

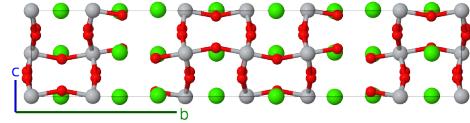
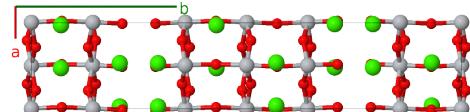
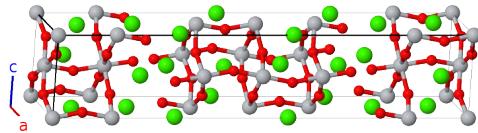
# $\text{Ca}_4\text{Ti}_3\text{O}_{10}$ Structure: A4B10C3\_oP68\_61\_2c\_5c\_ac-001

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<https://aflow.org/p/R6BH>

[https://aflow.org/p/A4B10C3\\_oP68\\_61\\_2c\\_5c\\_ac-001](https://aflow.org/p/A4B10C3_oP68_61_2c_5c_ac-001)

Ca  
O  
Ti



Prototype	$\text{Ca}_4\text{O}_{10}\text{Ti}_3$
AFLOW prototype label	A4B10C3_oP68_61_2c_5c_ac-001
ICSD	86242
Pearson symbol	oP68
Space group number	61
Space group symbol	$Pbca$
AFLOW prototype command	<pre>aflow --proto=A4B10C3_oP68_61_2c_5c_ac-001 --params=a,b/a,c/a,x2,y2,z2,x3,y3,z3,x4,y4,z4,x5,y5,z5,x6,y6,z6,x7,y7,z7,x8, y8,z8,x9,y9,z9</pre>

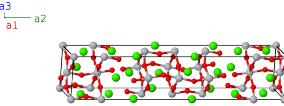
## Other compounds with this structure

( $\text{Ca}_{3.6}\text{Sr}_{0.4}\text{Ti}_3\text{O}_{10}$ )

- (Hawkins, 1991) give the structure the  $Pcab$  setting of space group #61. We use FINDSYM to place it in the standard  $Pbca$  setting. This requires a  $90^\circ$  rotation about the  $y$ -axis. In addition, the origin was shifted to place a titanium atom at the origin.
- Pararammelsbergite ( $\text{NiAs}_2$ ),  $\beta\text{-TeO}_2$  and brookite ( $C21$ ,  $\text{TiO}_2$ ) have the same AFLOW prototype label, A2B\_oP24\_61\_2c\_c. They are generated by the same symmetry operations with different sets of parameters (`--params`) specified in their corresponding CIF files.

## Simple Orthorhombic primitive vectors

$$\begin{aligned}\mathbf{a}_1 &= a\hat{\mathbf{x}} \\ \mathbf{a}_2 &= b\hat{\mathbf{y}} \\ \mathbf{a}_3 &= c\hat{\mathbf{z}}\end{aligned}$$



