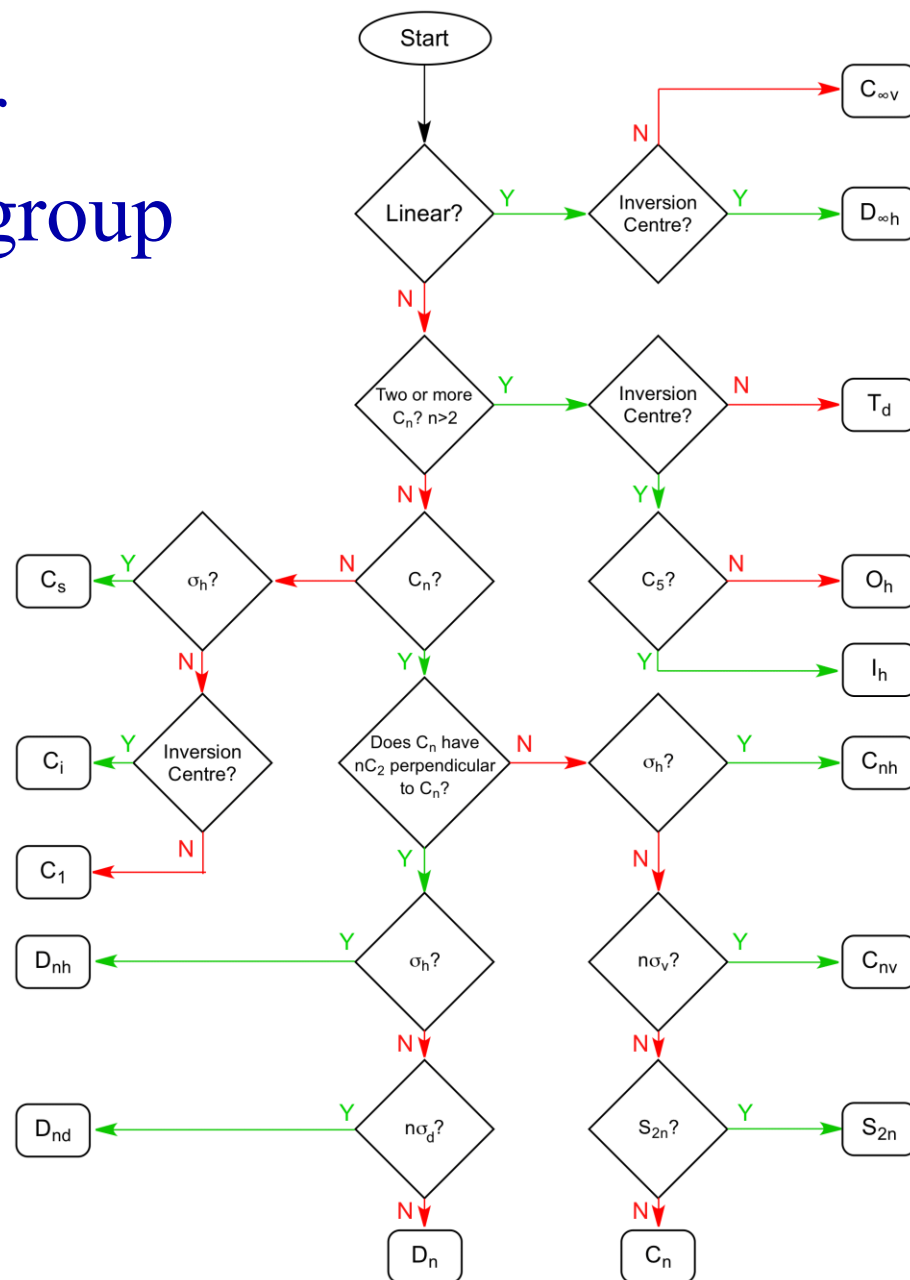
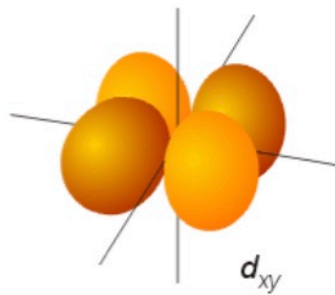
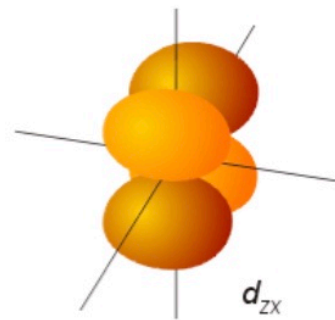
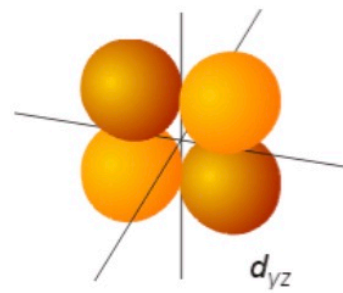
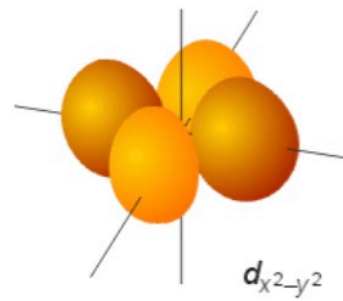
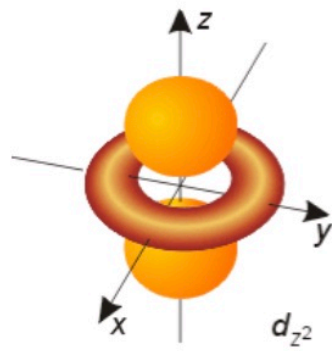


A flow chart for determining the point group of a molecule



By SYMMETRYNAIK -
 File:Point_group_determination_flowchart.png, CC BY-SA 4.0,
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Shape of the d orbitals



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1. The Groups C_1 , C_s , C_i

C_1 (1)	E
A	1

$C_s=C_h$ (m)	E	σ_h		
A'	1	1	x, y, R_z	x^2, y^2, z^2, xy
A''	1	-1	z, R_x, R_y	yz, xz

