

$\therefore \psi_1$ and ψ_2 are orthogonal.

Similarly it can be shown that

$$\int \psi_2^* \psi_3 d\tau = 0, \quad \int \psi_3^* \psi_4 d\tau = 0, \quad \int \psi_1^* \psi_3 d\tau = 0$$

$$\int \psi_1^* \psi_4 d\tau = 0, \quad \int \psi_2^* \psi_4 d\tau = 0$$

$\therefore \psi_1, \psi_2, \psi_3, \psi_4$ form an orthonormal set.

$$(9) \quad \psi_{sp^2(z)} = \frac{1}{\sqrt{3}} 2s + \sqrt{\frac{2}{3}} 2p_z$$

$$\int \psi_{sp^2(z)}^* \psi_{sp^2(z)} d\tau = \int \left(\frac{1}{\sqrt{3}} 2s^* + \sqrt{\frac{2}{3}} 2p_z^* \right) \left(\frac{1}{\sqrt{3}} 2s + \sqrt{\frac{2}{3}} 2p_z \right) d\tau$$

$$= \frac{1}{3} \int 2s^* 2s d\tau + \frac{1}{\sqrt{3}} \frac{\sqrt{2}}{\sqrt{3}} \int 2s^* 2p_z d\tau + \sqrt{\frac{2}{3}} \frac{1}{\sqrt{3}} \int 2p_z^* 2s d\tau$$

$$+ \frac{2}{3} \int 2p_z^* 2p_z d\tau$$

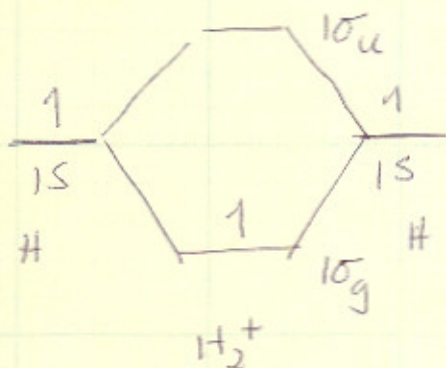
$$= \frac{1}{3} (1) + \frac{\sqrt{2}}{3} (0) + \frac{\sqrt{2}}{3} (0) + \frac{2}{3} (1)$$

$$= \frac{1}{3} + \frac{2}{3} = 1$$

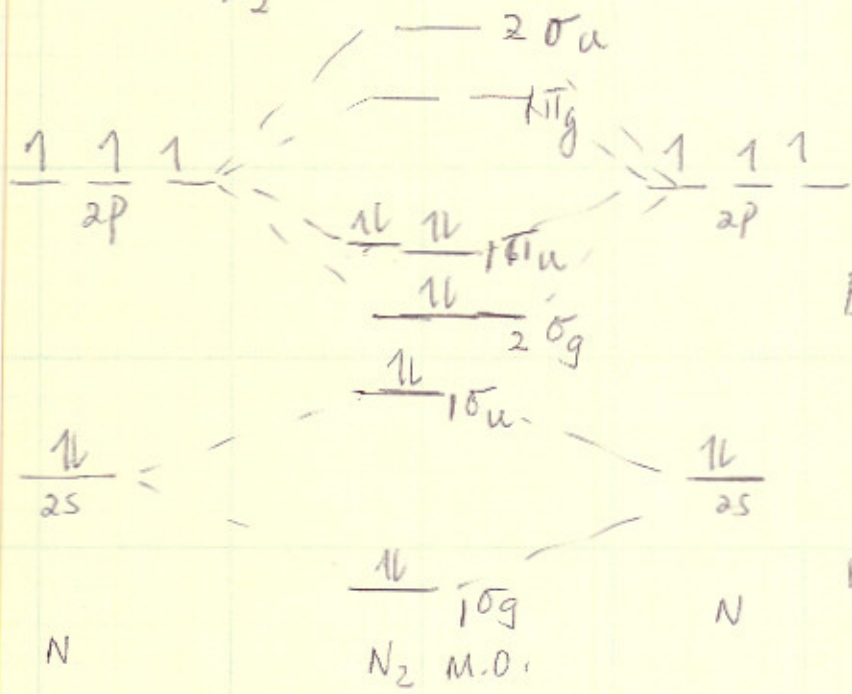
$\therefore \psi_{sp^2(z)}$ is normalized

since $2s$ and $2p_z$ are orthogonal to each other and $2s$ and $2p_z$ are normalized atomic orbitals

