Protoanthophyllite ($H_2Mg_7Si_8O_{24}$) Structure: A2B7C24D8_oP82_58_g_ae2f_2g5h_2h-001

This structure originally had the label `A2B7C24D8_oP82_58_g_ae2f_2g5h_2h`. Calls to that address will be redirected here.

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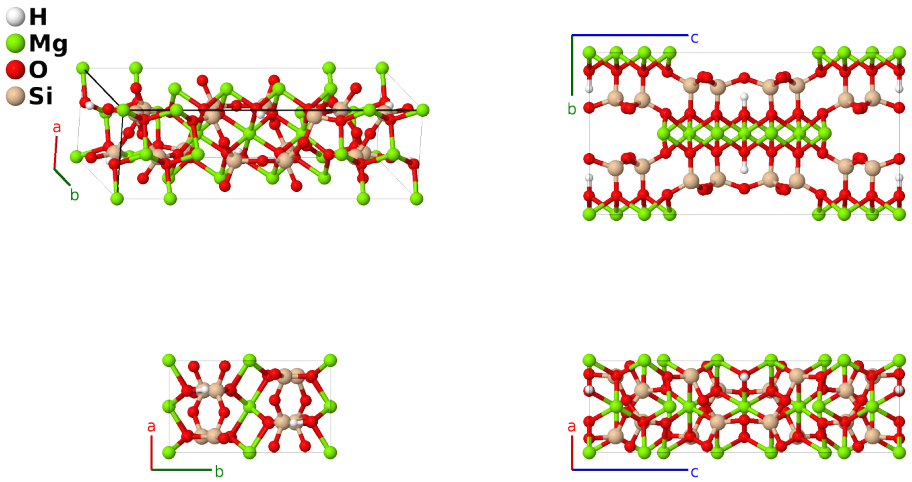
https://aflow.org/p/APMF

https://aflow.org/p/A2B7C24D8_oP82_58_g_ae2f_2g5h_2h-001

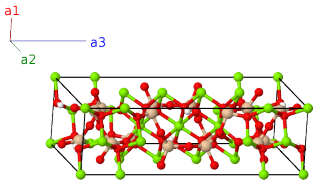


Prototype	$H_2Mg_7O_{24}Si_8$
AFLOW prototype label	A2B7C24D8_oP82_58_g_ae2f_2g5h_2h-001
Mineral name	protoanthophyllite
ICSD	98791
Pearson symbol	oP82
Space group number	58
Space group symbol	*Pnnm*
AFLOW prototype command	`aflow --proto=A2B7C24D8_oP82_58_g_ae2f_2g5h_2h-001 --params=`$a, b/a, c/a, z_2, z_3, z_4, x_5, y_5, x_6, y_6, x_7, y_7, x_8, y_8, z_8, x_9, y_9, z_9, x_{10}, y_{10}, z_{10}, x_{11}, y_{11}, z_{11}, x_{12}, y_{12}, z_{12}, x_{13}, y_{13}, z_{13}, x_{14}, y_{14}, z_{14}$

- This structure is approximately one-half of the unit cell of anthophyllite ($S4_4$).
- Like anthophyllite, iron is sometimes mixed with magnesium. For this sample, (Konishi, 2003) found that the Mg-I (2a) site contains 2.5% iron, Mg-III (4f) contains 2.1%, and Mg-IV (4f) contains 27.7% iron.
- Similarly, the silicon sites are have very small amounts of aluminum ($< 1\%$), and the (2b) site (1/2 1/2 1/2) is occupied by a sodium atom about 5% of the time. We ignore this later site.
- (Konishi, 2003) give the crystal structure in the *Pnmn* setting of space group #58. We used findsym to transform this to the standard *Pnnm* orientation.

