AP Chemistry Chapter 7 Answers - Kotz

7.4 (a) $\lambda = \frac{c}{\nu} = \frac{2.998 \times 10^8 \text{ m}\cdot\text{s}^{-1}}{1150 \times 10^3 \text{ s}^{-1}} = 261 \text{ m}$ $\quad 225 \text{ m} \cdot \frac{1 \text{ wavelength}}{261 \text{ m}} = 0.863 \text{ wavelengths}$

(b) $\lambda = \frac{c}{\nu} = \frac{2.998 \times 10^8 \text{ m}\cdot\text{s}^{-1}}{98.1 \times 10^6 \text{ s}^{-1}} = 3.06 \text{ m}$ $\quad 225 \text{ m} \cdot \frac{1 \text{ wavelength}}{3.06 \text{ m}} = 73.6 \text{ wavelengths}$

7.7 $396.15 \text{ nm} \cdot \frac{10^{-9} \text{ m}}{1 \text{ nm}} = 3.9615 \times 10^{-7} \text{ m}$

$\nu = \frac{c}{\lambda} = \frac{2.99792 \times 10^8 \text{ m}\cdot\text{s}^{-1}}{3.9615 \times 10^{-7} \text{ m}} = 7.5676 \times 10^{14} \text{ s}^{-1}$

$E = h\nu = (6.62607 \times 10^{-34} \text{ J}\cdot\text{s})(7.5676 \times 10^{14} \text{ s}^{-1}) = 5.0144 \times 10^{-19} \text{ J/photon}$

$5.0144 \times 10^{-19} \text{ J/photon} \cdot \frac{6.02214 \times 10^{23} \text{ photons}}{1.00 \text{ mol}} = 3.02 \times 10^5 \text{ J/mol photons}$

7.9 (d) FM radiowaves (c) microwaves (a) yellow light (b) X-rays

—increasing energy per photon→

7.12 $540 \text{ nm} \cdot \frac{10^{-9} \text{ m}}{1 \text{ nm}} = 5.4 \times 10^{-7} \text{ m}$

$E = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s})(2.998 \times 10^8 \text{ m}\cdot\text{s}^{-1})}{5.4 \times 10^{-7} \text{ m}} = 3.7 \times 10^{-19} \text{ J/photon}$

This radiation does not have enough energy to activate the switch. This is also true for radiation with wavelengths greater than 540 nm.

7.17 (a) From $n = 5$ to $n = 4$, 3, 2, or 1 = 4 lines

From $n = 4$ to $n = 3$, 2, or 1 = 3 lines

From $n = 3$ to $n = 2$ or 1 = 2 lines

From $n = 2$ to $n = 1$ = 1 line

Total = 10 lines possible

(b) Highest frequency (highest energy) $n = 5$ to $n = 1$

(c) Longest wavelength (lowest energy) $n = 5$ to $n = 4$

7.20 (a) $n = 2$ to $n = 4$ and (d) $n = 3$ to $n = 5$

7.24 $\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34} \text{ J}\cdot\text{s}}{(9.11 \times 10^{-31} \text{ kg})(1.3 \times 10^8 \text{ m}\cdot\text{s}^{-1})} = 5.6 \times 10^{-12} \text{ m}$

7.27 (a) ℓ can be 0, 1, 2, 3

(b) m_ℓ can be 0, ±1, ±2

(c) $n = 4$, $\ell = 0$, $m_\ell = 0$

(d) $n = 4$, $\ell = 3$, $m_\ell = 0, \pm1, \pm2, \pm3$

7.33 (a) When $n = 2$, the maximum value of ℓ is 1

(b) When $\ell = 0$, m_ℓ can only have a value of 0

(c) When $\ell = 0$, m_ℓ can only have a value of 0

7.39

	n	ℓ	m_ℓ
(a) 2*p*	2	1	–1
	2	1	0
	2	1	1
(b) 3*d*	3	2	–2
	3	2	–1
	3	2	0
	3	2	1
	3	2	2
(c) 4*f*	4	3	–3
	4	3	–2
	4	3	–1
	4	3	0
	4	3	1
	4	3	2
	4	3	3

7.45 (a) correct

(b) Incorrect; the intensity of a light beam is independent of frequency and is related to the number of photons of light with a certain energy.

(c) correct

7.51

orbital type	number of orbitals in a given subshell	number of nodal surfaces
s	1	0
p	3	1
d	5	2
f	7	3

7.57 He: $\Delta E = -Z^2Rhc\left(\frac{1}{n_{\text{final}}^2} - \frac{1}{n_{\text{initial}}^2}\right) = -(2^2)(1312 \text{ kJ/mol})\left(\frac{1}{\infty^2} - \frac{1}{1^2}\right) = 5248 \text{ kJ/mol}$

H: $\Delta E = -Z^2Rhc\left(\frac{1}{n_{\text{final}}^2} - \frac{1}{n_{\text{initial}}^2}\right) = -(1^2)(1312 \text{ kJ/mol})\left(\frac{1}{\infty^2} - \frac{1}{1^2}\right) = 1312 \text{ kJ/mol}$

7.61 $1.173 \times 10^6 \text{ eV} \cdot \dfrac{9.6485 \times 10^4 \text{ J/mol}}{1 \text{ eV}} \cdot \dfrac{1 \text{ mol}}{6.0221 \times 10^{23} \text{ photons}} = 1.879 \times 10^{-13} \text{ J/photon}$

$$\nu = \frac{E}{h} = \frac{1.879 \times 10^{-13} \text{ J}}{6.6261 \times 10^{-34} \text{ J}\cdot\text{s}} = 2.836 \times 10^{20} \text{ s}^{-1}$$

$$\lambda = \frac{c}{\nu} = \frac{2.9979 \times 10^{8} \text{ m}\cdot\text{s}^{-1}}{2.836 \times 10^{20} \text{ s}^{-1}} = 1.057 \times 10^{-12} \text{ m}$$

7.71 The electron behaves simultaneously as a wave and a particle. The modern view of atomic structure is based on the wave properties of the electron, and describes regions around an atom's nucleus in which there is the highest probability of finding a given electron.