MATTER & MINERALS

CHEMISTRY HOMEWORK - FALL - WEEK 8

Chapter 7

(47) (a) $V = \frac{90}{100} C = \frac{90}{100} \times 2.99 \times 10^{8}\ ms^{-1}$

$V = 2.691 \times 10^{8}\ ms^{-1}$

$\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}\ Js}{(1.67262 \times 10^{-27}\ kg)(2.691 \times 10^{8}\ ms^{-1})}$

$\lambda = 1.4721 \times 10^{-15}\ m$

$\frac{JS}{kg \cdot ms^{-1}} = \frac{kg\, m^2 s^{-2} \cdot s}{kg\, m\, s^{-1}}$

(b) $\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}\ Js}{(150 g)\ 10\ ms^{-1}}$

$= \frac{6.626 \times 10^{-34} (kg m^2 s^{-2})(s)}{(0.150\ kg)(10\ ms^{-1})} = 4.417 \times 10^{-34}\ m$

(51) $\Delta E = -2.178 \times 10^{-18} \left[\frac{1}{n_f^2} - \frac{1}{n_i^2} \right] J = \frac{hc}{\lambda}$

$\frac{1}{\lambda} = \frac{-2.178 \times 10^{-18}\ J}{(6.626 \times 10^{-34}\ JS)(2.99 \times 10^{8}\ ms^{-1})} \left[\frac{1}{n_f^2} - \frac{1}{n_i^2} \right]$

$= -1.0993 \times 10^{7}\ m^{-1} \left[\frac{1}{n_f^2} - \frac{1}{n_i^2} \right]$

$\frac{1}{\lambda} = -1.0993 \times 10^{5} \left[\frac{1}{n_f^2} - \frac{1}{n_i^2} \right] cm^{-1}$

(a) $n = 3 \rightarrow n = 2$ $\qquad n_f = 3 \quad n_i = 2$

$$\frac{1}{\lambda} = -1.0993\times10^{5}\left[\frac{1}{9} - \frac{1}{4}\right] cm^{-1}$$

$$\frac{1}{\lambda} = 1.5268\times10^{4}\ cm^{-1}$$

$$\lambda = \frac{1}{1.5268\times10^{4}\ cm^{-1}} = 6.54962\times10^{-5}\ cm \times \frac{10^{7}\ nm}{cm}$$

$$\lambda = \underline{\underline{654.9\ nm}}$$ visible region

(b) $n = 4 \rightarrow n = 2$ $\qquad n_f = 4 \quad n_i = 2$

$$\frac{1}{\lambda} = -1.0993\times10^{5}\left[\frac{1}{16} - \frac{1}{4}\right] cm^{-1} = 2.06119\times10^{4}\ cm^{-1}$$

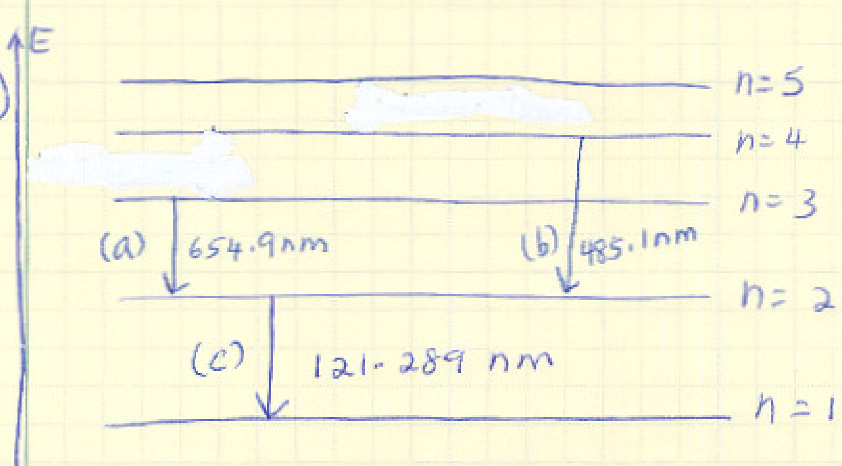
$$\lambda = \underline{\underline{485.1\ nm}}$$ visible region

(c) $n = 2 \rightarrow n = 1$ $\qquad n_f = 2 \quad n_i = 1$

$$\frac{1}{\lambda} = -1.0993\times10^{5}\left[\frac{1}{4} - \frac{1}{1}\right] cm^{-1} = 82447.50\ cm^{-1}$$

$$\lambda = \underline{\underline{121.289\ nm}}$$ UV region

(53)



(55) if $\lambda = 400\,nm = 400 \times 10^{-9} m$

$$E = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} Js)(2.99 \times 10^{8} ms^{-1})}{(400 \times 10^{-9} m)}$$

$$E = 4.953 \times 10^{-19} J$$

if $\lambda = 700\,nm = 700 \times 10^{-9} m$

$$E = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} JS)(2.99 \times 10^{8} ms^{-1})}{700 \times 10^{-9} m}$$

$$E = 2.830 \times 10^{-19} J$$

∴ visible light energy ranges from

$$2.830 \times 10^{-19} J \longrightarrow 4.953 \times 10^{-19} J$$

When a transition occurs from $n_i = 1 \longrightarrow n_f = 5$

$$\Delta E = -2.178 \times 10^{-18} J \left[\frac{1}{n_f^2} - \frac{1}{n_i^2} \right]$$

$$= -2.178 \times 10^{-18} J \left[\frac{1}{25} - \frac{1}{1} \right] = 2.091 \times 10^{-18}$$

This energy is higher than the visible region. Therefore a photon of visible light <u>does not</u> have sufficient energy to move an electron from $n = 5$ to $n = 1$

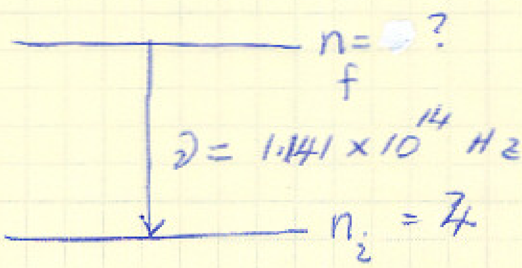
When a transition occurs from $n_i = 2$ to $n_f = 6$

$$\Delta E = -2.178 \times 10^{-18} J \left[\frac{1}{36} - \frac{1}{4} \right]$$

$$\Delta E = 4.84 \times 10^{-19} J$$

This energy is within the visible range. Therefore a photon of visible light <u>does</u> have sufficient energy to move an electron from $n = 2$ to $\underline{n = 6}$.

(57)



$$\Delta E = -2.178 \times 10^{-18} J \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$$

$$\Delta E = h\nu$$

$$\therefore (6.626 \times 10^{-34} Js)(1.141 \times 10^{14} Hz) = -2.178 \times 10^{-18} J \left(\frac{1}{n_f^2} - \frac{1}{16} \right)$$

$$7.560266 \times 10^{-20} J = -2.178 \times 10^{-18} J \left[\frac{1}{n_f^2} - \frac{1}{16} \right]$$

$$-\frac{7.560266 \times 10^{-20} J}{2.178 \times 10^{-18} J} = \frac{1}{n_f^2} - 0.0625$$

$$-0.034712 = \frac{1}{n_f^2} - 0.0625$$

$$\frac{1}{n_f^2} = -0.034712 + 0.0625 = 0.027788$$

$$n_f^2 = \frac{1}{0.027788} = 35.9867 \; ; \; n_f \doteq 5.99$$

$$\underline{n_f = 6}$$