Simple Orthorhombic primitive vectors

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



Basis vectors

		Lattice coordinates		Cartesian coordinates	Wyckoff position	Atom type
$\mathbf{B_1}$	=	0	=	0	(2a)	Mg I
$\mathbf{B_2}$	=	$\frac{1}{2}\,\mathbf{a}_1 + \frac{1}{2}\,\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$	=	$\frac{1}{2}a\,\hat{\mathbf{x}} + \frac{1}{2}b\,\hat{\mathbf{y}} + \frac{1}{2}c\,\hat{\mathbf{z}}$	(2a)	Mg I
$\mathbf{B_3}$	=	$z_2\,\mathbf{a}_3$	=	$cz_2\,\hat{\mathbf{z}}$	(4e)	Mg II
$\mathbf{B_4}$	=	$\frac{1}{2}\,\mathbf{a}_1 + \frac{1}{2}\,\mathbf{a}_2 - \left(z_2 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\frac{1}{2}a\,\hat{\mathbf{x}} + \frac{1}{2}b\,\hat{\mathbf{y}} - c\left(z_2 - \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(4e)	Mg II
$\mathbf{B_5}$	=	$-z_2\,\mathbf{a}_3$	=	$-cz_2\,\hat{\mathbf{z}}$	(4e)	Mg II
$\mathbf{B_6}$	=	$\frac{1}{2}\,\mathbf{a}_1 + \frac{1}{2}\,\mathbf{a}_2 + \left(z_2 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\frac{1}{2}a\,\hat{\mathbf{x}} + \frac{1}{2}b\,\hat{\mathbf{y}} + c\left(z_2 + \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(4e)	Mg II
$\mathbf{B_7}$	=	$\frac{1}{2}\,\mathbf{a}_2 + z_3\,\mathbf{a}_3$	=	$\frac{1}{2}b\,\hat{\mathbf{y}} + cz_3\,\hat{\mathbf{z}}$	(4f)	Mg III
$\mathbf{B_8}$	=	$\frac{1}{2}\,\mathbf{a}_1 - \left(z_3 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\frac{1}{2}a\,\hat{\mathbf{x}} - c\left(z_3 - \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(4f)	Mg III
$\mathbf{B_9}$	=	$\frac{1}{2}\,\mathbf{a}_2 - z_3\,\mathbf{a}_3$	=	$\frac{1}{2}b\,\hat{\mathbf{y}} - cz_3\,\hat{\mathbf{z}}$	(4f)	Mg III
$\mathbf{B_{10}}$	=	$\frac{1}{2}\,\mathbf{a}_1 + \left(z_3 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\frac{1}{2}a\,\hat{\mathbf{x}} + c\left(z_3 + \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(4f)	Mg III
$\mathbf{B_{11}}$	=	$\frac{1}{2}\,\mathbf{a}_2 + z_4\,\mathbf{a}_3$	=	$\frac{1}{2}b\,\hat{\mathbf{y}} + cz_4\,\hat{\mathbf{z}}$	(4f)	Mg IV
$\mathbf{B_{12}}$	=	$\frac{1}{2}\,\mathbf{a}_1 - \left(z_4 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\frac{1}{2}a\,\hat{\mathbf{x}} - c\left(z_4 - \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(4f)	Mg IV
$\mathbf{B_{13}}$	=	$\frac{1}{2}\,\mathbf{a}_2 - z_4\,\mathbf{a}_3$	=	$\frac{1}{2}b\,\hat{\mathbf{y}} - cz_4\,\hat{\mathbf{z}}$	(4f)	Mg IV
$\mathbf{B_{14}}$	=	$\frac{1}{2}\,\mathbf{a}_1 + \left(z_4 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\frac{1}{2}a\,\hat{\mathbf{x}} + c\left(z_4 + \frac{1}{2}\right)\,\hat{\mathbf{z}}$	(4f)	Mg IV
$\mathbf{B_{15}}$	=	$x_5\,\mathbf{a}_1 + y_5\,\mathbf{a}_2$	=	$ax_5\,\hat{\mathbf{x}} + by_5\,\hat{\mathbf{y}}$	(4g)	H I
$\mathbf{B_{16}}$	=	$-x_5\,\mathbf{a}_1 - y_5\,\mathbf{a}_2$	=	$-ax_5\,\hat{\mathbf{x}} - by_5\,\hat{\mathbf{y}}$	(4g)	H I
