

Name: \_\_\_\_\_

Date: \_\_\_\_\_

### Wave Properties of Light

#### Electromagnetic Spectrum

Radio  $3 \times 10^6$  Hz  
TV  $3 \times 10^8$  Hz

- Energy of one photon with a frequency of  $\nu$
- Speed of light =  $3 \times 10^8$  m/s
- Wavelength  $\lambda = c/\nu$
- Frequency of the photon is  $\nu$
- Wavelength in meters
- Frequency in Hertz (cycles per second)

IR  $3 \times 10^{11}$  Hz  
Visible  $4 \times 10^{14}$  Hz

#### Electromagnetic Spectrum (Wavelengths)

- $10^3$  m - Radio waves
- $10^2$  m - Microwaves
- $10^1$  m - Infrared
- $10^0$  m - Visible light
- $10^{-1}$  m - Ultraviolet
- $10^{-2}$  m - X-rays
- $10^{-3}$  m - Gamma rays

#### Worked Example

1. A photon has a frequency ( $\nu$ ) of  $3.00 \times 10^8$  Hz. Calculate its energy.
  
2. Calculate the energy ( $E$ ) and wavelength ( $\lambda$ ) of a photon of light with a frequency ( $\nu$ ) of  $3.00 \times 10^8$  Hz.
  
3. Calculate the frequency and the energy of the light that has a wavelength of 4000 nm.
  
4. Calculate the wavelength and energy of light that has a frequency of  $3.0 \times 10^8$  Hz.
  
5. A photon of light has a wavelength of  $3.0000 \times 10^2$  nm. Calculate its energy.
  
6. Calculate the number of photons having a wavelength of 300 nm required to produce 1.0 J of energy.
  
7. Calculate the total energy in  $1.0 \times 10^{17}$  photons of gamma radiation having  $\lambda = 3.0 \times 10^{-11}$  m.
  
8. Calculate the energy and frequency of red light having a wavelength of  $6.50 \times 10^2$  nm.
  
9. The wavelength of green light from a traffic signal is centered at  $5.50 \times 10^2$  nm. Calculate the frequency.
  
10. Calculate the frequency of light that has a wavelength of  $4.20 \times 10^2$  nm. Identify the type of electromagnetic radiation.