$C_i = S_2$ ($\bar{1}$)	E	i		
A_g	1	1	R_x, R_y, R_z	$x^2, y^2, z^2,$ xy, xz, yz
A_u	1	-1	x, y, z	

2. The Groups C_n ($n = 2, 3, \dots, 8$)

C_2 (2)	E	C_2		
A	1	1	z, R_z	x^2, y^2, z^2, xy
B	1	-1	x, y, R_x, R_y	yz, xz

C_3 (3)	E	C_3	C_3^2		$\varepsilon = \exp(2\pi i/3)$
A	1	1	1	z, R_z	$x^2 + y^2, z^2$
E	$\begin{Bmatrix} 1 & \varepsilon \\ 1 & \varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon & \varepsilon^* \\ \varepsilon^* & \varepsilon \end{Bmatrix}$		$(x, y)(R_x, R_y)$	$(x^2 - y^2, 2xy)(yz, xz)$

C_4 (4)	E	C_4	C_2	C_4^3		
A	1	1	1	1	z, R_z	$x^2 + y^2, z^2$
B	1	-1	1	-1		$x^2 - y^2, 2xy$
E	$\begin{Bmatrix} 1 & i \\ 1 & -i \end{Bmatrix}$	$\begin{Bmatrix} i & -i \\ -i & i \end{Bmatrix}$	$\begin{Bmatrix} -1 & -1 \\ -1 & 1 \end{Bmatrix}$		$(x, y)(R_x, R_y)$	(yz, xz)

C_5	E	C_5	C_5^2	C_5^3	C_5^4		$\varepsilon = \exp(2\pi i/5)$
A	1	1	1	1	1	z, R_z	$x^2 + y^2, z^2$
E ₁	$\begin{Bmatrix} 1 & \varepsilon \\ 1 & \varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon & \varepsilon^2 \\ \varepsilon^* & \varepsilon^{*2} \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon^2 & \varepsilon^{*2} \\ \varepsilon^{*2} & \varepsilon^2 \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon^{*2} & \varepsilon^* \\ \varepsilon^2 & \varepsilon \end{Bmatrix}$		$(x, y)(R_x, R_y)$	(yz, xz)
E ₂	$\begin{Bmatrix} 1 & \varepsilon^2 \\ 1 & \varepsilon^{*2} \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon^2 & \varepsilon^* \\ \varepsilon^{*2} & \varepsilon \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon^* & \varepsilon \\ \varepsilon & \varepsilon^{*2} \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon & \varepsilon^{*2} \\ \varepsilon^{*2} & \varepsilon^2 \end{Bmatrix}$			$(x^2 - y^2, 2xy)$

C_6 (6)	E	C_6	C_3	C_2	C_3^2	C_6^5		$\varepsilon = \exp(2\pi i/6)$
A	1	1	1	1	1	1	z, R_z	$x^2 + y^2, z^2$
B	1	-1	1	-1	1	-1		
E ₁	$\begin{Bmatrix} 1 & \varepsilon \\ 1 & \varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon & -\varepsilon^* \\ \varepsilon^* & -\varepsilon \end{Bmatrix}$	$\begin{Bmatrix} -\varepsilon^* & -1 \\ -\varepsilon & -1 \end{Bmatrix}$	$\begin{Bmatrix} -1 & -\varepsilon \\ -1 & -\varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon^* & \varepsilon \\ \varepsilon & \varepsilon^* \end{Bmatrix}$		(x, y) (R_x, R_y)	(xy, yz)
E ₂	$\begin{Bmatrix} 1 & -\varepsilon^* \\ 1 & -\varepsilon \end{Bmatrix}$	$\begin{Bmatrix} -\varepsilon^* & -\varepsilon \\ -\varepsilon & -\varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} 1 & -\varepsilon^* \\ 1 & -\varepsilon \end{Bmatrix}$	$\begin{Bmatrix} -\varepsilon^* & -\varepsilon \\ -\varepsilon & -\varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} -\varepsilon & -\varepsilon^* \\ -\varepsilon^* & -\varepsilon \end{Bmatrix}$			$(x^2 - y^2, 2xy)$

2. The Groups C_n ($n = 2, 3, \dots, 8$) (cont..)

C_7	E	C_7	C_7^2	C_7^3	C_7^4	C_7^5	C_7^6		$\varepsilon = \exp(2\pi i/7)$
A	1	1	1	1	1	1	1	z, R_z	$x^2 + y^2, z^2$
E_1	$\begin{Bmatrix} 1 & \varepsilon & \varepsilon^2 & \varepsilon^3 & \varepsilon^{*3} & \varepsilon^{*2} & \varepsilon^{*} \\ 1 & \varepsilon^{*} & \varepsilon^{*2} & \varepsilon^{*3} & \varepsilon^3 & \varepsilon^2 & \varepsilon \end{Bmatrix}$							(x, y) (R_x, R_y)	(xz, yz)
E_2	$\begin{Bmatrix} 1 & \varepsilon^2 & \varepsilon^{*3} & \varepsilon^{*} & \varepsilon & \varepsilon^3 & \varepsilon^{*2} \\ 1 & \varepsilon^{*2} & \varepsilon^3 & \varepsilon & \varepsilon^{*} & \varepsilon^{*3} & \varepsilon^2 \end{Bmatrix}$								$(x^2 - y^2, 2xy)$
E_3	$\begin{Bmatrix} 1 & \varepsilon^3 & \varepsilon^{*} & \varepsilon^2 & \varepsilon^{*2} & \varepsilon & \varepsilon^{*3} \\ 1 & \varepsilon^{*3} & \varepsilon & \varepsilon^{*2} & \varepsilon^2 & \varepsilon^{*} & \varepsilon^3 \end{Bmatrix}$								

