Wave Problems Name: Key

1. A very bright line in the bright-line spectrum of hydrogen has a wavelength of 4.10×10^{-5} centimeters. What is the frequency of this line?

4.10×10^{-7} m

$c = \lambda \nu$

$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^{8} \text{ m/s}}{4.10 \times 10^{-7} \text{ m}} = \boxed{7.32 \times 10^{14} \text{ Hz}}$

2. A wave has 5.00×10^{-10} J of energy. What is the frequency and wavelength of this wave?

$E = h\nu$

$\nu = \frac{E}{h} = \frac{5.00 \times 10^{-10} \text{ J}}{6.63 \times 10^{-34} \text{ J·s}} = \boxed{7.54 \times 10^{23} \text{ Hz}}$

$c = \lambda \nu$

$\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^{8} \text{ m/s}}{7.54 \times 10^{23} \text{ 1/s}} = \boxed{3.98 \times 10^{-16} \text{ m}}$

3. A band of light viewed with a spectroscope has a wavelength of 1.32×10^{-7}m. What is the energy released by the atom of this element?

$c = \lambda \nu$ $\quad \nu = \frac{c}{\lambda}$

$E = h\nu$

$E = \frac{hc}{\lambda} = \frac{(6.63 \times 10^{-34} \text{ J·s})(3.00 \times 10^{8} \text{ m/s})}{1.32 \times 10^{-7} \text{ m}} = \boxed{1.51 \times 10^{-18} \text{ J}}$

4. A cosmic ray has a frequency of 3.00×10^{14} MHz. What is its wavelength? What is the energy of this wave?

$\frac{3.00 \times 10^{14} \text{ MHz}}{1} \times \frac{10^{6} \text{ Hz}}{1 \text{ MHz}} = 3.00 \times 10^{20} \text{ Hz}$

$c = \lambda \nu$

$\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^{8} \text{ m/s}}{3.00 \times 10^{20} \text{ 1/s}} = \boxed{1.00 \times 10^{-12} \text{ m}}$

$E = h\nu$

$= (6.63 \times 10^{-34} \text{ J·s})(3.00 \times 10^{20} \text{ Hz})$

$= \boxed{1.99 \times 10^{-13} \text{ J}}$

5. The radio station WUNC broadcasts at a frequency of 91.5 MHz. What is the wavelength of this broadcast? What is the energy of this wave? $9.15 \times 10^7\ Hz$

$c = \lambda\upsilon$

$\lambda = \frac{c}{\upsilon} = \frac{3.00 \times 10^8\ m/s}{9.15 \times 10^7\ Hz} = \boxed{3.28\ m}$

$E = h\upsilon = (6.63 \times 10^{-34}\ J \cdot s)(9.15 \times 10^7\ Hz) = \boxed{6.07 \times 10^{-26}\ J}$

6. An ultraviolet wave has a wavelength of 4.50×10^{-1} μm. What is its frequency? What is its energy?

$\frac{4.50 \times 10^{-1}\ \mu m}{1} \times \frac{10^{-6}\ m}{1\ \mu m} = 4.50 \times 10^{-7}\ m$

$c = \lambda\upsilon$

$\upsilon = \frac{c}{\lambda} = \frac{3.00 \times 10^8\ m/s}{4.50 \times 10^{-7}\ m} = \boxed{6.67 \times 10^{14}\ Hz}$

$E = h\upsilon = (6.63 \times 10^{-34}\ J \cdot s)(6.67 \times 10^{14}\ Hz) = \boxed{4.42 \times 10^{-19}\ J}$

7. A wave with 2.23×10^{-18} Joules has what wavelength?

$E = h\upsilon \quad \upsilon = E/h$

$c = \lambda\upsilon \quad \lambda = \frac{c}{\upsilon} = \frac{ch}{E} = \frac{(3.00 \times 10^8\ m/s)(6.63 \times 10^{-34}\ J \cdot s)}{2.23 \times 10^{-18}\ J} = \boxed{8.92 \times 10^{-8}\ m}$

8. If you have a wave that has a wavelength of 3.22×10^{-7} meters. What is its frequency?

$c = \lambda\upsilon$

$\upsilon = \frac{c}{\lambda} = \frac{3.00 \times 10^8\ m/s}{3.22 \times 10^{-7}\ m} = \boxed{9.32 \times 10^{14}\ Hz}$

9. A wave with a frequency of 4.90×10^{26} Hz has what wavelength? How much energy does this wave have?

$c = \lambda\upsilon$

$\lambda = \frac{c}{\upsilon} = \frac{3.00 \times 10^8\ m/s}{4.90 \times 10^{26}\ Hz} = \boxed{6.12 \times 10^{-19}\ m}$

$E = h\upsilon = (6.63 \times 10^{-34}\ J \cdot s)(4.90 \times 10^{26}\ Hz) = \boxed{3.25 \times 10^{-7}\ J}$

10. A wave with a wavelength of 4.00×10^2 nm has what frequency? What is its energy?

$4.00 \times 10^{-7}\ m$

$c = \lambda\upsilon$

$\upsilon = \frac{c}{\lambda} = \frac{3.00 \times 10^8\ m/s}{4.00 \times 10^{-7}\ m} = \boxed{7.50 \times 10^{14}\ Hz}$

$E = h\upsilon = (6.63 \times 10^{-34}\ J \cdot s)(7.50 \times 10^{14}\ Hz) = \boxed{4.97 \times 10^{-19}\ J}$