Low Temperature CsW_2O_6 Structure: AB6C2_cP72_198_2a_4b_ab-001

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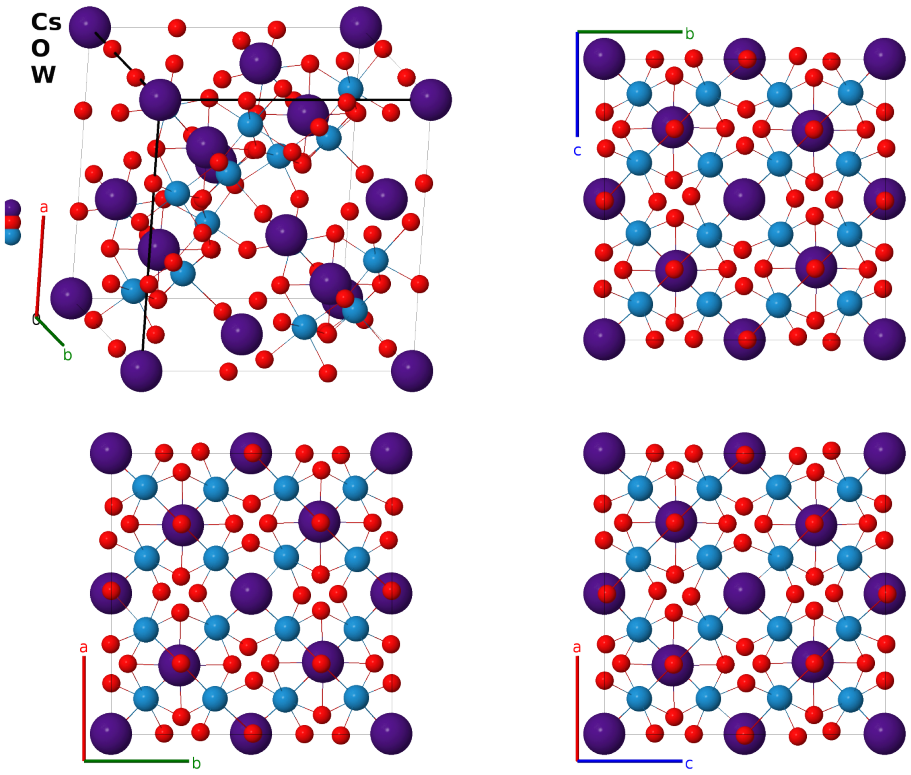
https://aflow.org/prototype-encyclopedia/WBDQ

https://aflow.org/prototype-encyclopedia/AB6C2_cP72_198_2a_4b_ab-001

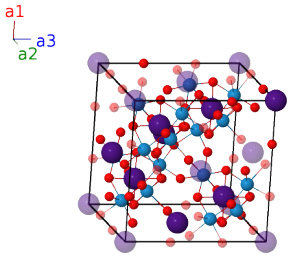


Prototype	CsO_6W_2
AFLOW prototype label	AB6C2_cP72_198_2a_4b_ab-001
Pearson symbol	cP72
Space group number	198
Space group symbol	$P2_13$
AFLOW prototype command	`aflow --proto=AB6C2_cP72_198_2a_4b_ab-001 --params=`$a, x_1, x_2, x_3, x_4, y_4, z_4, x_5, y_5, z_5, x_6, y_6, z_6, x_7, y_7, z_7, x_8, y_8, z_8$

- This is the ground state structure of CsW_2O_6, with data taken at 100K. Above 215K this transforms into the cubic (or β-) pyrochlore structure, $E8_1$.