C_8	E	C_8	C_4	C_2	C_4^3	C_8^3	C_8^5	C_8^7		$\varepsilon = \exp(2\pi i/8)$
A	1	1	1	1	1	1	1	1	z, R_z	$x^2 + y^2, z^2$
B	1	-1	1	1	1	-1	-1	-1		
E_1	$\begin{Bmatrix} 1 & \varepsilon & i & -1 & -i & -\varepsilon^{*} & -\varepsilon & \varepsilon^{*} \\ 1 & \varepsilon^{*} & -i & -1 & i & -\varepsilon & -\varepsilon^{*} & \varepsilon \end{Bmatrix}$								(x, y) (R_x, R_y)	(xz, yz)
E_2	$\begin{Bmatrix} 1 & i & -1 & 1 & -1 & -i & i & -i \\ 1 & -i & -1 & 1 & -1 & i & -i & i \end{Bmatrix}$									$(x^2 - y^2, 2xy)$
E_3	$\begin{Bmatrix} 1 & -\varepsilon & i & -1 & -i & \varepsilon^{*} & \varepsilon & -\varepsilon^{*} \\ 1 & -\varepsilon^{*} & -i & -1 & i & \varepsilon & \varepsilon^{*} & -\varepsilon \end{Bmatrix}$									

3. The Groups D_n ($n = 2, 3, 4, 5, 6$)

D_2 (222)	E	$C_2(z)$	$C_2(y)$	$C_2(x)$		
A	1	1	1	1		x^2, y^2, z^2
B ₁	1	1	-1	-1	z, R_z	xy
B ₂	1	-1	1	-1	y, R_y	xz
B ₃	1	-1	-1	1	x, R_x	yz

D_3 (32)	E	$2C_3$	$3C_2$			
A ₁	1	1	1			$x^2 + y^2, z^2$
A ₂	1	1	-1	z, R_z		
E	2	-1	0	$(x, y)(R_x, R_y)$	$(x^2 - y^2, 2xy)$	(xz, yz)

D_4 (422)	E	$2C_4$	$C_2 (= C_4^2)$	$2C_2'$	$2C_2''$		
A ₁	1	1	1	1	1		$x^2 + y^2, z^2$
A ₂	1	1	1	-1	-1	z, R_z	
B ₁	1	-1	1	1	-1		$x^2 - y^2$
B ₂	1	-1	1	-1	1		xy
E	2	0	-2	0	0	$(x, y)(R_x, R_y)$	(xz, yz)

D_5	E	$2C_5$	$2C_5^2$	$5C_2$			
A ₁	1	1	1	1			$x^2 + y^2, z^2$
A ₂	1	1	1	-1	z, R_z		
E ₁	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	$(x, y)(R_x, R_y)$	(xz, yz)	
E ₂	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0			$(x^2 - y^2, 2xy)$

D_6 (622)	E	$2C_6$	$2C_3$	C_2	$3C_2'$	$3C_2''$		
A ₁	1	1	1	1	1	1		$x^2 + y^2, z^2$
A ₂	1	1	1	1	-1	-1	z, R_z	
B ₁	1	-1	1	-1	1	-1		
B ₂	1	-1	1	-1	-1	1		
E ₁	2	1	-1	-2	0	0	$(x, y)(R_x, R_y)$	(xz, yz)
E ₂	2	-1	-1	2	0	0		$(x^2 - y^2, 2xy)$

4. The Groups C_{nv} ($n = 2, 3, 4, 5, 6$)

C_{2v} ($2mm$)	E	C_2	$\sigma_v(xz)$	$\sigma'_v(yz)$		
A_1	1	1	1	1	z	x^2, y^2, z^2
A_2	1	1	-1	-1	R_z	xy
B_1	1	-1	1	-1	x, R_y	xz
B_2	1	-1	-1	1	y, R_x	yz

C_{3v} ($3m$)	E	$2C_3$	$3\sigma_v$			
A_1	1	1	1	z	$x^2 + y^2, z^2$	
A_2	1	1	-1	R_z		
E	2	-1	0	$(x, y)(R_x, R_y)$	$(x^2 - y^2, 2xy)(xz, yz)$	

C_{4v} ($4mm$)	E	$2C_4$	C_2	$2\sigma_v$	$2\sigma_d$		
A_1	1	1	1	1	1	z	$x^2 + y^2, z^2$
A_2	1	1	1	-1	-1	R_z	
B_1	1	-1	1	1	-1		$x^2 - y^2$
B_2	1	-1	1	-1	1		xy
E	2	0	-2	0	0	$(x, y)(R_x, R_y)$	(xz, yz)

C_{5v}	E	$2C_5$	$2C_5^2$	$5\sigma_v$		
A_1	1	1	1	1	z	$x^2 + y^2, z^2$
A_2	1	1	1	-1	R_z	
E_1	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	$(x, y)(R_x, R_y)$	(xz, yz)
E_2	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0		$(x^2 - y^2, 2xy)$

C_{6v} ($6mm$)	E	$2C_6$	$2C_3$	C_2	$3\sigma_v$	$3\sigma_d$		
A_1	1	1	1	1	1	1	z	$x^2 + y^2, z^2$
A_2	1	1	1	1	-1	-1	R_z	
B_1	1	-1	1	-1	1	-1		
B_2	1	-1	1	-1	-1	1		
E_1	2	1	-1	-2	0	0	$(x, y)(R_x, R_y)$	(xz, yz)
E_2	2	-1	-1	2	0	0		$(x^2 - y^2, 2xy)$

5. The Groups C_{nh} ($n = 2, 3, 4, 5, 6$)

C_{2h} ($2/m$)	E	C_2	I	σ_h		
A_g	1	1	1	1	R_z	x^2, y^2, z^2, xy
B_g	1	-1	1	-1	R_x, R_y	xz, yz
A_u	1	1	-1	-1	z	
B_u	1	-1	-1	1	x, y	