## Basis vectors

	Lattice coordinates	=	Cartesian coordinates	Wyckoff position	Atom type
$\mathbf{B}_1$	0	=	0	(4a)	Ti I
$\mathbf{B}_2$	$\frac{1}{2}\mathbf{a}_1 + \frac{1}{2}\mathbf{a}_3$	=	$\frac{1}{2}a\hat{\mathbf{x}} + \frac{1}{2}c\hat{\mathbf{z}}$	(4a)	Ti I
$\mathbf{B}_3$	$\frac{1}{2}\mathbf{a}_2 + \frac{1}{2}\mathbf{a}_3$	=	$\frac{1}{2}b\hat{\mathbf{y}} + \frac{1}{2}c\hat{\mathbf{z}}$	(4a)	Ti I
$\mathbf{B}_4$	$\frac{1}{2}\mathbf{a}_1 + \frac{1}{2}\mathbf{a}_2$	=	$\frac{1}{2}a\hat{\mathbf{x}} + \frac{1}{2}b\hat{\mathbf{y}}$	(4a)	Ti I
$\mathbf{B}_5$	$x_2\mathbf{a}_1 + y_2\mathbf{a}_2 + z_2\mathbf{a}_3$	=	$ax_2\hat{\mathbf{x}} + by_2\hat{\mathbf{y}} + cz_2\hat{\mathbf{z}}$	(8c)	Ca I
$\mathbf{B}_6$	$-(x_2 - \frac{1}{2})\mathbf{a}_1 - y_2\mathbf{a}_2 + (z_2 + \frac{1}{2})\mathbf{a}_3$	=	$-a(x_2 - \frac{1}{2})\hat{\mathbf{x}} - by_2\hat{\mathbf{y}} + c(z_2 + \frac{1}{2})\hat{\mathbf{z}}$	(8c)	Ca I
$\mathbf{B}_7$	$-x_2\mathbf{a}_1 + (y_2 + \frac{1}{2})\mathbf{a}_2 - (z_2 - \frac{1}{2})\mathbf{a}_3$	=	$-ax_2\hat{\mathbf{x}} + b(y_2 + \frac{1}{2})\hat{\mathbf{y}} - c(z_2 - \frac{1}{2})\hat{\mathbf{z}}$	(8c)	Ca I
$\mathbf{B}_8$	$(x_2 + \frac{1}{2})\mathbf{a}_1 - (y_2 - \frac{1}{2})\mathbf{a}_2 - z_2\mathbf{a}_3$	=	$a(x_2 + \frac{1}{2})\hat{\mathbf{x}} - b(y_2 - \frac{1}{2})\hat{\mathbf{y}} - cz_2\hat{\mathbf{z}}$	(8c)	Ca I
$\mathbf{B}_9$	$-x_2\mathbf{a}_1 - y_2\mathbf{a}_2 - z_2\mathbf{a}_3$	=	$-ax_2\hat{\mathbf{x}} - by_2\hat{\mathbf{y}} - cz_2\hat{\mathbf{z}}$	(8c)	Ca I
$\mathbf{B}_{10}$	$(x_2 + \frac{1}{2})\mathbf{a}_1 + y_2\mathbf{a}_2 - (z_2 - \frac{1}{2})\mathbf{a}_3$	=	$a(x_2 + \frac{1}{2})\hat{\mathbf{x}} + by_2\hat{\mathbf{y}} - c(z_2 - \frac{1}{2})\hat{\mathbf{z}}$	(8c)	Ca I
$\mathbf{B}_{11}$	$x_2\mathbf{a}_1 - (y_2 - \frac{1}{2})\mathbf{a}_2 + (z_2 + \frac{1}{2})\mathbf{a}_3$	=	$ax_2\hat{\mathbf{x}} - b(y_2 - \frac{1}{2})\hat{\mathbf{y}} + c(z_2 + \frac{1}{2})\hat{\mathbf{z}}$	(8c)	Ca I
$\mathbf{B}_{12}$	$-(x_2 - \frac{1}{2})\mathbf{a}_1 + (y_2 + \frac{1}{2})\mathbf{a}_2 + z_2\mathbf{a}_3$	=	$-a(x_2 - \frac{1}{2})\hat{\mathbf{x}} + b(y_2 + \frac{1}{2})\hat{\mathbf{y}} + cz_2\hat{\mathbf{z}}$	(8c)	Ca I
$\mathbf{B}_{13}$	$x_3\mathbf{a}_1 + y_3\mathbf{a}_2 + z_3\mathbf{a}_3$	=	$ax_3\hat{\mathbf{x}} + by_3\hat{\mathbf{y}} + cz_3\hat{\mathbf{z}}$	(8c)	Ca II
$\mathbf{B}_{14}$	$-(x_3 - \frac{1}{2})\mathbf{a}_1 - y_3\mathbf{a}_2 + (z_3 + \frac{1}{2})\mathbf{a}_3$	=	$-a(x_3 - \frac{1}{2})\hat{\mathbf{x}} - by_3\hat{\mathbf{y}} + c(z_3 + \frac{1}{2})\hat{\mathbf{z}}$	(8c)	Ca II
