$(CdSO_4)_3{\cdot}8H_2O$ ($H4_{20}$) Structure: A3B16C20D3_mC168_15_ef_8f_10f_ef-001

This structure previously used the label(s) `A3B16C20D3_mC168_15_ef_8f_10f_ef`. Calls to these addresses will be redirected here.

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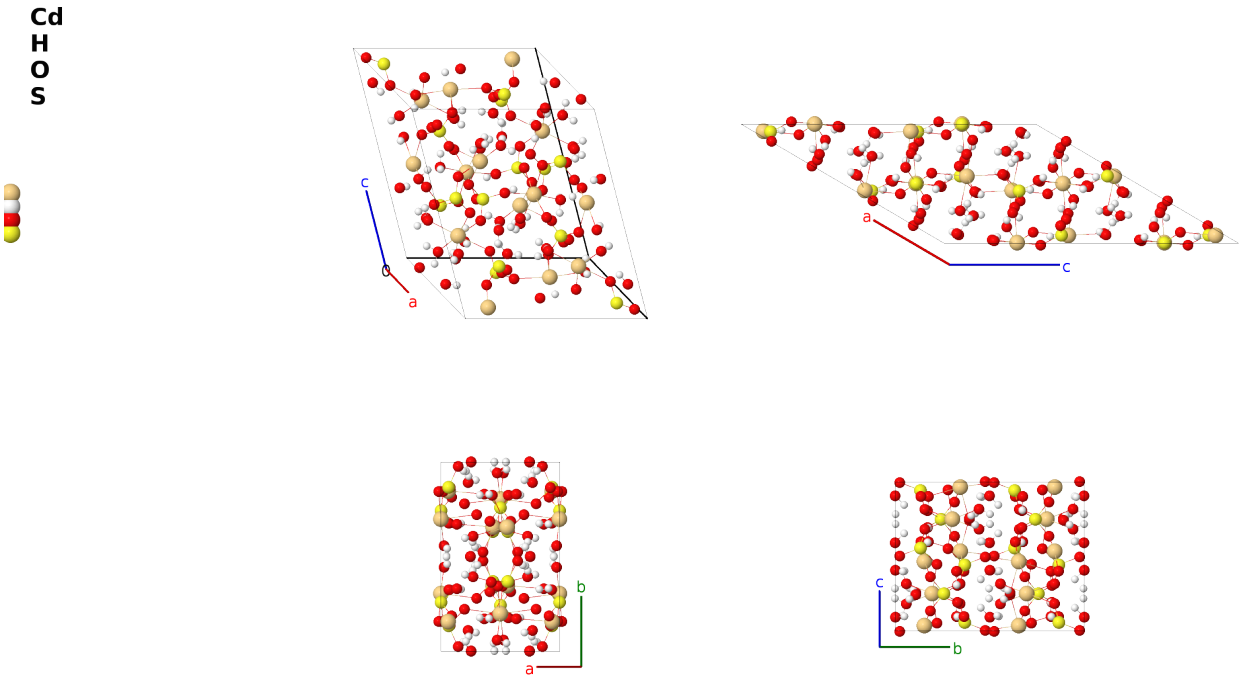
https://aflow.org/prototype-encyclopedia/VXAE

https://aflow.org/prototype-encyclopedia/A3B16C20D3_mC168_15_ef_8f_10f_ef-001

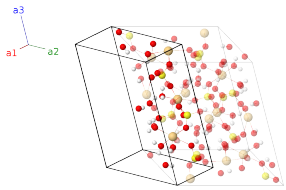


Prototype	$Cd_3H_{16}O_{20}S_3$
AFLOW prototype label	A3B16C20D3_mC168_15_ef_8f_10f_ef-001
***Strukturbericht* designation**	$H4_{20}$
ICSD	24400
CCDC	1600438
Pearson symbol	mC168
Space group number	15
Space group symbol	$C2/c$
AFLOW prototype command	`aflow --proto=A3B16C20D3_mC168_15_ef_8f_10f_ef-001 --params=`$a, b/a, c/a, \beta, y_1, y_2, x_3, y_3, z_3, x_4, y_4, z_4, x_5, y_5, z_5, x_6, y_6, z_6, x_7, y_7, z_7, x_8, y_8, z_8, x_9, y_9, z_9, x_{10}, y_{10}, z_{10}, x_{11}, y_{11}, z_{11}, x_{12}, y_{12}, z_{12}, x_{13}, y_{13}, z_{13}, x_{14}, y_{14}, z_{14}, x_{15}, y_{15}, z_{15}, x_{16}, y_{16}, z_{16}, x_{17}, y_{17}, z_{17}, x_{18}, y_{18}, z_{18}, x_{19}, y_{19}, z_{19}, x_{20}, y_{20}, z_{20}, x_{21}, y_{21}, z_{21}, x_{22}, y_{22}, z_{22}$

- (Lipson, 1938) originally found this structure and (Gottfried, 1938) gave it the *Strukturbericht* designation $H4_{20}$. Later (Caminiti, 1981) located the hydrogen atoms. As this does not change the rest of the structure we use their results.
- Some of the H-O distances appear to be very small. For example, the O-VIII – H-III distance is only 0.43Å. We have checked our inputs compared to (Caminiti, 1981) and found no error. Unfortunately they do not provide H-O distances for comparison.

