$$\boxed{H\Psi = E\Psi}$$

CLASSICAL	QUANTUM MECH.
PARTICLE	WAVE
NEWTON'S LAW	SCHRÖDINGE EQ.
X, P_x	$\Psi(x, y, z, t)$
DETERMINISTIC	PROBABILISTIC

ALL THE PROPERTIES OF THE QUANTUM "PARTICLE" IS IN $\Psi(x, y, z, t)$.

Probability of finding the particle AT $\underline{r} + dV$ IS GIVEN BY

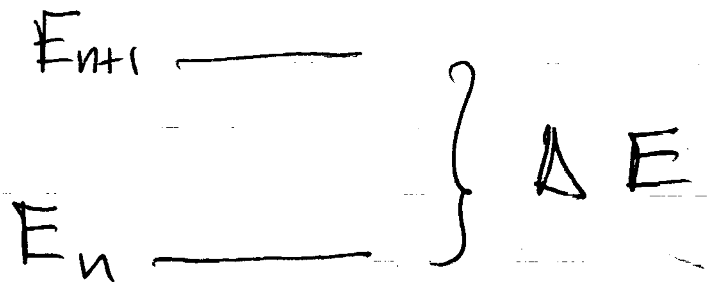
$$P(\underline{r})\,dV = |\Psi(\underline{r})|^2\,dV$$

$$\underline{r} = (x, y, z)$$

CARTESIAN COOR. $dV = dx\,dy\,dz$

SPHERICAL COOR. $dV = r^2 \sin\theta\,dr\,d\theta\,d\varphi$

GIVEN THE ENERGY LEVELS

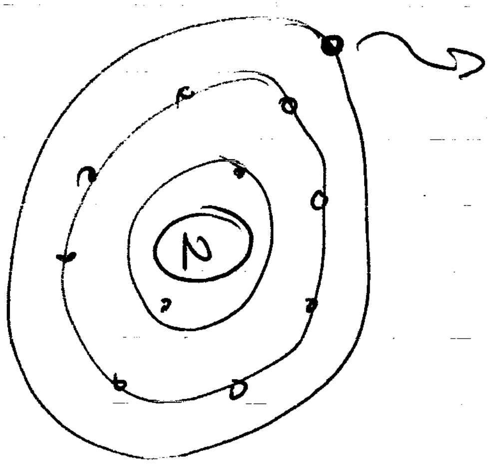


IF $\Delta E \gg kT \Longrightarrow$ QM

IF $\Delta E \ll kT \Longrightarrow$ CM

$kT \sim$ ENERGY EXCHANGE DUE TO COLLISIONS

Multi Electron ATOMS



e^- DOES NOT SEE THE FULL NUCLEAR CHARGE DUE TO THE OTHER ELECTRONS

$$Z \longrightarrow Z_{eff}(r)$$

$Z \downarrow$ HYDROGEN ATOM

ATOMS – Still preserve the SPHERICAL SYMMETRY!

$$\Phi_{n,\ell m}(r,\theta,\varphi) = F_{n,\ell,m}(r)\, G_{\ell m}(\theta,\varphi)$$

$$G_{\ell m} \longrightarrow Y_{\ell}^{m}(\theta,\varphi)$$

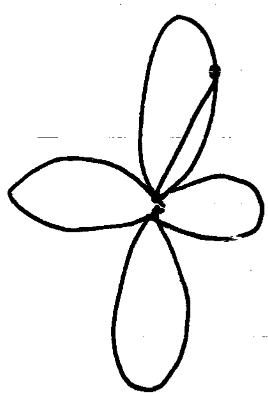
ORBITALS

POLAR REPRESENTATION

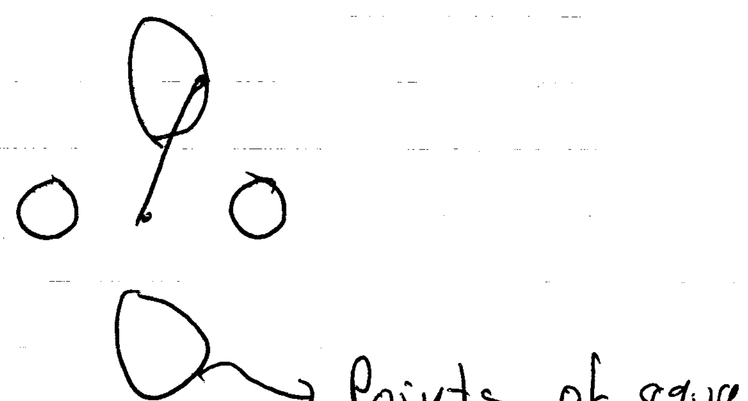
UNIQUE !