Simple Cubic primitive vectors

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



Basis vectors

		Lattice coordinates		Cartesian coordinates	Wyckoff position	Atom type
$\mathbf{B_1}$	=	$x_1\,\mathbf{a}_1 + x_1\,\mathbf{a}_2 + x_1\,\mathbf{a}_3$	=	$ax_1\,\hat{\mathbf{x}} + ax_1\,\hat{\mathbf{y}} + ax_1\,\hat{\mathbf{z}}$	(4a)	Cs I
$\mathbf{B_2}$	=	$-\left(x_1-\frac{1}{2}\right)\,\mathbf{a}_1 - x_1\,\mathbf{a}_2 + \left(x_1+\frac{1}{2}\right)\,\mathbf{a}_3$	=	$-a\left(x_1-\frac{1}{2}\right)\,\hat{\mathbf{x}} - ax_1\,\hat{\mathbf{y}} + a\left(x_1+\frac{1}{2}\right)\,\hat{\mathbf{z}}$	(4a)	Cs I
$\mathbf{B_3}$	=	$-x_1\,\mathbf{a}_1 + \left(x_1+\frac{1}{2}\right)\,\mathbf{a}_2 - \left(x_1-\frac{1}{2}\right)\,\mathbf{a}_3$	=	$-ax_1\,\hat{\mathbf{x}} + a\left(x_1+\frac{1}{2}\right)\,\hat{\mathbf{y}} - a\left(x_1-\frac{1}{2}\right)\,\hat{\mathbf{z}}$	(4a)	Cs I
$\mathbf{B_4}$	=	$\left(x_1+\frac{1}{2}\right)\,\mathbf{a}_1 - \left(x_1-\frac{1}{2}\right)\,\mathbf{a}_2 - x_1\,\mathbf{a}_3$	=	$a\left(x_1+\frac{1}{2}\right)\,\hat{\mathbf{x}} - a\left(x_1-\frac{1}{2}\right)\,\hat{\mathbf{y}} - ax_1\,\hat{\mathbf{z}}$	(4a)	Cs I
$\mathbf{B_5}$	=	$x_2\,\mathbf{a}_1 + x_2\,\mathbf{a}_2 + x_2\,\mathbf{a}_3$	=	$ax_2\,\hat{\mathbf{x}} + ax_2\,\hat{\mathbf{y}} + ax_2\,\hat{\mathbf{z}}$	(4a)	Cs II
$\mathbf{B_6}$	=	$-\left(x_2-\frac{1}{2}\right)\,\mathbf{a}_1 - x_2\,\mathbf{a}_2 + \left(x_2+\frac{1}{2}\right)\,\mathbf{a}_3$	=	$-a\left(x_2-\frac{1}{2}\right)\,\hat{\mathbf{x}} - ax_2\,\hat{\mathbf{y}} + a\left(x_2+\frac{1}{2}\right)\,\hat{\mathbf{z}}$	(4a)	Cs II
$\mathbf{B_7}$	=	$-x_2\,\mathbf{a}_1 + \left(x_2+\frac{1}{2}\right)\,\mathbf{a}_2 - \left(x_2-\frac{1}{2}\right)\,\mathbf{a}_3$	=	$-ax_2\,\hat{\mathbf{x}} + a\left(x_2+\frac{1}{2}\right)\,\hat{\mathbf{y}} - a\left(x_2-\frac{1}{2}\right)\,\hat{\mathbf{z}}$	(4a)	Cs II
$\mathbf{B_8}$	=	$\left(x_2+\frac{1}{2}\right)\,\mathbf{a}_1 - \left(x_2-\frac{1}{2}\right)\,\mathbf{a}_2 - x_2\,\mathbf{a}_3$	=	$a\left(x_2+\frac{1}{2}\right)\,\hat{\mathbf{x}} - a\left(x_2-\frac{1}{2}\right)\,\hat{\mathbf{y}} - ax_2\,\hat{\mathbf{z}}$	(4a)	Cs II
$\mathbf{B_9}$	=	$x_3\,\mathbf{a}_1 + x_3\,\mathbf{a}_2 + x_3\,\mathbf{a}_3$	=	$ax_3\,\hat{\mathbf{x}} + ax_3\,\hat{\mathbf{y}} + ax_3\,\hat{\mathbf{z}}$	(4a)	W I
$\mathbf{B_{10}}$	=	$-\left(x_3-\frac{1}{2}\right)\,\mathbf{a}_1 - x_3\,\mathbf{a}_2 + \left(x_3+\frac{1}{2}\right)\,\mathbf{a}_3$	=	$-a\left(x_3-\frac{1}{2}\right)\,\hat{\mathbf{x}} - ax_3\,\hat{\mathbf{y}} + a\left(x_3+\frac{1}{2}\right)\,\hat{\mathbf{z}}$	(4a)	W I
$\mathbf{B_{11}}$	=	$-x_3\,\mathbf{a}_1 + \left(x_3+\frac{1}{2}\right)\,\mathbf{a}_2 - \left(x_3-\frac{1}{2}\right)\,\mathbf{a}_3$	=	$-ax_3\,\hat{\mathbf{x}} + a\left(x_3+\frac{1}{2}\right)\,\hat{\mathbf{y}} - a\left(x_3-\frac{1}{2}\right)\,\hat{\mathbf{z}}$	(4a)	W I
