11/9/2018

Exam 3 ~ next Thu!

- Rest of ch 5
- All of ch 6
- Ch. 7, up until WED

- today: all material ⇝ exam 4

MasteringChemistry: this week's homework will be due on WED @ 5PM!

Schrödinger eq (SE)

$$-\frac{\hbar^2}{2m}\nabla^2\Psi + V\Psi = E\Psi$$

↳ solve for Ψ, E

Ψ: wavefunction (psi)
orbital

$\Psi^2 \propto$ prob.

Ψ, E depend on 3 quantum numbers (QN)
+ also a 4th QN (spin) for e^-.

(1) Principal QN, $n = 1, 2, 3, \ldots$

-det's size + E of ψ

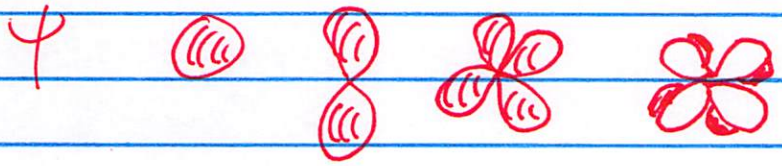
H-atom: $E_n = -R_H\left(\frac{1}{n^2}\right)$

(2) Angular momentum QN, $\ell = 0, \ldots, n-1$

ex: if $n = 3$, $\ell = 0$, or 1, or 2

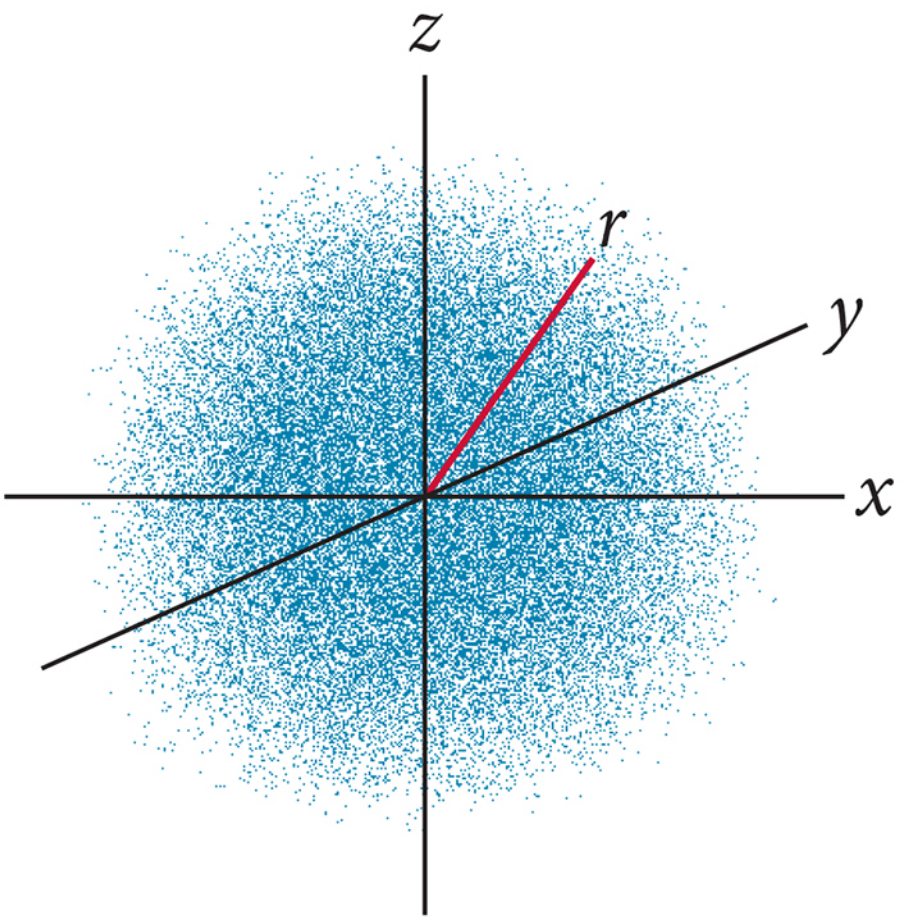
-det's shape of ψ

value of ℓ	0	1	2	3
letter designation	s	p	d	f



Value of l	Letter Designation
$l = 0$	s
$l = 1$	p
$l = 2$	d
$l = 3$	f

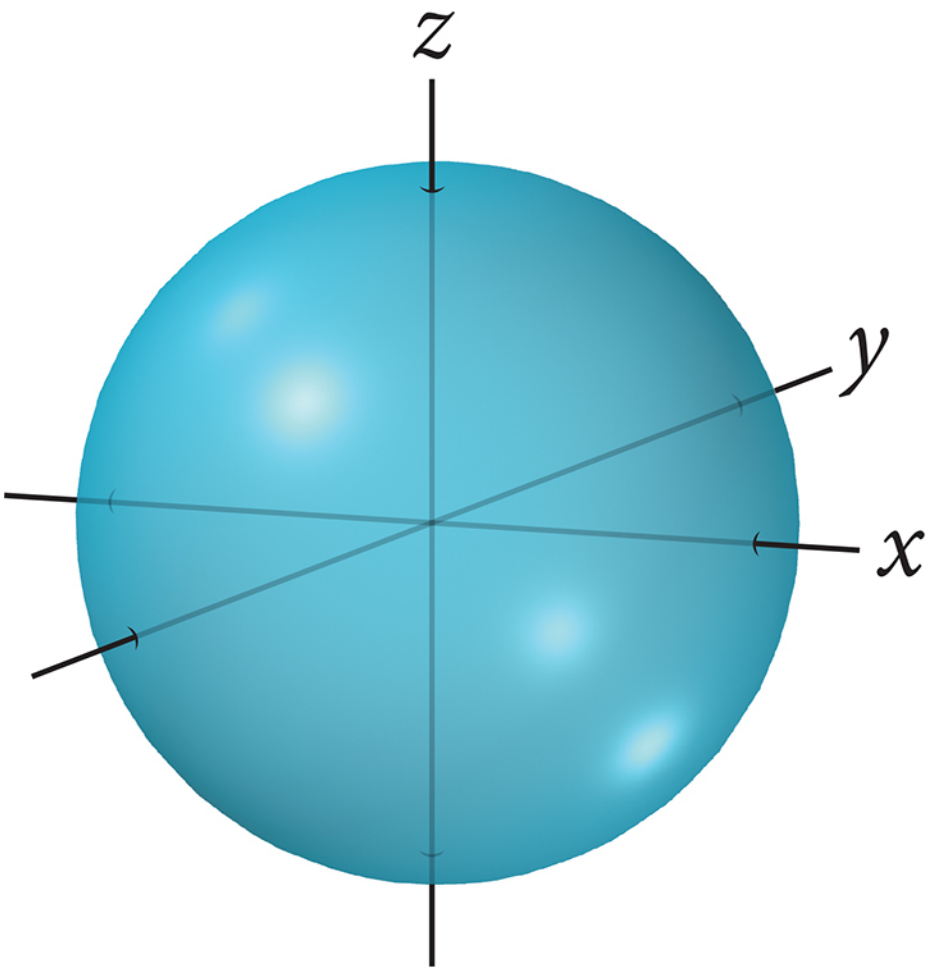
1*s* orbital



(a)

Density of dots proportional to probability density (ψ^2).

