Information for the Exam on Unit Q

Things You Must Know

(1) Superposition Principle
(2) Boundary conditions for standing waves
(3) Conditions for constructive and destructive interference
(4) Rayleigh criterion
(5) Photon model of light
(6) Wave nature of matter
(7) "The Rules"
(8) Spectra – emission, absorption, and the selection rule
(9) Pauli exclusion principle
(10) Spectroscopic notation and the Periodic Table
(11) Energy eigenfunctions

Potential Useful Information

$v = \lambda f$ $\qquad$ $f = 1/T$

path difference = $d \sin\theta$ $\qquad$ $a \sin\theta_{1d} = \begin{cases} \lambda & \text{single slit} \\ 1.22\lambda & \text{circular opening} \end{cases}$

$E = hf = \dfrac{hc}{\lambda}$ $\qquad$ $\lambda = \dfrac{h}{p}$

$p \approx mv$ $\qquad$ $K \approx p^2/2m$

$|{+x}\rangle = \begin{bmatrix} \sqrt{1/2} \\ \sqrt{1/2} \end{bmatrix}$ $\quad$ $|{-x}\rangle = \begin{bmatrix} \sqrt{1/2} \\ -\sqrt{1/2} \end{bmatrix}$ $\quad$ $|{+y}\rangle = \begin{bmatrix} \sqrt{1/2} \\ i\sqrt{1/2} \end{bmatrix}$ $\quad$ $|{-y}\rangle = \begin{bmatrix} i\sqrt{1/2} \\ \sqrt{1/2} \end{bmatrix}$

$|{+z}\rangle = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ $\quad$ $|{-z}\rangle = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ $\quad$ $|{+\theta}\rangle = \begin{bmatrix} \cos\frac{1}{2}\theta \\ i\sin\frac{1}{2}\theta \end{bmatrix}$ $\quad$ $|{-\theta}\rangle = \begin{bmatrix} i\sin\frac{1}{2}\theta \\ \cos\frac{1}{2}\theta \end{bmatrix}$

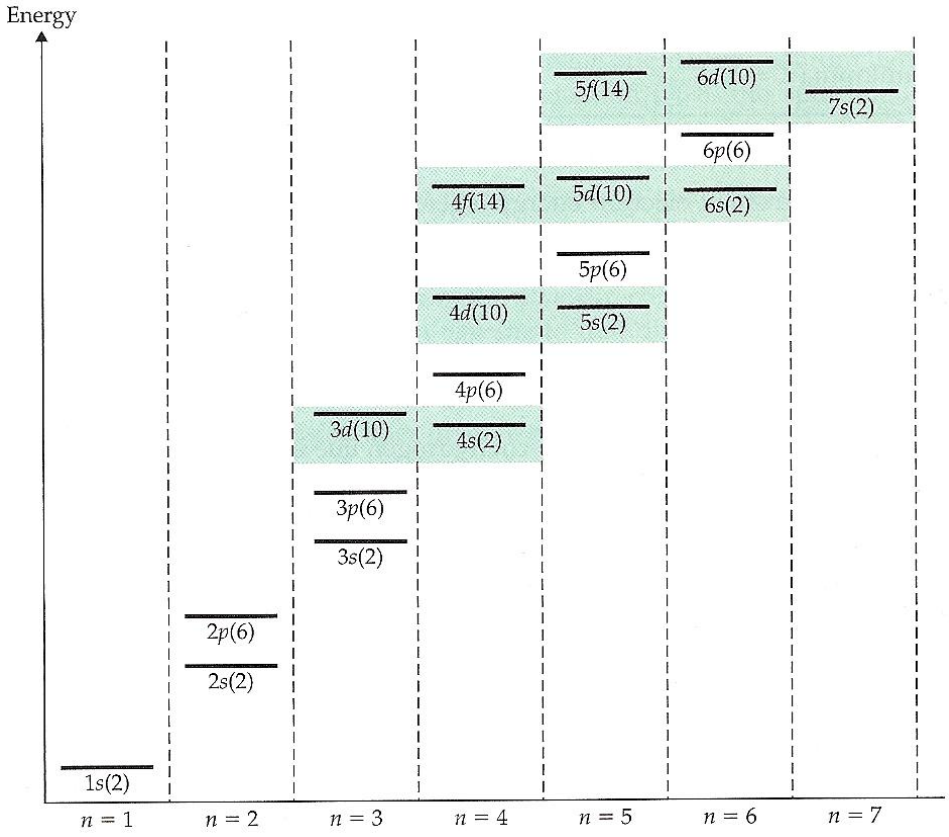
$E_n = \dfrac{h^2 n^2}{8mL^2}$ for a quanton in a box $\qquad$ $E_n = -\dfrac{13.6 \text{ eV}}{n^2}$ for the Bohr model

$E_n = \dfrac{h\omega}{2\pi}\left(n + \frac{1}{2}\right)$, where $\omega = \sqrt{\dfrac{k_s}{m}}$ for a simple harmonic oscillator

Label	*s*	*p*	*d*	*f*
ℓ	0	1	2	3

$\ell \le n - 1$ $\qquad$ $-\mathsf{l} \le m \le +\mathsf{l}$ $\qquad$ $m_s = \pm\frac{1}{2}$

$$-\frac{\hbar^2}{2m}\frac{d^2\psi_E(x)}{dx^2} + V(x)\psi_E(x) = E\psi_E(x)$$



Physical Constants

$c = 3 \times 10^8$ m/s $1\text{ eV} = 1.602 \times 10^{-19}$ J

$h = 6.63 \times 10^{-34}$ J·s $hc = 1240$ eV·nm

$m_{\text{proton}} = 1.7 \times 10^{-27}$ kg $m_{\text{proton}}c^2 = 938.27$ MeV

$m_{\text{electron}} = 9 \times 10^{-31}$ kg $m_{\text{electron}}c^2 = 0.511$ MeV

Propagation of Uncertainties (on exam, *not* Quiz)

In general: $f(a,b,\text{K})$

$$U[f] = \sqrt{\left(\frac{\partial f}{\partial a}U[a]\right)^2 + \left(\frac{\partial f}{\partial b}U[b]\right)^2 + \text{K}}$$

If $f = \dfrac{ab\text{K}}{cd\text{K}}$

$$U[f] = |f|\sqrt{\left(\frac{U[a]}{a}\right)^2 + \left(\frac{U[b]}{b}\right)^2 + \left(\frac{U[c]}{c}\right)^2 + \text{K}}$$

If $f = a + b + \text{K} - c - d - \text{K}$

$$U[f] = \sqrt{(U[a])^2 + (U[b])^2 + (U[c])^2 + \text{K}}$$