C_{3h} ($\bar{6}$)	E	C_3	C_3^2	σ_h	S_3	S_3^5		$\varepsilon = \exp(2\pi i/3)$
A'	1	1	1	1	1	1	R_z	$x^2 + y^2, z^2$
E'	$\begin{Bmatrix} 1 & \varepsilon & \varepsilon^* \\ 1 & \varepsilon^* & \varepsilon \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon & \varepsilon^* \\ \varepsilon^* & \varepsilon \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon^* & \varepsilon \\ \varepsilon & \varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} 1 & 1 \\ 1 & 1 \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon & \varepsilon^* \\ \varepsilon^* & \varepsilon \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon^* & \varepsilon \\ \varepsilon & \varepsilon^* \end{Bmatrix}$	(x, y)	$(x^2 - y^2, 2xy)$
A''	1	1	1	-1	-1	-1	z	
E''	$\begin{Bmatrix} 1 & \varepsilon & \varepsilon^* \\ 1 & \varepsilon^* & \varepsilon \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon & \varepsilon^* \\ \varepsilon^* & \varepsilon \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon^* & \varepsilon \\ \varepsilon & \varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} -1 & -1 \\ -1 & -1 \end{Bmatrix}$	$\begin{Bmatrix} -\varepsilon & -\varepsilon^* \\ -\varepsilon^* & -\varepsilon \end{Bmatrix}$	$\begin{Bmatrix} -\varepsilon^* & -\varepsilon \\ -\varepsilon & -\varepsilon^* \end{Bmatrix}$	(R_x, R_y)	(xz, yz)

C_{4h} ($4/m$)	E	C_4	C_2	C_4^3	i	S_4^3	σ_h	S_4		
A_g	1	1	1	1	1	1	1	1	R_z	$x^2 + y^2, z^2$
B_g	1	-1	1	-1	1	-1	1	-1		$(x^2 - y^2, 2xy)$
E_g	$\begin{Bmatrix} 1 & i & -1 & -i \\ 1 & -i & -1 & i \end{Bmatrix}$	$\begin{Bmatrix} i & -i \\ -i & i \end{Bmatrix}$	$\begin{Bmatrix} -1 & 1 \\ 1 & -1 \end{Bmatrix}$	$\begin{Bmatrix} -i & i \\ i & -i \end{Bmatrix}$	$\begin{Bmatrix} 1 & 1 \\ 1 & 1 \end{Bmatrix}$	$\begin{Bmatrix} i & -i \\ -i & i \end{Bmatrix}$	$\begin{Bmatrix} -1 & 1 \\ 1 & -1 \end{Bmatrix}$	$\begin{Bmatrix} -i & i \\ i & -i \end{Bmatrix}$	(R_x, R_y)	(xz, yz)
A_u	1	1	1	1	-1	-1	-1	-1	z	
B_u	1	-1	1	-1	-1	1	-1	1		
E_u	$\begin{Bmatrix} 1 & i & -1 & -i \\ 1 & -i & -1 & i \end{Bmatrix}$	$\begin{Bmatrix} i & -i \\ -i & i \end{Bmatrix}$	$\begin{Bmatrix} -1 & 1 \\ 1 & -1 \end{Bmatrix}$	$\begin{Bmatrix} -i & i \\ i & -i \end{Bmatrix}$	$\begin{Bmatrix} -1 & 1 \\ 1 & -1 \end{Bmatrix}$	$\begin{Bmatrix} -i & i \\ i & -i \end{Bmatrix}$	$\begin{Bmatrix} 1 & 1 \\ 1 & 1 \end{Bmatrix}$	$\begin{Bmatrix} i & -i \\ -i & i \end{Bmatrix}$	(x, y)	

5. The Groups C_{nh} ($n = 2, 3, 4, 5, 6$) (cont...)

C_{5h}	E	C_5	C_5^2	C_5^3	C_5^4	σ_h	S_5	S_5^7	S_5^3	S_5^9	$\varepsilon = \exp(2\pi i/5)$
A'	1	1	1	1	1	1	1	1	1	1	R_z x^2+y^2, z^2
E'_1	$\left\{ \begin{array}{c} 1 \\ 1 \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon \\ \varepsilon^* \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^2 \\ \varepsilon^{*2} \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^{*2} \\ \varepsilon^2 \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^* \\ \varepsilon \end{array} \right.$	$\left\{ \begin{array}{c} 1 \\ 1 \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon \\ \varepsilon^* \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^2 \\ \varepsilon^{*2} \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^{*2} \\ \varepsilon^2 \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^* \\ \varepsilon \end{array} \right.$	(x, y)
E'_2	$\left\{ \begin{array}{c} 1 \\ 1 \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^2 \\ \varepsilon^{*2} \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^* \\ \varepsilon \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon \\ \varepsilon^* \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^{*2} \\ \varepsilon^2 \end{array} \right.$	$\left\{ \begin{array}{c} 1 \\ 1 \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^2 \\ \varepsilon^{*2} \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^* \\ \varepsilon \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon \\ \varepsilon^* \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^{*2} \\ \varepsilon^2 \end{array} \right.$	z $(x^2-y^2, 2xy)$
A''	1	1	1	1	1	-1	-1	-1	-1	-1	
E''_1	$\left\{ \begin{array}{c} 1 \\ 1 \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon \\ \varepsilon^* \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^2 \\ \varepsilon^{*2} \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^{*2} \\ \varepsilon^2 \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^* \\ \varepsilon \end{array} \right.$	$\left\{ \begin{array}{c} -1 \\ -1 \end{array} \right.$	$\left\{ \begin{array}{c} -\varepsilon \\ -\varepsilon^* \end{array} \right.$	$\left\{ \begin{array}{c} -\varepsilon^2 \\ -\varepsilon^{*2} \end{array} \right.$	$\left\{ \begin{array}{c} -\varepsilon^{*2} \\ -\varepsilon^2 \end{array} \right.$	$\left\{ \begin{array}{c} -\varepsilon^* \\ -\varepsilon \end{array} \right.$	(R_x, R_y) (xz, yz)
E''_2	$\left\{ \begin{array}{c} 1 \\ 1 \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^2 \\ \varepsilon^{*2} \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^* \\ \varepsilon \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon \\ \varepsilon^* \end{array} \right.$	$\left\{ \begin{array}{c} \varepsilon^{*2} \\ \varepsilon^2 \end{array} \right.$	$\left\{ \begin{array}{c} -1 \\ -1 \end{array} \right.$	$\left\{ \begin{array}{c} -\varepsilon^2 \\ -\varepsilon^{*2} \end{array} \right.$	$\left\{ \begin{array}{c} -\varepsilon^* \\ -\varepsilon \end{array} \right.$	$\left\{ \begin{array}{c} -\varepsilon \\ -\varepsilon^* \end{array} \right.$	$\left\{ \begin{array}{c} -\varepsilon^{*2} \\ -\varepsilon^2 \end{array} \right.$	

