Y_3Ni_2 Structure: A2B3_tP80_92_4b_2a5b-001
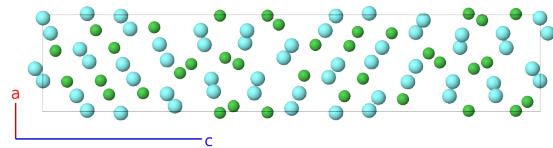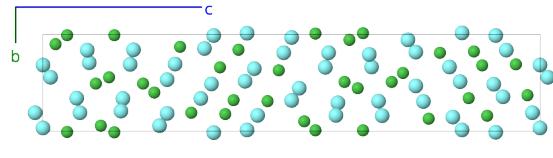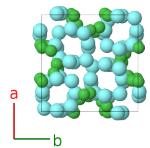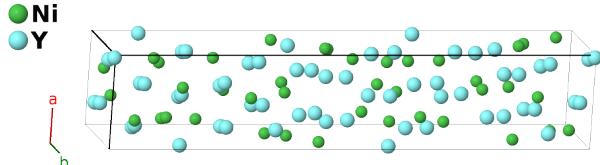
Prototype	Ni_2Y_3
AFLOW prototype label	A2B3_tP80_92_4b_2a5b-001
ICSD	1287
Pearson symbol	tP80
Space group number	92
Space group symbol	$P4_12_12$
AFLOW prototype command	aflow --proto=A2B3_tP80_92_4b_2a5b-001

$\qquad$ --params=$a, c/a, x_1, x_2, x_3, y_3, z_3, x_4, y_4, z_4, x_5, y_5, z_5, x_6, y_6, z_6, x_7, y_7, z_7, x_8, y_8, z_8, x_9,$
$y_9, z_9, x_{10}, y_{10}, z_{10}, x_{11}, y_{11}, z_{11}$

Simple Tetragonal primitive vectors

$$\mathbf{a_1} = a\,\hat{\mathbf{x}}$$
$$\mathbf{a_2} = a\,\hat{\mathbf{y}}$$
$$\mathbf{a_3} = c\,\hat{\mathbf{z}}$$
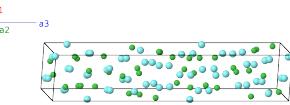
Basis vectors

		Lattice coordinates		Cartesian coordinates	Wyckoff position	Atom type
$\mathbf{B_1}$	$=$	$x_1\,\mathbf{a_1} + x_1\,\mathbf{a_2}$	$=$	$ax_1\,\hat{\mathbf{x}} + ax_1\,\hat{\mathbf{y}}$	(4a)	Y I
$\mathbf{B_2}$	$=$	$-x_1\,\mathbf{a_1} - x_1\,\mathbf{a_2} + \frac{1}{2}\,\mathbf{a_3}$	$=$	$-ax_1\,\hat{\mathbf{x}} - ax_1\,\hat{\mathbf{y}} + \frac{1}{2}c\,\hat{\mathbf{z}}$	(4a)	Y I
$\mathbf{B_3}$	$=$	$-\left(x_1 - \frac{1}{2}\right)\mathbf{a_1} + \left(x_1 + \frac{1}{2}\right)\mathbf{a_2} + \frac{1}{4}\,\mathbf{a_3}$	$=$	$-a\left(x_1 - \frac{1}{2}\right)\hat{\mathbf{x}} + a\left(x_1 + \frac{1}{2}\right)\hat{\mathbf{y}} + \frac{1}{4}c\,\hat{\mathbf{z}}$	(4a)	Y I
$\mathbf{B_4}$	$=$	$\left(x_1 + \frac{1}{2}\right)\mathbf{a_1} - \left(x_1 - \frac{1}{2}\right)\mathbf{a_2} + \frac{3}{4}\,\mathbf{a_3}$	$=$	$a\left(x_1 + \frac{1}{2}\right)\hat{\mathbf{x}} - a\left(x_1 - \frac{1}{2}\right)\hat{\mathbf{y}} + \frac{3}{4}c\,\hat{\mathbf{z}}$	(4a)	Y I
$\mathbf{B_5}$	$=$	$x_2\,\mathbf{a_1} + x_2\,\mathbf{a_2}$	$=$	$ax_2\,\hat{\mathbf{x}} + ax_2\,\hat{\mathbf{y}}$	(4a)	Y II

