**Question**

Explain how the equation of a cylinder, of radius $a$ whose axis in the direction of $\hat{\mathbf{n}}$ passes through$B$, can be written in any of the forms

**(i)** $|(\mathbf{r}-\mathbf{b})\times\hat{\mathbf{n}}| = a.$

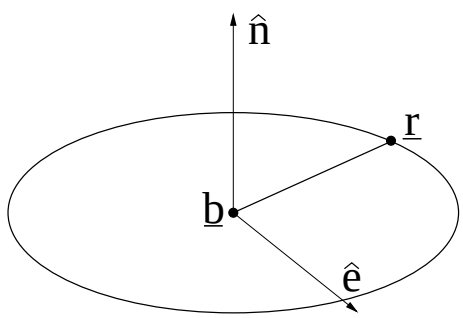
**(ii)** $(\mathbf{r}-\mathbf{b})\times\hat{\mathbf{n}} = a\hat{\mathbf{e}}$

where $\hat{\mathbf{e}}$ is a unit vector orthogonal to $\hat{\mathbf{n}}$.

**(iii)** $(\mathbf{r}-\mathbf{b}) = a\hat{\mathbf{R}} + t\hat{\mathbf{n}} \quad t\epsilon\mathbf{R}$

where $\hat{\mathbf{R}}$ is a unit vector perpendicular to $\hat{\mathbf{n}}$ such that $\hat{\mathbf{R}}, -\hat{\mathbf{e}}, \hat{\mathbf{n}}$ form a righthanded system.

**Answer**




$\mathbf{r}-\mathbf{b}$ is perpendicular to $n$ So $|r-b| = a$.
So $(r-b)\times n = a\hat{e}$
or $|(r-b)\times n| = a$
Also $|\mathbf{r}-\mathbf{b} = a\hat{R} + t\hat{n}$