$\mathbf{B_{12}}$	=	$\left(x_3+\frac{1}{2}\right)\,\mathbf{a}_1 - \left(x_3-\frac{1}{2}\right)\,\mathbf{a}_2 - x_3\,\mathbf{a}_3$	=	$a\left(x_3+\frac{1}{2}\right)\,\hat{\mathbf{x}} - a\left(x_3-\frac{1}{2}\right)\,\hat{\mathbf{y}} - ax_3\,\hat{\mathbf{z}}$	(4a)	W I
$\mathbf{B_{13}}$	=	$x_4\,\mathbf{a}_1 + y_4\,\mathbf{a}_2 + z_4\,\mathbf{a}_3$	=	$ax_4\,\hat{\mathbf{x}} + ay_4\,\hat{\mathbf{y}} + az_4\,\hat{\mathbf{z}}$	(12b)	O I
$\mathbf{B_{14}}$	=	$-\left(x_4-\frac{1}{2}\right)\,\mathbf{a}_1 - y_4\,\mathbf{a}_2 + \left(z_4+\frac{1}{2}\right)\,\mathbf{a}_3$	=	$-a\left(x_4-\frac{1}{2}\right)\,\hat{\mathbf{x}} - ay_4\,\hat{\mathbf{y}} + a\left(z_4+\frac{1}{2}\right)\,\hat{\mathbf{z}}$	(12b)	O I
$\mathbf{B_{15}}$	=	$-x_4\,\mathbf{a}_1 + \left(y_4+\frac{1}{2}\right)\,\mathbf{a}_2 - \left(z_4-\frac{1}{2}\right)\,\mathbf{a}_3$	=	$-ax_4\,\hat{\mathbf{x}} + a\left(y_4+\frac{1}{2}\right)\,\hat{\mathbf{y}} - a\left(z_4-\frac{1}{2}\right)\,\hat{\mathbf{z}}$	(12b)	O I
$\mathbf{B_{16}}$	=	$\left(x_4+\frac{1}{2}\right)\,\mathbf{a}_1 - \left(y_4-\frac{1}{2}\right)\,\mathbf{a}_2 - z_4\,\mathbf{a}_3$	=	$a\left(x_4+\frac{1}{2}\right)\,\hat{\mathbf{x}} - a\left(y_4-\frac{1}{2}\right)\,\hat{\mathbf{y}} - az_4\,\hat{\mathbf{z}}$	(12b)	O I
$\mathbf{B_{17}}$	=	$z_4\,\mathbf{a}_1 + x_4\,\mathbf{a}_2 + y_4\,\mathbf{a}_3$	=	$az_4\,\hat{\mathbf{x}} + ax_4\,\hat{\mathbf{y}} + ay_4\,\hat{\mathbf{z}}$	(12b)	O I
$\mathbf{B_{18}}$	=	$\left(z_4+\frac{1}{2}\right)\,\mathbf{a}_1 - \left(x_4-\frac{1}{2}\right)\,\mathbf{a}_2 - y_4\,\mathbf{a}_3$	=	$a\left(z_4+\frac{1}{2}\right)\,\hat{\mathbf{x}} - a\left(x_4-\frac{1}{2}\right)\,\hat{\mathbf{y}} - ay_4\,\hat{\mathbf{z}}$	(12b)	O I
$\mathbf{B_{19}}$	=	$-\left(z_4-\frac{1}{2}\right)\,\mathbf{a}_1 - x_4\,\mathbf{a}_2 + \left(y_4+\frac{1}{2}\right)\,\mathbf{a}_3$	=	$-a\left(z_4-\frac{1}{2}\right)\,\hat{\mathbf{x}} - ax_4\,\hat{\mathbf{y}} + a\left(y_4+\frac{1}{2}\right)\,\hat{\mathbf{z}}$	(12b)	O I
$\mathbf{B_{20}}$	=	$-z_4\,\mathbf{a}_1 + \left(x_4+\frac{1}{2}\right)\,\mathbf{a}_2 - \left(y_4-\frac{1}{2}\right)\,\mathbf{a}_3$	=	$-az_4\,\hat{\mathbf{x}} + a\left(x_4+\frac{1}{2}\right)\,\hat{\mathbf{y}} - a\left(y_4-\frac{1}{2}\right)\,\hat{\mathbf{z}}$	(12b)	O I

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\begin{array}{lcccccc}
\mathbf{B_{21}} & = & y_4\,\mathbf{a}_1 + z_4\,\mathbf{a}_2 + x_4\,\mathbf{a}_3 & = & a y_4\,\hat{\mathbf{x}} + a z_4\,\hat{\mathbf{y}} + a x_4\,\hat{\mathbf{z}} & \text{(12b)} & \text{O I} \\
\mathbf{B_{22}} & = & -y_4\,\mathbf{a}_1 + \left(z_4 + \tfrac{1}{2}\right)\,\mathbf{a}_2 - \left(x_4 - \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a y_4\,\hat{\mathbf{x}} + a\left(z_4 + \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - a\left(x_4 - \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O I} \\