$$\mathbf{B}_6 = -x_2\,\mathbf{a}_1 - x_2\,\mathbf{a}_2 + \tfrac{1}{2}\,\mathbf{a}_3 = -ax_2\,\hat{\mathbf{x}} - ax_2\,\hat{\mathbf{y}} + \tfrac{1}{2}c\,\hat{\mathbf{z}} \qquad (4a) \qquad \text{Y II}$$

$$\mathbf{B}_7 = -\left(x_2 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(x_2 + \tfrac{1}{2}\right)\mathbf{a}_2 + \tfrac{1}{4}\,\mathbf{a}_3 = -a\left(x_2 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(x_2 + \tfrac{1}{2}\right)\hat{\mathbf{y}} + \tfrac{1}{4}c\,\hat{\mathbf{z}} \qquad (4a) \qquad \text{Y II}$$

$$\mathbf{B}_8 = \left(x_2 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(x_2 - \tfrac{1}{2}\right)\mathbf{a}_2 + \tfrac{3}{4}\,\mathbf{a}_3 = a\left(x_2 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(x_2 - \tfrac{1}{2}\right)\hat{\mathbf{y}} + \tfrac{3}{4}c\,\hat{\mathbf{z}} \qquad (4a) \qquad \text{Y II}$$

$$\mathbf{B}_9 = x_3\,\mathbf{a}_1 + y_3\,\mathbf{a}_2 + z_3\,\mathbf{a}_3 = ax_3\,\hat{\mathbf{x}} + ay_3\,\hat{\mathbf{y}} + cz_3\,\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni I}$$

$$\mathbf{B}_{10} = -x_3\,\mathbf{a}_1 - y_3\,\mathbf{a}_2 + \left(z_3 + \tfrac{1}{2}\right)\mathbf{a}_3 = -ax_3\,\hat{\mathbf{x}} - ay_3\,\hat{\mathbf{y}} + c\left(z_3 + \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni I}$$

$$\mathbf{B}_{11} = -\left(y_3 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(x_3 + \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_3 + \tfrac{1}{4}\right)\mathbf{a}_3 = -a\left(y_3 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(x_3 + \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_3 + \tfrac{1}{4}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni I}$$

$$\mathbf{B}_{12} = \left(y_3 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(x_3 - \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_3 + \tfrac{3}{4}\right)\mathbf{a}_3 = a\left(y_3 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(x_3 - \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_3 + \tfrac{3}{4}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni I}$$

$$\mathbf{B}_{13} = -\left(x_3 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(y_3 + \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_3 - \tfrac{1}{4}\right)\mathbf{a}_3 = -a\left(x_3 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(y_3 + \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_3 - \tfrac{1}{4}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni I}$$

$$\mathbf{B}_{14} = \left(x_3 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(y_3 - \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_3 - \tfrac{3}{4}\right)\mathbf{a}_3 = a\left(x_3 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(y_3 - \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_3 - \tfrac{3}{4}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni I}$$

$$\mathbf{B}_{15} = y_3\,\mathbf{a}_1 + x_3\,\mathbf{a}_2 - z_3\,\mathbf{a}_3 = ay_3\,\hat{\mathbf{x}} + ax_3\,\hat{\mathbf{y}} - cz_3\,\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni I}$$

$$\mathbf{B}_{16} = -y_3\,\mathbf{a}_1 - x_3\,\mathbf{a}_2 - \left(z_3 - \tfrac{1}{2}\right)\mathbf{a}_3 = -ay_3\,\hat{\mathbf{x}} - ax_3\,\hat{\mathbf{y}} - c\left(z_3 - \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni I}$$

$$\mathbf{B}_{17} = x_4\,\mathbf{a}_1 + y_4\,\mathbf{a}_2 + z_4\,\mathbf{a}_3 = ax_4\,\hat{\mathbf{x}} + ay_4\,\hat{\mathbf{y}} + cz_4\,\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni II}$$