$\mathbf{B}_{15}$	$-x_3\mathbf{a}_1 + (y_3 + \frac{1}{2})\mathbf{a}_2 - (z_3 - \frac{1}{2})\mathbf{a}_3$	=	$-ax_3\hat{\mathbf{x}} + b(y_3 + \frac{1}{2})\hat{\mathbf{y}} - c(z_3 - \frac{1}{2})\hat{\mathbf{z}}$	(8c)	Ca II
$\mathbf{B}_{16}$	$(x_3 + \frac{1}{2})\mathbf{a}_1 - (y_3 - \frac{1}{2})\mathbf{a}_2 - z_3\mathbf{a}_3$	=	$a(x_3 + \frac{1}{2})\hat{\mathbf{x}} - b(y_3 - \frac{1}{2})\hat{\mathbf{y}} - cz_3\hat{\mathbf{z}}$	(8c)	Ca II
$\mathbf{B}_{17}$	$-x_3\mathbf{a}_1 - y_3\mathbf{a}_2 - z_3\mathbf{a}_3$	=	$-ax_3\hat{\mathbf{x}} - by_3\hat{\mathbf{y}} - cz_3\hat{\mathbf{z}}$	(8c)	Ca II
$\mathbf{B}_{18}$	$(x_3 + \frac{1}{2})\mathbf{a}_1 + y_3\mathbf{a}_2 - (z_3 - \frac{1}{2})\mathbf{a}_3$	=	$a(x_3 + \frac{1}{2})\hat{\mathbf{x}} + by_3\hat{\mathbf{y}} - c(z_3 - \frac{1}{2})\hat{\mathbf{z}}$	(8c)	Ca II
$\mathbf{B}_{19}$	$x_3\mathbf{a}_1 - (y_3 - \frac{1}{2})\mathbf{a}_2 + (z_3 + \frac{1}{2})\mathbf{a}_3$	=	$ax_3\hat{\mathbf{x}} - b(y_3 - \frac{1}{2})\hat{\mathbf{y}} + c(z_3 + \frac{1}{2})\hat{\mathbf{z}}$	(8c)	Ca II
$\mathbf{B}_{20}$	$-(x_3 - \frac{1}{2})\mathbf{a}_1 + (y_3 + \frac{1}{2})\mathbf{a}_2 + z_3\mathbf{a}_3$	=	$-a(x_3 - \frac{1}{2})\hat{\mathbf{x}} + b(y_3 + \frac{1}{2})\hat{\mathbf{y}} + cz_3\hat{\mathbf{z}}$	(8c)	Ca II
$\mathbf{B}_{21}$	$x_4\mathbf{a}_1 + y_4\mathbf{a}_2 + z_4\mathbf{a}_3$	=	$ax_4\hat{\mathbf{x}} + by_4\hat{\mathbf{y}} + cz_4\hat{\mathbf{z}}$	(8c)	O I
$\mathbf{B}_{22}$	$-(x_4 - \frac{1}{2})\mathbf{a}_1 - y_4\mathbf{a}_2 + (z_4 + \frac{1}{2})\mathbf{a}_3$	=	$-a(x_4 - \frac{1}{2})\hat{\mathbf{x}} - by_4\hat{\mathbf{y}} + c(z_4 + \frac{1}{2})\hat{\mathbf{z}}$	(8c)	O I
$\mathbf{B}_{23}$	$-x_4\mathbf{a}_1 + (y_4 + \frac{1}{2})\mathbf{a}_2 - (z_4 - \frac{1}{2})\mathbf{a}_3$	=	$-ax_4\hat{\mathbf{x}} + b(y_4 + \frac{1}{2})\hat{\mathbf{y}} - c(z_4 - \frac{1}{2})\hat{\mathbf{z}}$	(8c)	O I
$\mathbf{B}_{24}$	$(x_4 + \frac{1}{2})\mathbf{a}_1 - (y_4 - \frac{1}{2})\mathbf{a}_2 - z_4\mathbf{a}_3$	=	$a(x_4 + \frac{1}{2})\hat{\mathbf{x}} - b(y_4 - \frac{1}{2})\hat{\mathbf{y}} - cz_4\hat{\mathbf{z}}$	(8c)	O I
$\mathbf{B}_{25}$	$-x_4\mathbf{a}_1 - y_4\mathbf{a}_2 - z_4\mathbf{a}_3$	=	$-ax_4\hat{\mathbf{x}} - by_4\hat{\mathbf{y}} - cz_4\hat{\mathbf{z}}$	(8c)	O I
$\mathbf{B}_{26}$	$(x_4 + \frac{1}{2})\mathbf{a}_1 + y_4\mathbf{a}_2 - (z_4 - \frac{1}{2})\mathbf{a}_3$	=	$a(x_4 + \frac{1}{2})\hat{\mathbf{x}} + by_4\hat{\mathbf{y}} - c(z_4 - \frac{1}{2})\hat{\mathbf{z}}$	(8c)	O I
$\mathbf{B}_{27}$	$x_4\mathbf{a}_1 - (y_4 - \frac{1}{2})\mathbf{a}_2 + (z_4 + \frac{1}{2})\mathbf{a}_3$	=	$ax_4\hat{\mathbf{x}} - b(y_4 - \frac{1}{2})\hat{\mathbf{y}} + c(z_4 + \frac{1}{2})\hat{\mathbf{z}}$	(8c)	O I