\mathbf{B_{23}} & = & \left(y_4 + \tfrac{1}{2}\right)\,\mathbf{a}_1 - \left(z_4 - \tfrac{1}{2}\right)\,\mathbf{a}_2 - x_4\,\mathbf{a}_3 & = & a\left(y_4 + \tfrac{1}{2}\right)\,\hat{\mathbf{x}} - a\left(z_4 - \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - a x_4\,\hat{\mathbf{z}} & \text{(12b)} & \text{O I} \\
\mathbf{B_{24}} & = & -\left(y_4 - \tfrac{1}{2}\right)\,\mathbf{a}_1 - z_4\,\mathbf{a}_2 + \left(x_4 + \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a\left(y_4 - \tfrac{1}{2}\right)\,\hat{\mathbf{x}} - a z_4\,\hat{\mathbf{y}} + a\left(x_4 + \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O I} \\
\mathbf{B_{25}} & = & x_5\,\mathbf{a}_1 + y_5\,\mathbf{a}_2 + z_5\,\mathbf{a}_3 & = & a x_5\,\hat{\mathbf{x}} + a y_5\,\hat{\mathbf{y}} + a z_5\,\hat{\mathbf{z}} & \text{(12b)} & \text{O II} \\
\mathbf{B_{26}} & = & -\left(x_5 - \tfrac{1}{2}\right)\,\mathbf{a}_1 - y_5\,\mathbf{a}_2 + \left(z_5 + \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a\left(x_5 - \tfrac{1}{2}\right)\,\hat{\mathbf{x}} - a y_5\,\hat{\mathbf{y}} + a\left(z_5 + \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O II} \\
\mathbf{B_{27}} & = & -x_5\,\mathbf{a}_1 + \left(y_5 + \tfrac{1}{2}\right)\,\mathbf{a}_2 - \left(z_5 - \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a x_5\,\hat{\mathbf{x}} + a\left(y_5 + \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - a\left(z_5 - \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O II} \\
\mathbf{B_{28}} & = & \left(x_5 + \tfrac{1}{2}\right)\,\mathbf{a}_1 - \left(y_5 - \tfrac{1}{2}\right)\,\mathbf{a}_2 - z_5\,\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}} - a z_5\,\hat{\mathbf{z}} & \text{(12b)} & \text{O II} \\
\mathbf{B_{29}} & = & z_5\,\mathbf{a}_1 + x_5\,\mathbf{a}_2 + y_5\,\mathbf{a}_3 & = & a z_5\,\hat{\mathbf{x}} + a x_5\,\hat{\mathbf{y}} + a y_5\,\hat{\mathbf{z}} & \text{(12b)} & \text{O II} \\
\mathbf{B_{30}} & = & \left(z_5 + \tfrac{1}{2}\right)\,\mathbf{a}_1 - \left(x_5 - \tfrac{1}{2}\right)\,\mathbf{a}_2 - y_5\,\mathbf{a}_3 & = & a\left(z_5 + \tfrac{1}{2}\right)\,\hat{\mathbf{x}} - a\left(x_5 - \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - a y_5\,\hat{\mathbf{z}} & \text{(12b)} & \text{O II} \\
\mathbf{B_{31}} & = & -\left(z_5 - \tfrac{1}{2}\right)\,\mathbf{a}_1 - x_5\,\mathbf{a}_2 + \left(y_5 + \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a\left(z_5 - \tfrac{1}{2}\right)\,\hat{\mathbf{x}} - a x_5\,\hat{\mathbf{y}} + a\left(y_5 + \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O II} \\