$$\mathbf{B}_{18} = -x_4\,\mathbf{a}_1 - y_4\,\mathbf{a}_2 + \left(z_4 + \tfrac{1}{2}\right)\mathbf{a}_3 = -ax_4\,\hat{\mathbf{x}} - ay_4\,\hat{\mathbf{y}} + c\left(z_4 + \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni II}$$

$$\mathbf{B}_{19} = -\left(y_4 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(x_4 + \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_4 + \tfrac{1}{4}\right)\mathbf{a}_3 = -a\left(y_4 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(x_4 + \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_4 + \tfrac{1}{4}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni II}$$

$$\mathbf{B}_{20} = \left(y_4 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(x_4 - \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_4 + \tfrac{3}{4}\right)\mathbf{a}_3 = a\left(y_4 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(x_4 - \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_4 + \tfrac{3}{4}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni II}$$

$$\mathbf{B}_{21} = -\left(x_4 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(y_4 + \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_4 - \tfrac{1}{4}\right)\mathbf{a}_3 = -a\left(x_4 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(y_4 + \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_4 - \tfrac{1}{4}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni II}$$

$$\mathbf{B}_{22} = \left(x_4 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(y_4 - \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_4 - \tfrac{3}{4}\right)\mathbf{a}_3 = a\left(x_4 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(y_4 - \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_4 - \tfrac{3}{4}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni II}$$

$$\mathbf{B}_{23} = y_4\,\mathbf{a}_1 + x_4\,\mathbf{a}_2 - z_4\,\mathbf{a}_3 = ay_4\,\hat{\mathbf{x}} + ax_4\,\hat{\mathbf{y}} - cz_4\,\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni II}$$

$$\mathbf{B}_{24} = -y_4\,\mathbf{a}_1 - x_4\,\mathbf{a}_2 - \left(z_4 - \tfrac{1}{2}\right)\mathbf{a}_3 = -ay_4\,\hat{\mathbf{x}} - ax_4\,\hat{\mathbf{y}} - c\left(z_4 - \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni II}$$

$$\mathbf{B}_{25} = x_5\,\mathbf{a}_1 + y_5\,\mathbf{a}_2 + z_5\,\mathbf{a}_3 = ax_5\,\hat{\mathbf{x}} + ay_5\,\hat{\mathbf{y}} + cz_5\,\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni III}$$

$$\mathbf{B}_{26} = -x_5\,\mathbf{a}_1 - y_5\,\mathbf{a}_2 + \left(z_5 + \tfrac{1}{2}\right)\mathbf{a}_3 = -ax_5\,\hat{\mathbf{x}} - ay_5\,\hat{\mathbf{y}} + c\left(z_5 + \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni III}$$

$$\mathbf{B}_{27} = -\left(y_5 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(x_5 + \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_5 + \tfrac{1}{4}\right)\mathbf{a}_3 = -a\left(y_5 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(x_5 + \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_5 + \tfrac{1}{4}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni III}$$

$$\mathbf{B}_{28} = \left(y_5 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(x_5 - \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_5 + \tfrac{3}{4}\right)\mathbf{a}_3 = a\left(y_5 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(x_5 - \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_5 + \tfrac{3}{4}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni III}$$

$$\mathbf{B}_{29} = -\left(x_5 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(y_5 + \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_5 - \tfrac{1}{4}\right)\mathbf{a}_3 = -a\left(x_5 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(y_5 + \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_5 - \tfrac{1}{4}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni III}$$

$$\mathbf{B}_{30} = \left(x_5 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(y_5 - \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_5 - \tfrac{3}{4}\right)\mathbf{a}_3 = a\left(x_5 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(y_5 - \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_5 - \tfrac{3}{4}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni III}$$

$$\mathbf{B}_{31} = y_5\,\mathbf{a}_1 + x_5\,\mathbf{a}_2 - z_5\,\mathbf{a}_3 = ay_5\,\hat{\mathbf{x}} + ax_5\,\hat{\mathbf{y}} - cz_5\,\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni III}$$

