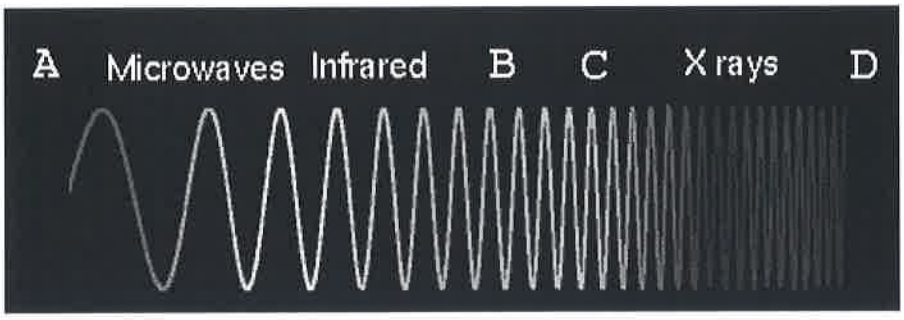
$s = \lambda f$
$s = 3.0 \times 10^8$ m/s

$E = hf$
$h = 6.63 \times 10^{-34}$ J·s

Chemistry
Light Equation Practice

Name KEY
Date

1. In the spaces provided, write the names for the types of electromagnetic waves labeled A-D. Choose from the following list: Radio waves, gamma rays, visible light, ultraviolet waves



A RADIO B VISIBLE C UV D GAMMA

2. Which wave above moves the fastest? Explain. All same speed → 3.0×10^8 m/s
3. What is the frequency range for visible light? 400nm - 700nm
4. What is the color of the…
   a. longest wavelength visible light? Red
   b. shortest wavelength visible light? Violet
   c. Determine the frequency of each of these lights.

Red → $700\text{nm} \left| \frac{1\text{m}}{10^9\text{nm}} \right. = 7 \times 10^{-7}\text{m}$

$3.0 \times 10^8 \text{m/s} = 7 \times 10^{-7} \cdot f$

$f_{red} = 4.29 \times 10^{14}$ Hz

Violet → 4×10^{-7} m

$3.0 \times 10^8 = 4 \times 10^{-7} f$

$f_{violet} = 7.5 \times 10^{14}$

5. The yellow light given off by a sodium vapor lamp used for public lighting has a wavelength of 589 nm. What is the frequency of this radiation?

$\lambda = \frac{589\text{nm}}{1} \left| \frac{1\text{m}}{10^9\text{nm}} \right. = 5.89 \times 10^{-7}\text{m}$

$f = ?$

$s = 3 \times 10^8$ m/s

$s = \lambda f$

$3.0 \times 10^8 = 5.89 \times 10^{-7} \cdot f$

$f = 5.09 \times 10^{14}$ Hz

6. A laser used to weld detached retinas produces radiation with a frequency of 4.69×10^{14} Hz. What is the wavelength of this radiation?

$f = 4.69 \times 10^{14}$ Hz

$\lambda = ?$

$s = 3 \times 10^8$ m/s

$s = \lambda f$

$3.0 \times 10^8 = \lambda \cdot 4.69 \times 10^{14}$

$\lambda = 6.40 \times 10^{-7}$ m

7. What is the wavelength of radiation whose frequency is 6.24×10^{14} Hz? Would you be able to see this radiation? (Does it fall within the visible range of colors on the spectrum?)

$f = 6.24 \times 10^{14}$ Hz

$\lambda = ?$

$s = 3 \times 10^8$ m/s

$s = \lambda f$

$3.0 \times 10^8 = \lambda \cdot 6.24 \times 10^{14}$

$\lambda = \frac{4.81 \times 10^{-7}\text{m}}{1} \left| \frac{10^9\text{nm}}{1\text{m}} \right. = 480.8\text{nm}$

Visible Light is 400-700nm. 480.8nm is in range, so yes we can see VIOLET!

8. A neon light emits radiation of 616 nm wavelength. What is the frequency of this radiation?

$\lambda = 616\text{ nm} \left| \frac{1\text{m}}{10^9\text{nm}} \right. = 6.16 \times 10^{-7}\text{m}$ $\quad f = ?$ $\quad S = \lambda f$ $\quad 3.0 \times 10^8 = 6.16 \times 10^{-7} \cdot f$ $\quad f = 4.87 \times 10^{14}\text{ Hz}$

9. Excited barium atoms emit visible light whose frequency is 6.59×10^{14} Hz. Determine the wavelength.

$f = 6.59 \times 10^{14}$ $\quad \lambda = ?$ $\quad S = \lambda f$ $\quad 3.0 \times 10^8 = \lambda \cdot 6.59 \times 10^{14}$ $\quad \lambda = 4.55 \times 10^{-7}\text{m}$

10. The frequency of the radiation used in all microwave ovens sold in the United States is 2.45 GHz (the unit GHz stands for "gigahertz"; 1 GHz is a billion cycles per second, or 10^9 s^{-1}). What is the wavelength (in meters) of this radiation?