Base-centered Monoclinic primitive vectors

$$\begin{aligned}
\mathbf{a_1} &= \tfrac{1}{2}a\,\hat{\mathbf{x}} - \tfrac{1}{2}b\,\hat{\mathbf{y}} \\
\mathbf{a_2} &= \tfrac{1}{2}a\,\hat{\mathbf{x}} + \tfrac{1}{2}b\,\hat{\mathbf{y}} \\
\mathbf{a_3} &= c\cos\beta\,\hat{\mathbf{x}} + c\sin\beta\,\hat{\mathbf{z}}
\end{aligned}$$



Basis vectors

		Lattice coordinates		Cartesian coordinates	Wyckoff position	Atom type
$\mathbf{B_1}$	=	$-y_1\,\mathbf{a}_1 + y_1\,\mathbf{a}_2 + \frac{1}{4}\,\mathbf{a}_3$	=	$\frac{1}{4}c\cos\beta\,\hat{\mathbf{x}} + by_1\,\hat{\mathbf{y}} + \frac{1}{4}c\sin\beta\,\hat{\mathbf{z}}$	(4e)	Cd I
$\mathbf{B_2}$	=	$y_1\,\mathbf{a}_1 - y_1\,\mathbf{a}_2 + \frac{3}{4}\,\mathbf{a}_3$	=	$\frac{3}{4}c\cos\beta\,\hat{\mathbf{x}} - by_1\,\hat{\mathbf{y}} + \frac{3}{4}c\sin\beta\,\hat{\mathbf{z}}$	(4e)	Cd I
$\mathbf{B_3}$	=	$-y_2\,\mathbf{a}_1 + y_2\,\mathbf{a}_2 + \frac{1}{4}\,\mathbf{a}_3$	=	$\frac{1}{4}c\cos\beta\,\hat{\mathbf{x}} + by_2\,\hat{\mathbf{y}} + \frac{1}{4}c\sin\beta\,\hat{\mathbf{z}}$	(4e)	S I
$\mathbf{B_4}$	=	$y_2\,\mathbf{a}_1 - y_2\,\mathbf{a}_2 + \frac{3}{4}\,\mathbf{a}_3$	=	$\frac{3}{4}c\cos\beta\,\hat{\mathbf{x}} - by_2\,\hat{\mathbf{y}} + \frac{3}{4}c\sin\beta\,\hat{\mathbf{z}}$	(4e)	S I
$\mathbf{B_5}$	=	$(x_3 - y_3)\,\mathbf{a}_1 + (x_3 + y_3)\,\mathbf{a}_2 + z_3\,\mathbf{a}_3$	=	$(ax_3 + cz_3\cos\beta)\,\hat{\mathbf{x}} + by_3\,\hat{\mathbf{y}} + cz_3\sin\beta\,\hat{\mathbf{z}}$	(8f)	Cd II
$\mathbf{B_6}$	=	$-(x_3 + y_3)\,\mathbf{a}_1 - (x_3 - y_3)\,\mathbf{a}_2 - \left(z_3 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_3 + c\left(z_3 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_3\,\hat{\mathbf{y}} - c\left(z_3 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(8f)	Cd II
$\mathbf{B_7}$	=	$-(x_3 - y_3)\,\mathbf{a}_1 - (x_3 + y_3)\,\mathbf{a}_2 - z_3\,\mathbf{a}_3$	=	$-(ax_3 + cz_3\cos\beta)\,\hat{\mathbf{x}} - by_3\,\hat{\mathbf{y}} - cz_3\sin\beta\,\hat{\mathbf{z}}$	(8f)	Cd II
$\mathbf{B_8}$	=	$(x_3 + y_3)\,\mathbf{a}_1 + (x_3 - y_3)\,\mathbf{a}_2 + \left(z_3 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_3 + c\left(z_3 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_3\,\hat{\mathbf{y}} + c\left(z_3 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(8f)	Cd II
$\mathbf{B_9}$	=	$(x_4 - y_4)\,\mathbf{a}_1 + (x_4 + y_4)\,\mathbf{a}_2 + z_4\,\mathbf{a}_3$	=	$(ax_4 + cz_4\cos\beta)\,\hat{\mathbf{x}} + by_4\,\hat{\mathbf{y}} + cz_4\sin\beta\,\hat{\mathbf{z}}$	(8f)	H I
$\mathbf{B_{10}}$	=	$-(x_4 + y_4)\,\mathbf{a}_1 - (x_4 - y_4)\,\mathbf{a}_2 - \left(z_4 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_4 + c\left(z_4 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_4\,\hat{\mathbf{y}} - c\left(z_4 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(8f)	H I
$\mathbf{B_{11}}$	=	$-(x_4 - y_4)\,\mathbf{a}_1 - (x_4 + y_4)\,\mathbf{a}_2 - z_4\,\mathbf{a}_3$	=	$-(ax_4 + cz_4\cos\beta)\,\hat{\mathbf{x}} - by_4\,\hat{\mathbf{y}} - cz_4\sin\beta\,\hat{\mathbf{z}}$	(8f)	H I
$\mathbf{B_{12}}$	=	$(x_4 + y_4)\,\mathbf{a}_1 + (x_4 - y_4)\,\mathbf{a}_2 + \left(z_4 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_4 + c\left(z_4 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_4\,\hat{\mathbf{y}} + c\left(z_4 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(8f)	H I
$\mathbf{B_{13}}$	=	$(x_5 - y_5)\,\mathbf{a}_1 + (x_5 + y_5)\,\mathbf{a}_2 + z_5\,\mathbf{a}_3$	=	$(ax_5 + cz_5\cos\beta)\,\hat{\mathbf{x}} + by_5\,\hat{\mathbf{y}} + cz_5\sin\beta\,\hat{\mathbf{z}}$	(8f)	H II
$\mathbf{B_{14}}$	=	$-(x_5 + y_5)\,\mathbf{a}_1 - (x_5 - y_5)\,\mathbf{a}_2 - \left(z_5 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_5 + c\left(z_5 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_5\,\hat{\mathbf{y}} - c\left(z_5 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(8f)	H II
$\mathbf{B_{15}}$	=	$-(x_5 - y_5)\,\mathbf{a}_1 - (x_5 + y_5)\,\mathbf{a}_2 - z_5\,\mathbf{a}_3$	=	$-(ax_5 + cz_5\cos\beta)\,\hat{\mathbf{x}} - by_5\,\hat{\mathbf{y}} - cz_5\sin\beta\,\hat{\mathbf{z}}$	(8f)	H II
$\mathbf{B_{16}}$	=	$(x_5 + y_5)\,\mathbf{a}_1 + (x_5 - y_5)\,\mathbf{a}_2 + \left(z_5 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_5 + c\left(z_5 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_5\,\hat{\mathbf{y}} + c\left(z_5 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(8f)	H II
$\mathbf{B_{17}}$	=	$(x_6 - y_6)\,\mathbf{a}_1 + (x_6 + y_6)\,\mathbf{a}_2 + z_6\,\mathbf{a}_3$	=	$(ax_6 + cz_6\cos\beta)\,\hat{\mathbf{x}} + by_6\,\hat{\mathbf{y}} + cz_6\sin\beta\,\hat{\mathbf{z}}$	(8f)	H III