\mathbf{B_{32}} & = & -z_5\,\mathbf{a}_1 + \left(x_5 + \tfrac{1}{2}\right)\,\mathbf{a}_2 - \left(y_5 - \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a z_5\,\hat{\mathbf{x}} + a\left(x_5 + \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - a\left(y_5 - \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O II} \\
\mathbf{B_{33}} & = & y_5\,\mathbf{a}_1 + z_5\,\mathbf{a}_2 + x_5\,\mathbf{a}_3 & = & a y_5\,\hat{\mathbf{x}} + a z_5\,\hat{\mathbf{y}} + a x_5\,\hat{\mathbf{z}} & \text{(12b)} & \text{O II} \\
\mathbf{B_{34}} & = & -y_5\,\mathbf{a}_1 + \left(z_5 + \tfrac{1}{2}\right)\,\mathbf{a}_2 - \left(x_5 - \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a y_5\,\hat{\mathbf{x}} + a\left(z_5 + \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - a\left(x_5 - \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O II} \\
\mathbf{B_{35}} & = & \left(y_5 + \tfrac{1}{2}\right)\,\mathbf{a}_1 - \left(z_5 - \tfrac{1}{2}\right)\,\mathbf{a}_2 - x_5\,\mathbf{a}_3 & = & a\left(y_5 + \tfrac{1}{2}\right)\,\hat{\mathbf{x}} - a\left(z_5 - \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - a x_5\,\hat{\mathbf{z}} & \text{(12b)} & \text{O II} \\
\mathbf{B_{36}} & = & -\left(y_5 - \tfrac{1}{2}\right)\,\mathbf{a}_1 - z_5\,\mathbf{a}_2 + \left(x_5 + \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a\left(y_5 - \tfrac{1}{2}\right)\,\hat{\mathbf{x}} - a z_5\,\hat{\mathbf{y}} + a\left(x_5 + \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O II} \\
\mathbf{B_{37}} & = & x_6\,\mathbf{a}_1 + y_6\,\mathbf{a}_2 + z_6\,\mathbf{a}_3 & = & a x_6\,\hat{\mathbf{x}} + a y_6\,\hat{\mathbf{y}} + a z_6\,\hat{\mathbf{z}} & \text{(12b)} & \text{O III} \\
\mathbf{B_{38}} & = & -\left(x_6 - \tfrac{1}{2}\right)\,\mathbf{a}_1 - y_6\,\mathbf{a}_2 + \left(z_6 + \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a\left(x_6 - \tfrac{1}{2}\right)\,\hat{\mathbf{x}} - a y_6\,\hat{\mathbf{y}} + a\left(z_6 + \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O III} \\
\mathbf{B_{39}} & = & -x_6\,\mathbf{a}_1 + \left(y_6 + \tfrac{1}{2}\right)\,\mathbf{a}_2 - \left(z_6 - \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a x_6\,\hat{\mathbf{x}} + a\left(y_6 + \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - a\left(z_6 - \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O III} \\
\mathbf{B_{40}} & = & \left(x_6 + \tfrac{1}{2}\right)\,\mathbf{a}_1 - \left(y_6 - \tfrac{1}{2}\right)\,\mathbf{a}_2 - z_6\,\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}} - a z_6\,\hat{\mathbf{z}} & \text{(12b)} & \text{O III} \\
\mathbf{B_{41}} & = & z_6\,\mathbf{a}_1 + x_6\,\mathbf{a}_2 + y_6\,\mathbf{a}_3 & = & a z_6\,\hat{\mathbf{x}} + a x_6\,\hat{\mathbf{y}} + a y_6\,\hat{\mathbf{z}} & \text{(12b)} & \text{O III} \\
\mathbf{B_{42}} & = & \left(z_6 + \tfrac{1}{2}\right)\,\mathbf{a}_1 - \left(x_6 - \tfrac{1}{2}\right)\,\mathbf{a}_2 - y_6\,\mathbf{a}_3 & = & a\left(z_6 + \tfrac{1}{2}\right)\,\hat{\mathbf{x}} - a\left(x_6 - \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - a y_6\,\hat{\mathbf{z}} & \text{(12b)} & \text{O III} \\