<b>B<sub>28</sub></b>	$= -(x_4 - \frac{1}{2}) \mathbf{a}_1 + (y_4 + \frac{1}{2}) \mathbf{a}_2 + z_4 \mathbf{a}_3$	$= -a(x_4 - \frac{1}{2}) \hat{\mathbf{x}} + b(y_4 + \frac{1}{2}) \hat{\mathbf{y}} + cz_4 \hat{\mathbf{z}}$	(8c)	O I
<b>B<sub>29</sub></b>	$= x_5 \mathbf{a}_1 + y_5 \mathbf{a}_2 + z_5 \mathbf{a}_3$	$= ax_5 \hat{\mathbf{x}} + by_5 \hat{\mathbf{y}} + cz_5 \hat{\mathbf{z}}$	(8c)	O II
<b>B<sub>30</sub></b>	$= -(x_5 - \frac{1}{2}) \mathbf{a}_1 - y_5 \mathbf{a}_2 + (z_5 + \frac{1}{2}) \mathbf{a}_3$	$= -a(x_5 - \frac{1}{2}) \hat{\mathbf{x}} - by_5 \hat{\mathbf{y}} + c(z_5 + \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O II
<b>B<sub>31</sub></b>	$= -x_5 \mathbf{a}_1 + (y_5 + \frac{1}{2}) \mathbf{a}_2 - (z_5 - \frac{1}{2}) \mathbf{a}_3$	$= -ax_5 \hat{\mathbf{x}} + b(y_5 + \frac{1}{2}) \hat{\mathbf{y}} - c(z_5 - \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O II
<b>B<sub>32</sub></b>	$= (x_5 + \frac{1}{2}) \mathbf{a}_1 - (y_5 - \frac{1}{2}) \mathbf{a}_2 - z_5 \mathbf{a}_3$	$= a(x_5 + \frac{1}{2}) \hat{\mathbf{x}} - b(y_5 - \frac{1}{2}) \hat{\mathbf{y}} - cz_5 \hat{\mathbf{z}}$	(8c)	O II
<b>B<sub>33</sub></b>	$= -x_5 \mathbf{a}_1 - y_5 \mathbf{a}_2 - z_5 \mathbf{a}_3$	$= -ax_5 \hat{\mathbf{x}} - by_5 \hat{\mathbf{y}} - cz_5 \hat{\mathbf{z}}$	(8c)	O II
<b>B<sub>34</sub></b>	$= (x_5 + \frac{1}{2}) \mathbf{a}_1 + y_5 \mathbf{a}_2 - (z_5 - \frac{1}{2}) \mathbf{a}_3$	$= a(x_5 + \frac{1}{2}) \hat{\mathbf{x}} + by_5 \hat{\mathbf{y}} - c(z_5 - \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O II
<b>B<sub>35</sub></b>	$= x_5 \mathbf{a}_1 - (y_5 - \frac{1}{2}) \mathbf{a}_2 + (z_5 + \frac{1}{2}) \mathbf{a}_3$	$= ax_5 \hat{\mathbf{x}} - b(y_5 - \frac{1}{2}) \hat{\mathbf{y}} + c(z_5 + \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O II
<b>B<sub>36</sub></b>	$= -(x_5 - \frac{1}{2}) \mathbf{a}_1 + (y_5 + \frac{1}{2}) \mathbf{a}_2 + z_5 \mathbf{a}_3$	$= -a(x_5 - \frac{1}{2}) \hat{\mathbf{x}} + b(y_5 + \frac{1}{2}) \hat{\mathbf{y}} + cz_5 \hat{\mathbf{z}}$	(8c)	O II
<b>B<sub>37</sub></b>	$= x_6 \mathbf{a}_1 + y_6 \mathbf{a}_2 + z_6 \mathbf{a}_3$	$= ax_6 \hat{\mathbf{x}} + by_6 \hat{\mathbf{y}} + cz_6 \hat{\mathbf{z}}$	(8c)	O III
<b>B<sub>38</sub></b>	$= -(x_6 - \frac{1}{2}) \mathbf{a}_1 - y_6 \mathbf{a}_2 + (z_6 + \frac{1}{2}) \mathbf{a}_3$	$= -a(x_6 - \frac{1}{2}) \hat{\mathbf{x}} - by_6 \hat{\mathbf{y}} + c(z_6 + \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O III