$$\mathbf{B}_{32} = -y_5\,\mathbf{a}_1 - x_5\,\mathbf{a}_2 - \left(z_5 - \tfrac{1}{2}\right)\mathbf{a}_3 = -ay_5\,\hat{\mathbf{x}} - ax_5\,\hat{\mathbf{y}} - c\left(z_5 - \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni III}$$

$$\mathbf{B}_{33} = x_6\,\mathbf{a}_1 + y_6\,\mathbf{a}_2 + z_6\,\mathbf{a}_3 = ax_6\,\hat{\mathbf{x}} + ay_6\,\hat{\mathbf{y}} + cz_6\,\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni IV}$$

$$\mathbf{B}_{34} = -x_6\,\mathbf{a}_1 - y_6\,\mathbf{a}_2 + \left(z_6 + \tfrac{1}{2}\right)\mathbf{a}_3 = -ax_6\,\hat{\mathbf{x}} - ay_6\,\hat{\mathbf{y}} + c\left(z_6 + \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni IV}$$

$$\mathbf{B}_{35} = -\left(y_6 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(x_6 + \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_6 + \tfrac{1}{4}\right)\mathbf{a}_3 = -a\left(y_6 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(x_6 + \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_6 + \tfrac{1}{4}\right)\hat{\mathbf{z}} \qquad (8b) \qquad \text{Ni IV}$$

$$\mathbf{B_{36}} = \left(y_6 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(x_6 - \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_6 + \tfrac{3}{4}\right)\mathbf{a}_3 = a\left(y_6 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(x_6 - \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_6 + \tfrac{3}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Ni IV}$$

$$\mathbf{B_{37}} = -\left(x_6 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(y_6 + \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_6 - \tfrac{1}{4}\right)\mathbf{a}_3 = -a\left(x_6 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(y_6 + \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_6 - \tfrac{1}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Ni IV}$$

$$\mathbf{B_{38}} = \left(x_6 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(y_6 - \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_6 - \tfrac{3}{4}\right)\mathbf{a}_3 = a\left(x_6 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(y_6 - \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_6 - \tfrac{3}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Ni IV}$$

$$\mathbf{B_{39}} = y_6\,\mathbf{a}_1 + x_6\,\mathbf{a}_2 - z_6\,\mathbf{a}_3 = ay_6\,\hat{\mathbf{x}} + ax_6\,\hat{\mathbf{y}} - cz_6\,\hat{\mathbf{z}} \quad (8b) \quad \text{Ni IV}$$

$$\mathbf{B_{40}} = -y_6\,\mathbf{a}_1 - x_6\,\mathbf{a}_2 - \left(z_6 - \tfrac{1}{2}\right)\mathbf{a}_3 = -ay_6\,\hat{\mathbf{x}} - ax_6\,\hat{\mathbf{y}} - c\left(z_6 - \tfrac{1}{2}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Ni IV}$$

$$\mathbf{B_{41}} = x_7\,\mathbf{a}_1 + y_7\,\mathbf{a}_2 + z_7\,\mathbf{a}_3 = ax_7\,\hat{\mathbf{x}} + ay_7\,\hat{\mathbf{y}} + cz_7\,\hat{\mathbf{z}} \quad (8b) \quad \text{Y III}$$

$$\mathbf{B_{42}} = -x_7\,\mathbf{a}_1 - y_7\,\mathbf{a}_2 + \left(z_7 + \tfrac{1}{2}\right)\mathbf{a}_3 = -ax_7\,\hat{\mathbf{x}} - ay_7\,\hat{\mathbf{y}} + c\left(z_7 + \tfrac{1}{2}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y III}$$

$$\mathbf{B_{43}} = -\left(y_7 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(x_7 + \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_7 + \tfrac{1}{4}\right)\mathbf{a}_3 = -a\left(y_7 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(x_7 + \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_7 + \tfrac{1}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y III}$$

$$\mathbf{B_{44}} = \left(y_7 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(x_7 - \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_7 + \tfrac{3}{4}\right)\mathbf{a}_3 = a\left(y_7 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(x_7 - \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_7 + \tfrac{3}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y III}$$