$\mathbf{B_{17}}$	=	$-\left(x_5 - \frac{1}{2}\right)\,\mathbf{a}_1 + \left(y_5 + \frac{1}{2}\right)\,\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$	=	$-a\left(x_5 - \frac{1}{2}\right)\,\hat{\mathbf{x}} + b\left(y_5 + \frac{1}{2}\right)\,\hat{\mathbf{y}} + \frac{1}{2}c\,\hat{\mathbf{z}}$	(4g)	H I
$\mathbf{B_{18}}$	=	$\left(x_5 + \frac{1}{2}\right)\,\mathbf{a}_1 - \left(y_5 - \frac{1}{2}\right)\,\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$	=	$a\left(x_5 + \frac{1}{2}\right)\,\hat{\mathbf{x}} - b\left(y_5 - \frac{1}{2}\right)\,\hat{\mathbf{y}} + \frac{1}{2}c\,\hat{\mathbf{z}}$	(4g)	H I
$\mathbf{B_{19}}$	=	$x_6\,\mathbf{a}_1 + y_6\,\mathbf{a}_2$	=	$ax_6\,\hat{\mathbf{x}} + by_6\,\hat{\mathbf{y}}$	(4g)	O I
$\mathbf{B_{20}}$	=	$-x_6\,\mathbf{a}_1 - y_6\,\mathbf{a}_2$	=	$-ax_6\,\hat{\mathbf{x}} - by_6\,\hat{\mathbf{y}}$	(4g)	O I
$\mathbf{B_{21}}$	=	$-\left(x_6 - \frac{1}{2}\right)\,\mathbf{a}_1 + \left(y_6 + \frac{1}{2}\right)\,\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$	=	$-a\left(x_6 - \frac{1}{2}\right)\,\hat{\mathbf{x}} + b\left(y_6 + \frac{1}{2}\right)\,\hat{\mathbf{y}} + \frac{1}{2}c\,\hat{\mathbf{z}}$	(4g)	O I
$\mathbf{B_{22}}$	=	$\left(x_6 + \frac{1}{2}\right)\,\mathbf{a}_1 - \left(y_6 - \frac{1}{2}\right)\,\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$	=	$a\left(x_6 + \frac{1}{2}\right)\,\hat{\mathbf{x}} - b\left(y_6 - \frac{1}{2}\right)\,\hat{\mathbf{y}} + \frac{1}{2}c\,\hat{\mathbf{z}}$	(4g)	O I
$\mathbf{B_{23}}$	=	$x_7\,\mathbf{a}_1 + y_7\,\mathbf{a}_2$	=	$ax_7\,\hat{\mathbf{x}} + by_7\,\hat{\mathbf{y}}$	(4g)	O II
$\mathbf{B_{24}}$	=	$-x_7\,\mathbf{a}_1 - y_7\,\mathbf{a}_2$	=	$-ax_7\,\hat{\mathbf{x}} - by_7\,\hat{\mathbf{y}}$	(4g)	O II
$\mathbf{B_{25}}$	=	$-\left(x_7 - \frac{1}{2}\right)\,\mathbf{a}_1 + \left(y_7 + \frac{1}{2}\right)\,\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$	=	$-a\left(x_7 - \frac{1}{2}\right)\,\hat{\mathbf{x}} + b\left(y_7 + \frac{1}{2}\right)\,\hat{\mathbf{y}} + \frac{1}{2}c\,\hat{\mathbf{z}}$	(4g)	O II
$\mathbf{B_{26}}$	=	$\left(x_7 + \frac{1}{2}\right)\,\mathbf{a}_1 - \left(y_7 - \frac{1}{2}\right)\,\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$	=	$a\left(x_7 + \frac{1}{2}\right)\,\hat{\mathbf{x}} - b\left(y_7 - \frac{1}{2}\right)\,\hat{\mathbf{y}} + \frac{1}{2}c\,\hat{\mathbf{z}}$	(4g)	O II
$\mathbf{B_{27}}$	=	$x_8\,\mathbf{a}_1 + y_8\,\mathbf{a}_2 + z_8\,\mathbf{a}_3$	=	$ax_8\,\hat{\mathbf{x}} + by_8\,\hat{\mathbf{y}} + cz_8\,\hat{\mathbf{z}}$	(8h)	O III
$\mathbf{B_{28}}$	=	$-x_8\,\mathbf{a}_1 - y_8\,\mathbf{a}_2 + z_8\,\mathbf{a}_3$	=	$-ax_8\,\hat{\mathbf{x}} - by_8\,\hat{\mathbf{y}} + cz_8\,\hat{\mathbf{z}}$	(8h)	O III

$$
\begin{array}{lcccccc}