<b>B<sub>39</sub></b>	$= -x_6 \mathbf{a}_1 + (y_6 + \frac{1}{2}) \mathbf{a}_2 - (z_6 - \frac{1}{2}) \mathbf{a}_3$	$= -ax_6 \hat{\mathbf{x}} + b(y_6 + \frac{1}{2}) \hat{\mathbf{y}} - c(z_6 - \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O III
<b>B<sub>40</sub></b>	$= (x_6 + \frac{1}{2}) \mathbf{a}_1 - (y_6 - \frac{1}{2}) \mathbf{a}_2 - z_6 \mathbf{a}_3$	$= a(x_6 + \frac{1}{2}) \hat{\mathbf{x}} - b(y_6 - \frac{1}{2}) \hat{\mathbf{y}} - cz_6 \hat{\mathbf{z}}$	(8c)	O III
<b>B<sub>41</sub></b>	$= -x_6 \mathbf{a}_1 - y_6 \mathbf{a}_2 - z_6 \mathbf{a}_3$	$= -ax_6 \hat{\mathbf{x}} - by_6 \hat{\mathbf{y}} - cz_6 \hat{\mathbf{z}}$	(8c)	O III
<b>B<sub>42</sub></b>	$= (x_6 + \frac{1}{2}) \mathbf{a}_1 + y_6 \mathbf{a}_2 - (z_6 - \frac{1}{2}) \mathbf{a}_3$	$= a(x_6 + \frac{1}{2}) \hat{\mathbf{x}} + by_6 \hat{\mathbf{y}} - c(z_6 - \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O III
<b>B<sub>43</sub></b>	$= x_6 \mathbf{a}_1 - (y_6 - \frac{1}{2}) \mathbf{a}_2 + (z_6 + \frac{1}{2}) \mathbf{a}_3$	$= ax_6 \hat{\mathbf{x}} - b(y_6 - \frac{1}{2}) \hat{\mathbf{y}} + c(z_6 + \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O III
<b>B<sub>44</sub></b>	$= -(x_6 - \frac{1}{2}) \mathbf{a}_1 + (y_6 + \frac{1}{2}) \mathbf{a}_2 + z_6 \mathbf{a}_3$	$= -a(x_6 - \frac{1}{2}) \hat{\mathbf{x}} + b(y_6 + \frac{1}{2}) \hat{\mathbf{y}} + cz_6 \hat{\mathbf{z}}$	(8c)	O III
<b>B<sub>45</sub></b>	$= x_7 \mathbf{a}_1 + y_7 \mathbf{a}_2 + z_7 \mathbf{a}_3$	$= ax_7 \hat{\mathbf{x}} + by_7 \hat{\mathbf{y}} + cz_7 \hat{\mathbf{z}}$	(8c)	O IV
<b>B<sub>46</sub></b>	$= -(x_7 - \frac{1}{2}) \mathbf{a}_1 - y_7 \mathbf{a}_2 + (z_7 + \frac{1}{2}) \mathbf{a}_3$	$= -a(x_7 - \frac{1}{2}) \hat{\mathbf{x}} - by_7 \hat{\mathbf{y}} + c(z_7 + \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O IV
<b>B<sub>47</sub></b>	$= -x_7 \mathbf{a}_1 + (y_7 + \frac{1}{2}) \mathbf{a}_2 - (z_7 - \frac{1}{2}) \mathbf{a}_3$	$= -ax_7 \hat{\mathbf{x}} + b(y_7 + \frac{1}{2}) \hat{\mathbf{y}} - c(z_7 - \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O IV
<b>B<sub>48</sub></b>	$= (x_7 + \frac{1}{2}) \mathbf{a}_1 - (y_7 - \frac{1}{2}) \mathbf{a}_2 - z_7 \mathbf{a}_3$	$= a(x_7 + \frac{1}{2}) \hat{\mathbf{x}} - b(y_7 - \frac{1}{2}) \hat{\mathbf{y}} - cz_7 \hat{\mathbf{z}}$	(8c)	O IV