$$\mathbf{B_{18}} = -(x_6+y_6)\,\mathbf{a}_1-(x_6-y_6)\,\mathbf{a}_2-\left(z_6-\tfrac{1}{2}\right)\mathbf{a}_3 = -\left(ax_6+c\left(z_6-\tfrac{1}{2}\right)\cos\beta\right)\hat{\mathbf{x}}+by_6\,\hat{\mathbf{y}}-c\left(z_6-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H III}$$

$$\mathbf{B_{19}} = -(x_6-y_6)\,\mathbf{a}_1-(x_6+y_6)\,\mathbf{a}_2-z_6\,\mathbf{a}_3 = -(ax_6+cz_6\cos\beta)\,\hat{\mathbf{x}}-by_6\,\hat{\mathbf{y}}-cz_6\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H III}$$

$$\mathbf{B_{20}} = (x_6+y_6)\,\mathbf{a}_1+(x_6-y_6)\,\mathbf{a}_2+\left(z_6+\tfrac{1}{2}\right)\mathbf{a}_3 = \left(ax_6+c\left(z_6+\tfrac{1}{2}\right)\cos\beta\right)\hat{\mathbf{x}}-by_6\,\hat{\mathbf{y}}+c\left(z_6+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H III}$$

$$\mathbf{B_{21}} = (x_7-y_7)\,\mathbf{a}_1+(x_7+y_7)\,\mathbf{a}_2+z_7\,\mathbf{a}_3 = (ax_7+cz_7\cos\beta)\,\hat{\mathbf{x}}+by_7\,\hat{\mathbf{y}}+cz_7\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H IV}$$

$$\mathbf{B_{22}} = -(x_7+y_7)\,\mathbf{a}_1-(x_7-y_7)\,\mathbf{a}_2-\left(z_7-\tfrac{1}{2}\right)\mathbf{a}_3 = -\left(ax_7+c\left(z_7-\tfrac{1}{2}\right)\cos\beta\right)\hat{\mathbf{x}}+by_7\,\hat{\mathbf{y}}-c\left(z_7-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H IV}$$

$$\mathbf{B_{23}} = -(x_7-y_7)\,\mathbf{a}_1-(x_7+y_7)\,\mathbf{a}_2-z_7\,\mathbf{a}_3 = -(ax_7+cz_7\cos\beta)\,\hat{\mathbf{x}}-by_7\,\hat{\mathbf{y}}-cz_7\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H IV}$$