\mathbf{B_{43}} & = & -\left(z_6 - \tfrac{1}{2}\right)\,\mathbf{a}_1 - x_6\,\mathbf{a}_2 + \left(y_6 + \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a\left(z_6 - \tfrac{1}{2}\right)\,\hat{\mathbf{x}} - a x_6\,\hat{\mathbf{y}} + a\left(y_6 + \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O III} \\
\mathbf{B_{44}} & = & -z_6\,\mathbf{a}_1 + \left(x_6 + \tfrac{1}{2}\right)\,\mathbf{a}_2 - \left(y_6 - \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a z_6\,\hat{\mathbf{x}} + a\left(x_6 + \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - a\left(y_6 - \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O III} \\
\mathbf{B_{45}} & = & y_6\,\mathbf{a}_1 + z_6\,\mathbf{a}_2 + x_6\,\mathbf{a}_3 & = & a y_6\,\hat{\mathbf{x}} + a z_6\,\hat{\mathbf{y}} + a x_6\,\hat{\mathbf{z}} & \text{(12b)} & \text{O III} \\
\mathbf{B_{46}} & = & -y_6\,\mathbf{a}_1 + \left(z_6 + \tfrac{1}{2}\right)\,\mathbf{a}_2 - \left(x_6 - \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a y_6\,\hat{\mathbf{x}} + a\left(z_6 + \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - a\left(x_6 - \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O III} \\
\mathbf{B_{47}} & = & \left(y_6 + \tfrac{1}{2}\right)\,\mathbf{a}_1 - \left(z_6 - \tfrac{1}{2}\right)\,\mathbf{a}_2 - x_6\,\mathbf{a}_3 & = & a\left(y_6 + \tfrac{1}{2}\right)\,\hat{\mathbf{x}} - a\left(z_6 - \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - a x_6\,\hat{\mathbf{z}} & \text{(12b)} & \text{O III} \\
\mathbf{B_{48}} & = & -\left(y_6 - \tfrac{1}{2}\right)\,\mathbf{a}_1 - z_6\,\mathbf{a}_2 + \left(x_6 + \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a\left(y_6 - \tfrac{1}{2}\right)\,\hat{\mathbf{x}} - a z_6\,\hat{\mathbf{y}} + a\left(x_6 + \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O III} \\
\mathbf{B_{49}} & = & x_7\,\mathbf{a}_1 + y_7\,\mathbf{a}_2 + z_7\,\mathbf{a}_3 & = & a x_7\,\hat{\mathbf{x}} + a y_7\,\hat{\mathbf{y}} + a z_7\,\hat{\mathbf{z}} & \text{(12b)} & \text{O IV} \\
\mathbf{B_{50}} & = & -\left(x_7 - \tfrac{1}{2}\right)\,\mathbf{a}_1 - y_7\,\mathbf{a}_2 + \left(z_7 + \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -a\left(x_7 - \tfrac{1}{2}\right)\,\hat{\mathbf{x}} - a y_7\,\hat{\mathbf{y}} + a\left(z_7 + \tfrac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O IV}
\end{array}
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\begin{array}{rcccccc}
\mathbf{B_{51}} & = & -x_7\,\mathbf{a}_1+\left(y_7+\frac{1}{2}\right)\,\mathbf{a}_2-\left(z_7-\frac{1}{2}\right)\,\mathbf{a}_3 & = & -ax_7\,\hat{\mathbf{x}}+a\left(y_7+\frac{1}{2}\right)\,\hat{\mathbf{y}}-a\left(z_7-\frac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O IV} \\
