Mulliken Symbols for Various irreducible representations of a point group.

The Symbols for irreducible representation were given by Mulliken, hence they are known as Mulliken Symbols.

These symbols can be find by the following

Rules.

(I) All unidimensional repentations are represented either by A or B, two dimensional representations are represented by E, and three dimensional representations are represented by T.

(ii) One dimensional representations which are symmetrical with respect to the Principal axis (i.e character of C_n operation is +1) are designated as A while those antisymmetric in this respect (i.e Character of C_n operation −1) are designated as B.

(iii) Those irreducible representations which are symmetrical with respect to the subsidiary axis, or in its absence to σ_v plane, subscript 1, (i.e A_1, B_1 E_1, T_1) is used and for antisymmetric subscript 2 (i.e B_2, A_2 E_2, T_2) is used.

(iv) Primes and double Primes are attached to all A, B, E or T to indicate the symmetric and antisymmetric character, with respect to σ_h, A' or E' appears for σ_h having +1 and A'' or E'' appears for the σ_h having −1.

(v) Subscript g and u are used to indicate the symmetric and antisymmetric character with respect to the inversion. If the point group has no centre of symmetry, g and u are not used. Term g stands for gerade (Centro Symmetric) and u stands for ungerade (Non-Centro Symmetric)

Construction of character table for C_{2v} Point group.

(i) There are total number of four Symmetry Operations in C_{2v} point group i.e. E, $C_{2(z)}$, σ_{xy}, σ_{yz}

(ii) These operations belong to four different Classes hence there are four ~~irredu~~ irreducible representations let they be Γ_1, Γ_2, Γ_3, Γ_4

(iii) It also requires that the sum of the square of the dimensions of these representation equals h (order of the group) i.e 4.

Hence each representation must be unidimensional

So that $1^2 + 1^2 + 1^2 + 1^2 = 4$

Because the character of identity operation is equal to the dimension of the representation and hence E must be equal to one (1) in all of them.

	E	$C_2(z)$	σ_{xz}	σ_{yz}
Γ_1	1			
Γ_2	1			
Γ_3	1			
Γ_4	1			

The sum of the squares of the character of an irreducible representation must be equal to 4 as

$$\sum_R [\chi_i(R)]^2 = 4$$

i.e $1^2 + 1^2 + 1^2 + 1^2 = 4$

	E	$C_2(z)$	σ_{xz}	σ_{yz}
Γ_1	1	1	1	1
Γ_2	1			
Γ_3	1			
Γ_4	1			

(iv) The sum of the squares of the characters of other irreducible representations must be equal to four and the character must also be orthogonal. Hence, character must,

Hence character must include two +1 and two −1.

Therefore we will have,

	E	$C_2(z)$	σ_{xz}	σ_{yz}
Γ	1	1	1	1
Γ	1	−1	−1	1
Γ	1	−1	1	−1
Γ	1	1	−1	−1

All these representations are also orthogonal to one another taking Γ_2, Γ_3 we have

$(1)(1) + (-1)(-1) + (-1)(1) + (1)(-1) = 0$