WS 4.1 *Name:*_____ *p.*____

$c = 3.00 \times 10^{8}$ m/s $h = 6.63 \times 10^{-34}$ J•s 1 m $= 10^{9}$ nm (or 1 nm $= 10^{-9}$ m)

1a. List the types of electromagnetic radiation in order from lowest energy to highest energy.
Here they are in alphabetical order:
gamma rays, infrared (IR), microwave, radio, ultraviolet(uv), visible (blue green indigo orange red violet yellow), x-rays

lowest energy highest energy

b. Which type of EM radiation has the longest wavelength?_____

c. Which has the highest frequency?_____

2. Consider two photons of light energy:
Photon #1 has a frequency of 4.38×10^{14} Hz. Photon #2 has a wavelength of 404 nm.

a. Calculate the wavelength of photon #1, in meters:

b. Convert the wavelength of photon #1 to nanometers.

c. What color is photon #1?_____

Photon #2 has a wavelength of 404 nm.

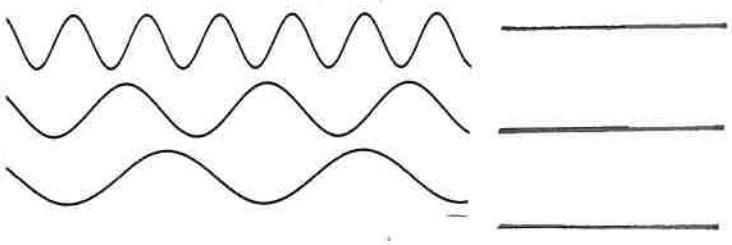
d. What color is this?_____
e. Convert the wavelength of photon #2 to meters.

f. Calculate the frequency of photon #2:

g. Which photon had a higher frequency?_____
Which photon had a longer wavelength?_____
Which photon had a higher energy?_____
Which photon travels at a faster speed?_____

A third photon (photon #3!) has a wavelength of 582 nm and a frequency of 5.15×10^{14} Hz.
h. What color is photon #3?_____

3. Consider the three electromagnetic waves shown below. If the three waves correspond to the three photons in problem 2, which wave is which? Label each one with the number (1, 2, or 3) and the color.



4. Fill in the blanks with "directly" or "inversely" for electromagnetic radiation.

Energy of electromagnetic radiation is _____ related to frequency.

Frequency of electromagnetic radiation is _____ related to wavelength.

Energy of electromagnetic radiation is _____ related to wavelength.

5. Radio waves travel at _____ visible light waves.
a. a faster speed than b. a slower speed than c. the same speed as

6. Radio waves travel at _____ sound waves.
a. a faster speed than b. a slower speed than c. the same speed as

7. Determine the wavelength (in m and nm), the frequency (in Hz), the photon energy, and the type of EM radiation (part of the spectrum) for each problem, below. (You will need the chart on WS 4.0)

a. Electromagnetic radiation emitted by a laser pen, with a wavelength of 410. nm

λ = _____

λ = _____

ν = _____

E = _____

Part of spectrum_____

b. EM radiation with a frequency of 104.7 MHz (MegaHertz), which is the same as 1.047×10^{8} Hz.

λ = _____

λ = _____

ν = _____

E = _____

Part of spectrum_____

c. A photon absorbed by a H_2O molecule in a microwave oven, with an energy of 1.62×10^{-24} J .

λ = _____

λ = _____

ν = _____

E = _____

Part of spectrum__microwave____*

* this would be "radio" according to the chart on 4.0... but many charts for EM radiation show an overlap of microwaves with the higher energy radio waves., and would classify this as a microwave.

7d. EM radiation emitted when a C=O bond in carbon dioxide (O=C=O) vibrates, with a wavelength of 5200 nm.

λ = _____

λ = _____

ν = _____

E = _____

Part of spectrum_____

e. EM radiation absorbed by sunscreen, with a photon energy of 6.4×10^{-19} J.

λ = _____

λ = _____

ν = _____

E = _____

Part of spectrum_____

f. EM radiation absorbed by a chlorophyll molecule in a leaf, with a frequency of 4.53×10^{14} Hz.

λ = _____

λ = _____

ν = _____

E = _____

Part of spectrum_____

g. EM radiation emitted from the nucleus of a potassium-40 isotope, during a nuclear reaction, with a wavelength of 8.50×10^{-13} meters.

λ = _____

λ = _____

ν = _____

E = _____

Part of spectrum_____