Orthorhombic $Nb_{12}O_{29}$ Structure: A12B29_oC164_63_6f_3c13f-001

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https://aflow.org/prototype-encyclopedia/V0KX

https://aflow.org/prototype-encyclopedia/A12B29_oC164_63_6f_3c13f-001

Prototype	$Nb_{12}O_{29}$
AFLOW prototype label	A12B29_oC164_63_6f_3c13f-001
ICSD	24089
CCDC	1600139
Pearson symbol	oC164
Space group number	63
Space group symbol	$Cmcm$
AFLOW prototype command	`aflow --proto=A12B29_oC164_63_6f_3c13f-001 --params=`$a, b/a, c/a, y_1, y_2, y_3, y_4, z_4, y_5, z_5, y_6, z_6, y_7, z_7, y_8, z_8, y_9, z_9, y_{10}, z_{10}, y_{11}, z_{11}, y_{12}, z_{12}, y_{13}, z_{13}, y_{14}, z_{14}, y_{15}, z_{15}, y_{16}, z_{16}, y_{17}, z_{17}, y_{18}, z_{18}, y_{19}, z_{19}, y_{20}, z_{20}, y_{21}, z_{21}, y_{22}, z_{22}$

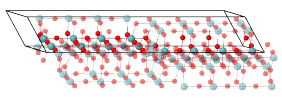
Other compounds with this structure

$Ti_2Nb_{10}O_{29}$

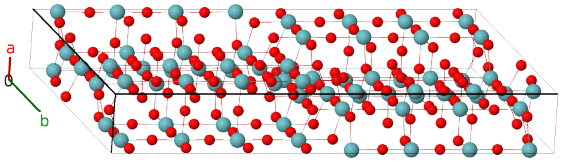
- $Nb_{12}O_{29}$ is known to exist in a least two phases (Norin, 1963; Norin, 1966):
  - a monoclinic phase and
  - an orthorhombic phase (this structure).
- (Wadsley, 1961) earlier found that both known phases of $Ti_2Nb_{12}O_{29}$ are isostructural with the corresponding $Nb_{12}O_{29}$ phase, but as the titanium and niobium atoms are alloyed on the same site we use the binary $Nb_{12}O_{29}$ as the prototype.
- (Norin, 1963) gives the structure of orthorhombic $Nb_{12}O_{29}$ in the *Amma* setting of space group #63. We used FINDSYM to transform it to the standard *Cmcm* setting.

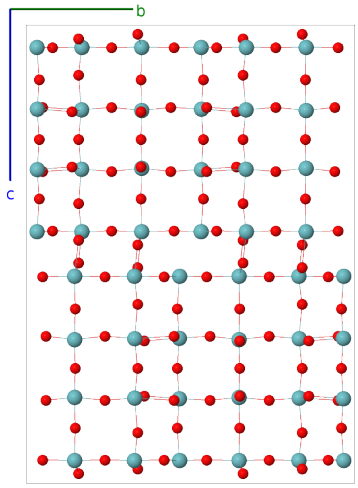
Base-centered Orthorhombic primitive vectors

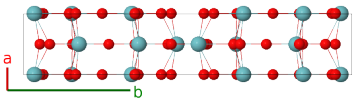
$$\mathbf{a_1} = \frac{1}{2}a\,\hat{\mathbf{x}} - \frac{1}{2}b\,\hat{\mathbf{y}}$$
$$\mathbf{a_2} = \frac{1}{2}a\,\hat{\mathbf{x}} + \frac{1}{2}b\,\hat{\mathbf{y}}$$
$$\mathbf{a_3} = c\,\hat{\mathbf{z}}$$