1*s* orbital surface



3) Magnetic QN, m_ℓ : $-\ell, \ldots, 0, \ldots, +\ell$

ex: $\ell = 2$, m_ℓ : -2, or -1, or 0, or $+1$, or $+2$

- def's orientation of ψ

ex: $n = 2$, $\ell = 0$, or $+1$

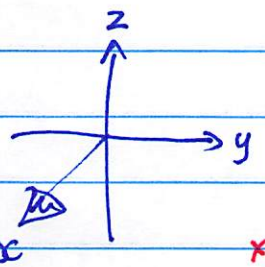
$2s$ (n, ℓ) → $m_\ell = 0$

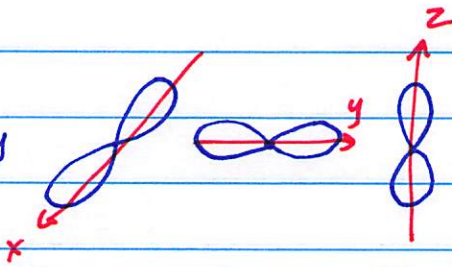
$2p$ (n, ℓ) → $m_\ell = -1, 0, \text{or } +1$

1-orientation

2s-orbital

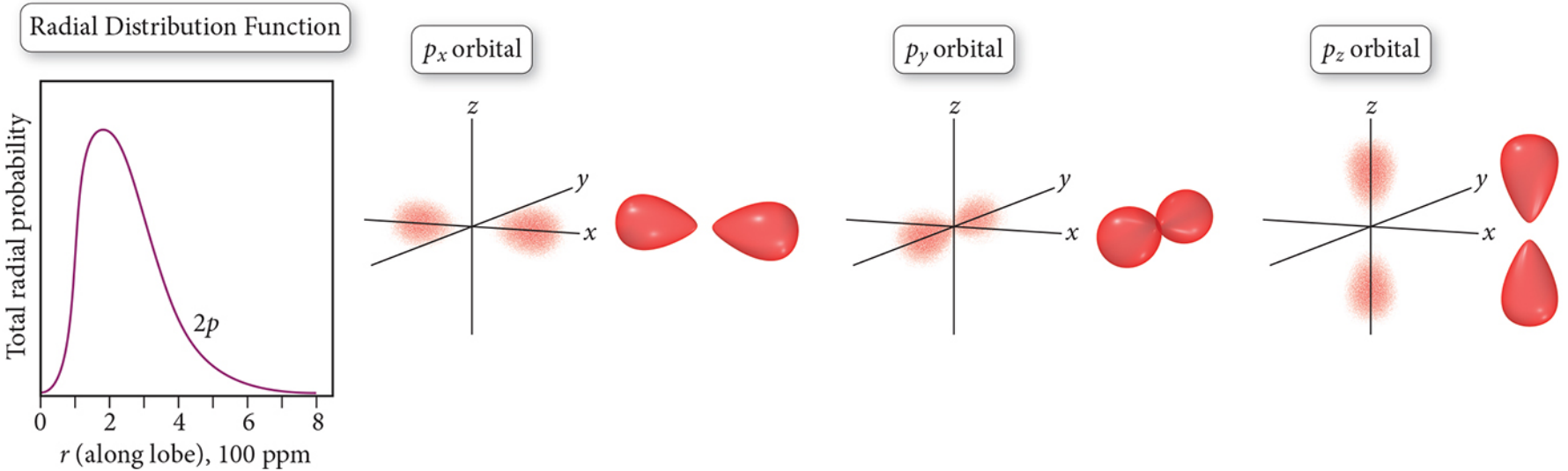
3 orientations





$2p_x$ $2p_y$ $2p_z$

three x 2p orbitals

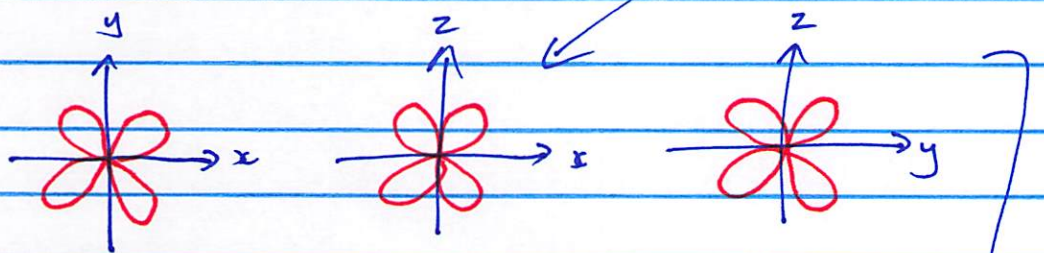


$0, \ldots, n-1$

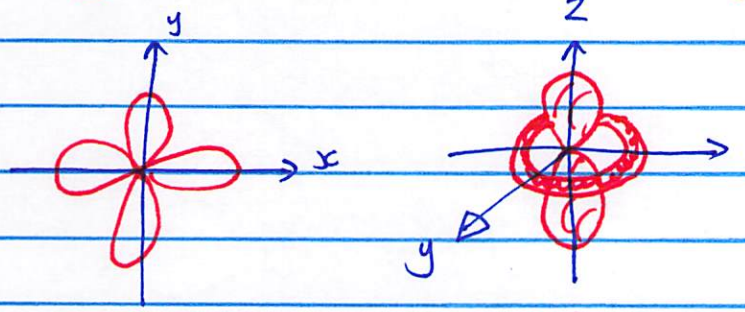
$n=3$, $\ell = 0, 1,$ or 2

$M_\ell = 0$ | $M_\ell = -1, 0, +1$ | $M_\ell = -2, -1, 0, +1,$ or $+2$