C_{6h} (6/m)	E	C_6	C_3	C_2	C_3^2	C_6^5	i	S_3^5	S_6^5	σ_h	S_6	S_3	$\varepsilon = \exp(2\pi i/6)$
A_g	1	1	1	1	1	1	1	1	1	1	1	1	x^2+y^2, z^2
B_g	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	(R_x, R_y)
E_{1g}	$\begin{Bmatrix} 1 & \varepsilon & -\varepsilon^* & -1 & -\varepsilon & \varepsilon^* \\ 1 & \varepsilon^* & -\varepsilon & -1 & -\varepsilon^* & \varepsilon \end{Bmatrix}$												(xz, yz)
E_{2g}	$\begin{Bmatrix} 1 & -\varepsilon^* & -\varepsilon & 1 & -\varepsilon^* & -\varepsilon \\ 1 & -\varepsilon & -\varepsilon^* & 1 & -\varepsilon & -\varepsilon^* \end{Bmatrix}$												$(x^2-y^2, 2xy)$
A_u	1	1	1	1	1	1	-1	-1	-1	-1	-1	-1	z
B_u	1	-1	1	-1	1	-1	-1	1	-1	1	-1	1	
E_{1u}	$\begin{Bmatrix} 1 & \varepsilon & -\varepsilon^* & -1 & -\varepsilon & \varepsilon^* \\ 1 & \varepsilon^* & -\varepsilon & -1 & -\varepsilon^* & \varepsilon \end{Bmatrix}$												(x, y)
E_{2u}	$\begin{Bmatrix} 1 & -\varepsilon^* & -\varepsilon & 1 & -\varepsilon^* & -\varepsilon \\ 1 & -\varepsilon & -\varepsilon^* & 1 & -\varepsilon & -\varepsilon^* \end{Bmatrix}$												

6. The Groups D_{nh} ($n = 2, 3, 4, 5, 6$)

D_{2h} (mmm)	E	$C_2(z)$	$C_2(y)$	$C_2(x)$	i	$\sigma(xy)$	$\sigma(xz)$	$\sigma(yz)$	
A_g	1	1	1	1	1	1	1	1	x^2, y^2, z^2
B_{1g}	1	1	-1	-1	1	1	-1	-1	R_z xy
B_{2g}	1	-1	1	-1	1	-1	1	-1	R_y xz
B_{3g}	1	-1	-1	1	1	-1	-1	1	R_x yz
A_u	1	1	1	1	-1	-1	-1	-1	
B_{1u}	1	1	-1	-1	-1	-1	1	1	z
B_{2u}	1	-1	1	-1	-1	1	-1	1	y
B_{3u}	1	-1	-1	1	-1	1	1	-1	x

D_{3h} ($\bar{6}$) $m2$	E	$2C_3$	$3C_2$	σ_h	$2S_3$	$3\sigma_v$	
A'_1	1	1	1	1	1	1	$x^2 + y^2, z^2$
A'_2	1	1	-1	1	1	-1	R_z
E'	2	-1	0	2	-1	0	(x, y) $(x^2 - y^2, 2xy)$
A''_1	1	1	1	-1	-1	-1	
A''_2	1	1	-1	-1	-1	1	z
E''	2	-1	0	-2	1	0	(R_x, R_y) (xz, yz)

D_{4h} ($4/mmm$)	E	$2C_4$	C_2	$2C'_2$	$2C''_2$	i	$2S_4$	σ_h	$2\sigma_v$	$2\sigma_d$	
A_{1g}	1	1	1	1	1	1	1	1	1	1	$x^2 + y^2, z^2$
A_{2g}	1	1	1	-1	-1	1	1	1	-1	-1	R_z
B_{1g}	1	-1	1	1	-1	1	-1	1	1	-1	$x^2 - y^2$
B_{2g}	1	-1	1	-1	1	1	-1	1	-1	1	xy
E_g	2	0	-2	0	0	2	0	-2	0	0	(R_x, R_y) (xz, yz)
A_{1u}	1	1	1	1	1	-1	-1	-1	-1	-1	
A_{2u}	1	1	1	-1	-1	-1	-1	-1	1	1	z
B_{1u}	1	-1	1	1	-1	-1	1	-1	-1	1	
B_{2u}	1	-1	1	-1	1	-1	1	-1	1	-1	
E_u	2	0	-2	0	0	-2	0	2	0	0	(x, y)

6. The Groups D_{nh} ($n = 2, 3, 4, 5, 6$) (cont...)

D_{5h}	E	$2C_5$	$2C_5^2$	$5C_2$	σ_h	$2S_5$	$2S_5^3$	$5\sigma_v$	
A'_1	1	1	1	1	1	1	1	1	$x^2 + y^2, z^2$
A'_2	1	1	1	-1	1	1	1	-1	R_z
E'_1	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	(x, y)
E'_2	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0	$(x^2 - y^2, 2xy)$
A''_1	1	1	1	1	-1	-1	-1	-1	
A''_2	1	1	1	-1	-1	-1	-1	1	z
E''_1	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	-2	$-2 \cos 72^\circ$	$-2 \cos 144^\circ$	0	(R_x, R_y)
E''_2	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0	-2	$-2 \cos 144^\circ$	$-2 \cos 72^\circ$	0	(xy, yz)