INFINITE
CONTOUR (OF EQUAL PROBABILITY)

REPRESENTATION.



d_{z^2}



d_{z^2}

Polar

$(|d_{z^2}|, \theta, \varphi)$ (r, θ, φ)

ORBITAL

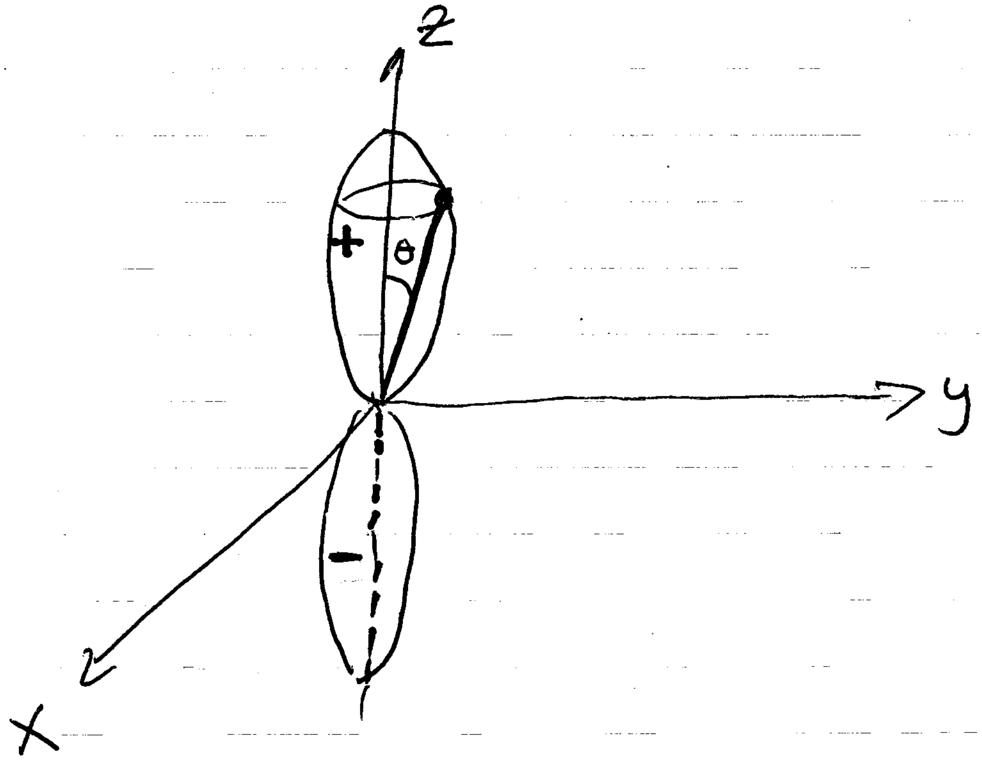
$$Y_l^m \in \mathbb{C}$$

$$\left.\begin{matrix} s \\ p \\ d \end{matrix} \text{ ORBITALS} \right\} \in \mathbb{R}$$

$$\boxed{P_z = \sqrt{\frac{3}{4\pi}} \cos\theta}$$

P_z (part) WAVE FUNCTION

$|P_z|^2 \sim$ Probability OF FINDING THE ELECTRON



$\varphi = \frac{\pi}{2}$

DISTANCE FROM THE ORIGIN $= \sqrt{|P_z|^2}$

$\sim$ PROBABITY

Plotting $(|P_z|, \theta, \varphi)$

Probability in DIRECTION (θ, φ)

NO RADIAL PART!

Solve the multi-electron

SE $\Longrightarrow$ $E_{n\ell m}$

$\Phi_{n\ell m}$

$\downarrow$

$\boxed{\text{SPIN}}$

$\downarrow$

HUND'S RULE