CHEM-1110 EM RADIATION

1 (a) $\lambda\nu = c$ $\quad \nu = \frac{c}{\lambda} = \frac{3.00\times10^{8}\ m\cdot s^{-1}}{7.00\times10^{-7}\ m} = 4.29\times10^{14}\ s^{-1}$

$E = h\nu = (6.63\times10^{-34}\ J\cdot s)(4.29\times10^{14}\ s^{-1}) = 2.84\times10^{-19}\ J$

(b) $\nu = 7.50\times10^{14}\ s^{-1}$ $\quad E = 4.97\times10^{-19}\ J$

2 $\Delta E = E_5 - E_2 = \left(\frac{-2.18\times10^{-18}}{5^2}\right) - \left(\frac{-2.18\times10^{-18}}{2^2}\right) = 4.58\times10^{-19}\ J$

$E = \frac{hc}{\lambda}$ $\quad \lambda = \frac{hc}{E} = \frac{h\cdot c}{4.58\times10^{-19}} = 4.34\times10^{-7}\ m = \underline{434\ nm}$

3 $\Delta E = \frac{hc}{\lambda} = \frac{hc}{4.861\times10^{-7}\ m} = 4.09\times10^{-19}\ J$

$\Delta E = E_n - E_2 = \left(\frac{-2.18\times10^{-18}}{n^2}\right) - \left(\frac{-2.18\times10^{-18}}{2^2}\right) = 4.09\times10^{-19}$

$n = 4$

4 (a) $\Delta E = E_5 - E_1 = 2.09\times10^{-18}\ J$

$\lambda = \frac{hc}{E} = \frac{hc}{2.09\times10^{-18}\ J} = 9.52\times10^{-8}\ m = \underline{\underline{95.2}}\ nm$

(b) UV.

5 $\lambda = \frac{hc}{E} = \frac{hc}{2.797\times10^{5}\ \frac{J}{mol}\times\frac{1\ mol}{6.02\times10^{23}}} = 4.28\times10^{-7}\ m = \underline{\underline{428\ nm}}$

6 $n = \frac{PV}{RT} = \frac{(748/760)(1.0)}{R\ \ 295} = 0.0406\ mol\ air$

$= 2.446\times10^{22}\ molec\ air = 6.12\times10^{15}\ molec\ O_3$

$E = \frac{hc}{\lambda} = \frac{hc}{2.54\times10^{-7}\ m} = 7.83\times10^{-19}\ J/molec\ O_3$

$6.12\times10^{15} \times 7.83\times10^{-19}\ J = \underline{4.79\times10^{-3}\ J}$

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7. $Q = m \cdot s \cdot \Delta t = (1.00\times10^{3}\,g)\left(4.184\,\frac{J}{g\cdot{}^{\circ}C}\right)(10^{\circ}C) = 4.184\times10^{4}\,J$

$E_{PHOTON} = \frac{hc}{\lambda} = \frac{h\,c}{3.00\times10^{-3}\,m} = 6.63\times10^{-23}\,J$

$4.184\times10^{4}\,J \times \frac{1\ PHOTON}{6.63\times10^{-23}\,J} = \underline{6.31\times10^{26}}\ PHOTONS$

8. (a) $\Delta E = E_4 - E_1 = 1.4\times10^{-18}\,J$

(b) $\Delta E = E_4 - E_2 = 1.64\times10^{-18}\,J$ energy must be emitted.

$\lambda\nu = c \qquad E = \frac{hc}{\lambda} = h\nu \qquad \nu = \frac{E}{h} = \frac{1.64\times10^{-18}}{h} = \underline{2.47\times10^{15}}$ Hz

9. (a) $\Delta E = \left(\frac{-2.18\times10^{-18}}{\infty^2}\right) - \left(\frac{-2.18\times10^{-18}}{5^2}\right) = \underline{8.72\times10^{-20}}\,J$

(b) $\Delta E = \left[\frac{-2.18\times10^{-18}(3^2)}{\infty^2}\right] - \left(\frac{-2.18\times10^{-18}(3^2)}{1^2}\right) = 1.962\times10^{-17}\,J$

10. (a) SIX (b) FROM $n=4$ to $n=1$ (c) $n=3$ to $n=2$

11. $\Delta E = 1312\times2^2 = 5248$ kJ/mol for He^{+}.

$\Delta E = 1312\times Z^2$ kJ/mol for X^{n+}

$\therefore 1312\times Z^2 = 12.25\times 5248$

$Z^2 = 49 \qquad \therefore Z = 7$

$X = N$ and $n+ = +6$ SPECIES IS N^{6+}