D_{6h} ($6/mmm$)	E	$2C_6$	$2C_3$	C_2	$3C'_2$	$3C''_2$	i	$2S_3$	$2S_6$	σ_h	$3\sigma_d$	$3\sigma_v$	
A_{1g}	1	1	1	1	1	1	1	1	1	1	1	1	$x^2 + y^2, z^2$
A_{2g}	1	1	1	1	-1	-1	1	1	1	1	-1	-1	R_z
B_{1g}	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	
B_{2g}	1	-1	1	-1	-1	1	1	-1	1	-1	-1	1	
E_{1g}	2	1	-1	-2	0	0	2	1	-1	-2	0	0	$(R_x - R_y)$
E_{2g}	2	-1	-1	2	0	0	2	-1	-1	2	0	0	(xz, yz) $(x^2 - y^2, 2xy)$
A_{1u}	1	1	1	1	1	1	-1	-1	-1	-1	-1	-1	
A_{2u}	1	1	1	1	-1	-1	-1	-1	-1	-1	1	1	z
B_{1u}	1	-1	1	-1	1	-1	-1	1	-1	1	-1	1	
B_{2u}	1	-1	1	-1	-1	1	-1	1	-1	1	1	-1	
E_{1u}	2	1	-1	-2	0	0	-2	-1	1	2	0	0	(x, y)
E_{2u}	2	-1	-1	2	0	0	-2	1	1	-2	0	0	

7. The Groups D_{nd} ($n = 2, 3, 4, 5, 6$)

$D_{2d} = V_d$ $(\overline{42})_m$	E	$2S_4$	C_2	$2C'_2$	$2\sigma_d$		
A_1	1	1	1	1	1		$x^2 + y^2, z^2$
A_2	1	1	1	-1	-1	R_z	
B_1	1	-1	1	1	-1		$x^2 - y^2$
B_2	1	-1	1	-1	1	z	xy
E	2	0	-2	0	0	(x, y) (R_x, R_y)	(xz, yz)

D_{3d} $(\overline{3})_m$	E	$2C_3$	$3C_2$	i	$2S_6$	$3\sigma_d$		
A_{1g}	1	1	1	1	1	1		$x^2 + y^2, z^2$
A_{2g}	1	1	-1	1	1	-1	R_z	
E_g	2	-1	0	2	-1	0	(R_x, R_y)	$(x^2 - y^2, 2xy)$ (xz, yz)
A_{1u}	1	1	1	-1	-1	-1		
A_{2u}	1	1	-1	-1	-1	1	z	
E_u	2	-1	0	-2	1	0	(x, y)	

D_{4d}	E	$2S_8$	$2C_4$	$2S_8^3$	C_2	$4C'_2$	$4\sigma_d$		
A_1	1	1	1	1	1	1	1		$x^2 + y^2, z^2$
A_2	1	1	1	1	1	-1	-1	R_z	
B_1	1	-1	1	-1	1	1	-1		
B_2	1	-1	1	-1	1	-1	1	z	
E_1	2	$\sqrt{2}$	0	$-\sqrt{2}$	-2	0	0	(x, y)	
E_2	2	0	-2	0	2	0	0		$(x^2 - y^2, 2xy)$
E_3	2	$-\sqrt{2}$	0	$\sqrt{2}$	-2	0	0	(R_x, R_y)	(xz, yz)

7. The Groups D_{nd} ($n = 2, 3, 4, 5, 6$) (cont..)

D_{5d}	E	$2C_5$	$2C_5^2$	$5C_2$	i	$2S_{10}^3$	$2S_{10}$	$5\sigma_d$	
A_{1g}	1	1	1	1	1	1	1	1	$x^2 + y^2, z^2$
A_{2g}	1	1	1	-1	1	1	1	-1	R_z
E_{1g}	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	(R_x, R_y)
E_{2g}	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0	$(x^2 - y^2, 2xy)$
A_{1u}	1	1	1	1	-1	-1	-1	-1	
A_{2u}	1	1	1	-1	-1	-1	-1	1	z
E_{1u}	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	-2	$-2 \cos 72^\circ$	$-2 \cos 144^\circ$	0	(x, y)
E_{2u}	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0	-2	$-2 \cos 144^\circ$	$-2 \cos 72^\circ$	0	

D_{6d}	E	$2S_{12}$	$2C_6$	$2S_4$	$2C_3$	$2S_{12}^5$	C_2	$6C'_2$	$6\sigma_d$	
A_1	1	1	1	1	1	1	1	1	1	$x^2 + y^2, z^2$
A_2	1	1	1	1	1	1	1	-1	-1	R_z
B_1	1	-1	1	-1	1	-1	1	1	-1	
B_2	1	-1	1	-1	1	-1	1	-1	1	z
E_1	2	$\sqrt{3}$	1	0	-1	$-\sqrt{3}$	-2	0	0	(x, y)
E_2	2	1	-1	-2	-1	1	2	0	0	$(x^2 - y^2, 2xy)$
E_3	2	0	-2	0	2	0	-2	0	0	
E_4	2	-1	-1	2	-1	-1	2	0	0	
E_5	2	$-\sqrt{3}$	1	0	-1	$\sqrt{3}$	-2	0	0	(R_x, R_y)

8. The Groups S_n ($n = 4, 6, 8$)

S_4 ($\bar{4}$)	E	S_4	C_2	S_4^3		
A	1	1	1	1	R_z	$x^2 + y^2, z^2$
B	1	-1	1	-1	z	$(x^2 - y^2, 2xy)$
E	$\begin{Bmatrix} 1 & i \\ 1 & -i \end{Bmatrix}$	$\begin{Bmatrix} i \\ -i \end{Bmatrix}$	$\begin{Bmatrix} -1 \\ -1 \end{Bmatrix}$	$\begin{Bmatrix} -i \\ i \end{Bmatrix}$	$(x, y) (R_x, R_y)$	(xz, yz)