\mathbf{B_{29}} & = & -\left(x_8-\frac{1}{2}\right)\mathbf{a}_1+\left(y_8+\frac{1}{2}\right)\mathbf{a}_2- & = & -a\left(x_8-\frac{1}{2}\right)\hat{\mathbf{x}}+b\left(y_8+\frac{1}{2}\right)\hat{\mathbf{y}}-c\left(z_8-\frac{1}{2}\right)\hat{\mathbf{z}} & (8h) & \text{O III}\\
 & & \left(z_8-\frac{1}{2}\right)\mathbf{a}_3 & & & & \\
\mathbf{B_{30}} & = & \left(x_8+\frac{1}{2}\right)\mathbf{a}_1-\left(y_8-\frac{1}{2}\right)\mathbf{a}_2- & = & a\left(x_8+\frac{1}{2}\right)\hat{\mathbf{x}}-b\left(y_8-\frac{1}{2}\right)\hat{\mathbf{y}}-c\left(z_8-\frac{1}{2}\right)\hat{\mathbf{z}} & (8h) & \text{O III}\\
 & & \left(z_8-\frac{1}{2}\right)\mathbf{a}_3 & & & & \\
\mathbf{B_{31}} & = & -x_8\,\mathbf{a}_1-y_8\,\mathbf{a}_2-z_8\,\mathbf{a}_3 & = & -ax_8\,\hat{\mathbf{x}}-by_8\,\hat{\mathbf{y}}-cz_8\,\hat{\mathbf{z}} & (8h) & \text{O III}\\
\mathbf{B_{32}} & = & x_8\,\mathbf{a}_1+y_8\,\mathbf{a}_2-z_8\,\mathbf{a}_3 & = & ax_8\,\hat{\mathbf{x}}+by_8\,\hat{\mathbf{y}}-cz_8\,\hat{\mathbf{z}} & (8h) & \text{O III}\\
\mathbf{B_{33}} & = & \left(x_8+\frac{1}{2}\right)\mathbf{a}_1-\left(y_8-\frac{1}{2}\right)\mathbf{a}_2+ & = & a\left(x_8+\frac{1}{2}\right)\hat{\mathbf{x}}-b\left(y_8-\frac{1}{2}\right)\hat{\mathbf{y}}+c\left(z_8+\frac{1}{2}\right)\hat{\mathbf{z}} & (8h) & \text{O III}\\
 & & \left(z_8+\frac{1}{2}\right)\mathbf{a}_3 & & & & \\
\mathbf{B_{34}} & = & -\left(x_8-\frac{1}{2}\right)\mathbf{a}_1+\left(y_8+\frac{1}{2}\right)\mathbf{a}_2+ & = & -a\left(x_8-\frac{1}{2}\right)\hat{\mathbf{x}}+b\left(y_8+\frac{1}{2}\right)\hat{\mathbf{y}}+c\left(z_8+\frac{1}{2}\right)\hat{\mathbf{z}} & (8h) & \text{O III}\\
 & & \left(z_8+\frac{1}{2}\right)\mathbf{a}_3 & & & & \\
\mathbf{B_{35}} & = & x_9\,\mathbf{a}_1+y_9\,\mathbf{a}_2+z_9\,\mathbf{a}_3 & = & ax_9\,\hat{\mathbf{x}}+by_9\,\hat{\mathbf{y}}+cz_9\,\hat{\mathbf{z}} & (8h) & \text{O IV}\\
\mathbf{B_{36}} & = & -x_9\,\mathbf{a}_1-y_9\,\mathbf{a}_2+z_9\,\mathbf{a}_3 & = & -ax_9\,\hat{\mathbf{x}}-by_9\,\hat{\mathbf{y}}+cz_9\,\hat{\mathbf{z}} & (8h) & \text{O IV}\\
\mathbf{B_{37}} & = & -\left(x_9-\frac{1}{2}\right)\mathbf{a}_1+\left(y_9+\frac{1}{2}\right)\mathbf{a}_2- & = & -a\left(x_9-\frac{1}{2}\right)\hat{\mathbf{x}}+b\left(y_9+\frac{1}{2}\right)\hat{\mathbf{y}}-c\left(z_9-\frac{1}{2}\right)\hat{\mathbf{z}} & (8h) & \text{O IV}\\
 & & \left(z_9-\frac{1}{2}\right)\mathbf{a}_3 & & & & \\
\mathbf{B_{38}} & = & \left(x_9+\frac{1}{2}\right)\mathbf{a}_1-\left(y_9-\frac{1}{2}\right)\mathbf{a}_2- & = & a\left(x_9+\frac{1}{2}\right)\hat{\mathbf{x}}-b\left(y_9-\frac{1}{2}\right)\hat{\mathbf{y}}-c\left(z_9-\frac{1}{2}\right)\hat{\mathbf{z}} & (8h) & \text{O IV}\\
 & & \left(z_9-\frac{1}{2}\right)\mathbf{a}_3 & & & & \\
\mathbf{B_{39}} & = & -x_9\,\mathbf{a}_1-y_9\,\mathbf{a}_2-z_9\,\mathbf{a}_3 & = & -ax_9\,\hat{\mathbf{x}}-by_9\,\hat{\mathbf{y}}-cz_9\,\hat{\mathbf{z}} & (8h) & \text{O IV}\\
