

CHEM 1035 – Homework 8 Solutions

7.8 $93.5 \text{ MHz} = 93.5 \times 10^6 \text{ Hz}$

$$v\lambda = c$$

$$(93.5 \times 10^6 \text{ Hz})(\lambda) = 3.0 \times 10^8 \text{ m/sec}$$

$$\lambda = \frac{3.0 \times 10^8 \text{ m/sec}}{93.5 \times 10^6 \text{ sec}^{-1}} = 3.2 \text{ m}$$

7.10. $1.3 \text{ \AA} = 1.3 \times 10^{-10} \text{ m}$

$$E = h\nu = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J} \cdot \text{sec})(3.0 \times 10^8 \text{ m/sec})}{1.3 \times 10^{-10} \text{ m}} = 1.53 \times 10^{-15} \text{ J}$$

7.15 $E = 1.33 \text{ MeV} = 1.33 \times 10^6 \text{ eV}$

$$1.33 \times 10^6 \text{ eV} \times \frac{1.602 \times 10^{-19} \text{ J}}{\text{eV}} = 2.13 \times 10^{-13} \text{ J}$$

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

$$\lambda = \frac{hc}{E} = \frac{(6.626 \times 10^{-34} \text{ J} \cdot \text{s})(3.0 \times 10^8 \text{ m/sec})}{2.13 \times 10^{-13} \text{ J}} = 9.32 \times 10^{-13} \text{ m}$$

7.24 $\frac{1}{\lambda} = R \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$ where $R = 1.097 \times 10^7 \text{ m}^{-1}$

$$\frac{1}{\lambda} = (1.097 \times 10^7 \text{ m}^{-1}) \left(\frac{1}{1} - \frac{1}{9} \right) = 9.75 \times 10^7 \text{ m}^{-1}$$

$$\lambda = 1.026 \times 10^{-7} \text{ m}$$

7.28 $E = h\nu = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J} \cdot \text{s})(3.0 \times 10^8 \text{ m/sec})}{1.026 \times 10^{-7} \text{ m}} = 1.937 \times 10^{-18} \text{ J}$

$$1.937 \times 10^{-18} \text{ J} \times \frac{6.022 \times 10^{23} \text{ photon}}{\text{mole}} = 1.167 \times 10^6 \text{ J/mole}$$

7.30 $\frac{1}{\lambda} = R \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$

$$\therefore E \propto \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \text{ and wavelength is inversely related to wavelength (greater}$$

energy corresponds with smaller wavelength.

- a. $E \propto \left(\frac{1}{4} - \frac{1}{\infty} \right) = 0.25$
- b. $E \propto \left(\frac{1}{16} - \frac{1}{400} \right) = 0.06$
- c. $E \propto \left(\frac{1}{9} - \frac{1}{100} \right) = 0.101$
- d. $E \propto \left(\frac{1}{4} - \frac{1}{1} \right) = -0.75$

Therefore, (b) has the longest wavelength, (c) the next longest, (a) the next longest, and (d) the shortest wavelength

7.33 $436\text{nm} = 436 \times 10^{-9}\text{m}$

$$E = h\nu = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J} \cdot \text{s})(3.0 \times 10^8 \text{ m/sec})}{4.36 \times 10^{-7} \text{ m}} = 4.56 \times 10^{-19} \text{ J}$$

7.42 The deBroglie wavelength is given by: $\lambda = \frac{h}{mu}$

$$100 \times 10^{-12} \text{ m} = \frac{6.626 \times 10^{-34} \text{ J} \cdot \text{s}}{(142 \text{ g} \times \frac{1 \text{ kg}}{1000 \text{ g}})u}$$

$$u = 4.67 \times 10^{-23} \text{ m/sec}$$

7.44 Using the deBroglie wavelength

$$671 \times 10^{-9} \text{ m} = \frac{6.626 \times 10^{-34} \text{ J} \cdot \text{s}}{m(3.0 \times 10^8 \text{ m/sec})}$$

$$m = 3.29 \times 10^{-54} \text{ kg}$$

- 7.56 a. $n = 2, l = 0 \rightarrow$ "s" orbital, $m_l = 0, 1$ orbital
 b. $n = 3, l = 2 \rightarrow$ "d" orbital, $m_l = -2, -1, 0, 1, 2$; 5 orbitals
 c. $n = 5, l = 1 \rightarrow$ "p" orbital, $m_l = -1, 0, 1$; 3 orbitals

- 7.58 a. 6g $n = 6, l = 4, m_l = -4, -3, -2, -1, 0, 1, 2, 3, 4$; 9 orbitals
 b. 4s $n = 4, l = 0, m_l = 0$; 1 orbital
 c. 3d $n = 3, l = 2, m_l = -2, -1, 0, 1, 2$; 5 orbitals

- 7.60 a. $n = 2, l = 0, m_l = 0 \rightarrow$ allowed
- b. $n = 2, l = 2, m_l = +1 \rightarrow$ not allowed, l can only have values from 0 to $(n-1)$
- c. $n = 7, l = 1, m_l = 2 \rightarrow$ not allowed, m_l can only have values ranging from $-l$ to $+l$

- d. $n=3, l=1, m_l = -2 \rightarrow$ not allowed, m_l can only have values ranging from $-l$ to $+l$