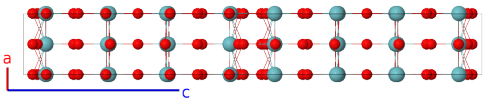


Nb
O









Basis vectors

		Lattice coordinates		Cartesian coordinates	Wyckoff position	Atom type
$\mathbf{B_1}$	=	$-y_1\,\mathbf{a}_1 + y_1\,\mathbf{a}_2 + \frac{1}{4}\,\mathbf{a}_3$	=	$by_1\,\hat{\mathbf{y}} + \frac{1}{4}c\,\hat{\mathbf{z}}$	(4c)	O I
$\mathbf{B_2}$	=	$y_1\,\mathbf{a}_1 - y_1\,\mathbf{a}_2 + \frac{3}{4}\,\mathbf{a}_3$	=	$-by_1\,\hat{\mathbf{y}} + \frac{3}{4}c\,\hat{\mathbf{z}}$	(4c)	O I
$\mathbf{B_3}$	=	$-y_2\,\mathbf{a}_1 + y_2\,\mathbf{a}_2 + \frac{1}{4}\,\mathbf{a}_3$	=	$by_2\,\hat{\mathbf{y}} + \frac{1}{4}c\,\hat{\mathbf{z}}$	(4c)	O II
$\mathbf{B_4}$	=	$y_2\,\mathbf{a}_1 - y_2\,\mathbf{a}_2 + \frac{3}{4}\,\mathbf{a}_3$	=	$-by_2\,\hat{\mathbf{y}} + \frac{3}{4}c\,\hat{\mathbf{z}}$	(4c)	O II
$\mathbf{B_5}$	=	$-y_3\,\mathbf{a}_1 + y_3\,\mathbf{a}_2 + \frac{1}{4}\,\mathbf{a}_3$	=	$by_3\,\hat{\mathbf{y}} + \frac{1}{4}c\,\hat{\mathbf{z}}$	(4c)	O III
$\mathbf{B_6}$	=	$y_3\,\mathbf{a}_1 - y_3\,\mathbf{a}_2 + \frac{3}{4}\,\mathbf{a}_3$	=	$-by_3\,\hat{\mathbf{y}} + \frac{3}{4}c\,\hat{\mathbf{z}}$	(4c)	O III
$\mathbf{B_7}$	=	$-y_4\,\mathbf{a}_1 + y_4\,\mathbf{a}_2 + z_4\,\mathbf{a}_3$	=	$by_4\,\hat{\mathbf{y}} + cz_4\,\hat{\mathbf{z}}$	(8f)	Nb I
$\mathbf{B_8}$	=	$y_4\,\mathbf{a}_1 - y_4\,\mathbf{a}_2 + \left(z_4 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-by_4\,\hat{\mathbf{y}} + c\left(z_4 + \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	Nb I
$\mathbf{B_9}$	=	$-y_4\,\mathbf{a}_1 + y_4\,\mathbf{a}_2 - \left(z_4 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$by_4\,\hat{\mathbf{y}} - c\left(z_4 - \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	Nb I
$\mathbf{B_{10}}$	=	$y_4\,\mathbf{a}_1 - y_4\,\mathbf{a}_2 - z_4\,\mathbf{a}_3$	=	$-by_4\,\hat{\mathbf{y}} - cz_4\,\hat{\mathbf{z}}$	(8f)	Nb I
$\mathbf{B_{11}}$	=	$-y_5\,\mathbf{a}_1 + y_5\,\mathbf{a}_2 + z_5\,\mathbf{a}_3$	=	$by_5\,\hat{\mathbf{y}} + cz_5\,\hat{\mathbf{z}}$	(8f)	Nb II
$\mathbf{B_{12}}$	=	$y_5\,\mathbf{a}_1 - y_5\,\mathbf{a}_2 + \left(z_5 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-by_5\,\hat{\mathbf{y}} + c\left(z_5 + \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	Nb II
$\mathbf{B_{13}}$	=	$-y_5\,\mathbf{a}_1 + y_5\,\mathbf{a}_2 - \left(z_5 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$by_5\,\hat{\mathbf{y}} - c\left(z_5 - \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	Nb II
