

PG No. 7 C_{2v} $mm2$ [orthorhombic] (polar, internal axial dipole)

* Harmonics for rank 0

* Harmonics for rank 1

$$\bar{Q}_1^{(1,0)}[g](A_1)$$

** symmetry

$$z$$

** expression

$$\frac{\sqrt{2}G_{xy}}{2} - \frac{\sqrt{2}G_{yx}}{2}$$

$$\bar{Q}_1^{(1,0)}[g](B_1)$$

** symmetry

$$x$$

** expression

$$\frac{\sqrt{2}G_{yz}}{2} - \frac{\sqrt{2}G_{zy}}{2}$$

$$\bar{Q}_1^{(1,0)}[g](B_2)$$

** symmetry

$$y$$

** expression

$$-\frac{\sqrt{2}G_{xz}}{2} + \frac{\sqrt{2}G_{zx}}{2}$$

* Harmonics for rank 2

$$\bar{Q}_2^{(1,0)}[g](A_1, 1)$$

** symmetry

$$-\frac{x^2}{2} - \frac{y^2}{2} + z^2$$

** expression

$$\frac{\sqrt{6}G_{xyz}}{2} - \frac{\sqrt{6}G_{yxz}}{2}$$

$$\bar{Q}_2^{(1,0)}[g](A_1, 2)$$

** symmetry

$$\frac{\sqrt{3}(x-y)(x+y)}{2}$$

** expression

$$\frac{\sqrt{2}G_{xyz}}{2} + \frac{\sqrt{2}G_{yxz}}{2} - \sqrt{2}G_{zxy}$$

$$\bar{Q}_2^{(1,0)}[g](A_2)$$

** symmetry

$$\sqrt{3}xy$$

** expression

$$-\frac{\sqrt{2}G_{xxz}}{2} + \frac{\sqrt{2}G_{yyz}}{2} + \frac{\sqrt{2}G_z(x-y)(x+y)}{2}$$

$$\bar{Q}_2^{(1,0)}[g](B_1)$$

** symmetry

$$\sqrt{3}xz$$

** expression

$$\frac{\sqrt{2}G_{xxy}}{2} - \frac{\sqrt{2}G_y(x-z)(x+z)}{2} - \frac{\sqrt{2}G_zyz}{2}$$

$$\bar{Q}_2^{(1,0)}[g](B_2)$$

** symmetry

$$\sqrt{3}yz$$

** expression

$$\frac{\sqrt{2}G_x(y-z)(y+z)}{2} - \frac{\sqrt{2}G_yxy}{2} + \frac{\sqrt{2}G_zxz}{2}$$

* Harmonics for rank 3

$$\bar{Q}_3^{(1,0)}[g](A_1, 1)$$

** symmetry

$$-\frac{z(3x^2 + 3y^2 - 2z^2)}{2}$$

** expression

$$-\frac{\sqrt{3}G_xy(x^2 + y^2 - 4z^2)}{4} + \frac{\sqrt{3}G_yx(x^2 + y^2 - 4z^2)}{4}$$

$$\bar{Q}_3^{(1,0)}[g](A_1, 2)$$

** symmetry

$$\frac{\sqrt{15}z(x-y)(x+y)}{2}$$

** expression

$$\frac{\sqrt{5}G_xy(x^2 - y^2 + 2z^2)}{4} - \frac{\sqrt{5}G_yx(x^2 - y^2 - 2z^2)}{4} - \sqrt{5}G_zxyz$$

$$\bar{Q}_3^{(1,0)}[g](A_2)$$

** symmetry

$$\sqrt{15}xyz$$

** expression

$$\frac{\sqrt{5}G_xx(y-z)(y+z)}{2} - \frac{\sqrt{5}G_yy(x-z)(x+z)}{2} + \frac{\sqrt{5}G_zz(x-y)(x+y)}{2}$$

$$\bar{Q}_3^{(1,0)}[g](B_1, 1)$$

** symmetry

$$\frac{x(2x^2 - 3y^2 - 3z^2)}{2}$$

** expression

$$\frac{\sqrt{3}G_yz(4x^2 - y^2 - z^2)}{4} - \frac{\sqrt{3}G_zy(4x^2 - y^2 - z^2)}{4}$$

$$\bar{Q}_3^{(1,0)}[g](B_1, 2)$$

** symmetry

$$\frac{\sqrt{15}x(y-z)(y+z)}{2}$$

** expression

$$-\sqrt{5}G_xxyz + \frac{\sqrt{5}G_yz(2x^2 + y^2 - z^2)}{4} + \frac{\sqrt{5}G_zy(2x^2 - y^2 + z^2)}{4}$$

$$\bar{Q}_3^{(1,0)}[g](B_2, 1)$$

** symmetry

$$-\frac{y(3x^2 - 2y^2 + 3z^2)}{2}$$

** expression

$$\frac{\sqrt{3}G_xz(x^2 - 4y^2 + z^2)}{4} - \frac{\sqrt{3}G_zx(x^2 - 4y^2 + z^2)}{4}$$

$$\bar{Q}_3^{(1,0)}[g](B_2, 2)$$

** symmetry

$$-\frac{\sqrt{15}y(x-z)(x+z)}{2}$$

** expression

$$\frac{\sqrt{5}G_xz(x^2 + 2y^2 - z^2)}{4} - \sqrt{5}G_yxyz - \frac{\sqrt{5}G_zx(x^2 - 2y^2 - z^2)}{4}$$

