

12.18

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Question

The S_2 operation on a molecule with the axis of rotation as the Z-axis, moves a nucleus at (x, y, z) to

- ① $(-x, -y, z)$ ② $(x, -y, -z)$ ③ $(-x, y, -z)$ ④ $(-x, -y, -z)$

Solution

The rotation matrix for a rotation by an angle θ about the z-axis is:

$$R_z(\theta) = \begin{pmatrix} \cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{pmatrix} \quad (1)$$

Let the point be $\mathbf{x} = \begin{pmatrix} x \\ y \\ z \end{pmatrix}$. Therefore the rotated vector will be:

$$R_z(\theta)\mathbf{x} = \begin{pmatrix} \cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} \quad (2)$$

$$\begin{pmatrix} x \cos \theta - y \sin \theta \\ x \sin \theta + y \cos \theta \\ z \end{pmatrix} \quad (3)$$

Solution

It can be seen that a rotation about the Z-axis does not change the z-coordinate. Hence option (**A**) is correct.

Codes Permalink

Figure

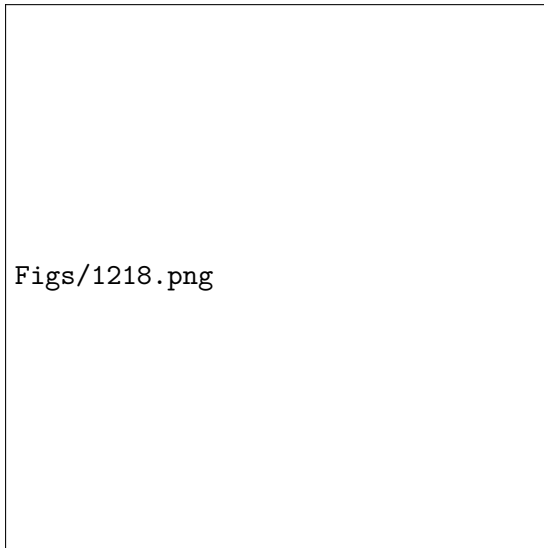


Figure: Plot