$f = 2.45\text{ GHz} \left| \frac{10^9\text{Hz}}{1\text{GHz}} \right. = 2.45 \times 10^9\text{ Hz}$ $\quad \lambda = ?$ $\quad S = \lambda f$ $\quad 3.0 \times 10^8 = \lambda \cdot 2.45 \times 10^9$ $\quad \lambda = 0.122\text{m}$

11. The U.S. Navy has a system for communicating with submerged submarines. The system uses radio waves with a frequency of 76 s^{-1}. What is the wavelength of this radiation in meters?

$f = 76\text{ Hz}$ $\quad \lambda = ?$ $\quad S = \lambda f$ $\quad 3.0 \times 10^8 = \lambda \cdot 76$ $\quad \lambda = 3.95 \times 10^6\text{m}$

12. An Argon laser releases light from excited electrons at a frequency of 6.29×10^{14} Hz.
    a. Determine the speed at which this light travels. Always $3.0 \times 10^8 \frac{\text{m}}{\text{s}}$
    b. Determine the wavelength of this light?

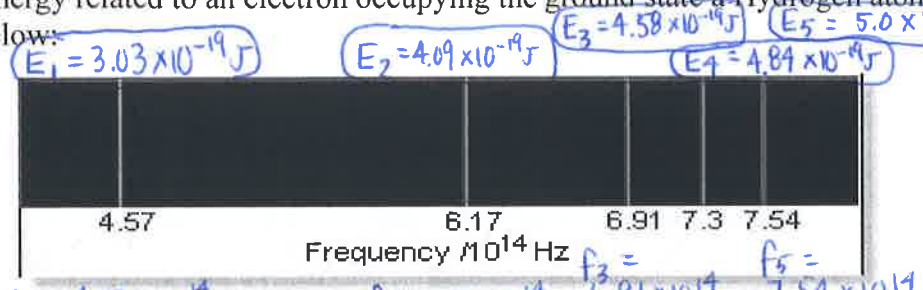
$S = \lambda f$ $\quad 3.0 \times 10^8 = \lambda \cdot 6.29 \times 10^{14}$ $\quad \lambda = 4.77 \times 10^{-7}\text{m}$

    c. Determine the change in energy of the electrons releasing these photons.

$E = ?$ $\quad f = 6.29 \times 10^{14}$ $\quad h = 6.626 \times 10^{-34}$ $\quad E = hf$ $\quad = 6.626 \times 10^{-34} \cdot 6.29 \cdot 10^{14}$ $\quad E = 4.17 \times 10^{-19}\text{ J}$

13. Determine the energy related to an electron occupying the ground state a Hydrogen atom given its bright-line spectrum below:

$E = ?$ $\quad f = \text{various bands}$ $\quad h = 6.626 \times 10^{-34}$ $\quad E = hf$



$f_1 = 4.57 \times 10^{14}$ $\quad f_2 = 6.17 \times 10^{14}$ $\quad f_3 = 6.91 \times 10^{14}$ $\quad f_4 = 7.3 \times 10^{14}$ $\quad f_5 = 7.54 \times 10^{14}$

14. Calculate the energy of an X-ray photon if the wavelength is 5.00×10^{-10} m?

$E = ?$ $\quad \lambda = 5.0 \times 10^{-10}$ $\quad h = 6.626 \times 10^{-34}$ $\quad S = 3 \times 10^8$

First find f: $S = \lambda f$ $\quad 3.0 \times 10^8 = 5 \times 10^{-10} f$ $\quad f = 6.0 \times 10^{17}\text{ Hz}$

Then find E: $E = hf$ $\quad E = 6.626 \times 10^{-34} \cdot 6.0 \times 10^{17}$ $\quad E = 3.98 \times 10^{-16}\text{ J}$

15. An ultraviolet wave has a wavelength of 725 nm.
    a. Determine the frequency of this wave.

$S = 3.0 \times 10^8$ $\quad \lambda = 725\text{ nm} \left| \frac{1\text{m}}{10^9\text{nm}} \right. = 7.25 \times 10^{-7}\text{m}$ $\quad S = \lambda f$ $\quad 3.0 \times 10^8 = 7.25 \times 10^{-7} \cdot f$ $\quad f = 4.14 \times 10^{14}\text{ Hz}$

    b. Determine the energy change of the electron giving this light off.

$E = ?$ $\quad f = 4.14 \times 10^{14}$ $\quad E = hf$ $\quad E = 6.626 \times 10^{-34} \cdot 4.14 \times 10^{14}$ $\quad E = 2.74 \times 10^{-19}\text{ J}$