$\mathbf{B_{14}}$	=	$y_5\,\mathbf{a}_1 - y_5\,\mathbf{a}_2 - z_5\,\mathbf{a}_3$	=	$-by_5\,\hat{\mathbf{y}} - cz_5\,\hat{\mathbf{z}}$	(8f)	Nb II
$\mathbf{B_{15}}$	=	$-y_6\,\mathbf{a}_1 + y_6\,\mathbf{a}_2 + z_6\,\mathbf{a}_3$	=	$by_6\,\hat{\mathbf{y}} + cz_6\,\hat{\mathbf{z}}$	(8f)	Nb III
$\mathbf{B_{16}}$	=	$y_6\,\mathbf{a}_1 - y_6\,\mathbf{a}_2 + \left(z_6 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-by_6\,\hat{\mathbf{y}} + c\left(z_6 + \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	Nb III
$\mathbf{B_{17}}$	=	$-y_6\,\mathbf{a}_1 + y_6\,\mathbf{a}_2 - \left(z_6 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$by_6\,\hat{\mathbf{y}} - c\left(z_6 - \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	Nb III
$\mathbf{B_{18}}$	=	$y_6\,\mathbf{a}_1 - y_6\,\mathbf{a}_2 - z_6\,\mathbf{a}_3$	=	$-by_6\,\hat{\mathbf{y}} - cz_6\,\hat{\mathbf{z}}$	(8f)	Nb III
$\mathbf{B_{19}}$	=	$-y_7\,\mathbf{a}_1 + y_7\,\mathbf{a}_2 + z_7\,\mathbf{a}_3$	=	$by_7\,\hat{\mathbf{y}} + cz_7\,\hat{\mathbf{z}}$	(8f)	Nb IV
$\mathbf{B_{20}}$	=	$y_7\,\mathbf{a}_1 - y_7\,\mathbf{a}_2 + \left(z_7 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-by_7\,\hat{\mathbf{y}} + c\left(z_7 + \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	Nb IV
$\mathbf{B_{21}}$	=	$-y_7\,\mathbf{a}_1 + y_7\,\mathbf{a}_2 - \left(z_7 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$by_7\,\hat{\mathbf{y}} - c\left(z_7 - \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	Nb IV
$\mathbf{B_{22}}$	=	$y_7\,\mathbf{a}_1 - y_7\,\mathbf{a}_2 - z_7\,\mathbf{a}_3$	=	$-by_7\,\hat{\mathbf{y}} - cz_7\,\hat{\mathbf{z}}$	(8f)	Nb IV
$\mathbf{B_{23}}$	=	$-y_8\,\mathbf{a}_1 + y_8\,\mathbf{a}_2 + z_8\,\mathbf{a}_3$	=	$by_8\,\hat{\mathbf{y}} + cz_8\,\hat{\mathbf{z}}$	(8f)	Nb V
$\mathbf{B_{24}}$	=	$y_8\,\mathbf{a}_1 - y_8\,\mathbf{a}_2 + \left(z_8 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-by_8\,\hat{\mathbf{y}} + c\left(z_8 + \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	Nb V
$\mathbf{B_{25}}$	=	$-y_8\,\mathbf{a}_1 + y_8\,\mathbf{a}_2 - \left(z_8 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$by_8\,\hat{\mathbf{y}} - c\left(z_8 - \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	Nb V
$\mathbf{B_{26}}$	=	$y_8\,\mathbf{a}_1 - y_8\,\mathbf{a}_2 - z_8\,\mathbf{a}_3$	=	$-by_8\,\hat{\mathbf{y}} - cz_8\,\hat{\mathbf{z}}$	(8f)	Nb V
