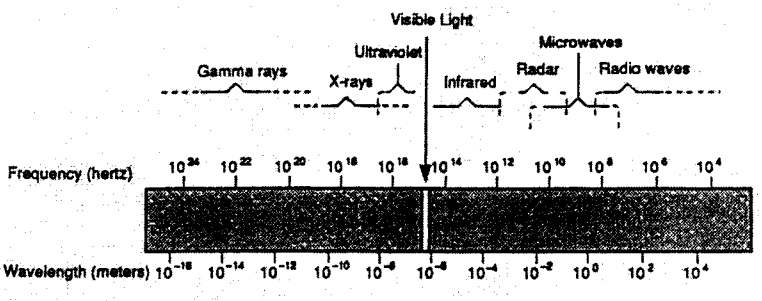
Name: KEY
Hour: ___ Date: _____

Chemistry: *Light Problems*



Directions: Solve the following problems. Show proper set-up, work, and units for full credit. Box in your final answer.

1. A wave has a frequency of 22 Hz and a wavelength of 4.0 m. What is its velocity?

$\nu = 22\ Hz$ $\quad v = \lambda \times \nu$ $\quad \boxed{v = 88\ m/s}$

$\lambda = 4.0\ m$ $\quad v = 4.0\ m \times 22\ Hz$

$v = ?$

2. What is the frequency of a wave if its wavelength is 3.6×10^{-9} m and its velocity is 3.0×10^{8} m/s?

$\lambda = 3.6 \times 10^{-9}\ m$ $\quad v = \lambda \times \nu$ $\quad \nu = \frac{v}{\lambda}$ $\quad \nu = \frac{3.0 \times 10^{8}\ m/s}{3.6 \times 10^{-9}\ m}$ $\quad \boxed{\nu = 8.3 \times 10^{16}\ Hz}$

$v = 3.0 \times 10^{8}\ m/s$

$\nu = ?$

3. As you move across the continuous spectrum from red to violet, what happens to...

   a. wavelength? decreases

   b. frequency? increases

4. A beam of microwaves has a frequency of 1.0×10^{9} Hz. A radar beam has a frequency of 5×10^{11} Hz. Which type of radiation...

   a. has the longer wavelength? microwave

   b. is nearer to visible light in the electromagnetic spectrum? radar

   c. is closer to X-rays in frequency value? radar

5. A bright line spectrum contains a line with a wavelength of 518 nm. Determine...

   a. the wavelength, in meters. (Hint: 1×10^{9} nm = 1 m)

$\frac{518\ nm}{1} \times \frac{1\ m}{1 \times 10^{9}\ nm} = \boxed{5.18 \times 10^{-7}\ m}$

   b. the frequency.

$c = 3.0 \times 10^{8}\ m/s$ $\quad \nu = \frac{c}{\lambda}$ $\quad \nu = \frac{3.0 \times 10^{8}\ m/s}{5.18 \times 10^{-7}\ m} = \boxed{5.79 \times 10^{14}\ Hz}$

$\lambda = 5.18 \times 10^{-7}\ m$ $\quad c = \lambda \times \nu$

   c. the energy.

$E = h\nu$ $\quad E = 6.626 \times 10^{-34}\ J \cdot s \times 5.79 \times 10^{14}\ \frac{1}{s} = \boxed{3.84 \times 10^{-19}\ J}$

   d. the color of the line.

green

6. A photon has an energy of 4.00×10^{-19} J. Find...

a. the frequency of the radiation.

$E = 4.00 \times 10^{-19} J$ $\quad \frac{E}{h} = \frac{h\nu}{h}$ $\quad \nu = \frac{E}{h}$ $\quad \nu = \frac{4.00 \times 10^{-19} J}{6.626 \times 10^{-34} J \cdot s}$ $\quad \nu = 6.04 \times 10^{\blacksquare} Hz$

b. the wavelength of the radiation.

$c = \lambda \cdot \nu$ $\quad \lambda = \frac{c}{\nu}$ $\quad \lambda = \frac{3.0 \times 10^{8} m/s}{6.04 \times 10^{14} 1/s} = 4.97 \times 10^{-7} m$

c. the region of the electromagnetic spectrum that this radiation represents.

Green

7. A photon of light has a wavelength of 3.20×10^{5} m. Find...

a. the frequency of the radiation.

$\lambda = 3.20 \times 10^{5} m$ $\quad c = 3.0 \times 10^{8} m/s$ $\quad c = \nu \times \lambda$ $\quad \nu = \frac{c}{\lambda}$ $\quad \nu = \frac{3.0 \times 10^{8} m/s}{3.2 \times 10^{5} m} = 937.5 Hz$

b. the energy of the photon.

$E = h\nu$ $\quad E = 6.626 \times 10^{-34} J \cdot s \times 937.5 Hz$

$E =$

c. the region of the electromagnetic spectrum that this radiation represents.

.937 KHz radio waves (Long wave)

8. Determine the frequency of light with a wavelength of 4.257×10^{-7} cm.

$\lambda = 4.257 \times 10^{-7} cm$ $\quad c = 3.0 \times 10^{8} m/s$ $\quad c = \lambda \cdot \nu$ $\quad \nu = \frac{c}{\lambda}$

$\nu = \frac{3.0 \times 10^{8} m/s}{4.257 \times 10^{-9} m}$

9. How many minutes would it take a radio wave with a frequency of 7.25×10^{5} Hz to travel from Mars to Earth if the distance between the two planets is approximately 8.0×10^{7} km?

$t = ?$
$\nu = 7.25 \times 10^{5} Hz$
$d = 8.0 \times 10^{7} Km$
$v = 3.0 \times 10^{8} m/s$

$\frac{8.0 \times 10^{7} \cancel{Km}}{1} \times \frac{1000 \cancel{m}}{1 \cancel{Km}} \times \frac{1 s}{3.0 \times 10^{8} \cancel{m}} \times \frac{1 min}{60 \cancel{s}} = 4.44 min$

10. Cobalt-60 is an artificial radioisotope that is produced in a nuclear reactor for use as a gamma-ray source in the treatment of certain types of cancer. If the wavelength of the gamma radiation from a cobalt-60 source is 1.00×10^{-3} nm, calculate the energy of a photon of this radiation.

Selected Answers: 1. 88 m/s; 2. 8.3×10^{16} Hz; 5a. 5.18×10^{-7} m; 5b. 5.79×10^{14} Hz; 5c. 3.84×10^{-19} J; 6a. 6.03×10^{14} Hz; 6b. 4.97×10^{-7} m; 7a. 938 Hz; 7b. 6.21×10^{-31} J; 8. 7.047×10^{16} Hz; 9. 4.4 minutes; 10. 1.99×10^{-13} J