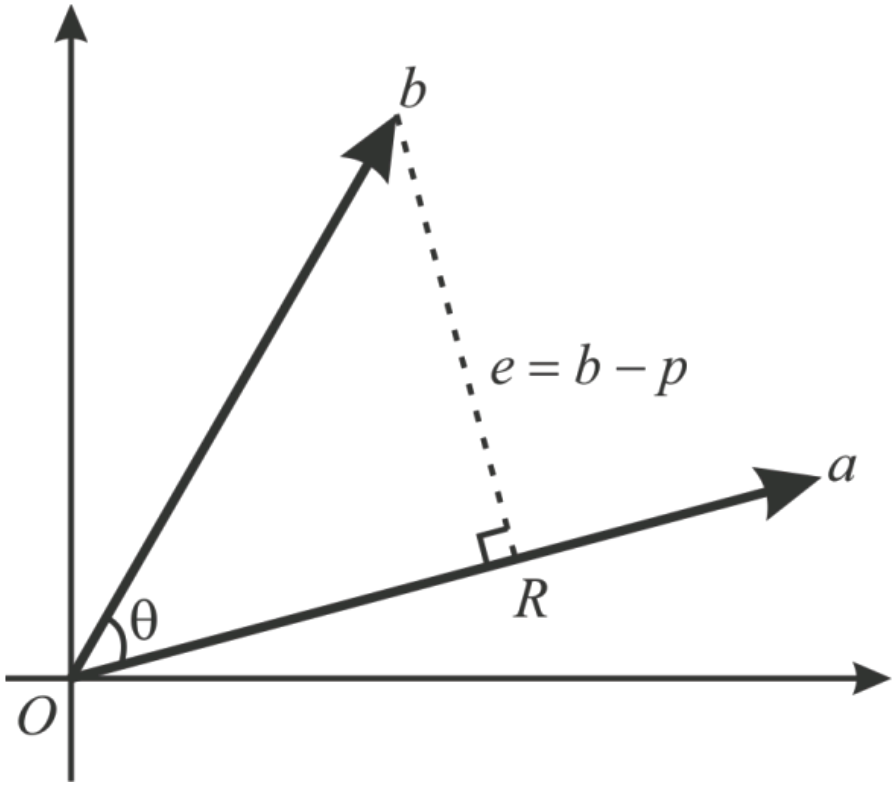
## Step-1

Consider this diagram;




The objective is to find norm of $p$ .

## Step-2

It is observed that $OR = p$ is the projection of $b$ on $a$.

This implies;

$$p = \hat{x}\,a$$
$$= \frac{a^T b}{a^T a} a$$
$$= \frac{a^T b}{\|a\|^2} a$$ and â€¦â€¦ (1)

$\cos\theta = \frac{a^T b}{\|a\|\|b\|}$ â€¦â€¦ (2)

By definition of norm, $\|p\|^2 = p^T p$

Use (1), and get $\|p\|^2 = \left(\frac{a^T b}{\|a\|^2} a\right)^T \frac{a^T b}{\|a\|^2} a$

Use (2), it can be written this as $= \frac{(\|a\|\|b\|\cos\theta) a^T}{\|a\|^2} \frac{(\|a\|\|b\|\cos\theta) a}{\|a\|^2}$ while norm is a scalar

$$= \frac{(\|a\|\|b\|\cos\theta)^2 a^T a}{\|a\|^2 \|a\|^2}$$

$$= \frac{(\|a\|\|b\|\cos\theta)^2 \|a\|^2}{\|a\|^2 \|a\|^2}$$

$$= \|b\|^2 \cos^2\theta$$

Since norm is a non negative quantity, by applying square root on both sides, get $\|p\| = \|b\|\cos\theta$

Hence, norm of $p$ is $\boxed{\|p\| = \|b\|\cos\theta}$