$\mathbf{B_{27}}$	=	$-y_9\,\mathbf{a}_1 + y_9\,\mathbf{a}_2 + z_9\,\mathbf{a}_3$	=	$by_9\,\hat{\mathbf{y}} + cz_9\,\hat{\mathbf{z}}$	(8f)	Nb VI
$\mathbf{B_{28}}$	=	$y_9\,\mathbf{a}_1 - y_9\,\mathbf{a}_2 + \left(z_9 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-by_9\,\hat{\mathbf{y}} + c\left(z_9 + \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	Nb VI
$\mathbf{B_{29}}$	=	$-y_9\,\mathbf{a}_1 + y_9\,\mathbf{a}_2 - \left(z_9 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$by_9\,\hat{\mathbf{y}} - c\left(z_9 - \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	Nb VI
$\mathbf{B_{30}}$	=	$y_9\,\mathbf{a}_1 - y_9\,\mathbf{a}_2 - z_9\,\mathbf{a}_3$	=	$-by_9\,\hat{\mathbf{y}} - cz_9\,\hat{\mathbf{z}}$	(8f)	Nb VI
$\mathbf{B_{31}}$	=	$-y_{10}\,\mathbf{a}_1 + y_{10}\,\mathbf{a}_2 + z_{10}\,\mathbf{a}_3$	=	$by_{10}\,\hat{\mathbf{y}} + cz_{10}\,\hat{\mathbf{z}}$	(8f)	O IV
$\mathbf{B_{32}}$	=	$y_{10}\,\mathbf{a}_1 - y_{10}\,\mathbf{a}_2 + \left(z_{10} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-by_{10}\,\hat{\mathbf{y}} + c\left(z_{10} + \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	O IV
$\mathbf{B_{33}}$	=	$-y_{10}\,\mathbf{a}_1 + y_{10}\,\mathbf{a}_2 - \left(z_{10} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$by_{10}\,\hat{\mathbf{y}} - c\left(z_{10} - \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	O IV
$\mathbf{B_{34}}$	=	$y_{10}\,\mathbf{a}_1 - y_{10}\,\mathbf{a}_2 - z_{10}\,\mathbf{a}_3$	=	$-by_{10}\,\hat{\mathbf{y}} - cz_{10}\,\hat{\mathbf{z}}$	(8f)	O IV
$\mathbf{B_{35}}$	=	$-y_{11}\,\mathbf{a}_1 + y_{11}\,\mathbf{a}_2 + z_{11}\,\mathbf{a}_3$	=	$by_{11}\,\hat{\mathbf{y}} + cz_{11}\,\hat{\mathbf{z}}$	(8f)	O V
$\mathbf{B_{36}}$	=	$y_{11}\,\mathbf{a}_1 - y_{11}\,\mathbf{a}_2 + \left(z_{11} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-by_{11}\,\hat{\mathbf{y}} + c\left(z_{11} + \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	O V
$\mathbf{B_{37}}$	=	$-y_{11}\,\mathbf{a}_1 + y_{11}\,\mathbf{a}_2 - \left(z_{11} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$by_{11}\,\hat{\mathbf{y}} - c\left(z_{11} - \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	O V
$\mathbf{B_{38}}$	=	$y_{11}\,\mathbf{a}_1 - y_{11}\,\mathbf{a}_2 - z_{11}\,\mathbf{a}_3$	=	$-by_{11}\,\hat{\mathbf{y}} - cz_{11}\,\hat{\mathbf{z}}$	(8f)	O V

