Answers

1. ν = frequency
   λ = wavelength
   c = speed of light in vaccum $2.998 \times 10^8 ms^{-1}$

$$2.50 \cancel{GHz} \cdot \frac{10^9 Hz}{1 \cancel{GHz}} = 2.50 \times 10^9 Hz$$

↓ can also be defined as

$$\frac{1 \text{ cycle}}{\text{second}}$$

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

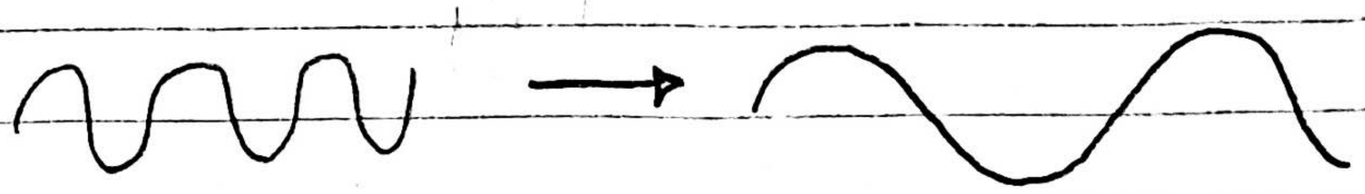
$$\lambda = \frac{c}{\nu} = \frac{2.998 \times 10^8 m s^{-1}}{2.50 \times 10^9 s^{-1}} \Rightarrow 0.120 m$$

2. $3.7 MHz \times \frac{10^6 Hz}{1 MHz} = 3700000 Hz \rightarrow 3.7 \times 10^6 s^{-1}$

$$\lambda = \frac{c}{\nu} = \frac{2.998 \times 10^8 m s^{-1}}{3.7 \times 10^6 s^{-1}} = 81.02 m$$

3. They are inversely proportional

$\lambda \frac{1}{\alpha} \nu$ ∴ a. $\lambda \uparrow \nu \downarrow$



b. $\lambda \downarrow \nu \uparrow$

4. $2.68 \times 10^6 \text{ Hz} = \nu$

$h = 6.63 \times 10^{-34} \text{ J.s}$

$c = 3.00 \times 10^8 \text{ m/s}$

$$\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8 \text{ m/s}}{2.68 \times 10^6 \text{ s}^{-1}} \Rightarrow 111.94 \text{ m}$$

$$E = h\nu = (2.68 \times 10^6 \text{ H}_2 \overset{s^{-1}}{\nearrow})(6.63 \times 10^{-34} \text{ J.s}) \Rightarrow 1.78 \times 10^{-27} \text{ J}$$

5. $\nu = 6.165 \times 10^{14} \text{ H}_2$

$$\lambda = \frac{3.00 \times 10^8 \text{ m s}^{-1}}{6.169 \times 10^{14} \text{ s}^{-1}} = 4.87 \times 10^{-7} \text{ m}$$

$$E = (6.63 \times 10^{-34} \text{ J.s})(6.165 \times 10^{14} \text{ s}^{-1}) = 4.1 \times 10^{-19} \text{ J}$$

6. $\lambda = .400 \text{ nm} \times \frac{1 \text{ m}}{10^9 \text{ nm}} = 4.0 \times 10^{-7} \text{ m}$

$$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \text{ m s}^{-1}}{4.0 \times 10^{-7} \text{ m}} = 7.5 \times 10^{14} \text{ H}_2 \text{ or } \text{s}^{-1}$$

$$E = h\nu = (6.63 \times 10^{-34} \text{ J.s})(7.5 \times 10^{14} \text{ s}^{-1}) = 4.97 \times 10^{-19} \text{ J}$$

(7) a) $E = \frac{hc}{\lambda}$

$E \uparrow$ ←

380nm ← → 780nm

ultraviolet — infared

↓

smaller wavelength $\uparrow E \downarrow \lambda$ ∴ ultraviolet is higher E

b) $43.0 \cancel{kJ}/mol \times \frac{1000J}{1\cancel{kJ}} \times \frac{1 mol}{6.022 \times 10^{23}} = 7.14 \times 10^{-20} J$

rel between λ & ν

light eq. — Derivation

$E = \frac{hc}{\lambda}$

$\lambda E = hc$

$\lambda = \frac{hc}{E}$

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

$E = h\nu$ (Planks) $\quad \nu = \frac{E}{h}$ $\quad ch = E\lambda$

$E = \frac{ch}{\lambda}$

$$\lambda = \frac{6.63 \times 10^{-34} \cancel{J}\cdot s \times 3.00 \times 10^{8} m/s}{7.14 \times 10^{-20} \cancel{J}} = 2.78 \times 10^{-6} m$$

↓

$2.78 \times 10^{-6} m \times \frac{10^{9} nm}{1 m} =$ ↙

2785.7nm

8. $\lambda = 6.80 \times 10^{-5} cm \times \frac{1 m}{100 cm} = 6.8 \times 10^{-7} m$

$C = \lambda \nu$

$\nu = \frac{c}{\lambda} = \frac{3.0 \times 10^{8} m/s}{6.8 \times 10^{-7} m} = 4.4 \times 10^{14} s^{-1}$ OR $4.4 \times 10^{14} Hz$

$E = h \cdot \nu = 6.63 \times 10^{-34} J \cdot s \times 4.4 \times 10^{14} 1/s = \boxed{2.9 \times 10^{-19} J}$