

Homework Set 6

Trivially, there are two character classes, and there are two irreps, each of which is one-dimensional. It isn't that tough to find the other irreps for this group, as illustrated at right.

i	E	i
Γ^+	1	1
Γ^-	1	-1

The classes of the bigger group are the classes of D_4 times the classes of i , so

there are ten of them (this is getting big and messy). The character table looks like the old one, but then sort of multiplied times a copy of the character table for i , so we get

\mathcal{D}_{4h}	E	G	A,B	C,D	F,H	i	iG	iA,iB	iC,iD	iE,iF
Γ^{1+}	1	1	1	1	1	1	1	1	1	1
Γ^{2+}	1	1	1	-1	-1	1	1	1	-1	-1
Γ^{3+}	1	1	-1	1	-1	1	1	-1	1	-1
Γ^{4+}	1	1	-1	-1	1	1	1	-1	-1	1
Γ^{5+}	2	-2	0	0	0	2	-2	0	0	0
Γ^{1-}	1	1	1	1	1	-1	-1	-1	-1	-1
Γ^{2-}	1	1	1	-1	-1	-1	-1	-1	1	1
Γ^{3-}	1	1	-1	1	-1	-1	-1	1	-1	1
Γ^{4-}	1	1	-1	-1	1	-1	-1	1	1	-1
Γ^{5-}	2	-2	0	0	0	-2	2	0	0	0

four copies of it, but with the lower-right one multiplied by -1.

I don't really like the names for these elements. If I were naming these columns, they would be named $E, C_2, 2\sigma_v, 2\sigma'_v, 2C_4, i, \sigma_h, 2C'_2, 2C''_2, 2S_4$ in that order, where the initial number means the number of elements in that class, C_2 and C_4 represent rotations by 180 and 90 degrees respectively ($360/2$ and $360/4$) about the principal (z) axis, σ_h means reflection across the horizontal (xy) plane, σ_v and σ'_v represent reflections across different types of vertical planes, C'_2 and C''_2 represent 180 degree rotations around axes perpendicular to the z -axis, and S_4 represents 90 degree rotation about the z -axis combined with a reflection across the horizontal plane ($S_4 \equiv \sigma_h C_4$).