$$
\begin{array}{lcccccc}
\mathbf{B_{39}} & = & -y_{12}\,\mathbf{a}_1 + y_{12}\,\mathbf{a}_2 + z_{12}\,\mathbf{a}_3 & = & by_{12}\,\hat{\mathbf{y}} + cz_{12}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O VI} \\
\mathbf{B_{40}} & = & y_{12}\,\mathbf{a}_1 - y_{12}\,\mathbf{a}_2 + \left(z_{12}+\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -by_{12}\,\hat{\mathbf{y}} + c\left(z_{12}+\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O VI} \\
\mathbf{B_{41}} & = & -y_{12}\,\mathbf{a}_1 + y_{12}\,\mathbf{a}_2 - \left(z_{12}-\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & by_{12}\,\hat{\mathbf{y}} - c\left(z_{12}-\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O VI} \\
\mathbf{B_{42}} & = & y_{12}\,\mathbf{a}_1 - y_{12}\,\mathbf{a}_2 - z_{12}\,\mathbf{a}_3 & = & -by_{12}\,\hat{\mathbf{y}} - cz_{12}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O VI} \\
\mathbf{B_{43}} & = & -y_{13}\,\mathbf{a}_1 + y_{13}\,\mathbf{a}_2 + z_{13}\,\mathbf{a}_3 & = & by_{13}\,\hat{\mathbf{y}} + cz_{13}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O VII} \\
\mathbf{B_{44}} & = & y_{13}\,\mathbf{a}_1 - y_{13}\,\mathbf{a}_2 + \left(z_{13}+\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -by_{13}\,\hat{\mathbf{y}} + c\left(z_{13}+\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O VII} \\
\mathbf{B_{45}} & = & -y_{13}\,\mathbf{a}_1 + y_{13}\,\mathbf{a}_2 - \left(z_{13}-\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & by_{13}\,\hat{\mathbf{y}} - c\left(z_{13}-\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O VII} \\
\mathbf{B_{46}} & = & y_{13}\,\mathbf{a}_1 - y_{13}\,\mathbf{a}_2 - z_{13}\,\mathbf{a}_3 & = & -by_{13}\,\hat{\mathbf{y}} - cz_{13}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O VII} \\
\mathbf{B_{47}} & = & -y_{14}\,\mathbf{a}_1 + y_{14}\,\mathbf{a}_2 + z_{14}\,\mathbf{a}_3 & = & by_{14}\,\hat{\mathbf{y}} + cz_{14}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O VIII} \\
\mathbf{B_{48}} & = & y_{14}\,\mathbf{a}_1 - y_{14}\,\mathbf{a}_2 + \left(z_{14}+\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -by_{14}\,\hat{\mathbf{y}} + c\left(z_{14}+\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O VIII} \\
\mathbf{B_{49}} & = & -y_{14}\,\mathbf{a}_1 + y_{14}\,\mathbf{a}_2 - \left(z_{14}-\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & by_{14}\,\hat{\mathbf{y}} - c\left(z_{14}-\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O VIII} \\
\mathbf{B_{50}} & = & y_{14}\,\mathbf{a}_1 - y_{14}\,\mathbf{a}_2 - z_{14}\,\mathbf{a}_3 & = & -by_{14}\,\hat{\mathbf{y}} - cz_{14}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O VIII} \\
\mathbf{B_{51}} & = & -y_{15}\,\mathbf{a}_1 + y_{15}\,\mathbf{a}_2 + z_{15}\,\mathbf{a}_3 & = & by_{15}\,\hat{\mathbf{y}} + cz_{15}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O IX} \\
\mathbf{B_{52}} & = & y_{15}\,\mathbf{a}_1 - y_{15}\,\mathbf{a}_2 + \left(z_{15}+\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -by_{15}\,\hat{\mathbf{y}} + c\left(z_{15}+\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O IX} \\
