

Name \_\_\_\_\_

## Waves and Energy

Answer the following questions:

- 1) What is the frequency of light with the wavelength of 680.nm? What color is it? (1 nm =  $1 \times 10^{-9}$  m)  
 **$4.41 \times 10^{14} \text{ s}^{-1}$  Red**
- 2) A wave of radiation is released from a nucleus of an atom with a frequency of  $3.00 \times 10^{19} \text{ s}^{-1}$ . What kind of electromagnetic radiation is it?  
 **$1.00 \times 10^{-11} \text{ m}$  Gamma**
- 3) A 10.0kg mass is converted completely to energy. How many Joules of energy is released? (remember that  $1 \text{ J} = 1 \text{ kg m}^2/\text{s}^2$ )  
 **$9.00 \times 10^{17} \text{ J}$**
- 4) What is the energy contained in an infrared wave with a frequency of  $3.25 \times 10^{12} \text{ s}^{-1}$ ?  
 **$2.15 \times 10^{-21} \text{ J}$**
- 5) What is the wavelength of a radio wave with a frequency of 101.1MHz? (1 MHz =  $1 \times 10^6$ Hz)  
**2.967m**
- 6) What is the energy contained in a light wave with the wavelength of  $5.00 \times 10^{-7} \text{ m}$ ?  
 **$3.98 \times 10^{-19} \text{ J}$**
- 7) What is the frequency of a wave that has an energy of  $5.02 \times 10^{-25} \text{ kJ}$ ?  
 **$7.58 \times 10^{11} \text{ s}^{-1}$**
- 8) What mass of a Uranium-235 nucleus is lost if the energy released is equal to  $3.50 \times 10^{-11} \text{ J}$ ?  
 **$3.89 \times 10^{-28} \text{ kg}$**
- 9) How much energy is contained in a wave of blue light that has a wavelength of 450.nm?  
 **$4.42 \times 10^{-19} \text{ J}$**
- 10) The sun loses about  $4.00 \times 10^{12} \text{ g/sec}$  of mass in its energy conversion. How much Energy would the sun give off in a year? (use 365 days = 1 year)  
 **$1.14 \times 10^{34} \text{ J}$**
- 11) What is the mass of a photon of microwave radiation that has a wavelength of  $1.00 \times 10^{-2} \text{ m}$ ?  
 **$2.21 \times 10^{-40} \text{ kg}$**
- 12) What wavelength of radiation in nanometers is given off by an electron if it loses a mass of  $4.55 \times 10^{-33} \text{ g}$ ?  
**485nm**
- 13) How much less energy is released from an IR photon with a frequency of  $1.07 \times 10^{14} \text{ s}^{-1}$  verses a visible light photon with a wavelength of  $5.86 \times 10^{-7} \text{ m}$ ?  
 **$2.68 \times 10^{-19} \text{ J}$**

Answer the following mass defect/nuclear binding energy problems:

- 14) Calculate the nuclear binding energy from the helium-4 (mass He-4 = 4.0026amu, 1 proton = 1.0078amu, 1 neutron = 1.0087amu, 1amu =  $1.66 \times 10^{-27} \text{ kg}$ )  
 **$4.5418 \times 10^{-12} \text{ J}$**
- 15) Based on the following atomic mass values, what would be the energy released from a single fusion reaction with H-2 and H-3 and releasing a neutron along with a He-4? (H-2 = 2.01410amu, H-3 = 3.01605amu, He-4 = 4.00260amu, 1 neutron = 1.0087amu, and 1amu =  $1.66 \times 10^{-27} \text{ kg}$ )  
 **$2.8162 \times 10^{-12} \text{ J}$**
- 16) Calculate the difference in nuclear binding energy between Mg-24 and Mg-27. (Mg-24 = 23.9850amu, Mg-27 = 26.9843amu, 1 proton = 1.0078amu, 1 neutron = 1.0087amu, 1amu =  $1.66 \times 10^{-27} \text{ kg}$ )

4.0639x10<sup>-12</sup>J