$$\mathbf{B_{45}} = -\left(x_7 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(y_7 + \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_7 - \tfrac{1}{4}\right)\mathbf{a}_3 = -a\left(x_7 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(y_7 + \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_7 - \tfrac{1}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y III}$$

$$\mathbf{B_{46}} = \left(x_7 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(y_7 - \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_7 - \tfrac{3}{4}\right)\mathbf{a}_3 = a\left(x_7 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(y_7 - \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_7 - \tfrac{3}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y III}$$

$$\mathbf{B_{47}} = y_7\,\mathbf{a}_1 + x_7\,\mathbf{a}_2 - z_7\,\mathbf{a}_3 = ay_7\,\hat{\mathbf{x}} + ax_7\,\hat{\mathbf{y}} - cz_7\,\hat{\mathbf{z}} \quad (8b) \quad \text{Y III}$$

$$\mathbf{B_{48}} = -y_7\,\mathbf{a}_1 - x_7\,\mathbf{a}_2 - \left(z_7 - \tfrac{1}{2}\right)\mathbf{a}_3 = -ay_7\,\hat{\mathbf{x}} - ax_7\,\hat{\mathbf{y}} - c\left(z_7 - \tfrac{1}{2}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y III}$$

$$\mathbf{B_{49}} = x_8\,\mathbf{a}_1 + y_8\,\mathbf{a}_2 + z_8\,\mathbf{a}_3 = ax_8\,\hat{\mathbf{x}} + ay_8\,\hat{\mathbf{y}} + cz_8\,\hat{\mathbf{z}} \quad (8b) \quad \text{Y IV}$$

$$\mathbf{B_{50}} = -x_8\,\mathbf{a}_1 - y_8\,\mathbf{a}_2 + \left(z_8 + \tfrac{1}{2}\right)\mathbf{a}_3 = -ax_8\,\hat{\mathbf{x}} - ay_8\,\hat{\mathbf{y}} + c\left(z_8 + \tfrac{1}{2}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y IV}$$

$$\mathbf{B_{51}} = -\left(y_8 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(x_8 + \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_8 + \tfrac{1}{4}\right)\mathbf{a}_3 = -a\left(y_8 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(x_8 + \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_8 + \tfrac{1}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y IV}$$

$$\mathbf{B_{52}} = \left(y_8 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(x_8 - \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_8 + \tfrac{3}{4}\right)\mathbf{a}_3 = a\left(y_8 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(x_8 - \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_8 + \tfrac{3}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y IV}$$

$$\mathbf{B_{53}} = -\left(x_8 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(y_8 + \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_8 - \tfrac{1}{4}\right)\mathbf{a}_3 = -a\left(x_8 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(y_8 + \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_8 - \tfrac{1}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y IV}$$

$$\mathbf{B_{54}} = \left(x_8 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(y_8 - \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_8 - \tfrac{3}{4}\right)\mathbf{a}_3 = a\left(x_8 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(y_8 - \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_8 - \tfrac{3}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y IV}$$

$$\mathbf{B_{55}} = y_8\,\mathbf{a}_1 + x_8\,\mathbf{a}_2 - z_8\,\mathbf{a}_3 = ay_8\,\hat{\mathbf{x}} + ax_8\,\hat{\mathbf{y}} - cz_8\,\hat{\mathbf{z}} \quad (8b) \quad \text{Y IV}$$

$$\mathbf{B_{56}} = -y_8\,\mathbf{a}_1 - x_8\,\mathbf{a}_2 - \left(z_8 - \tfrac{1}{2}\right)\mathbf{a}_3 = -ay_8\,\hat{\mathbf{x}} - ax_8\,\hat{\mathbf{y}} - c\left(z_8 - \tfrac{1}{2}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y IV}$$

$$\mathbf{B_{57}} = x_9\,\mathbf{a}_1 + y_9\,\mathbf{a}_2 + z_9\,\mathbf{a}_3 = ax_9\,\hat{\mathbf{x}} + ay_9\,\hat{\mathbf{y}} + cz_9\,\hat{\mathbf{z}} \quad (8b) \quad \text{Y V}$$