\mathbf{B_{52}} & = & \left(x_7+\frac{1}{2}\right)\,\mathbf{a}_1-\left(y_7-\frac{1}{2}\right)\,\mathbf{a}_2-z_7\,\mathbf{a}_3 & = & a\left(x_7+\frac{1}{2}\right)\,\hat{\mathbf{x}}-a\left(y_7-\frac{1}{2}\right)\,\hat{\mathbf{y}}-az_7\,\hat{\mathbf{z}} & \text{(12b)} & \text{O IV} \\
\mathbf{B_{53}} & = & z_7\,\mathbf{a}_1+x_7\,\mathbf{a}_2+y_7\,\mathbf{a}_3 & = & az_7\,\hat{\mathbf{x}}+ax_7\,\hat{\mathbf{y}}+ay_7\,\hat{\mathbf{z}} & \text{(12b)} & \text{O IV} \\
\mathbf{B_{54}} & = & \left(z_7+\frac{1}{2}\right)\,\mathbf{a}_1-\left(x_7-\frac{1}{2}\right)\,\mathbf{a}_2-y_7\,\mathbf{a}_3 & = & a\left(z_7+\frac{1}{2}\right)\,\hat{\mathbf{x}}-a\left(x_7-\frac{1}{2}\right)\,\hat{\mathbf{y}}-ay_7\,\hat{\mathbf{z}} & \text{(12b)} & \text{O IV} \\
\mathbf{B_{55}} & = & -\left(z_7-\frac{1}{2}\right)\,\mathbf{a}_1-x_7\,\mathbf{a}_2+\left(y_7+\frac{1}{2}\right)\,\mathbf{a}_3 & = & -a\left(z_7-\frac{1}{2}\right)\,\hat{\mathbf{x}}-ax_7\,\hat{\mathbf{y}}+a\left(y_7+\frac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O IV} \\
\mathbf{B_{56}} & = & -z_7\,\mathbf{a}_1+\left(x_7+\frac{1}{2}\right)\,\mathbf{a}_2-\left(y_7-\frac{1}{2}\right)\,\mathbf{a}_3 & = & -az_7\,\hat{\mathbf{x}}+a\left(x_7+\frac{1}{2}\right)\,\hat{\mathbf{y}}-a\left(y_7-\frac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O IV} \\
\mathbf{B_{57}} & = & y_7\,\mathbf{a}_1+z_7\,\mathbf{a}_2+x_7\,\mathbf{a}_3 & = & ay_7\,\hat{\mathbf{x}}+az_7\,\hat{\mathbf{y}}+ax_7\,\hat{\mathbf{z}} & \text{(12b)} & \text{O IV} \\
\mathbf{B_{58}} & = & -y_7\,\mathbf{a}_1+\left(z_7+\frac{1}{2}\right)\,\mathbf{a}_2-\left(x_7-\frac{1}{2}\right)\,\mathbf{a}_3 & = & -ay_7\,\hat{\mathbf{x}}+a\left(z_7+\frac{1}{2}\right)\,\hat{\mathbf{y}}-a\left(x_7-\frac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O IV} \\
\mathbf{B_{59}} & = & \left(y_7+\frac{1}{2}\right)\,\mathbf{a}_1-\left(z_7-\frac{1}{2}\right)\,\mathbf{a}_2-x_7\,\mathbf{a}_3 & = & a\left(y_7+\frac{1}{2}\right)\,\hat{\mathbf{x}}-a\left(z_7-\frac{1}{2}\right)\,\hat{\mathbf{y}}-ax_7\,\hat{\mathbf{z}} & \text{(12b)} & \text{O IV} \\
\mathbf{B_{60}} & = & -\left(y_7-\frac{1}{2}\right)\,\mathbf{a}_1-z_7\,\mathbf{a}_2+\left(x_7+\frac{1}{2}\right)\,\mathbf{a}_3 & = & -a\left(y_7-\frac{1}{2}\right)\,\hat{\mathbf{x}}-az_7\,\hat{\mathbf{y}}+a\left(x_7+\frac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{O IV} \\
\mathbf{B_{61}} & = & 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}}+az_8\,\hat{\mathbf{z}} & \text{(12b)} & \text{W II} \\
\mathbf{B_{62}} & = & -\left(x_8-\frac{1}{2}\right)\,\mathbf{a}_1-y_8\,\mathbf{a}_2+\left(z_8+\frac{1}{2}\right)\,\mathbf{a}_3 & = & -a\left(x_8-\frac{1}{2}\right)\,\hat{\mathbf{x}}-ay_8\,\hat{\mathbf{y}}+a\left(z_8+\frac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{W II} \\