S_6 ($\bar{3}$)	E	C_3	C_3^2	i	S_6^5	S_6		$\varepsilon = \exp(2\pi i/3)$
A _g	1	1	1	1	1	1	R_z	$x^2 + y^2, z^2$
E _g	$\begin{Bmatrix} 1 & \varepsilon \\ 1 & \varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon \\ \varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon^* \\ \varepsilon \end{Bmatrix}$	$\begin{Bmatrix} 1 \\ 1 \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon \\ \varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon^* \\ \varepsilon \end{Bmatrix}$	(R_x, R_y)	$(x^2 - y^2, 2xy) (xy, yz)$
A _u	1	1	1	-1	-1	-1	z	
E _u	$\begin{Bmatrix} 1 & \varepsilon \\ 1 & \varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon \\ \varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon^* \\ \varepsilon \end{Bmatrix}$	$\begin{Bmatrix} 1 \\ 1 \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon \\ \varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon^* \\ \varepsilon \end{Bmatrix}$	(x, y)	

S_8	E	S_8	C_4	S_8^3	C_2	S_8^5	C_4^3	S_8^7		$\varepsilon = \exp(2\pi i/8)$
A	1	1	1	1	1	1	1	1	R_z	$x^2 + y^2, z^2$
B	1	-1	1	-1	1	-1	1	-1	z	
E ₁	$\begin{Bmatrix} 1 & \varepsilon \\ 1 & \varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon \\ \varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} i \\ -i \end{Bmatrix}$	$\begin{Bmatrix} -\varepsilon^* \\ -\varepsilon \end{Bmatrix}$	$\begin{Bmatrix} -1 \\ -1 \end{Bmatrix}$	$\begin{Bmatrix} -\varepsilon \\ -\varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} -i \\ i \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon^* \\ \varepsilon \end{Bmatrix}$	(x, y)	
E ₂	$\begin{Bmatrix} 1 & i \\ 1 & -i \end{Bmatrix}$	$\begin{Bmatrix} i \\ -i \end{Bmatrix}$	$\begin{Bmatrix} -1 \\ -1 \end{Bmatrix}$	$\begin{Bmatrix} -i \\ i \end{Bmatrix}$	$\begin{Bmatrix} 1 \\ 1 \end{Bmatrix}$	$\begin{Bmatrix} i \\ -i \end{Bmatrix}$	$\begin{Bmatrix} -1 \\ -1 \end{Bmatrix}$	$\begin{Bmatrix} -i \\ i \end{Bmatrix}$		$(x^2 - y^2, 2xy)$
E ₃	$\begin{Bmatrix} 1 & -\varepsilon^* \\ 1 & -\varepsilon \end{Bmatrix}$	$\begin{Bmatrix} -\varepsilon^* \\ -\varepsilon \end{Bmatrix}$	$\begin{Bmatrix} -i \\ i \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon \\ \varepsilon^* \end{Bmatrix}$	$\begin{Bmatrix} -1 \\ -1 \end{Bmatrix}$	$\begin{Bmatrix} \varepsilon^* \\ \varepsilon \end{Bmatrix}$	$\begin{Bmatrix} i \\ -i \end{Bmatrix}$	$\begin{Bmatrix} -\varepsilon \\ -\varepsilon^* \end{Bmatrix}$	(R_x, R_y)	(xy, yz)

9. The Cubic Groups

T (23)	E	$4C_3$	$4C_3^2$	$3C_2$	$\varepsilon = \exp(2\pi i/3)$	
A	1	1	1	1	$x^2 + y^2 + z^2$	
E	$\begin{Bmatrix} 1 & \varepsilon & \varepsilon^* & 1 \\ 1 & \varepsilon^* & \varepsilon & 1 \end{Bmatrix}$				$(\sqrt{3} (x^2 - y^2)2z^2 - x^2 - y^2)$	
T	3	0	0	-1	(x, y, z) (R_x, R_y, R_z)	(xy, xz, yz)

T_d ($\bar{4}3m$)	E	$8C_3$	$3C_2$	$6S_4$	$6\sigma_d$	
A ₁	1	1	1	1	1	$x^2 + y^2 + z^2$
A ₂	1	1	1	-1	-1	
E	2	-1	2	0	0	$(2z^2 - x^2 - y^2, \sqrt{3} (x^2 - y^2))$
T ₁	3	0	-1	1	-1	(R_x, R_y, R_z)
T ₂	3	0	-1	-1	1	(x, y, z) (xy, xz, yz)

T_h ($m\bar{3}$)	E	$4C_3$	$4C_3^2$	$3C_2$	i	$4S_6$	$4S_6^2$	$3\sigma_d$	$\varepsilon = \exp(2\pi i/3)$
A _g	1	1	1	1	1	1	1	1	$x^2 + y^2 + z^2$
E _g	$\begin{Bmatrix} 1 & \varepsilon & \varepsilon^* & 1 & 1 & \varepsilon & \varepsilon^* & 1 \\ 1 & \varepsilon^* & \varepsilon & 1 & 1 & \varepsilon^* & \varepsilon & 1 \end{Bmatrix}$								$(2z^2 - x^2 - y^2, \sqrt{3} (x^2 - y^2))$
T _g	3	0	0	-1	3	0	0	-1	(R_x, R_y, R_z) (xy, yz, xz)
A _u	1	1	1	1	-1	-1	-1	-1	
E _u	$\begin{Bmatrix} 1 & \varepsilon & \varepsilon^* & 1 & -1 & -\varepsilon & -\varepsilon^* & -1 \\ 1 & \varepsilon^* & \varepsilon & 1 & -1 & -\varepsilon^* & -\varepsilon & -1 \end{Bmatrix}$								
T _u	3	0	0	-1	-3	0	0	1	(x, y, z)

O (432)	E	$8C_3$	$3C_2$	$6C_4$	$6C_2'$	
A ₁	1	1	1	1	1	$x^2 + y^2 + z^2$
A ₂	1	1	1	-1	-1	
E	2	-1	2	0	0	$(2z^2 - x^2 - y^2, \sqrt{3} (x^2 - y^2))$
T ₁	3	0	-1	1	-1	(x, y, z) (R_x, R_y, R_z)
T ₂	3	0	-1	-1	1	(xy, xz, yz)

