Show ALL equations, work, units, and significant figures in performing the following calculations. Identify the type of radiation in each problem. (Use your electromagnetic spectrum)

\[ C = \frac{\lambda}{\nu} \quad E = h\nu \]

\[ C = 3.00 \times 10^8 \text{ m/s} \quad h = 6.626 \times 10^{-34} \text{ J-s (or J/Hz)} \]

1. What is the wavelength of a wave having a frequency of \(3.76 \times 10^{14} \text{ s}^{-1}\)?
2. What is the frequency of a \(6.9 \times 10^{-13} \text{ m}\) wave?
3. What is the wavelength of a \(2.99 \text{ Hz}\) wave?
4. What is the wavelength of a \(1.28 \times 10^{17} \text{ Hz}\) wave?
5. What is the frequency of a \(7.43 \times 10^{-15} \text{ m}\) wave?
6. What is the frequency of a \(2.600 \text{ cm}\) wave?
7. What is the wavelength of a \(4.34 \times 10^{15} /\text{s}\) wave?
8. What is the frequency of a \(5.6 \times 10^{10} \text{ \mu m}\) wave?
9. What is the wavelength of \(109.6 \text{ MHz}\) wave?
10. What is the energy of a \(7.66 \times 10^{14} \text{ Hz}\) wave?
11. What is the frequency of a wave carrying \(8.35 \times 10^{-18} \text{ J}\) of energy?
12. What is the energy of a \(3.12 \times 10^{18} \text{ s}^{-1}\) wave?
13. What is the frequency of a \(1.31 \times 10^{-22} \text{ J}\) wave? What is its wavelength?
14. What is the wavelength of a \(7.65 \times 10^{-17} \text{ J}\) wave?
15. What is the energy of a \(9,330 \text{ cm}\) wave?
16. What is the wavelength of a \(1.32 \times 10^{-6} \text{ eV}\) wave?
17. What is the energy in electron-volts (eV) of a \(4.22 \text{ \mu m}\) wave?
18. What is the wavelength of a \(1.528 \times 10^{-13} \text{ J}\) wave?
Show ALL equations, work, units, and significant figures in performing the following calculations. Identify the type of radiation in each problem. (Use your electromagnetic spectrum)

\[ C = \lambda \nu \quad E = h \nu \]

\[ C = 3.00 \times 10^8 \text{ m/s} \quad h = 6.626 \times 10^{-34} \text{ J-s (or J/Hz)} \]

\[ 1 \text{ eV} = 1.602 \times 10^{-19} \text{ J} \]

1. What is the wavelength of a wave having a frequency of \(3.76 \times 10^{14} \text{ s}^{-1}\)?

\[ \lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8 \text{ m/s}}{3.76 \times 10^{14} \text{ s}^{-1}} = 7.98 \times 10^{-7} \text{ m} \]

2. What is the frequency of a \(6.9 \times 10^{-13} \text{ m}\) wave?

\[ \nu = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \text{ m/s}}{6.9 \times 10^{-13} \text{ m}} = 4.35 \times 10^{20} \text{ s}^{-1} \]

3. What is the wavelength of a 2.99 Hz wave?

\[ \lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8 \text{ m/s}}{2.99 \text{ Hz}} = 1.00 \times 10^8 \text{ m} \]

4. What is the wavelength of a \(1.28 \times 10^{17} \text{ Hz}\) wave?

\[ \lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8 \text{ m/s}}{1.28 \times 10^{17} \text{ Hz}} = 2.34 \times 10^{-9} \text{ m} \]

5. What is the frequency of a \(7.43 \times 10^{-5} \text{ m}\) wave?

6. What is the frequency of a 2,600 cm wave?

7. What is the wavelength of a \(4.34 \times 10^{15} \text{ /s}\) wave?

8. What is the frequency of a \(5.6 \times 10^{10} \mu\text{m}\) wave?

\[ \nu = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \text{ m/s}}{5.6 \times 10^{10} \mu\text{m}} = 5.4 \times 10^3 \text{ s}^{-1} \]

9. What is the wavelength of 109.6 MHz wave?

\[ \lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8 \text{ m/s}}{109.6 \text{ MHz}} = \frac{3.00 \times 10^8 \text{ m}}{109.6 \text{ MHz}} \times \frac{1 \text{ MHz}}{10^6 \text{ Hz}} \times \frac{1 \text{ Hz}}{s} \]
= 2.74 m