\mathbf{B_{63}} & = & -x_8\,\mathbf{a}_1+\left(y_8+\frac{1}{2}\right)\,\mathbf{a}_2-\left(z_8-\frac{1}{2}\right)\,\mathbf{a}_3 & = & -ax_8\,\hat{\mathbf{x}}+a\left(y_8+\frac{1}{2}\right)\,\hat{\mathbf{y}}-a\left(z_8-\frac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{W II} \\
\mathbf{B_{64}} & = & \left(x_8+\frac{1}{2}\right)\,\mathbf{a}_1-\left(y_8-\frac{1}{2}\right)\,\mathbf{a}_2-z_8\,\mathbf{a}_3 & = & a\left(x_8+\frac{1}{2}\right)\,\hat{\mathbf{x}}-a\left(y_8-\frac{1}{2}\right)\,\hat{\mathbf{y}}-az_8\,\hat{\mathbf{z}} & \text{(12b)} & \text{W II} \\
\mathbf{B_{65}} & = & z_8\,\mathbf{a}_1+x_8\,\mathbf{a}_2+y_8\,\mathbf{a}_3 & = & az_8\,\hat{\mathbf{x}}+ax_8\,\hat{\mathbf{y}}+ay_8\,\hat{\mathbf{z}} & \text{(12b)} & \text{W II} \\
\mathbf{B_{66}} & = & \left(z_8+\frac{1}{2}\right)\,\mathbf{a}_1-\left(x_8-\frac{1}{2}\right)\,\mathbf{a}_2-y_8\,\mathbf{a}_3 & = & a\left(z_8+\frac{1}{2}\right)\,\hat{\mathbf{x}}-a\left(x_8-\frac{1}{2}\right)\,\hat{\mathbf{y}}-ay_8\,\hat{\mathbf{z}} & \text{(12b)} & \text{W II} \\
\mathbf{B_{67}} & = & -\left(z_8-\frac{1}{2}\right)\,\mathbf{a}_1-x_8\,\mathbf{a}_2+\left(y_8+\frac{1}{2}\right)\,\mathbf{a}_3 & = & -a\left(z_8-\frac{1}{2}\right)\,\hat{\mathbf{x}}-ax_8\,\hat{\mathbf{y}}+a\left(y_8+\frac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{W II} \\
\mathbf{B_{68}} & = & -z_8\,\mathbf{a}_1+\left(x_8+\frac{1}{2}\right)\,\mathbf{a}_2-\left(y_8-\frac{1}{2}\right)\,\mathbf{a}_3 & = & -az_8\,\hat{\mathbf{x}}+a\left(x_8+\frac{1}{2}\right)\,\hat{\mathbf{y}}-a\left(y_8-\frac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{W II} \\
\mathbf{B_{69}} & = & y_8\,\mathbf{a}_1+z_8\,\mathbf{a}_2+x_8\,\mathbf{a}_3 & = & ay_8\,\hat{\mathbf{x}}+az_8\,\hat{\mathbf{y}}+ax_8\,\hat{\mathbf{z}} & \text{(12b)} & \text{W II} \\
\mathbf{B_{70}} & = & -y_8\,\mathbf{a}_1+\left(z_8+\frac{1}{2}\right)\,\mathbf{a}_2-\left(x_8-\frac{1}{2}\right)\,\mathbf{a}_3 & = & -ay_8\,\hat{\mathbf{x}}+a\left(z_8+\frac{1}{2}\right)\,\hat{\mathbf{y}}-a\left(x_8-\frac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{W II} \\
\mathbf{B_{71}} & = & \left(y_8+\frac{1}{2}\right)\,\mathbf{a}_1-\left(z_8-\frac{1}{2}\right)\,\mathbf{a}_2-x_8\,\mathbf{a}_3 & = & a\left(y_8+\frac{1}{2}\right)\,\hat{\mathbf{x}}-a\left(z_8-\frac{1}{2}\right)\,\hat{\mathbf{y}}-ax_8\,\hat{\mathbf{z}} & \text{(12b)} & \text{W II} \\
\mathbf{B_{72}} & = & -\left(y_8-\frac{1}{2}\right)\,\mathbf{a}_1-z_8\,\mathbf{a}_2+\left(x_8+\frac{1}{2}\right)\,\mathbf{a}_3 & = & -a\left(y_8-\frac{1}{2}\right)\,\hat{\mathbf{x}}-az_8\,\hat{\mathbf{y}}+a\left(x_8+\frac{1}{2}\right)\,\hat{\mathbf{z}} & \text{(12b)} & \text{W II}
\end{array}
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