Name: Key Date Period

Calculating Energy, Frequency, and Wavelength

Calculating Frequency & Wavelength of EM radiation

A. Defining variables

a. What is the variable that we use to represent frequency (Hz)? ν

b. What is the variable that we use to represent wavelength (m)? λ

c. What is the variable that we use to represent speed of light (m/s)? c
Note: All Electromagnetic spectrum waves travel at this same speed

d. Speed of light is a constant. How many m/s does light travel? 2.998×10^8

B. Deriving equations

Given the formula .....$c = \nu * \lambda$

1. What is the formula for calculating ν? $\nu = \frac{c}{\lambda}$
2. What is the formula for calculating λ? $\lambda = \frac{c}{\nu}$

C. Calculating Frequency (ν) and Wavelength (λ)
Show your work! Use a calculator and do the actual math – don't just leave the answer as a fraction!

1. A specific ultraviolet light has a wavelength of 90 nm. What is the frequency?

$90\ nm \times \frac{1\ m}{1E9\ nm} = 9E{-}8\ m$ $\quad \nu = \frac{2.998E8\ m/s}{9E{-}8\ m} = 3.33E15\ Hz \rightarrow 3E15\ Hz$

2. Green light has a frequency of 6.01×10^{14} Hz. What is the wavelength?

$\lambda = \frac{2.998E8\ m/s}{6.01E14\ 1/s} = 4.99E{-}7\ m$

3. What is the wavelength (in meters) of the electromagnetic carrier wave transmitted by The Sports Fan radio station at a frequency of 640 kHz? (*Hint: convert kHz into Hz by multiplying by 10³.*)

$640\ kHz \times \frac{1E3}{1\ kHz} = 6.4E5\ Hz = 6.4E5\ 1/s$ $\quad \lambda = \frac{2.998E8\ m/s}{6.4E5\ 1/s} = 468.48\ m \rightarrow 470\ m$

4. Calculate the wavelength of radiation with a frequency of 8.0×10^{14} Hz.

$\lambda = \frac{c}{\nu}$ $\quad \frac{3.00E8\ m/s}{8.0E14\ 1/s} = 3.75E{-}7\ m \rightarrow 3.8E{-}7\ m$ or $380\ nm$

Name: _____ Date_____ Period____

Calculating Energy & Frequency of EM radiation

A. Defining variables

a. Frequency (Hz or s^{-1}) = ν

b. Energy (Joules) = J

c. Planck's constant = h = 6.626×10^{-34} Joules*s

B. Deriving equations

Given the formula

$Energy_{photon} = h * \nu$.

a. What is the formula for calculating ν? $\nu = \frac{E}{h}$

C. Calculating Energy and Frequency (ν)

Show your work!

1. Calculate the energy of a photon of radiation with a frequency of 8.5×10^{14} Hz.

$E = (6.626E{-}34\ J \cdot s)(8.5E14\ 1/s) = 5.63E{-}19\ J \rightarrow 5.6E{-}19\ J$

2. Calculate the energy of a gamma ray photon whose frequency is 5.02×10^{20} Hz?

$5.02E20\ 1/s = \nu$

$E = (6.626E{-}34\ J \cdot s)(5.02E20\ 1/s) = 3.33E{-}13\ J$

3. Calculate the energy of a photon of radiation with a wavelength of 6.4 nm.

$6.4\ nm \times \frac{1\ m}{1E9\ nm} = 6.4E{-}9\ m$

$\nu = \frac{2.998E8\ m/s}{6.4E{-}9\ m} = 4.68E16\ 1/s$

$E = 6.626E{-}34\ J \cdot s\ (4.68E16\ 1/s) = 3.1E{-}17\ J$

4. What is the energy of light whose wavelength is 4.06×10^{-11} m?

$\nu = \frac{c}{\lambda}$ $\frac{3.00E8\ m/s}{4.06E{-}11\ m} = 7.39E18\ 1/s$

$E = (6.62E{-}34\ J \cdot s)(7.39E18\ 1/s) = 4.89E{-}15 \rightarrow 4.9E{-}15\ J$

Name: _____ Date_____ Period_____

General Knowledge

1. Rank these parts of the electromagnetic spectrum (ultraviolet, microwave, x-ray, gamma, radio, infrared, visible) from lowest energy (1) to highest (7):
   1. radio
   2. microwave
   3. infrared
   4. visible
   5. UV
   6. x-ray
   7. gamma

2. Rank these parts of the electromagnetic spectrum from lowest frequency (1) to highest (7)
   1. radio
   2. microwave
   3. Infrared
   4. visible
   5. UV
   6. x-ray
   7. gamma

3. Rank these parts of the electromagnetic spectrum from shortest wavelength (1) to longest (7):
   1. gamma
   2. x-ray
   3. UV
   4. visible
   5. Infrared
   6. microwave
   7. radio

4a. What is the relationship between frequency and energy? (Direct or Inverse) direct

b. What is the relationship between energy and wavelength? (Direct or Inverse) inverse

c. What is the relationship between frequency and wavelength? (Direct or Inverse) inverse