<b>B<sub>49</sub></b>	$= -x_7 \mathbf{a}_1 - y_7 \mathbf{a}_2 - z_7 \mathbf{a}_3$	$= -ax_7 \hat{\mathbf{x}} - by_7 \hat{\mathbf{y}} - cz_7 \hat{\mathbf{z}}$	(8c)	O IV
<b>B<sub>50</sub></b>	$= (x_7 + \frac{1}{2}) \mathbf{a}_1 + y_7 \mathbf{a}_2 - (z_7 - \frac{1}{2}) \mathbf{a}_3$	$= a(x_7 + \frac{1}{2}) \hat{\mathbf{x}} + by_7 \hat{\mathbf{y}} - c(z_7 - \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O IV
<b>B<sub>51</sub></b>	$= x_7 \mathbf{a}_1 - (y_7 - \frac{1}{2}) \mathbf{a}_2 + (z_7 + \frac{1}{2}) \mathbf{a}_3$	$= ax_7 \hat{\mathbf{x}} - b(y_7 - \frac{1}{2}) \hat{\mathbf{y}} + c(z_7 + \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O IV
<b>B<sub>52</sub></b>	$= -(x_7 - \frac{1}{2}) \mathbf{a}_1 + (y_7 + \frac{1}{2}) \mathbf{a}_2 + z_7 \mathbf{a}_3$	$= -a(x_7 - \frac{1}{2}) \hat{\mathbf{x}} + b(y_7 + \frac{1}{2}) \hat{\mathbf{y}} + cz_7 \hat{\mathbf{z}}$	(8c)	O IV
<b>B<sub>53</sub></b>	$= x_8 \mathbf{a}_1 + y_8 \mathbf{a}_2 + z_8 \mathbf{a}_3$	$= ax_8 \hat{\mathbf{x}} + by_8 \hat{\mathbf{y}} + cz_8 \hat{\mathbf{z}}$	(8c)	O V
<b>B<sub>54</sub></b>	$= -(x_8 - \frac{1}{2}) \mathbf{a}_1 - y_8 \mathbf{a}_2 + (z_8 + \frac{1}{2}) \mathbf{a}_3$	$= -a(x_8 - \frac{1}{2}) \hat{\mathbf{x}} - by_8 \hat{\mathbf{y}} + c(z_8 + \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O V
<b>B<sub>55</sub></b>	$= -x_8 \mathbf{a}_1 + (y_8 + \frac{1}{2}) \mathbf{a}_2 - (z_8 - \frac{1}{2}) \mathbf{a}_3$	$= -ax_8 \hat{\mathbf{x}} + b(y_8 + \frac{1}{2}) \hat{\mathbf{y}} - c(z_8 - \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O V
<b>B<sub>56</sub></b>	$= (x_8 + \frac{1}{2}) \mathbf{a}_1 - (y_8 - \frac{1}{2}) \mathbf{a}_2 - z_8 \mathbf{a}_3$	$= a(x_8 + \frac{1}{2}) \hat{\mathbf{x}} - b(y_8 - \frac{1}{2}) \hat{\mathbf{y}} - cz_8 \hat{\mathbf{z}}$	(8c)	O V
<b>B<sub>57</sub></b>	$= -x_8 \mathbf{a}_1 - y_8 \mathbf{a}_2 - z_8 \mathbf{a}_3$	$= -ax_8 \hat{\mathbf{x}} - by_8 \hat{\mathbf{y}} - cz_8 \hat{\mathbf{z}}$	(8c)	O V
<b>B<sub>58</sub></b>	$= (x_8 + \frac{1}{2}) \mathbf{a}_1 + y_8 \mathbf{a}_2 - (z_8 - \frac{1}{2}) \mathbf{a}_3$	$= a(x_8 + \frac{1}{2}) \hat{\mathbf{x}} + by_8 \hat{\mathbf{y}} - c(z_8 - \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O V
<b>B<sub>59</sub></b>	$= x_8 \mathbf{a}_1 - (y_8 - \frac{1}{2}) \mathbf{a}_2 + (z_8 + \frac{1}{2}) \mathbf{a}_3$	$= ax_8 \hat{\mathbf{x}} - b(y_8 - \frac{1}{2}) \hat{\mathbf{y}} + c(z_8 + \frac{1}{2}) \hat{\mathbf{z}}$	(8c)	O V