\mathbf{B_{40}} & = & x_9\,\mathbf{a}_1+y_9\,\mathbf{a}_2-z_9\,\mathbf{a}_3 & = & ax_9\,\hat{\mathbf{x}}+by_9\,\hat{\mathbf{y}}-cz_9\,\hat{\mathbf{z}} & (8h) & \text{O IV}\\
\mathbf{B_{41}} & = & \left(x_9+\frac{1}{2}\right)\mathbf{a}_1-\left(y_9-\frac{1}{2}\right)\mathbf{a}_2+ & = & a\left(x_9+\frac{1}{2}\right)\hat{\mathbf{x}}-b\left(y_9-\frac{1}{2}\right)\hat{\mathbf{y}}+c\left(z_9+\frac{1}{2}\right)\hat{\mathbf{z}} & (8h) & \text{O IV}\\
 & & \left(z_9+\frac{1}{2}\right)\mathbf{a}_3 & & & & \\
\mathbf{B_{42}} & = & -\left(x_9-\frac{1}{2}\right)\mathbf{a}_1+\left(y_9+\frac{1}{2}\right)\mathbf{a}_2+ & = & -a\left(x_9-\frac{1}{2}\right)\hat{\mathbf{x}}+b\left(y_9+\frac{1}{2}\right)\hat{\mathbf{y}}+c\left(z_9+\frac{1}{2}\right)\hat{\mathbf{z}} & (8h) & \text{O IV}\\
 & & \left(z_9+\frac{1}{2}\right)\mathbf{a}_3 & & & & \\
\mathbf{B_{43}} & = & x_{10}\,\mathbf{a}_1+y_{10}\,\mathbf{a}_2+z_{10}\,\mathbf{a}_3 & = & ax_{10}\,\hat{\mathbf{x}}+by_{10}\,\hat{\mathbf{y}}+cz_{10}\,\hat{\mathbf{z}} & (8h) & \text{O V}\\
\mathbf{B_{44}} & = & -x_{10}\,\mathbf{a}_1-y_{10}\,\mathbf{a}_2+z_{10}\,\mathbf{a}_3 & = & -ax_{10}\,\hat{\mathbf{x}}-by_{10}\,\hat{\mathbf{y}}+cz_{10}\,\hat{\mathbf{z}} & (8h) & \text{O V}\\
\mathbf{B_{45}} & = & -\left(x_{10}-\frac{1}{2}\right)\mathbf{a}_1+\left(y_{10}+\frac{1}{2}\right)\mathbf{a}_2- & = & -a\left(x_{10}-\frac{1}{2}\right)\hat{\mathbf{x}}+b\left(y_{10}+\frac{1}{2}\right)\hat{\mathbf{y}}- & (8h) & \text{O V}\\
 & & \left(z_{10}-\frac{1}{2}\right)\mathbf{a}_3 & & c\left(z_{10}-\frac{1}{2}\right)\hat{\mathbf{z}} & & \\
\mathbf{B_{46}} & = & \left(x_{10}+\frac{1}{2}\right)\mathbf{a}_1-\left(y_{10}-\frac{1}{2}\right)\mathbf{a}_2- & = & a\left(x_{10}+\frac{1}{2}\right)\hat{\mathbf{x}}-b\left(y_{10}-\frac{1}{2}\right)\hat{\mathbf{y}}- & (8h) & \text{O V}\\
 & & \left(z_{10}-\frac{1}{2}\right)\mathbf{a}_3 & & c\left(z_{10}-\frac{1}{2}\right)\hat{\mathbf{z}} & & \\
\mathbf{B_{47}} & = & -x_{10}\,\mathbf{a}_1-y_{10}\,\mathbf{a}_2-z_{10}\,\mathbf{a}_3 & = & -ax_{10}\,\hat{\mathbf{x}}-by_{10}\,\hat{\mathbf{y}}-cz_{10}\,\hat{\mathbf{z}} & (8h) & \text{O V}\\
\mathbf{B_{48}} & = & x_{10}\,\mathbf{a}_1+y_{10}\,\mathbf{a}_2-z_{10}\,\mathbf{a}_3 & = & ax_{10}\,\hat{\mathbf{x}}+by_{10}\,\hat{\mathbf{y}}-cz_{10}\,\hat{\mathbf{z}} & (8h) & \text{O V}\\
\mathbf{B_{49}} & = & \left(x_{10}+\frac{1}{2}\right)\mathbf{a}_1-\left(y_{10}-\frac{1}{2}\right)\mathbf{a}_2+ & = & a\left(x_{10}+\frac{1}{2}\right)\hat{\mathbf{x}}-b\left(y_{10}-\frac{1}{2}\right)\hat{\mathbf{y}}+ & (8h) & \text{O V}\\
 & & \left(z_{10}+\frac{1}{2}\right)\mathbf{a}_3 & & c\left(z_{10}+\frac{1}{2}\right)\hat{\mathbf{z}} & & \\
\mathbf{B_{50}} & = & -\left(x_{10}-\frac{1}{2}\right)\mathbf{a}_1+\left(y_{10}+\frac{1}{2}\right)\mathbf{a}_2+ & = & -a\left(x_{10}-\frac{1}{2}\right)\hat{\mathbf{x}}+b\left(y_{10}+\frac{1}{2}\right)\hat{\mathbf{y}}+ & (8h) & \text{O V}\\