* Harmonics for rank 4

$$\bar{Q}_4^{(1,0)}[g](A_1, 1)$$

** symmetry

$$\frac{\sqrt{21} (x^4 - 3x^2y^2 - 3x^2z^2 + y^4 - 3y^2z^2 + z^4)}{6}$$

** expression

$$-\frac{\sqrt{105}G_x yz (y-z)(y+z)}{6} + \frac{\sqrt{105}G_y xz (x-z)(x+z)}{6} - \frac{\sqrt{105}G_z xy (x-y)(x+y)}{6}$$

$$\bar{Q}_4^{(1,0)}[g](A_1, 2)$$

** symmetry

$$-\frac{\sqrt{15} (x^4 - 12x^2y^2 + 6x^2z^2 + y^4 + 6y^2z^2 - 2z^4)}{12}$$

** expression

$$-\frac{\sqrt{3}G_x yz (9x^2 + 2y^2 - 5z^2)}{6} + \frac{\sqrt{3}G_y xz (2x^2 + 9y^2 - 5z^2)}{6} + \frac{7\sqrt{3}G_z xy (x-y)(x+y)}{6}$$

$$\bar{Q}_4^{(1,0)}[g](A_1, 3)$$

** symmetry

$$\frac{\sqrt{5} (x-y)(x+y)(x^2 + y^2 - 6z^2)}{4}$$

** expression

$$-\frac{G_x yz (3x^2 - 4y^2 + 3z^2)}{2} + \frac{G_y xz (4x^2 - 3y^2 - 3z^2)}{2} - \frac{G_z xy (x^2 + y^2 - 6z^2)}{2}$$

$$\bar{Q}_4^{(1,0)}[g](A_2, 1)$$

** symmetry

$$\frac{\sqrt{35}xy (x-y)(x+y)}{2}$$

** expression

$$-\frac{\sqrt{7}G_x xz (x^2 - 3y^2)}{4} + \frac{\sqrt{7}G_y yz (3x^2 - y^2)}{4} + \frac{\sqrt{7}G_z (x^2 - 2xy - y^2)(x^2 + 2xy - y^2)}{4}$$

$$\bar{Q}_4^{(1,0)}[g](A_2, 2)$$

** symmetry

$$-\frac{\sqrt{5}xy (x^2 + y^2 - 6z^2)}{2}$$

** expression

$$\frac{G_x xz (x^2 + 15y^2 - 6z^2)}{4} - \frac{G_y yz (15x^2 + y^2 - 6z^2)}{4} - \frac{G_z (x-y)(x+y)(x^2 + y^2 - 6z^2)}{4}$$

$$\bar{Q}_4^{(1,0)}[g](B_1, 1)$$

** symmetry

$$-\frac{\sqrt{35}xz (x-z)(x+z)}{2}$$

** expression

$$-\frac{\sqrt{7}G_x xy (x^2 - 3z^2)}{4} + \frac{\sqrt{7}G_y (x^2 - 2xz - z^2)(x^2 + 2xz - z^2)}{4} + \frac{\sqrt{7}G_z yz (3x^2 - z^2)}{4}$$

$$\bar{Q}_4^{(1,0)}[g](B_1, 2)$$

** symmetry

$$-\frac{\sqrt{5}xz (x^2 - 6y^2 + z^2)}{2}$$

** expression

$$-\frac{G_x xy (x^2 - 6y^2 + 15z^2)}{4} + \frac{G_y (x-z)(x+z)(x^2 - 6y^2 + z^2)}{4} + \frac{G_z yz (15x^2 - 6y^2 + z^2)}{4}$$

$$\bar{Q}_4^{(1,0)}[g](B_2, 1)$$

** symmetry

$$\frac{\sqrt{35}yz (y-z)(y+z)}{2}$$

** expression

$$\frac{\sqrt{7}G_x (y^2 - 2yz - z^2) (y^2 + 2yz - z^2)}{4} - \frac{\sqrt{7}G_y xy (y^2 - 3z^2)}{4} + \frac{\sqrt{7}G_z xz (3y^2 - z^2)}{4}$$

$\bar{Q}_4^{(1,0)}[g](B_2, 2)$

** symmetry

$$\frac{\sqrt{5}yz (6x^2 - y^2 - z^2)}{2}$$

** expression

$$\frac{G_x (y - z) (y + z) (6x^2 - y^2 - z^2)}{4} - \frac{G_y xy (6x^2 - y^2 - 15z^2)}{4} + \frac{G_z xz (6x^2 - 15y^2 - z^2)}{4}$$