1 × 3s orbital | 3 × 3p orbital | 5 × 3d orbitals



$3d_{xy}$ $3d_{xz}$ $3d_{yz}$ } 5 orientations



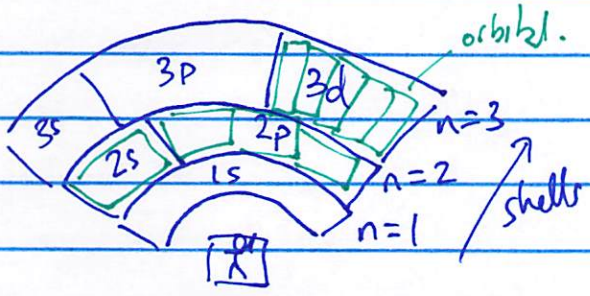
$3d_{x^2-y^2}$ $3d_{z^2}$

value of n: shell, ex: $n=1$, 1st shell

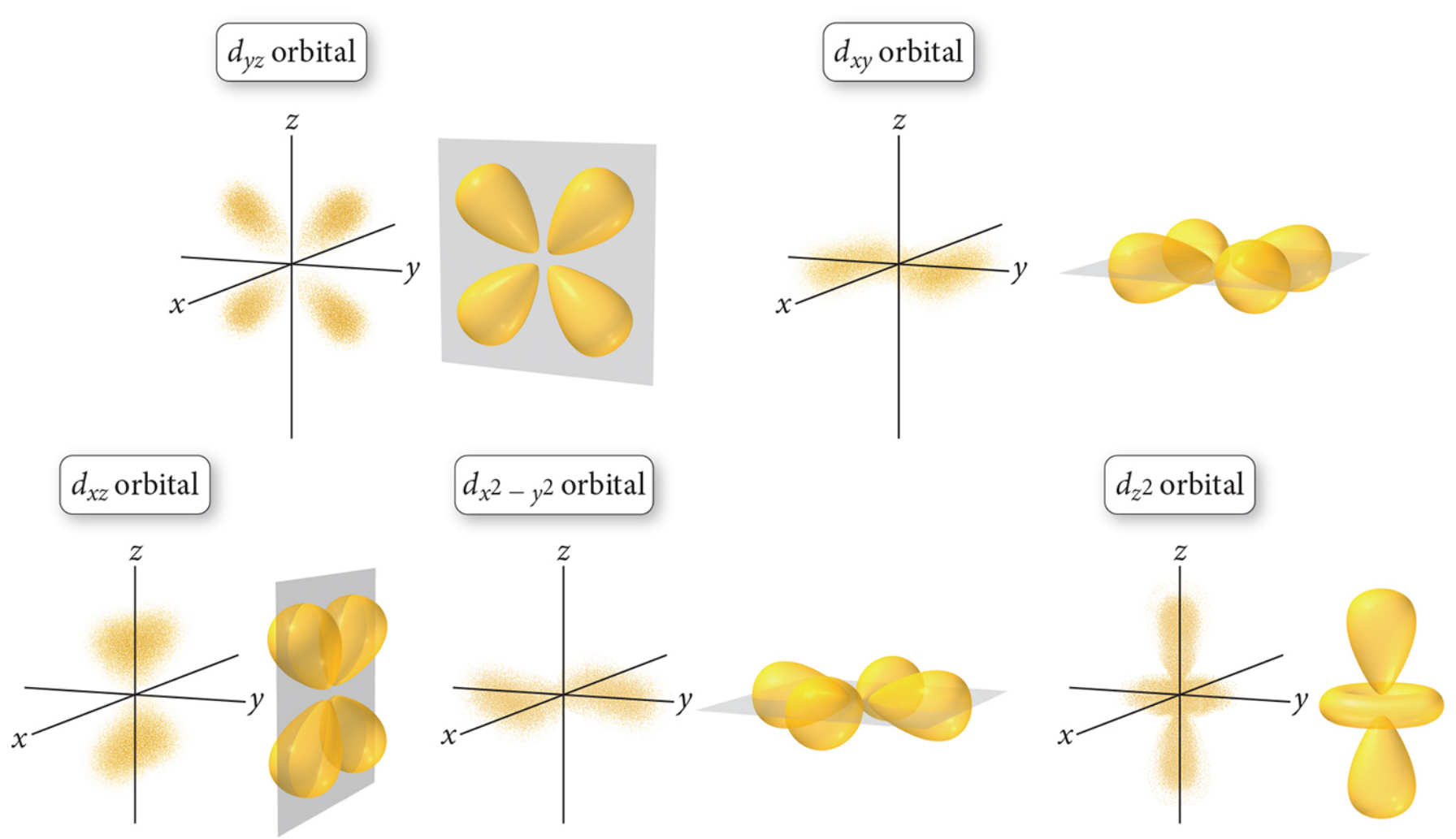
value of n, ℓ: sub-shell, ex: $n=3, \ell=2$ = 3d subshell

