**Energy Homework Answer Key**

*Helpful Hints*: 1 meter = 109 nanometers

 Assume all waves are traveling in a vacuum, unless otherwise noted.

1. List the electromagnetic spectrum from highest to lowest energy.

Gamma rays, x-rays, ultraviolet rays, visible light, infrared, microwaves, radio waves

1. List the electromagnetic spectrum from longest to shortest wavelength.

Radio waves, microwaves, infrared, visible light, ultraviolet rays, x-rays, gamma rays

1. Calculate the frequency of ultraviolet A with a wavelength of 350 nm.

**c=λυ** so **υ = c/λ**

First, change 350 nanometers to meters.

350 nm 🞨 1 meter / 109 nanometers = 3.5 🞨 10-7 meters

υ = 3.0 🞨 108 m/s / 3.5 🞨 10 -7 meters = 8.6 🞨 10 14 s-1

1. Calculate the energy, in quanta, of the ray above.

E = hυ

E= 6.626 🞨 10-34 J · S 🞨 8.6 🞨 10 14 s-1 = 5.7 🞨 10-19 Joules

1. Calculate the frequency of a wave traveling with a wavelength of 1.2 meters.
What type of ray would this most likely be?

**c=λυ so υ = c/λ**

υ = 3.00 🞨 10 8 m/s / 1.2 meters = 2.5 🞨 10 8 s-1

radio wave

1. Calculate the energy of a photon traveling with a frequency of 1.0 🞨 105 s-1.

E= h**υ**

E = (6.626 🞨 10-34 J · S ) ( 1.0 🞨 105 s-1) = 6.6 🞨 10 -29 Joules

1. Copper absorbs energy with a wavelength of 510 nm. If 2.20 🞨 104 J of energy is emitted, calculate the number of copper atoms that were present. Assume 1 atom emits 1 quantum.

**c= λυ E = h υ**

υ = 3.00 🞨 108 / 1.5 🞨 10-7 meters = 2.0 🞨 10 15 1/s

Ephoton = (2.0🞨10 15 1/S) (6.626 🞨 10-34 J · S) = 1.3 🞨 10-18 Joules

Since 1 photon emits 1.3 🞨 10-18 Joules and 1 atom emits 1 photon then:

2.20 🞨 104 Joules / 1.3 🞨 10-18 Joules = 1.7 🞨 10 22 atoms Cu

1. In problem 7, how many grams of copper were present?

1.7 🞨 1022 atoms Cu 🞨 1 mole Cu/6.022 🞨 10 23 atoms 🞨 63.55 g Cu/1 mole Cu

= 1.8 grams Cu

1. Calculate the frequency of a wave of wavelength 1.50 🞨 102 centimeters traveling at 80 % of the speed of light in a vacuum?

**c=λυ, so υ = c/λ**

υ = (3.00 🞨108 m/s 🞨 .80) / (.015 meters) = 1.6 🞨 1010 1/s

1. Calculate the energy for visible light of wavelength 400 nm, 550 nm and 700 nm. Graph energy vs. wavelength. What can be said about the relationship of energy to wavelength?

**c=λυ E =**  **hυ**

Energy for 400 nm = 4.97 🞨 10-19

Energy for 550 nm = 3.61 🞨 10-19

Energy for 700 nm = 2.84 🞨 10-19

Energy increases with decreasing wavelength