<b>B<sub>60</sub></b>	= $-\left(x_8 - \frac{1}{2}\right) \mathbf{a}_1 + \left(y_8 + \frac{1}{2}\right) \mathbf{a}_2 +$ $z_8 \mathbf{a}_3$	= $-a\left(x_8 - \frac{1}{2}\right) \hat{\mathbf{x}} + b\left(y_8 + \frac{1}{2}\right) \hat{\mathbf{y}} + cz_8 \hat{\mathbf{z}}$	(8c)	O V
<b>B<sub>61</sub></b>	$x_9 \mathbf{a}_1 + y_9 \mathbf{a}_2 + z_9 \mathbf{a}_3$	= $ax_9 \hat{\mathbf{x}} + by_9 \hat{\mathbf{y}} + cz_9 \hat{\mathbf{z}}$	(8c)	Ti II
<b>B<sub>62</sub></b>	$-\left(x_9 - \frac{1}{2}\right) \mathbf{a}_1 - y_9 \mathbf{a}_2 +$ $\left(z_9 + \frac{1}{2}\right) \mathbf{a}_3$	= $-a\left(x_9 - \frac{1}{2}\right) \hat{\mathbf{x}} - by_9 \hat{\mathbf{y}} + c\left(z_9 + \frac{1}{2}\right) \hat{\mathbf{z}}$	(8c)	Ti II
<b>B<sub>63</sub></b>	$-x_9 \mathbf{a}_1 + \left(y_9 + \frac{1}{2}\right) \mathbf{a}_2 -$ $\left(z_9 - \frac{1}{2}\right) \mathbf{a}_3$	= $-ax_9 \hat{\mathbf{x}} + b\left(y_9 + \frac{1}{2}\right) \hat{\mathbf{y}} - c\left(z_9 - \frac{1}{2}\right) \hat{\mathbf{z}}$	(8c)	Ti II
<b>B<sub>64</sub></b>	$\left(x_9 + \frac{1}{2}\right) \mathbf{a}_1 - \left(y_9 - \frac{1}{2}\right) \mathbf{a}_2 - z_9 \mathbf{a}_3$	= $a\left(x_9 + \frac{1}{2}\right) \hat{\mathbf{x}} - b\left(y_9 - \frac{1}{2}\right) \hat{\mathbf{y}} - cz_9 \hat{\mathbf{z}}$	(8c)	Ti II
<b>B<sub>65</sub></b>	$-x_9 \mathbf{a}_1 - y_9 \mathbf{a}_2 - z_9 \mathbf{a}_3$	= $-ax_9 \hat{\mathbf{x}} - by_9 \hat{\mathbf{y}} - cz_9 \hat{\mathbf{z}}$	(8c)	Ti II
<b>B<sub>66</sub></b>	$\left(x_9 + \frac{1}{2}\right) \mathbf{a}_1 + y_9 \mathbf{a}_2 - \left(z_9 - \frac{1}{2}\right) \mathbf{a}_3$	= $a\left(x_9 + \frac{1}{2}\right) \hat{\mathbf{x}} + by_9 \hat{\mathbf{y}} - c\left(z_9 - \frac{1}{2}\right) \hat{\mathbf{z}}$	(8c)	Ti II
<b>B<sub>67</sub></b>	$x_9 \mathbf{a}_1 - \left(y_9 - \frac{1}{2}\right) \mathbf{a}_2 + \left(z_9 + \frac{1}{2}\right) \mathbf{a}_3$	= $ax_9 \hat{\mathbf{x}} - b\left(y_9 - \frac{1}{2}\right) \hat{\mathbf{y}} + c\left(z_9 + \frac{1}{2}\right) \hat{\mathbf{z}}$	(8c)	Ti II
<b>B<sub>68</sub></b>	$-\left(x_9 - \frac{1}{2}\right) \mathbf{a}_1 + \left(y_9 + \frac{1}{2}\right) \mathbf{a}_2 +$ $z_9 \mathbf{a}_3$	= $-a\left(x_9 - \frac{1}{2}\right) \hat{\mathbf{x}} + b\left(y_9 + \frac{1}{2}\right) \hat{\mathbf{y}} + cz_9 \hat{\mathbf{z}}$	(8c)	Ti II

## References

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