$$\mathbf{B_{58}} = -x_9\,\mathbf{a}_1 - y_9\,\mathbf{a}_2 + \left(z_9 + \tfrac{1}{2}\right)\mathbf{a}_3 = -ax_9\,\hat{\mathbf{x}} - ay_9\,\hat{\mathbf{y}} + c\left(z_9 + \tfrac{1}{2}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y V}$$

$$\mathbf{B_{59}} = -\left(y_9 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(x_9 + \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_9 + \tfrac{1}{4}\right)\mathbf{a}_3 = -a\left(y_9 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(x_9 + \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_9 + \tfrac{1}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y V}$$

$$\mathbf{B_{60}} = \left(y_9 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(x_9 - \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_9 + \tfrac{3}{4}\right)\mathbf{a}_3 = a\left(y_9 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(x_9 - \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_9 + \tfrac{3}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y V}$$

$$\mathbf{B_{61}} = -\left(x_9 - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(y_9 + \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_9 - \tfrac{1}{4}\right)\mathbf{a}_3 = -a\left(x_9 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(y_9 + \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_9 - \tfrac{1}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y V}$$

$$\mathbf{B_{62}} = \left(x_9 + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(y_9 - \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_9 - \tfrac{3}{4}\right)\mathbf{a}_3 = a\left(x_9 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(y_9 - \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_9 - \tfrac{3}{4}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y V}$$

$$\mathbf{B_{63}} = y_9\,\mathbf{a}_1 + x_9\,\mathbf{a}_2 - z_9\,\mathbf{a}_3 = ay_9\,\hat{\mathbf{x}} + ax_9\,\hat{\mathbf{y}} - cz_9\,\hat{\mathbf{z}} \quad (8b) \quad \text{Y V}$$

$$\mathbf{B_{64}} = -y_9\,\mathbf{a}_1 - x_9\,\mathbf{a}_2 - \left(z_9 - \tfrac{1}{2}\right)\mathbf{a}_3 = -ay_9\,\hat{\mathbf{x}} - ax_9\,\hat{\mathbf{y}} - c\left(z_9 - \tfrac{1}{2}\right)\hat{\mathbf{z}} \quad (8b) \quad \text{Y V}$$

$$\mathbf{B_{65}} = x_{10}\,\mathbf{a}_1 + y_{10}\,\mathbf{a}_2 + z_{10}\,\mathbf{a}_3 = ax_{10}\,\hat{\mathbf{x}} + ay_{10}\,\hat{\mathbf{y}} + cz_{10}\,\hat{\mathbf{z}} \quad (8b) \quad \text{Y VI}$$

$$\mathbf{B_{66}} = -x_{10}\,\mathbf{a}_1 - y_{10}\,\mathbf{a}_2 + \left(z_{10} + \tfrac{1}{2}\right)\mathbf{a}_3 \quad = \quad -ax_{10}\,\hat{\mathbf{x}} - ay_{10}\,\hat{\mathbf{y}} + c\left(z_{10} + \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VI}$$

$$\mathbf{B_{67}} = -\left(y_{10} - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(x_{10} + \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_{10} + \tfrac{1}{4}\right)\mathbf{a}_3 \quad = \quad -a\left(y_{10} - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(x_{10} + \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_{10} + \tfrac{1}{4}\right)\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VI}$$

$$\mathbf{B_{68}} = \left(y_{10} + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(x_{10} - \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_{10} + \tfrac{3}{4}\right)\mathbf{a}_3 \quad = \quad a\left(y_{10} + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(x_{10} - \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_{10} + \tfrac{3}{4}\right)\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VI}$$

$$\mathbf{B_{69}} = -\left(x_{10} - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(y_{10} + \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_{10} - \tfrac{1}{4}\right)\mathbf{a}_3 \quad = \quad -a\left(x_{10} - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(y_{10} + \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_{10} - \tfrac{1}{4}\right)\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VI}$$