 & & \left(z_{10}+\frac{1}{2}\right)\mathbf{a}_3 & & c\left(z_{10}+\frac{1}{2}\right)\hat{\mathbf{z}} & & \\
\mathbf{B_{51}} & = & x_{11}\,\mathbf{a}_1+y_{11}\,\mathbf{a}_2+z_{11}\,\mathbf{a}_3 & = & ax_{11}\,\hat{\mathbf{x}}+by_{11}\,\hat{\mathbf{y}}+cz_{11}\,\hat{\mathbf{z}} & (8h) & \text{O VI}\\
\mathbf{B_{52}} & = & -x_{11}\,\mathbf{a}_1-y_{11}\,\mathbf{a}_2+z_{11}\,\mathbf{a}_3 & = & -ax_{11}\,\hat{\mathbf{x}}-by_{11}\,\hat{\mathbf{y}}+cz_{11}\,\hat{\mathbf{z}} & (8h) & \text{O VI}\\
\mathbf{B_{53}} & = & -\left(x_{11}-\frac{1}{2}\right)\mathbf{a}_1+\left(y_{11}+\frac{1}{2}\right)\mathbf{a}_2- & = & -a\left(x_{11}-\frac{1}{2}\right)\hat{\mathbf{x}}+b\left(y_{11}+\frac{1}{2}\right)\hat{\mathbf{y}}- & (8h) & \text{O VI}\\
 & & \left(z_{11}-\frac{1}{2}\right)\mathbf{a}_3 & & c\left(z_{11}-\frac{1}{2}\right)\hat{\mathbf{z}} & & \\
\mathbf{B_{54}} & = & \left(x_{11}+\frac{1}{2}\right)\mathbf{a}_1-\left(y_{11}-\frac{1}{2}\right)\mathbf{a}_2- & = & a\left(x_{11}+\frac{1}{2}\right)\hat{\mathbf{x}}-b\left(y_{11}-\frac{1}{2}\right)\hat{\mathbf{y}}- & (8h) & \text{O VI}\\
 & & \left(z_{11}-\frac{1}{2}\right)\mathbf{a}_3 & & c\left(z_{11}-\frac{1}{2}\right)\hat{\mathbf{z}} & & \\
\mathbf{B_{55}} & = & -x_{11}\,\mathbf{a}_1-y_{11}\,\mathbf{a}_2-z_{11}\,\mathbf{a}_3 & = & -ax_{11}\,\hat{\mathbf{x}}-by_{11}\,\hat{\mathbf{y}}-cz_{11}\,\hat{\mathbf{z}} & (8h) & \text{O VI}\\
\mathbf{B_{56}} & = & x_{11}\,\mathbf{a}_1+y_{11}\,\mathbf{a}_2-z_{11}\,\mathbf{a}_3 & = & ax_{11}\,\hat{\mathbf{x}}+by_{11}\,\hat{\mathbf{y}}-cz_{11}\,\hat{\mathbf{z}} & (8h) & \text{O VI}\\
\mathbf{B_{57}} & = & \left(x_{11}+\frac{1}{2}\right)\mathbf{a}_1-\left(y_{11}-\frac{1}{2}\right)\mathbf{a}_2+ & = & a\left(x_{11}+\frac{1}{2}\right)\hat{\mathbf{x}}-b\left(y_{11}-\frac{1}{2}\right)\hat{\mathbf{y}}+ & (8h) & \text{O VI}\\
 & & \left(z_{11}+\frac{1}{2}\right)\mathbf{a}_3 & & c\left(z_{11}+\frac{1}{2}\right)\hat{\mathbf{z}} & & \\
\end{array}
$$

$\mathbf{B_{58}}$	$=$	$-\left(x_{11}-\frac{1}{2}\right)\mathbf{a}_1+\left(y_{11}+\frac{1}{2}\right)\mathbf{a}_2+\left(z_{11}+\frac{1}{2}\right)\mathbf{a}_3$	$=$	$-a\left(x_{11}-\frac{1}{2}\right)\hat{\mathbf{x}}+b\left(y_{11}+\frac{1}{2}\right)\hat{\mathbf{y}}+c\left(z_{11}+\frac{1}{2}\right)\hat{\mathbf{z}}$	(8h)	O VI
$\mathbf{B_{59}}$	$=$	$x_{12}\,\mathbf{a}_1+y_{12}\,\mathbf{a}_2+z_{12}\,\mathbf{a}_3$	$=$	$ax_{12}\,\hat{\mathbf{x}}+by_{12}\,\hat{\mathbf{y}}+cz_{12}\,\hat{\mathbf{z}}$	(8h)	O VII
$\mathbf{B_{60}}$	$=$	$-x_{12}\,\mathbf{a}_1-y_{12}\,\mathbf{a}_2+z_{12}\,\mathbf{a}_3$	$=$	$-ax_{12}\,\hat{\mathbf{x}}-by_{12}\,\hat{\mathbf{y}}+cz_{12}\,\hat{\mathbf{z}}$	(8h)	O VII
