation.
3. Some diamonds appear yellow because they contain nitrogen compounds that absorb purple light of frequency 7.23×10^{14}Hz.
   a. Calculate the wavelength (in nm and Å) of the absorbed light.
   b. Calculate the energy per photon

Slide 12: Photo electric effect

When light hits a metal surface the packets of energy (photons) transfer their energy to the electrons in the metal. If the photons have energy above the threshold energy for the metal, the electrons are liberated, they flow towards the cathode and voltage can be measured.

The photo-electric effect is the phenomenon of _____striking a metal surface and producing an electric current (flow of electrons). IIf radiation is below _____energy, _____electrons are released.

Slide 13, more photoelectric effect. Any energy above the threshold energy is transferred to the electron as kinetic energy. Example: What is the Kinetic energy of an electron on a copper wire that is hit with a 250 nm photon? The threshold energy (work function) = 7.53×10^{-19} J. **Slide 14** has the answer.

Slide 15: Light has both _____ and _____properties

List the wave properties:

List the particle (energy packet) properties:

Slide 16: The hydrogen spectrum and the Rydberg equation.

What is the symbol for wavelength? What is the symbol for wavenumber?

What is n_1?

What is n_2?

The lines in this spectrum all correspond to $n_1 = 2$.

When

$n_2 = 3$ that is the red line, Calculate λ and E

$n_2 = 4$ that is the green line, Calculate λ and E

$n_2 = 5$ that is the blue line, Calculate λ and E

$n_2 = 6$ that is the violet line, Calculate λ and E

Answers are on slide 17.

Slides18-23 shows how to use your data from lab. If you did not get to do the lab, you will receive some data. Everyone should be able to do the calculations of a wavelength using a standard curve from Helium data.

Slide 24-25, using the Rydberg equation to calculate the energy of an electron moving from one energy level to another.

Exergonic = _____ the value for ΔE is _____

Endergonic=_____the value for ΔE is _____