$$\mathbf{B_{70}} = \left(x_{10} + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(y_{10} - \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_{10} - \tfrac{3}{4}\right)\mathbf{a}_3 \quad = \quad a\left(x_{10} + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(y_{10} - \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_{10} - \tfrac{3}{4}\right)\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VI}$$

$$\mathbf{B_{71}} = y_{10}\,\mathbf{a}_1 + x_{10}\,\mathbf{a}_2 - z_{10}\,\mathbf{a}_3 \quad = \quad ay_{10}\,\hat{\mathbf{x}} + ax_{10}\,\hat{\mathbf{y}} - cz_{10}\,\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VI}$$

$$\mathbf{B_{72}} = -y_{10}\,\mathbf{a}_1 - x_{10}\,\mathbf{a}_2 - \left(z_{10} - \tfrac{1}{2}\right)\mathbf{a}_3 \quad = \quad -ay_{10}\,\hat{\mathbf{x}} - ax_{10}\,\hat{\mathbf{y}} - c\left(z_{10} - \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VI}$$

$$\mathbf{B_{73}} = x_{11}\,\mathbf{a}_1 + y_{11}\,\mathbf{a}_2 + z_{11}\,\mathbf{a}_3 \quad = \quad ax_{11}\,\hat{\mathbf{x}} + ay_{11}\,\hat{\mathbf{y}} + cz_{11}\,\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VII}$$

$$\mathbf{B_{74}} = -x_{11}\,\mathbf{a}_1 - y_{11}\,\mathbf{a}_2 + \left(z_{11} + \tfrac{1}{2}\right)\mathbf{a}_3 \quad = \quad -ax_{11}\,\hat{\mathbf{x}} - ay_{11}\,\hat{\mathbf{y}} + c\left(z_{11} + \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VII}$$

$$\mathbf{B_{75}} = -\left(y_{11} - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(x_{11} + \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_{11} + \tfrac{1}{4}\right)\mathbf{a}_3 \quad = \quad -a\left(y_{11} - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(x_{11} + \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_{11} + \tfrac{1}{4}\right)\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VII}$$

$$\mathbf{B_{76}} = \left(y_{11} + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(x_{11} - \tfrac{1}{2}\right)\mathbf{a}_2 + \left(z_{11} + \tfrac{3}{4}\right)\mathbf{a}_3 \quad = \quad a\left(y_{11} + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(x_{11} - \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_{11} + \tfrac{3}{4}\right)\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VII}$$

$$\mathbf{B_{77}} = -\left(x_{11} - \tfrac{1}{2}\right)\mathbf{a}_1 + \left(y_{11} + \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_{11} - \tfrac{1}{4}\right)\mathbf{a}_3 \quad = \quad -a\left(x_{11} - \tfrac{1}{2}\right)\hat{\mathbf{x}} + a\left(y_{11} + \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_{11} - \tfrac{1}{4}\right)\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VII}$$

$$\mathbf{B_{78}} = \left(x_{11} + \tfrac{1}{2}\right)\mathbf{a}_1 - \left(y_{11} - \tfrac{1}{2}\right)\mathbf{a}_2 - \left(z_{11} - \tfrac{3}{4}\right)\mathbf{a}_3 \quad = \quad a\left(x_{11} + \tfrac{1}{2}\right)\hat{\mathbf{x}} - a\left(y_{11} - \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_{11} - \tfrac{3}{4}\right)\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VII}$$

$$\mathbf{B_{79}} = y_{11}\,\mathbf{a}_1 + x_{11}\,\mathbf{a}_2 - z_{11}\,\mathbf{a}_3 \quad = \quad ay_{11}\,\hat{\mathbf{x}} + ax_{11}\,\hat{\mathbf{y}} - cz_{11}\,\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VII}$$

$$\mathbf{B_{80}} = -y_{11}\,\mathbf{a}_1 - x_{11}\,\mathbf{a}_2 - \left(z_{11} - \tfrac{1}{2}\right)\mathbf{a}_3 \quad = \quad -ay_{11}\,\hat{\mathbf{x}} - ax_{11}\,\hat{\mathbf{y}} - c\left(z_{11} - \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8b)} \qquad \text{Y VII}$$

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