\mathbf{B_{53}} & = & -y_{15}\,\mathbf{a}_1 + y_{15}\,\mathbf{a}_2 - \left(z_{15}-\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & by_{15}\,\hat{\mathbf{y}} - c\left(z_{15}-\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O IX} \\
\mathbf{B_{54}} & = & y_{15}\,\mathbf{a}_1 - y_{15}\,\mathbf{a}_2 - z_{15}\,\mathbf{a}_3 & = & -by_{15}\,\hat{\mathbf{y}} - cz_{15}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O IX} \\
\mathbf{B_{55}} & = & -y_{16}\,\mathbf{a}_1 + y_{16}\,\mathbf{a}_2 + z_{16}\,\mathbf{a}_3 & = & by_{16}\,\hat{\mathbf{y}} + cz_{16}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O X} \\
\mathbf{B_{56}} & = & y_{16}\,\mathbf{a}_1 - y_{16}\,\mathbf{a}_2 + \left(z_{16}+\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -by_{16}\,\hat{\mathbf{y}} + c\left(z_{16}+\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O X} \\
\mathbf{B_{57}} & = & -y_{16}\,\mathbf{a}_1 + y_{16}\,\mathbf{a}_2 - \left(z_{16}-\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & by_{16}\,\hat{\mathbf{y}} - c\left(z_{16}-\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O X} \\
\mathbf{B_{58}} & = & y_{16}\,\mathbf{a}_1 - y_{16}\,\mathbf{a}_2 - z_{16}\,\mathbf{a}_3 & = & -by_{16}\,\hat{\mathbf{y}} - cz_{16}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O X} \\
\mathbf{B_{59}} & = & -y_{17}\,\mathbf{a}_1 + y_{17}\,\mathbf{a}_2 + z_{17}\,\mathbf{a}_3 & = & by_{17}\,\hat{\mathbf{y}} + cz_{17}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XI} \\
\mathbf{B_{60}} & = & y_{17}\,\mathbf{a}_1 - y_{17}\,\mathbf{a}_2 + \left(z_{17}+\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -by_{17}\,\hat{\mathbf{y}} + c\left(z_{17}+\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XI} \\
\mathbf{B_{61}} & = & -y_{17}\,\mathbf{a}_1 + y_{17}\,\mathbf{a}_2 - \left(z_{17}-\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & by_{17}\,\hat{\mathbf{y}} - c\left(z_{17}-\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XI} \\
\mathbf{B_{62}} & = & y_{17}\,\mathbf{a}_1 - y_{17}\,\mathbf{a}_2 - z_{17}\,\mathbf{a}_3 & = & -by_{17}\,\hat{\mathbf{y}} - cz_{17}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XI} \\
\mathbf{B_{63}} & = & -y_{18}\,\mathbf{a}_1 + y_{18}\,\mathbf{a}_2 + z_{18}\,\mathbf{a}_3 & = & by_{18}\,\hat{\mathbf{y}} + cz_{18}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XII} \\
\mathbf{B_{64}} & = & y_{18}\,\mathbf{a}_1 - y_{18}\,\mathbf{a}_2 + \left(z_{18}+\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -by_{18}\,\hat{\mathbf{y}} + c\left(z_{18}+\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XII} \\
\mathbf{B_{65}} & = & -y_{18}\,\mathbf{a}_1 + y_{18}\,\mathbf{a}_2 - \left(z_{18}-\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & by_{18}\,\hat{\mathbf{y}} - c\left(z_{18}-\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XII} \\
\mathbf{B_{66}} & = & y_{18}\,\mathbf{a}_1 - y_{18}\,\mathbf{a}_2 - z_{18}\,\mathbf{a}_3 & = & -by_{18}\,\hat{\mathbf{y}} - cz_{18}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XII} \\
\mathbf{B_{67}} & = & -y_{19}\,\mathbf{a}_1 + y_{19}\,\mathbf{a}_2 + z_{19}\,\mathbf{a}_3 & = & by_{19}\,\hat{\mathbf{y}} + cz_{19}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XIII} \\