②

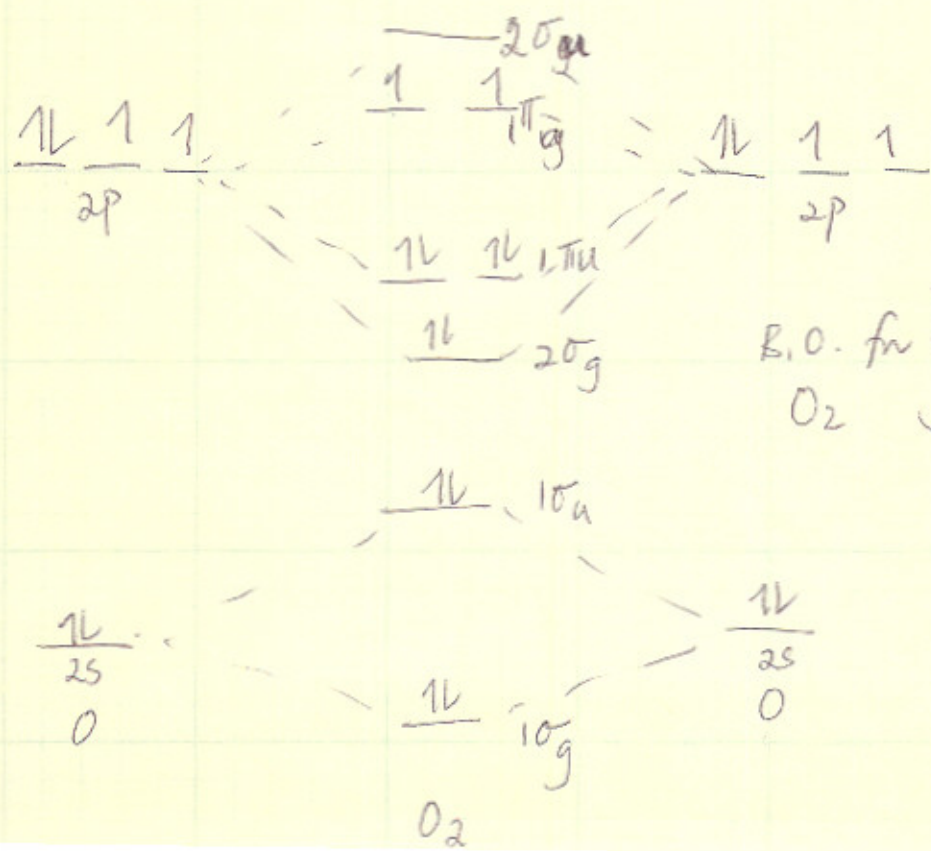


$$B.O. = \frac{1}{2} (1 - 0) = \underline{\underline{\frac{1}{2}}}$$



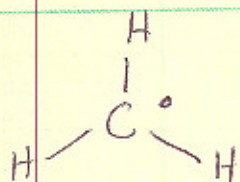
$$B.O. \text{ for } N_2 = \frac{1}{2} (8 - 2) = \underline{\underline{3}}$$

$$B.O. \text{ for } N_2^+ = \frac{1}{2} (7 - 2) = \underline{\underline{2.5}}$$



$$B.O. \text{ for } O_2 = \frac{1}{2} (8 - 4) = \underline{\underline{2}}$$

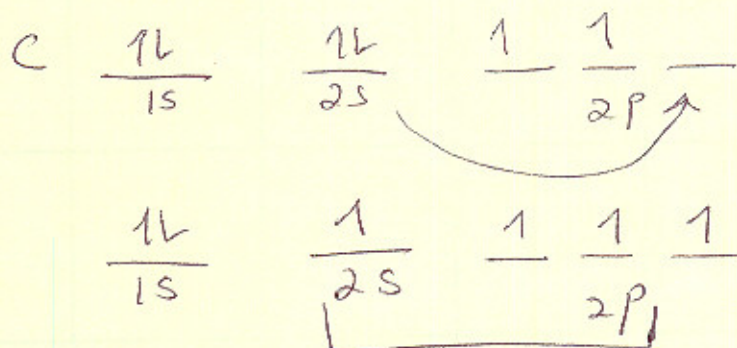
(12)



Planar radical

D_{3h} point group.

C is sp^2 hybridized.



sp^2 hybridization results in three hybrid orbitals at 120° to each other all on one plane.

The 1s orbitals of the 3 H atoms overlap with these sp^2 hybrid orbitals of C.

There is one unpaired electron in the unhybridized p orbital which is perpendicular to the plane of the molecule.

The plane of the molecule is the xy plane. \therefore The unpaired e^- is in the $2p_z$ orbital.

