Symmetries of the Cube

Let $\mathbf{R}_{1,1,1}$ be that symmetry which rotates the cube 120° clockwise around the axis through $(1,1,1)$ and $(-1,-1,-1)$. Let $\mathbf{R}_{1,y,1} = \mathbf{R}_{-1,y,-1}$ be that symmetry whose axis of rotation joins the midpoints of $(1,1,1)$ and $(1,-1,1)$, and $(-1,1,-1)$ and $(-1,-1,-1)$.

1. $\mathbf{R}_{1,1,1} = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{pmatrix}$: Clockwise 120° rotation about the axis.
2. $\mathbf{R}^2_{1,1,1} = \begin{pmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{pmatrix}$: Counterclockwise 120° rotation about the axis.
3. $\mathbf{R}_{1,1,-1} = \begin{pmatrix} 0 & 0 & -1 \\ 1 & 0 & 0 \\ 0 & -1 & 0 \end{pmatrix}$: Clockwise 120° rotation about the axis.
4. $\mathbf{R}^2_{1,1,-1} = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & -1 \\ -1 & 0 & 0 \end{pmatrix}$: Counterclockwise 120° rotation about the axis.
5. $\mathbf{R}_{1,-1,1} = \begin{pmatrix} 0 & 0 & 1 \\ -1 & 0 & 0 \\ 0 & -1 & 0 \end{pmatrix}$: Clockwise 120° rotation about the axis.
6. $\mathbf{R}^2_{1,-1,1} = \begin{pmatrix} 0 & -1 & 0 \\ 0 & 0 & -1 \\ 1 & 0 & 0 \end{pmatrix}$: Counterclockwise 120° rotation about the axis.
7. $\mathbf{R}_{-1,1,1} = \begin{pmatrix} 0 & 0 & -1 \\ -1 & 0 & 0 \\ 0 & 1 & 0 \end{pmatrix}$: Clockwise 120° rotation about the axis.
8. $\mathbf{R}^2_{-1,1,1} = \begin{pmatrix} 0 & -1 & 0 \\ 0 & 0 & 1 \\ -1 & 0 & 0 \end{pmatrix}$: Counterclockwise 120° rotation about the axis.
9. $\mathbf{R}_x = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & -1 & 0 \end{pmatrix}$: Clockwise 90° rotation about the x-axis.
10. $\mathbf{R}^2_x = \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{pmatrix}$: 180° rotation about the x-axis.

11. $\mathbf{R}_x^3 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & -1 \\ 0 & 1 & 0 \end{pmatrix}$: Counterclockwise 90° rotation about the x-axis.

12. $\mathbf{R}_y = \begin{pmatrix} 0 & 0 & -1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix}$: Clockwise 90° rotation about the y-axis.

13. $\mathbf{R}_y^2 = \begin{pmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{pmatrix}$: 180° rotation about the y-axis.

14. $\mathbf{R}_y^3 = \begin{pmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ -1 & 0 & 0 \end{pmatrix}$: Counterclockwise 90° rotation about the y-axis.

15. $\mathbf{R}_z = \begin{pmatrix} 0 & 1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$: Clockwise 90° rotation about the z-axis.

16. $\mathbf{R}_z^2 = \begin{pmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$: 180° rotation about the z-axis.

17. $\mathbf{R}_z^3 = \begin{pmatrix} 0 & -1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$: Counterclockwise 90° rotation about the z-axis.

18. $\mathbf{R}_{x,1,1} = \begin{pmatrix} -1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix}$: 180° rotation about the axis.

19. $\mathbf{R}_{x,1,-1} = \begin{pmatrix} -1 & 0 & 0 \\ 0 & 0 & -1 \\ 0 & -1 & 0 \end{pmatrix}$: 180° rotation about the axis.

20. $\mathbf{R}_{1,y,1} = \begin{pmatrix} 0 & 0 & 1 \\ 0 & -1 & 0 \\ 1 & 0 & 0 \end{pmatrix}$: 180° rotation about the axis.

21. $\mathbf{R}_{1,y,-1} = \begin{pmatrix} 0 & 0 & -1 \\ 0 & -1 & 0 \\ -1 & 0 & 0 \end{pmatrix}$: 180° rotation about the axis.

22. $\mathbf{R}_{1,1,z} = \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & -1 \end{pmatrix}$: 180° rotation about the axis.

23. $\mathbf{R}_{1,-1,z} = \begin{pmatrix} 0 & -1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & -1 \end{pmatrix}$: 180° rotation about the axis.

24. $\mathbf{I} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$: The identity.