Addition of angular momenta

Example used

$\Rightarrow$ hydrogen atom [orbiting S-orbital $1s^1$] ($l=0$)

What's inside the hydrogen atom
1) electron
2) proton
3) neutron

(electron and proton) $\Rightarrow$ fermions with spin $1/2$

$\Rightarrow$ hydrogen atom :- * S-orbital
* $l=0$
* no orbital angular momentum

$\Rightarrow$ Add the spin value for electron and proton to get the angular momentum for hydrogen atom

$\Rightarrow$ $S = S_1 + S_2$

[Total spin] = electron spin + proton spin [or nuclear spin]

Total spin $\rightarrow$ S_x, S_y, S_z

[you can go for S_x or S_y as each spin axis condemns one individual spin component]

S_z $\rightarrow$ $S_z \chi_1 \chi_2$ $\Rightarrow$ proton spin state

χ_1 $\rightarrow$ electron spin state

$\Rightarrow$ $S_z \chi_1 \chi_2 = (S_z^{(1)} + S_z^{(2)}) \chi_1 \chi_2$

$= (S_z^{(1)} \chi_1) \chi_2 + \chi_1 (S_z^{(2)} \chi_2)$

$S_z^{(1)}$ [first spin state]

$S_z^{(2)}$ [second spin state]

Note:- while you can write

$(S_z^{(1)} \chi_1) \chi_2 + (S_z^{(2)} \chi_1 \} \chi_2)$

its best to keep like states on one side while the unlike states on the other side

$\Rightarrow$ $S_z = m\hbar$

$(S_z)\chi = (m\hbar)\chi$

$S_{x/y/z} = (m\hbar)$ [eigen value]

$\Rightarrow$ $S_z \chi_1 \chi_2 = m_1 \hbar \chi_1 \chi_2 + m_2 \hbar \chi_1 \chi_2$

$S_z \chi_1 \chi_2 = \hbar (\chi_1 \chi_2) [m_1 + m_2]$

$\Rightarrow$ $m = m_1 + m_2$