$$\mathbf{B_{24}} = (x_7+y_7)\,\mathbf{a}_1+(x_7-y_7)\,\mathbf{a}_2+\left(z_7+\tfrac{1}{2}\right)\mathbf{a}_3 = \left(ax_7+c\left(z_7+\tfrac{1}{2}\right)\cos\beta\right)\hat{\mathbf{x}}-by_7\,\hat{\mathbf{y}}+c\left(z_7+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H IV}$$

$$\mathbf{B_{25}} = (x_8-y_8)\,\mathbf{a}_1+(x_8+y_8)\,\mathbf{a}_2+z_8\,\mathbf{a}_3 = (ax_8+cz_8\cos\beta)\,\hat{\mathbf{x}}+by_8\,\hat{\mathbf{y}}+cz_8\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H V}$$

$$\mathbf{B_{26}} = -(x_8+y_8)\,\mathbf{a}_1-(x_8-y_8)\,\mathbf{a}_2-\left(z_8-\tfrac{1}{2}\right)\mathbf{a}_3 = -\left(ax_8+c\left(z_8-\tfrac{1}{2}\right)\cos\beta\right)\hat{\mathbf{x}}+by_8\,\hat{\mathbf{y}}-c\left(z_8-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H V}$$

$$\mathbf{B_{27}} = -(x_8-y_8)\,\mathbf{a}_1-(x_8+y_8)\,\mathbf{a}_2-z_8\,\mathbf{a}_3 = -(ax_8+cz_8\cos\beta)\,\hat{\mathbf{x}}-by_8\,\hat{\mathbf{y}}-cz_8\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H V}$$

$$\mathbf{B_{28}} = (x_8+y_8)\,\mathbf{a}_1+(x_8-y_8)\,\mathbf{a}_2+\left(z_8+\tfrac{1}{2}\right)\mathbf{a}_3 = \left(ax_8+c\left(z_8+\tfrac{1}{2}\right)\cos\beta\right)\hat{\mathbf{x}}-by_8\,\hat{\mathbf{y}}+c\left(z_8+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H V}$$

$$\mathbf{B_{29}} = (x_9-y_9)\,\mathbf{a}_1+(x_9+y_9)\,\mathbf{a}_2+z_9\,\mathbf{a}_3 = (ax_9+cz_9\cos\beta)\,\hat{\mathbf{x}}+by_9\,\hat{\mathbf{y}}+cz_9\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H VI}$$

$$\mathbf{B_{30}} = -(x_9+y_9)\,\mathbf{a}_1-(x_9-y_9)\,\mathbf{a}_2-\left(z_9-\tfrac{1}{2}\right)\mathbf{a}_3 = -\left(ax_9+c\left(z_9-\tfrac{1}{2}\right)\cos\beta\right)\hat{\mathbf{x}}+by_9\,\hat{\mathbf{y}}-c\left(z_9-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H VI}$$

$$\mathbf{B_{31}} = -(x_9-y_9)\,\mathbf{a}_1-(x_9+y_9)\,\mathbf{a}_2-z_9\,\mathbf{a}_3 = -(ax_9+cz_9\cos\beta)\,\hat{\mathbf{x}}-by_9\,\hat{\mathbf{y}}-cz_9\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H VI}$$

$$\mathbf{B_{32}} = (x_9+y_9)\,\mathbf{a}_1+(x_9-y_9)\,\mathbf{a}_2+\left(z_9+\tfrac{1}{2}\right)\mathbf{a}_3 = \left(ax_9+c\left(z_9+\tfrac{1}{2}\right)\cos\beta\right)\hat{\mathbf{x}}-by_9\,\hat{\mathbf{y}}+c\left(z_9+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H VI}$$

$$\mathbf{B_{33}} = (x_{10}-y_{10})\,\mathbf{a}_1+(x_{10}+y_{10})\,\mathbf{a}_2+z_{10}\,\mathbf{a}_3 = (ax_{10}+cz_{10}\cos\beta)\,\hat{\mathbf{x}}+by_{10}\,\hat{\mathbf{y}}+cz_{10}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H VII}$$

$$\mathbf{B_{34}} = -(x_{10}+y_{10})\,\mathbf{a}_1-(x_{10}-y_{10})\,\mathbf{a}_2-\left(z_{10}-\tfrac{1}{2}\right)\mathbf{a}_3 = -\left(ax_{10}+c\left(z_{10}-\tfrac{1}{2}\right)\cos\beta\right)\hat{\mathbf{x}}+by_{10}\,\hat{\mathbf{y}}-c\left(z_{10}-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H VII}$$

$$\mathbf{B_{35}} = -(x_{10}-y_{10})\,\mathbf{a}_1-(x_{10}+y_{10})\,\mathbf{a}_2-z_{10}\,\mathbf{a}_3 = -(ax_{10}+cz_{10}\cos\beta)\,\hat{\mathbf{x}}-by_{10}\,\hat{\mathbf{y}}-cz_{10}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H VII}$$