$\mathbf{B_{61}}$	$=$	$-\left(x_{12}-\frac{1}{2}\right)\mathbf{a}_1+\left(y_{12}+\frac{1}{2}\right)\mathbf{a}_2-\left(z_{12}-\frac{1}{2}\right)\mathbf{a}_3$	$=$	$-a\left(x_{12}-\frac{1}{2}\right)\hat{\mathbf{x}}+b\left(y_{12}+\frac{1}{2}\right)\hat{\mathbf{y}}-c\left(z_{12}-\frac{1}{2}\right)\hat{\mathbf{z}}$	(8h)	O VII
$\mathbf{B_{62}}$	$=$	$\left(x_{12}+\frac{1}{2}\right)\mathbf{a}_1-\left(y_{12}-\frac{1}{2}\right)\mathbf{a}_2-\left(z_{12}-\frac{1}{2}\right)\mathbf{a}_3$	$=$	$a\left(x_{12}+\frac{1}{2}\right)\hat{\mathbf{x}}-b\left(y_{12}-\frac{1}{2}\right)\hat{\mathbf{y}}-c\left(z_{12}-\frac{1}{2}\right)\hat{\mathbf{z}}$	(8h)	O VII
$\mathbf{B_{63}}$	$=$	$-x_{12}\,\mathbf{a}_1-y_{12}\,\mathbf{a}_2-z_{12}\,\mathbf{a}_3$	$=$	$-ax_{12}\,\hat{\mathbf{x}}-by_{12}\,\hat{\mathbf{y}}-cz_{12}\,\hat{\mathbf{z}}$	(8h)	O VII
$\mathbf{B_{64}}$	$=$	$x_{12}\,\mathbf{a}_1+y_{12}\,\mathbf{a}_2-z_{12}\,\mathbf{a}_3$	$=$	$ax_{12}\,\hat{\mathbf{x}}+by_{12}\,\hat{\mathbf{y}}-cz_{12}\,\hat{\mathbf{z}}$	(8h)	O VII
$\mathbf{B_{65}}$	$=$	$\left(x_{12}+\frac{1}{2}\right)\mathbf{a}_1-\left(y_{12}-\frac{1}{2}\right)\mathbf{a}_2+\left(z_{12}+\frac{1}{2}\right)\mathbf{a}_3$	$=$	$a\left(x_{12}+\frac{1}{2}\right)\hat{\mathbf{x}}-b\left(y_{12}-\frac{1}{2}\right)\hat{\mathbf{y}}+c\left(z_{12}+\frac{1}{2}\right)\hat{\mathbf{z}}$	(8h)	O VII
$\mathbf{B_{66}}$	$=$	$-\left(x_{12}-\frac{1}{2}\right)\mathbf{a}_1+\left(y_{12}+\frac{1}{2}\right)\mathbf{a}_2+\left(z_{12}+\frac{1}{2}\right)\mathbf{a}_3$	$=$	$-a\left(x_{12}-\frac{1}{2}\right)\hat{\mathbf{x}}+b\left(y_{12}+\frac{1}{2}\right)\hat{\mathbf{y}}+c\left(z_{12}+\frac{1}{2}\right)\hat{\mathbf{z}}$	(8h)	O VII
$\mathbf{B_{67}}$	$=$	$x_{13}\,\mathbf{a}_1+y_{13}\,\mathbf{a}_2+z_{13}\,\mathbf{a}_3$	$=$	$ax_{13}\,\hat{\mathbf{x}}+by_{13}\,\hat{\mathbf{y}}+cz_{13}\,\hat{\mathbf{z}}$	(8h)	Si I
$\mathbf{B_{68}}$	$=$	$-x_{13}\,\mathbf{a}_1-y_{13}\,\mathbf{a}_2+z_{13}\,\mathbf{a}_3$	$=$	$-ax_{13}\,\hat{\mathbf{x}}-by_{13}\,\hat{\mathbf{y}}+cz_{13}\,\hat{\mathbf{z}}$	(8h)	Si I
$\mathbf{B_{69}}$	$=$	$-\left(x_{13}-\frac{1}{2}\right)\mathbf{a}_1+\left(y_{13}+\frac{1}{2}\right)\mathbf{a}_2-\left(z_{13}-\frac{1}{2}\right)\mathbf{a}_3$	$=$	$-a\left(x_{13}-\frac{1}{2}\right)\hat{\mathbf{x}}+b\left(y_{13}+\frac{1}{2}\right)\hat{\mathbf{y}}-c\left(z_{13}-\frac{1}{2}\right)\hat{\mathbf{z}}$	(8h)	Si I
$\mathbf{B_{70}}$	$=$	$\left(x_{13}+\frac{1}{2}\right)\mathbf{a}_1-\left(y_{13}-\frac{1}{2}\right)\mathbf{a}_2-\left(z_{13}-\frac{1}{2}\right)\mathbf{a}_3$	$=$	$a\left(x_{13}+\frac{1}{2}\right)\hat{\mathbf{x}}-b\left(y_{13}-\frac{1}{2}\right)\hat{\mathbf{y}}-c\left(z_{13}-\frac{1}{2}\right)\hat{\mathbf{z}}$	(8h)	Si I
$\mathbf{B_{71}}$	$=$	$-x_{13}\,\mathbf{a}_1-y_{13}\,\mathbf{a}_2-z_{13}\,\mathbf{a}_3$	$=$	$-ax_{13}\,\hat{\mathbf{x}}-by_{13}\,\hat{\mathbf{y}}-cz_{13}\,\hat{\mathbf{z}}$	(8h)	Si I