10. What is the energy of a $7.66 \times 10^{14}$ Hz wave?

\[ E = h \nu = 6.626 \times 10^{-34} \text{ J/Hz} \times 7.66 \times 10^{14} \text{ Hz} = 5.07 \times 10^{-19} \text{ J} \]

11. What is the frequency of a wave carrying $8.35 \times 10^{-18}$ J of energy?

\[ \nu = \frac{E}{h} = \frac{8.35 \times 10^{-18} \text{ J}}{6.626 \times 10^{-34} \text{ J-s}} = 1.26 \times 10^{16} \text{ s}^{-1} \]

12. What is the energy of a $3.12 \times 10^{18}$ s$^{-1}$ wave?

\[ E = h \nu = 6.626 \times 10^{-34} \text{ J-s} \times 3.12 \times 10^{18} \text{ s}^{-1} = 2.07 \times 10^{-15} \text{ J} \]

13. What is the frequency of a $1.31 \times 10^{-22}$ J wave? What is its wavelength?

\[ \nu = \frac{E}{h} = \frac{1.31 \times 10^{-22} \text{ J}}{6.626 \times 10^{-34} \text{ J-s}} = 1.977 \times 10^{11} \text{ s}^{-1} = 1.98 \times 10^{11} \text{ s}^{-1} \]

\[ \lambda = \frac{c}{\nu} = \frac{3.00 \times 10^{8} \text{ m/s}}{1.977 \times 10^{11} \text{ s}^{-1}} = 0.00152 \text{ m} = 1.52 \times 10^{-3} \text{ m} \]

14. What is the wavelength of a $7.65 \times 10^{-17}$ J wave?

\[ \nu = \frac{E}{h} = \frac{7.65 \times 10^{-17} \text{ J}}{6.626 \times 10^{-34} \text{ J-s}} = 1.154 \times 10^{17} \text{ s}^{-1} \]

\[ \lambda = \frac{c}{\nu} = \frac{3.00 \times 10^{8} \text{ m/s}}{1.154 \times 10^{17} \text{ s}^{-1}} = 0.00152 \text{ m} = 1.52 \times 10^{-3} \text{ m} \]

15. What is the energy of a 9.330 cm wave?

\[ \nu = \frac{c}{\lambda} = \frac{3.00 \times 10^{8} \text{ m/s}}{3.00 \times 10^{8} \text{ m} \times \frac{1}{1 \text{ cm}}} = 3.215 \times 10^{6} \text{ s}^{-1} \]
16. What is the wavelength of a 1.32 x 10^{-6} eV wave?

\[\nu = \frac{E}{h} = \frac{1.32 \times 10^{-6} \text{ eV}}{6.626 \times 10^{-34} \text{ J s}} \times \frac{1.602 \times 10^{-19} \text{ J}}{1 \text{ eV}} = 3.19133138 \times 10^{48} \text{ s}^{-1}\]

\[\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8 \text{ m/s}}{3.19133138 \times 10^{48} \text{ s}^{-1}} = \frac{3.00 \times 10^8 \text{ m}}{s} \times \frac{1}{3.19133138 \times 10^{48} \text{ s}^{-1}}\]

= 0.940 m

17. What is the energy in electron-volts (eV) of a 4.22 µm wave?

\[\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \text{ m/s}}{4.22 \mu\text{m}} = \frac{3.00 \times 10^8 \text{ m}}{s} \times \frac{1}{4.22 \mu\text{m}} \times \frac{1 \mu\text{m}}{10^{-6} \text{ m}}\]

= 7.109 004 73 x 10^{13} \text{ s}^{-1}

\[E = h \nu = 6.626 \times 10^{-34} \text{ J s} \times 7.10900473 \times 10^{13} \text{ s}^{-1} = 4.71 \times 10^{-20} \text{ J}\]

18. What is the wavelength of a 1.528 x 10^{-13} J wave?

\[\nu = \frac{E}{h} = \frac{1.528 \times 10^{-13} \text{ J}}{6.626 \times 2 \times 10^{-34} \text{ J s}} = 2.305997404 \times 10^{20} \text{ s}^{-1}\]

\[\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8 \text{ m/s}}{2.305997404 \times 10^{20} \text{ s}^{-1}} = \frac{3.00 \times 10^8 \text{ m}}{s} \times \frac{1}{2.305997404 \times 10^{20} \text{ s}^{-1}}\]

= 1.30 x 10^{-12} \text{ m}