9. The Cubic Groups (cont...)

O_h ($m\bar{3}m$)	E	$8C_3$	$6C_2$	$6C_4$	$3C_2$ ($= C_4^2$)	i	$6S_4$	$8S_6$	$3\sigma_h$	$6\sigma_d$	
A_{1g}	1	1	1	1	1	1	1	1	1	1	$x^2 + y^2 + z^2$
A_{2g}	1	1	-1	-1	1	1	-1	1	1	-1	
E_g	2	-1	0	0	2	2	0	-1	2	0	$(2z^2 - x^2 - y^2, \sqrt{3}(x^2 - y^2))$
T_{1g}	3	0	-1	1	-1	3	1	0	-1	-1	(R_x, R_y, R_z)
T_{2g}	3	0	1	-1	-1	3	-1	0	-1	1	(xy, xz, yz)
A_{1u}	1	1	1	1	1	-1	-1	-1	-1	-1	
A_{2u}	1	1	-1	-1	1	-1	1	-1	-1	1	
E_u	2	-1	0	0	2	-2	0	1	-2	0	
T_{1u}	3	0	-1	1	-1	-3	-1	0	1	1	(x, y, z)
T_{2u}	3	0	1	-1	-1	-3	1	0	1	-1	

10. The Groups I, I_h

I	E	$12C_5$	$12C_5^2$	$20C_3$	$15C_2$	$\eta^\pm = \frac{1}{2} \left(1 \pm 5^{\frac{1}{2}} \right)$
A	1	1	1	1	1	$x^2+y^2+z^2$
T ₁	3	η^+	η^-	0	-1	(x, y, z) (R_x, R_y, R_z)
T ₂	3	η^-	η^+	0	-1	
G	4	-1	-1	1	0	
H	5	0	0	-1	1	$(2z^2 - x^2 - y^2,$ $\sqrt{3} (x^2 - y^2)$ $xy, yz, zx)$

I_h	E	$12C_5$	$12C_5^2$	$20C_3$	$15C_2$	i	$12S_{10}$	$12S_{10}^3$	$20S_6$	15σ	$\eta^\pm = \frac{1}{2} \left(1 \pm 5^{\frac{1}{2}} \right)$
A _g	1	1	1	1	1	1	1	1	1	1	$x^2 + y^2 + z^2$
T _{1g}	3	η^+	η^-	0	-1	3	η^-	η^+	-1	-1	(R_x, R_y, R_z)
T _{2g}	3	η^-	η^+	0	-1	3	η^+	η^-	0	-1	
G _g	4	-1	-1	1	0	4	-1	-1	1	0	
H _g	5	0	0	-1	1	5	0	0	-1	1	$(2z^2 - x^2 - y^2,$ $\sqrt{3} (x^2 - y^2))$ (xy, yz, zx)
A _u	1	1	1	1	1	-1	-1	-1	-1	-1	
T _{1u}	3	η^+	η^-	0	-1	-3	η^-	η^+	0	1	(x, y, z)
T _{2u}	3	η^-	η^+	0	-1	-3	η^+	η^-	0	1	
G _u	4	-1	-1	1	0	-4	1	1	-1	0	
H _u	5	0	0	-1	1	-5	0	0	1	-1	

11. The Groups $C_{\infty v}$ and $D_{\infty h}$

$C_{\infty v}$	E	C_2	$2C_\infty^\phi$	...	$\infty\sigma_v$		
$A_1 \equiv \Sigma^+$	1	1	1	...	1	z	$x^2 + y^2, z^2$
$A_2 \equiv \Sigma^-$	1	1	1	...	-1	R_z	
$E_1 \equiv \Pi$	2	-2	$2 \cos \phi$	...	0	$(x, y) (R_x, R_y)$	(xz, yz)
$E_2 \equiv \Delta$	2	2	$2 \cos 2\phi$	...	0		$(x^2 - y^2, 2xy)$
$E_3 \equiv \Phi$	2	-2	$2 \cos 3\phi$	...	0		
...	...	...	...	...	...		
...	...	...	...	...	...		

$D_{\infty h}$	E	$2C_\infty^\phi$	...	$\infty\sigma_v$	i	$2S_\infty^\phi$	...	∞C_2	
Σ_g^+	1	1	...	1	1	1	...	1	$x^2 + y^2, z^2$
Σ_g^-	1	1	...	-1	1	1	...	-1	R_z
Π_g	2	$2 \cos \phi$	...	0	2	$-2 \cos \phi$	...	0	$(R_x, R_y) (xz, yz)$
Δ_g	2	$2 \cos 2\phi$	...	0	2	$2 \cos 2\phi$	...	0	$(x^2 - y^2, 2xy)$
...	...	...	...	...	...	...	...	...	
Σ_u^+	1	1	...	1	-1	-1	...	-1	z
Σ_u^-	1	1	...	-1	-1	-1	...	1	
Π_u	2	$2 \cos \phi$	...	0	-2	$2 \cos \phi$	...	0	(x, y)
Δ_u	2	$2 \cos 2\phi$	...	0	-2	$-2 \cos 2\phi$	...	0	
...	...	...	...	...	...	...	...	...	

12. The Full Rotation Group (SU₂ and R₃)

$$\chi^{(j)}(\phi) = \begin{cases} \frac{\sin\left(j + \frac{1}{2}\right)\phi}{\sin\frac{1}{2}\phi} & \phi \neq 0 \\ 2j+1 & \phi = 0 \end{cases}$$

Notation : Representation labelled $\Gamma^{(j)}$ with $j = 0, 1/2, 1, 3/2, \dots, \infty$, for $R_3 j$ is confined to integral values (and written l or L) and the labels $S \equiv \Gamma^{(0)}$, $P \equiv \Gamma^{(1)}$, $D \equiv \Gamma^{(2)}$, etc. are used.