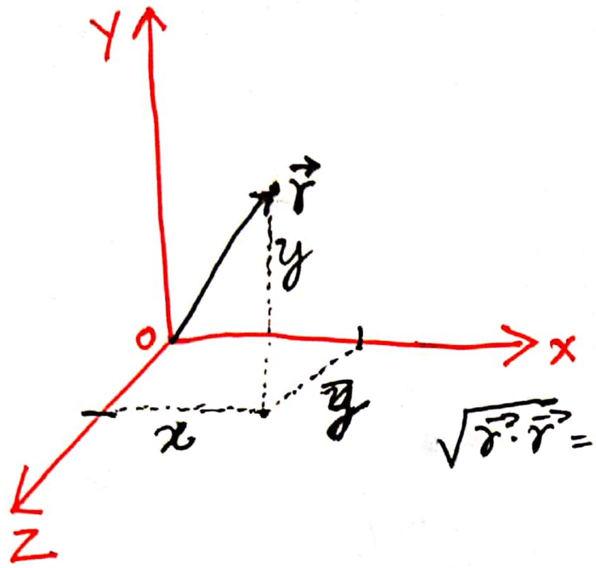
3)



$$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$$

Then

$$|\vec{r}| = \sqrt{(x-0)^2+(y-0)^2+(z-0)^2}$$

$$\sqrt{\vec{r}\cdot\vec{r}} = \sqrt{|\vec{r}|^2\cos(0)} = \sqrt{x^2+y^2+z^2} \quad \blacksquare$$

4) let,

$$\vec{r}^{\,b} = \begin{bmatrix} x^b \\ y^b \\ z^b \end{bmatrix} \quad \& \quad \vec{r}^{\,a} = \begin{bmatrix} x^a \\ y^a \\ z^a \end{bmatrix}$$

are the Component written in a Column Vector form.

Then

$$\sqrt{(x^a)^2+(y^a)^2+(z^a)^2} = \sqrt{\vec{r}^{\,a}\cdot\vec{r}^{\,a}}$$ from the previous Result

Similarly

$$\sqrt{(x^b)^2+(y^b)^2+(z^b)^2} = \sqrt{\vec{r}^{\,b}\cdot\vec{r}^{\,b}}$$

Given the Relation we can write following from what is given in the question 4.

$$\sqrt{\vec{r}^{\,b}\cdot\vec{r}^{\,b}} = \sqrt{[x^b \ y^b \ z^b]\begin{bmatrix} x^b \\ y^b \\ z^b \end{bmatrix}} = \sqrt{(R^{ba}\vec{r}^{\,a})^T(R^{ba}\vec{r}^{\,a})}$$

$$= \sqrt{\vec{r}^{\,a^T} R^{ba^T} R^{ba} \vec{r}^{\,a}}$$

from the property of the Orthonormality of R^{ba}

$$R^{ba^T} = R^{ba^{-1}}$$

$$\therefore \quad R^{ba^T} R^{ba} = I_{3\times3}$$

$$\therefore \sqrt{\vec{r}^{\,b} \cdot \vec{r}^{\,b}} = \sqrt{\vec{r}^{\,a^T} \vec{r}^{\,a}} = \sqrt{\begin{bmatrix} x^a & y^a & z^a \end{bmatrix} \begin{bmatrix} x^a \\ y^a \\ z^a \end{bmatrix}}$$

$$= \sqrt{(x^a)^2 + (y^a)^2 + (z^a)^2}$$

$\therefore$

$$\sqrt{(x^b)^2 + (y^b)^2 + (z^b)^2} = \sqrt{(x^a)^2 + (y^a)^2 + (z^a)^2} \quad \blacksquare$$