$$\mathbf{B_{36}} = (x_{10}+y_{10})\,\mathbf{a}_1+(x_{10}-y_{10})\,\mathbf{a}_2+\left(z_{10}+\tfrac{1}{2}\right)\mathbf{a}_3 = \left(ax_{10}+c\left(z_{10}+\tfrac{1}{2}\right)\cos\beta\right)\hat{\mathbf{x}}-by_{10}\,\hat{\mathbf{y}}+c\left(z_{10}+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H VII}$$

$$\mathbf{B_{37}} = (x_{11}-y_{11})\,\mathbf{a}_1+(x_{11}+y_{11})\,\mathbf{a}_2+z_{11}\,\mathbf{a}_3 = (ax_{11}+cz_{11}\cos\beta)\,\hat{\mathbf{x}}+by_{11}\,\hat{\mathbf{y}}+cz_{11}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H VIII}$$

$$\mathbf{B_{38}} = -(x_{11}+y_{11})\,\mathbf{a}_1-(x_{11}-y_{11})\,\mathbf{a}_2-\left(z_{11}-\tfrac{1}{2}\right)\mathbf{a}_3 = -\left(ax_{11}+c\left(z_{11}-\tfrac{1}{2}\right)\cos\beta\right)\hat{\mathbf{x}}+by_{11}\,\hat{\mathbf{y}}-c\left(z_{11}-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H VIII}$$

$$\mathbf{B_{39}} = -(x_{11}-y_{11})\,\mathbf{a}_1-(x_{11}+y_{11})\,\mathbf{a}_2-z_{11}\,\mathbf{a}_3 = -(ax_{11}+cz_{11}\cos\beta)\,\hat{\mathbf{x}}-by_{11}\,\hat{\mathbf{y}}-cz_{11}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H VIII}$$

$$\mathbf{B_{40}} = (x_{11}+y_{11})\,\mathbf{a}_1+(x_{11}-y_{11})\,\mathbf{a}_2+\left(z_{11}+\tfrac{1}{2}\right)\mathbf{a}_3 = \left(ax_{11}+c\left(z_{11}+\tfrac{1}{2}\right)\cos\beta\right)\hat{\mathbf{x}}-by_{11}\,\hat{\mathbf{y}}+c\left(z_{11}+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{H VIII}$$

$$\mathbf{B_{41}} = (x_{12}-y_{12})\,\mathbf{a}_1 + (x_{12}+y_{12})\,\mathbf{a}_2 + z_{12}\,\mathbf{a}_3 = (ax_{12}+cz_{12}\cos\beta)\,\hat{\mathbf{x}} + by_{12}\,\hat{\mathbf{y}} + cz_{12}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O I}$$

$$\mathbf{B_{42}} = -(x_{12}+y_{12})\,\mathbf{a}_1 - (x_{12}-y_{12})\,\mathbf{a}_2 - \left(z_{12}-\tfrac{1}{2}\right)\,\mathbf{a}_3 = -\left(ax_{12}+c\left(z_{12}-\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{12}\,\hat{\mathbf{y}} - c\left(z_{12}-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O I}$$

$$\mathbf{B_{43}} = -(x_{12}-y_{12})\,\mathbf{a}_1 - (x_{12}+y_{12})\,\mathbf{a}_2 - z_{12}\,\mathbf{a}_3 = -(ax_{12}+cz_{12}\cos\beta)\,\hat{\mathbf{x}} - by_{12}\,\hat{\mathbf{y}} - cz_{12}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O I}$$

$$\mathbf{B_{44}} = (x_{12}+y_{12})\,\mathbf{a}_1 + (x_{12}-y_{12})\,\mathbf{a}_2 + \left(z_{12}+\tfrac{1}{2}\right)\,\mathbf{a}_3 = \left(ax_{12}+c\left(z_{12}+\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{12}\,\hat{\mathbf{y}} + c\left(z_{12}+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O I}$$

$$\mathbf{B_{45}} = (x_{13}-y_{13})\,\mathbf{a}_1 + (x_{13}+y_{13})\,\mathbf{a}_2 + z_{13}\,\mathbf{a}_3 = (ax_{13}+cz_{13}\cos\beta)\,\hat{\mathbf{x}} + by_{13}\,\hat{\mathbf{y}} + cz_{13}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O II}$$

$$\mathbf{B_{46}} = -(x_{13}+y_{13})\,\mathbf{a}_1 - (x_{13}-y_{13})\,\mathbf{a}_2 - \left(z_{13}-\tfrac{1}{2}\right)\,\mathbf{a}_3 = -\left(ax_{13}+c\left(z_{13}-\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{13}\,\hat{\mathbf{y}} - c\left(z_{13}-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O II}$$

$$\mathbf{B_{47}} = -(x_{13}-y_{13})\,\mathbf{a}_1 - (x_{13}+y_{13})\,\mathbf{a}_2 - z_{13}\,\mathbf{a}_3 = -(ax_{13}+cz_{13}\cos\beta)\,\hat{\mathbf{x}} - by_{13}\,\hat{\mathbf{y}} - cz_{13}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O II}$$

