Name: _____ **Date:** _____

Worksheet: Quantum & Wave Calculations

Equations and Constants:

$E = h\nu$	$h = 6.626 \times 10^{-34}$ J·s	E = energy of one photon with a frequency of ν	1 J = 6.24×10^{18} eV
$c = \lambda\nu$	$c = 3.0 \times 10^{8}$ m/s	c = speed of light = 3.0×10^{8} m/s	1 eV = 1.6×10^{-19} J
		h = Planck's constant = 6.626×10^{-34} J·s	
		λ = wavelength in meters	
		ν = frequency (Hz) (pronounced "nu" or "ν")	

Electromagnetic Spectrum: (Wavelength, λ)

- $> 10^{-1}$ m = Microwaves
- $10^{-3} - 10^{-7}$ m = Infrared
- $10^{-7} - 10^{-8}$ m = Visible Light
- $10^{-8} - 10^{-9}$ m = Ultraviolet
- $10^{-9} - 10^{-11}$ m = X-Rays
- $< 10^{-11}$ m = Gamma Rays
- $10^{-1} - 10^{-3}$ m = Radar
- $10^{-3} - 10^{-7}$ m = Microwaves
- $10^{-7} - 10^{-8}$ m = Infrared
- $10^{-8} - 10^{-9}$ m = Visible Light
- $10^{-9} - 10^{-11}$ m = Ultraviolet
- $10^{-11} - 10^{-13}$ m = X-Rays
- $< 10^{-13}$ m = Gamma Rays

Show: Show your work!

1. A photon has a frequency (ν) of 2.00×10^{9} Hz. Calculate its energy.

2. Calculate the energy (E) and wavelength (λ) of a photon of light with a frequency (ν) of 8.00×10^{7} Hz.

3. Calculate the frequency and the energy of blue light that has a wavelength of 400.0 nm.

4. Calculate the wavelength and energy of light that has a frequency of 1.2×10^{7} Hz.

5. A photon of light has a wavelength of 0.0000 nm. Calculate the energy.

6. Calculate the number of photons having a wavelength of 10.0 μm required to produce 1.0 kJ of energy.

7. Calculate the total energy in 1.0×10^{7} photons of gamma radiation having $\lambda = 5.0 \times 10^{-11}$ m.

8. Calculate the energy and frequency of red light having a wavelength of 6.80×10^{-7} m.

9. The wavelength of green light from a traffic signal is centered at 5.20×10^{-7} m. Calculate the frequency.

10. Calculate the frequency of light that has a wavelength of 4.20×10^{-6} m. Identify the type of electromagnetic radiation.