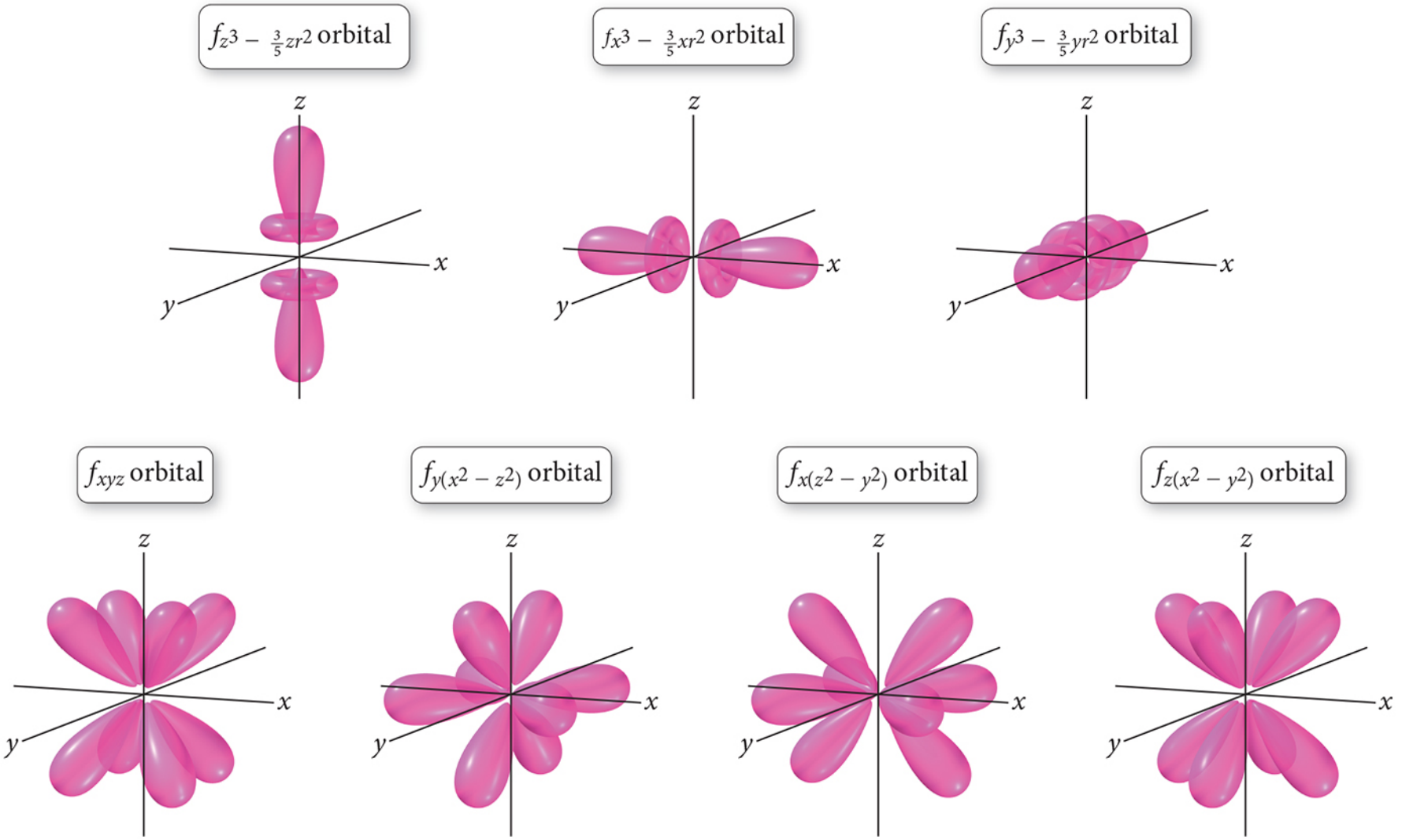
$n=3, \ell=1$ = 3p subshell

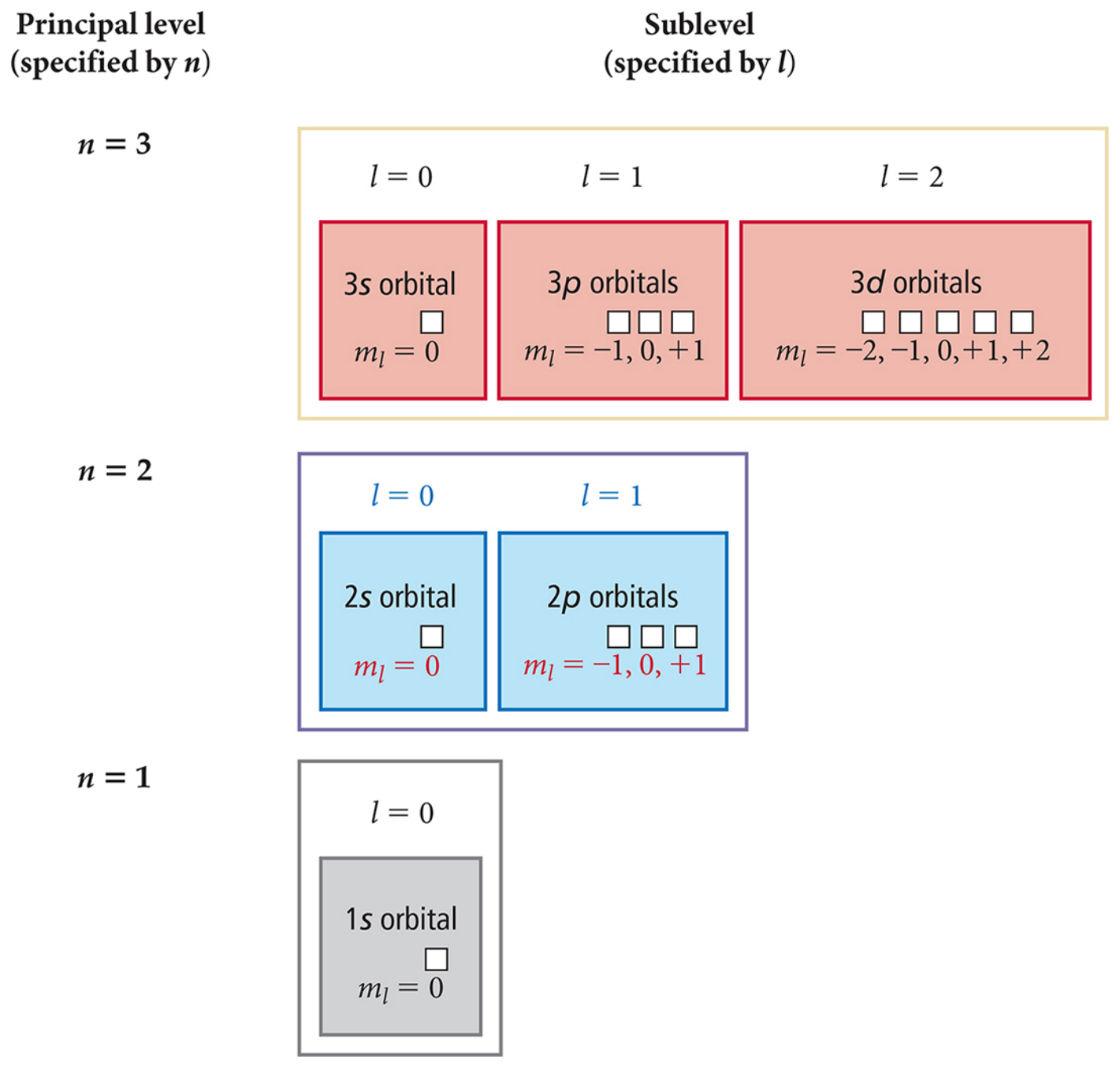
$n=3, \ell=0$ = 3s subshell



value of n, ℓ, m_ℓ : orbital, ψ





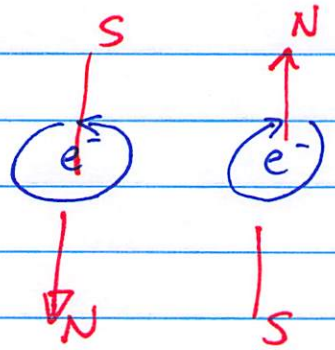


e⁻s also have a 4th QN : spin QN

$$m_s = \pm\frac{1}{2}$$

"as if e^- is spinning"

- counter-clockwise, $m_s = -\frac{1}{2}$
- clock-wise, $m_s = +\frac{1}{2}$



$m_s = -\frac{1}{2}$ "downspin" $m_s = +\frac{1}{2}$ "upspin"

Hints: n-subshells per shell

n^2 orbitals per shell

$2\ell+1$ orbitals per sub-shell.

	subshell
$n=1$, $\ell=0$	1s
$n=2$, $\ell=0,1$	2s, 2p
$n=4$, $\ell=0,1,2,3$	4s, 4p, 4d, 4f