$$\mathbf{B_{48}} = (x_{13}+y_{13})\,\mathbf{a}_1 + (x_{13}-y_{13})\,\mathbf{a}_2 + \left(z_{13}+\tfrac{1}{2}\right)\,\mathbf{a}_3 = \left(ax_{13}+c\left(z_{13}+\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{13}\,\hat{\mathbf{y}} + c\left(z_{13}+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O II}$$

$$\mathbf{B_{49}} = (x_{14}-y_{14})\,\mathbf{a}_1 + (x_{14}+y_{14})\,\mathbf{a}_2 + z_{14}\,\mathbf{a}_3 = (ax_{14}+cz_{14}\cos\beta)\,\hat{\mathbf{x}} + by_{14}\,\hat{\mathbf{y}} + cz_{14}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O III}$$

$$\mathbf{B_{50}} = -(x_{14}+y_{14})\,\mathbf{a}_1 - (x_{14}-y_{14})\,\mathbf{a}_2 - \left(z_{14}-\tfrac{1}{2}\right)\,\mathbf{a}_3 = -\left(ax_{14}+c\left(z_{14}-\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{14}\,\hat{\mathbf{y}} - c\left(z_{14}-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O III}$$

$$\mathbf{B_{51}} = -(x_{14}-y_{14})\,\mathbf{a}_1 - (x_{14}+y_{14})\,\mathbf{a}_2 - z_{14}\,\mathbf{a}_3 = -(ax_{14}+cz_{14}\cos\beta)\,\hat{\mathbf{x}} - by_{14}\,\hat{\mathbf{y}} - cz_{14}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O III}$$

$$\mathbf{B_{52}} = (x_{14}+y_{14})\,\mathbf{a}_1 + (x_{14}-y_{14})\,\mathbf{a}_2 + \left(z_{14}+\tfrac{1}{2}\right)\,\mathbf{a}_3 = \left(ax_{14}+c\left(z_{14}+\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{14}\,\hat{\mathbf{y}} + c\left(z_{14}+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O III}$$

$$\mathbf{B_{53}} = (x_{15}-y_{15})\,\mathbf{a}_1 + (x_{15}+y_{15})\,\mathbf{a}_2 + z_{15}\,\mathbf{a}_3 = (ax_{15}+cz_{15}\cos\beta)\,\hat{\mathbf{x}} + by_{15}\,\hat{\mathbf{y}} + cz_{15}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O IV}$$

$$\mathbf{B_{54}} = -(x_{15}+y_{15})\,\mathbf{a}_1 - (x_{15}-y_{15})\,\mathbf{a}_2 - \left(z_{15}-\tfrac{1}{2}\right)\,\mathbf{a}_3 = -\left(ax_{15}+c\left(z_{15}-\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{15}\,\hat{\mathbf{y}} - c\left(z_{15}-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O IV}$$

$$\mathbf{B_{55}} = -(x_{15}-y_{15})\,\mathbf{a}_1 - (x_{15}+y_{15})\,\mathbf{a}_2 - z_{15}\,\mathbf{a}_3 = -(ax_{15}+cz_{15}\cos\beta)\,\hat{\mathbf{x}} - by_{15}\,\hat{\mathbf{y}} - cz_{15}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O IV}$$

$$\mathbf{B_{56}} = (x_{15}+y_{15})\,\mathbf{a}_1 + (x_{15}-y_{15})\,\mathbf{a}_2 + \left(z_{15}+\tfrac{1}{2}\right)\,\mathbf{a}_3 = \left(ax_{15}+c\left(z_{15}+\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{15}\,\hat{\mathbf{y}} + c\left(z_{15}+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O IV}$$

$$\mathbf{B_{57}} = (x_{16}-y_{16})\,\mathbf{a}_1 + (x_{16}+y_{16})\,\mathbf{a}_2 + z_{16}\,\mathbf{a}_3 = (ax_{16}+cz_{16}\cos\beta)\,\hat{\mathbf{x}} + by_{16}\,\hat{\mathbf{y}} + cz_{16}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O V}$$

$$\mathbf{B_{58}} = -(x_{16}+y_{16})\,\mathbf{a}_1 - (x_{16}-y_{16})\,\mathbf{a}_2 - \left(z_{16}-\tfrac{1}{2}\right)\,\mathbf{a}_3 = -\left(ax_{16}+c\left(z_{16}-\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{16}\,\hat{\mathbf{y}} - c\left(z_{16}-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O V}$$

$$\mathbf{B_{59}} = -(x_{16}-y_{16})\,\mathbf{a}_1 - (x_{16}+y_{16})\,\mathbf{a}_2 - z_{16}\,\mathbf{a}_3 = -(ax_{16}+cz_{16}\cos\beta)\,\hat{\mathbf{x}} - by_{16}\,\hat{\mathbf{y}} - cz_{16}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O V}$$