$\mathbf{B_{72}}$	$=$	$x_{13}\,\mathbf{a}_1+y_{13}\,\mathbf{a}_2-z_{13}\,\mathbf{a}_3$	$=$	$ax_{13}\,\hat{\mathbf{x}}+by_{13}\,\hat{\mathbf{y}}-cz_{13}\,\hat{\mathbf{z}}$	(8h)	Si I
$\mathbf{B_{73}}$	$=$	$\left(x_{13}+\frac{1}{2}\right)\mathbf{a}_1-\left(y_{13}-\frac{1}{2}\right)\mathbf{a}_2+\left(z_{13}+\frac{1}{2}\right)\mathbf{a}_3$	$=$	$a\left(x_{13}+\frac{1}{2}\right)\hat{\mathbf{x}}-b\left(y_{13}-\frac{1}{2}\right)\hat{\mathbf{y}}+c\left(z_{13}+\frac{1}{2}\right)\hat{\mathbf{z}}$	(8h)	Si I
$\mathbf{B_{74}}$	$=$	$-\left(x_{13}-\frac{1}{2}\right)\mathbf{a}_1+\left(y_{13}+\frac{1}{2}\right)\mathbf{a}_2+\left(z_{13}+\frac{1}{2}\right)\mathbf{a}_3$	$=$	$-a\left(x_{13}-\frac{1}{2}\right)\hat{\mathbf{x}}+b\left(y_{13}+\frac{1}{2}\right)\hat{\mathbf{y}}+c\left(z_{13}+\frac{1}{2}\right)\hat{\mathbf{z}}$	(8h)	Si I
$\mathbf{B_{75}}$	$=$	$x_{14}\,\mathbf{a}_1+y_{14}\,\mathbf{a}_2+z_{14}\,\mathbf{a}_3$	$=$	$ax_{14}\,\hat{\mathbf{x}}+by_{14}\,\hat{\mathbf{y}}+cz_{14}\,\hat{\mathbf{z}}$	(8h)	Si II
$\mathbf{B_{76}}$	$=$	$-x_{14}\,\mathbf{a}_1-y_{14}\,\mathbf{a}_2+z_{14}\,\mathbf{a}_3$	$=$	$-ax_{14}\,\hat{\mathbf{x}}-by_{14}\,\hat{\mathbf{y}}+cz_{14}\,\hat{\mathbf{z}}$	(8h)	Si II
$\mathbf{B_{77}}$	$=$	$-\left(x_{14}-\frac{1}{2}\right)\mathbf{a}_1+\left(y_{14}+\frac{1}{2}\right)\mathbf{a}_2-\left(z_{14}-\frac{1}{2}\right)\mathbf{a}_3$	$=$	$-a\left(x_{14}-\frac{1}{2}\right)\hat{\mathbf{x}}+b\left(y_{14}+\frac{1}{2}\right)\hat{\mathbf{y}}-c\left(z_{14}-\frac{1}{2}\right)\hat{\mathbf{z}}$	(8h)	Si II
$\mathbf{B_{78}}$	$=$	$\left(x_{14}+\frac{1}{2}\right)\mathbf{a}_1-\left(y_{14}-\frac{1}{2}\right)\mathbf{a}_2-\left(z_{14}-\frac{1}{2}\right)\mathbf{a}_3$	$=$	$a\left(x_{14}+\frac{1}{2}\right)\hat{\mathbf{x}}-b\left(y_{14}-\frac{1}{2}\right)\hat{\mathbf{y}}-c\left(z_{14}-\frac{1}{2}\right)\hat{\mathbf{z}}$	(8h)	Si II
$\mathbf{B_{79}}$	$=$	$-x_{14}\,\mathbf{a}_1-y_{14}\,\mathbf{a}_2-z_{14}\,\mathbf{a}_3$	$=$	$-ax_{14}\,\hat{\mathbf{x}}-by_{14}\,\hat{\mathbf{y}}-cz_{14}\,\hat{\mathbf{z}}$	(8h)	Si II
$\mathbf{B_{80}}$	$=$	$x_{14}\,\mathbf{a}_1+y_{14}\,\mathbf{a}_2-z_{14}\,\mathbf{a}_3$	$=$	$ax_{14}\,\hat{\mathbf{x}}+by_{14}\,\hat{\mathbf{y}}-cz_{14}\,\hat{\mathbf{z}}$	(8h)	Si II
$\mathbf{B_{81}}$	$=$	$\left(x_{14}+\frac{1}{2}\right)\mathbf{a}_1-\left(y_{14}-\frac{1}{2}\right)\mathbf{a}_2+\left(z_{14}+\frac{1}{2}\right)\mathbf{a}_3$	$=$	$a\left(x_{14}+\frac{1}{2}\right)\hat{\mathbf{x}}-b\left(y_{14}-\frac{1}{2}\right)\hat{\mathbf{y}}+c\left(z_{14}+\frac{1}{2}\right)\hat{\mathbf{z}}$	(8h)	Si II
$\mathbf{B_{82}}$	$=$	$-\left(x_{14}-\frac{1}{2}\right)\mathbf{a}_1+\left(y_{14}+\frac{1}{2}\right)\mathbf{a}_2+\left(z_{14}+\frac{1}{2}\right)\mathbf{a}_3$	$=$	$-a\left(x_{14}-\frac{1}{2}\right)\hat{\mathbf{x}}+b\left(y_{14}+\frac{1}{2}\right)\hat{\mathbf{y}}+c\left(z_{14}+\frac{1}{2}\right)\hat{\mathbf{z}}$	(8h)	Si II

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