\mathbf{B_{68}} & = & y_{19}\,\mathbf{a}_1 - y_{19}\,\mathbf{a}_2 + \left(z_{19}+\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -by_{19}\,\hat{\mathbf{y}} + c\left(z_{19}+\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XIII} \\
\mathbf{B_{69}} & = & -y_{19}\,\mathbf{a}_1 + y_{19}\,\mathbf{a}_2 - \left(z_{19}-\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & by_{19}\,\hat{\mathbf{y}} - c\left(z_{19}-\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XIII} \\
\mathbf{B_{70}} & = & y_{19}\,\mathbf{a}_1 - y_{19}\,\mathbf{a}_2 - z_{19}\,\mathbf{a}_3 & = & -by_{19}\,\hat{\mathbf{y}} - cz_{19}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XIII} \\
\mathbf{B_{71}} & = & -y_{20}\,\mathbf{a}_1 + y_{20}\,\mathbf{a}_2 + z_{20}\,\mathbf{a}_3 & = & by_{20}\,\hat{\mathbf{y}} + cz_{20}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XIV} \\
\mathbf{B_{72}} & = & y_{20}\,\mathbf{a}_1 - y_{20}\,\mathbf{a}_2 + \left(z_{20}+\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -by_{20}\,\hat{\mathbf{y}} + c\left(z_{20}+\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XIV} \\
\mathbf{B_{73}} & = & -y_{20}\,\mathbf{a}_1 + y_{20}\,\mathbf{a}_2 - \left(z_{20}-\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & by_{20}\,\hat{\mathbf{y}} - c\left(z_{20}-\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XIV} \\
\mathbf{B_{74}} & = & y_{20}\,\mathbf{a}_1 - y_{20}\,\mathbf{a}_2 - z_{20}\,\mathbf{a}_3 & = & -by_{20}\,\hat{\mathbf{y}} - cz_{20}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XIV} \\
\mathbf{B_{75}} & = & -y_{21}\,\mathbf{a}_1 + y_{21}\,\mathbf{a}_2 + z_{21}\,\mathbf{a}_3 & = & by_{21}\,\hat{\mathbf{y}} + cz_{21}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XV} \\
\mathbf{B_{76}} & = & y_{21}\,\mathbf{a}_1 - y_{21}\,\mathbf{a}_2 + \left(z_{21}+\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -by_{21}\,\hat{\mathbf{y}} + c\left(z_{21}+\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XV} \\
\mathbf{B_{77}} & = & -y_{21}\,\mathbf{a}_1 + y_{21}\,\mathbf{a}_2 - \left(z_{21}-\tfrac{1}{2}\right)\,\mathbf{a}_3 & = & by_{21}\,\hat{\mathbf{y}} - c\left(z_{21}-\tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XV} \\
\mathbf{B_{78}} & = & y_{21}\,\mathbf{a}_1 - y_{21}\,\mathbf{a}_2 - z_{21}\,\mathbf{a}_3 & = & -by_{21}\,\hat{\mathbf{y}} - cz_{21}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XV} \\
\mathbf{B_{79}} & = & -y_{22}\,\mathbf{a}_1 + y_{22}\,\mathbf{a}_2 + z_{22}\,\mathbf{a}_3 & = & by_{22}\,\hat{\mathbf{y}} + cz_{22}\,\hat{\mathbf{z}} & \text{(8f)} & \text{O XVI}
\end{array}
$$

$\mathbf{B_{80}}$	=	$y_{22}\,\mathbf{a}_1 - y_{22}\,\mathbf{a}_2 + \left(z_{22} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-by_{22}\,\hat{\mathbf{y}} + c\left(z_{22} + \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	O XVI
$\mathbf{B_{81}}$	=	$-y_{22}\,\mathbf{a}_1 + y_{22}\,\mathbf{a}_2 - \left(z_{22} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$by_{22}\,\hat{\mathbf{y}} - c\left(z_{22} - \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(8f)	O XVI
$\mathbf{B_{82}}$	=	$y_{22}\,\mathbf{a}_1 - y_{22}\,\mathbf{a}_2 - z_{22}\,\mathbf{a}_3$	=	$-by_{22}\,\hat{\mathbf{y}} - cz_{22}\,\hat{\mathbf{z}}$	(8f)	O XVI

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