$$\mathbf{B_{60}} = (x_{16}+y_{16})\,\mathbf{a}_1 + (x_{16}-y_{16})\,\mathbf{a}_2 + \left(z_{16}+\tfrac{1}{2}\right)\,\mathbf{a}_3 = \left(ax_{16}+c\left(z_{16}+\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{16}\,\hat{\mathbf{y}} + c\left(z_{16}+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O V}$$

$$\mathbf{B_{61}} = (x_{17}-y_{17})\,\mathbf{a}_1 + (x_{17}+y_{17})\,\mathbf{a}_2 + z_{17}\,\mathbf{a}_3 = (ax_{17}+cz_{17}\cos\beta)\,\hat{\mathbf{x}} + by_{17}\,\hat{\mathbf{y}} + cz_{17}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O VI}$$

$$\mathbf{B_{62}} = -(x_{17}+y_{17})\,\mathbf{a}_1 - (x_{17}-y_{17})\,\mathbf{a}_2 - \left(z_{17}-\tfrac{1}{2}\right)\,\mathbf{a}_3 = -\left(ax_{17}+c\left(z_{17}-\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{17}\,\hat{\mathbf{y}} - c\left(z_{17}-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O VI}$$

$$\mathbf{B_{63}} = -(x_{17}-y_{17})\,\mathbf{a}_1 - (x_{17}+y_{17})\,\mathbf{a}_2 - z_{17}\,\mathbf{a}_3 = -(ax_{17}+cz_{17}\cos\beta)\,\hat{\mathbf{x}} - by_{17}\,\hat{\mathbf{y}} - cz_{17}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O VI}$$

$$\mathbf{B_{64}} = (x_{17}+y_{17})\,\mathbf{a}_1 + (x_{17}-y_{17})\,\mathbf{a}_2 + \left(z_{17}+\tfrac{1}{2}\right)\,\mathbf{a}_3 = \left(ax_{17} + c\left(z_{17}+\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{17}\,\hat{\mathbf{y}} + c\left(z_{17}+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O VI}$$

$$\mathbf{B_{65}} = (x_{18}-y_{18})\,\mathbf{a}_1 + (x_{18}+y_{18})\,\mathbf{a}_2 + z_{18}\,\mathbf{a}_3 = (ax_{18} + cz_{18}\cos\beta)\,\hat{\mathbf{x}} + by_{18}\,\hat{\mathbf{y}} + cz_{18}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O VII}$$

$$\mathbf{B_{66}} = -(x_{18}+y_{18})\,\mathbf{a}_1 - (x_{18}-y_{18})\,\mathbf{a}_2 - \left(z_{18}-\tfrac{1}{2}\right)\,\mathbf{a}_3 = -\left(ax_{18} + c\left(z_{18}-\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{18}\,\hat{\mathbf{y}} - c\left(z_{18}-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O VII}$$

$$\mathbf{B_{67}} = -(x_{18}-y_{18})\,\mathbf{a}_1 - (x_{18}+y_{18})\,\mathbf{a}_2 - z_{18}\,\mathbf{a}_3 = -(ax_{18} + cz_{18}\cos\beta)\,\hat{\mathbf{x}} - by_{18}\,\hat{\mathbf{y}} - cz_{18}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O VII}$$

$$\mathbf{B_{68}} = (x_{18}+y_{18})\,\mathbf{a}_1 + (x_{18}-y_{18})\,\mathbf{a}_2 + \left(z_{18}+\tfrac{1}{2}\right)\,\mathbf{a}_3 = \left(ax_{18} + c\left(z_{18}+\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{18}\,\hat{\mathbf{y}} + c\left(z_{18}+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O VII}$$

$$\mathbf{B_{69}} = (x_{19}-y_{19})\,\mathbf{a}_1 + (x_{19}+y_{19})\,\mathbf{a}_2 + z_{19}\,\mathbf{a}_3 = (ax_{19} + cz_{19}\cos\beta)\,\hat{\mathbf{x}} + by_{19}\,\hat{\mathbf{y}} + cz_{19}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O VIII}$$

$$\mathbf{B_{70}} = -(x_{19}+y_{19})\,\mathbf{a}_1 - (x_{19}-y_{19})\,\mathbf{a}_2 - \left(z_{19}-\tfrac{1}{2}\right)\,\mathbf{a}_3 = -\left(ax_{19} + c\left(z_{19}-\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{19}\,\hat{\mathbf{y}} - c\left(z_{19}-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O VIII}$$

$$\mathbf{B_{71}} = -(x_{19}-y_{19})\,\mathbf{a}_1 - (x_{19}+y_{19})\,\mathbf{a}_2 - z_{19}\,\mathbf{a}_3 = -(ax_{19} + cz_{19}\cos\beta)\,\hat{\mathbf{x}} - by_{19}\,\hat{\mathbf{y}} - cz_{19}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O VIII}$$

$$\mathbf{B_{72}} = (x_{19}+y_{19})\,\mathbf{a}_1 + (x_{19}-y_{19})\,\mathbf{a}_2 + \left(z_{19}+\tfrac{1}{2}\right)\,\mathbf{a}_3 = \left(ax_{19} + c\left(z_{19}+\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{19}\,\hat{\mathbf{y}} + c\left(z_{19}+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O VIII}$$

$$\mathbf{B_{73}} = (x_{20}-y_{20})\,\mathbf{a}_1 + (x_{20}+y_{20})\,\mathbf{a}_2 + z_{20}\,\mathbf{a}_3 = (ax_{20} + cz_{20}\cos\beta)\,\hat{\mathbf{x}} + by_{20}\,\hat{\mathbf{y}} + cz_{20}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O IX}$$

$$\mathbf{B_{74}} = -(x_{20}+y_{20})\,\mathbf{a}_1 - (x_{20}-y_{20})\,\mathbf{a}_2 - \left(z_{20}-\tfrac{1}{2}\right)\,\mathbf{a}_3 = -\left(ax_{20} + c\left(z_{20}-\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{20}\,\hat{\mathbf{y}} - c\left(z_{20}-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O IX}$$

$$\mathbf{B_{75}} = -(x_{20}-y_{20})\,\mathbf{a}_1 - (x_{20}+y_{20})\,\mathbf{a}_2 - z_{20}\,\mathbf{a}_3 = -(ax_{20} + cz_{20}\cos\beta)\,\hat{\mathbf{x}} - by_{20}\,\hat{\mathbf{y}} - cz_{20}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O IX}$$

$$\mathbf{B_{76}} = (x_{20}+y_{20})\,\mathbf{a}_1 + (x_{20}-y_{20})\,\mathbf{a}_2 + \left(z_{20}+\tfrac{1}{2}\right)\,\mathbf{a}_3 = \left(ax_{20} + c\left(z_{20}+\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{20}\,\hat{\mathbf{y}} + c\left(z_{20}+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O IX}$$

$$\mathbf{B_{77}} = (x_{21}-y_{21})\,\mathbf{a}_1 + (x_{21}+y_{21})\,\mathbf{a}_2 + z_{21}\,\mathbf{a}_3 = (ax_{21} + cz_{21}\cos\beta)\,\hat{\mathbf{x}} + by_{21}\,\hat{\mathbf{y}} + cz_{21}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O X}$$

$$\mathbf{B_{78}} = -(x_{21}+y_{21})\,\mathbf{a}_1 - (x_{21}-y_{21})\,\mathbf{a}_2 - \left(z_{21}-\tfrac{1}{2}\right)\,\mathbf{a}_3 = -\left(ax_{21} + c\left(z_{21}-\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{21}\,\hat{\mathbf{y}} - c\left(z_{21}-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O X}$$

$$\mathbf{B_{79}} = -(x_{21}-y_{21})\,\mathbf{a}_1 - (x_{21}+y_{21})\,\mathbf{a}_2 - z_{21}\,\mathbf{a}_3 = -(ax_{21} + cz_{21}\cos\beta)\,\hat{\mathbf{x}} - by_{21}\,\hat{\mathbf{y}} - cz_{21}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O X}$$

$$\mathbf{B_{80}} = (x_{21}+y_{21})\,\mathbf{a}_1 + (x_{21}-y_{21})\,\mathbf{a}_2 + \left(z_{21}+\tfrac{1}{2}\right)\,\mathbf{a}_3 = \left(ax_{21} + c\left(z_{21}+\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{21}\,\hat{\mathbf{y}} + c\left(z_{21}+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{O X}$$

$$\mathbf{B_{81}} = (x_{22}-y_{22})\,\mathbf{a}_1 + (x_{22}+y_{22})\,\mathbf{a}_2 + z_{22}\,\mathbf{a}_3 = (ax_{22} + cz_{22}\cos\beta)\,\hat{\mathbf{x}} + by_{22}\,\hat{\mathbf{y}} + cz_{22}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{S II}$$

$$\mathbf{B_{82}} = -(x_{22}+y_{22})\,\mathbf{a}_1 - (x_{22}-y_{22})\,\mathbf{a}_2 - \left(z_{22}-\tfrac{1}{2}\right)\,\mathbf{a}_3 = -\left(ax_{22} + c\left(z_{22}-\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{22}\,\hat{\mathbf{y}} - c\left(z_{22}-\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{S II}$$

$$\mathbf{B_{83}} = -(x_{22}-y_{22})\,\mathbf{a}_1 - (x_{22}+y_{22})\,\mathbf{a}_2 - z_{22}\,\mathbf{a}_3 = -(ax_{22} + cz_{22}\cos\beta)\,\hat{\mathbf{x}} - by_{22}\,\hat{\mathbf{y}} - cz_{22}\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{S II}$$

$$\mathbf{B_{84}} = (x_{22}+y_{22})\,\mathbf{a}_1 + (x_{22}-y_{22})\,\mathbf{a}_2 + \left(z_{22}+\tfrac{1}{2}\right)\,\mathbf{a}_3 = \left(ax_{22} + c\left(z_{22}+\tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{22}\,\hat{\mathbf{y}} + c\left(z_{22}+\tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} \quad (8f) \quad \text{S II}$$

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