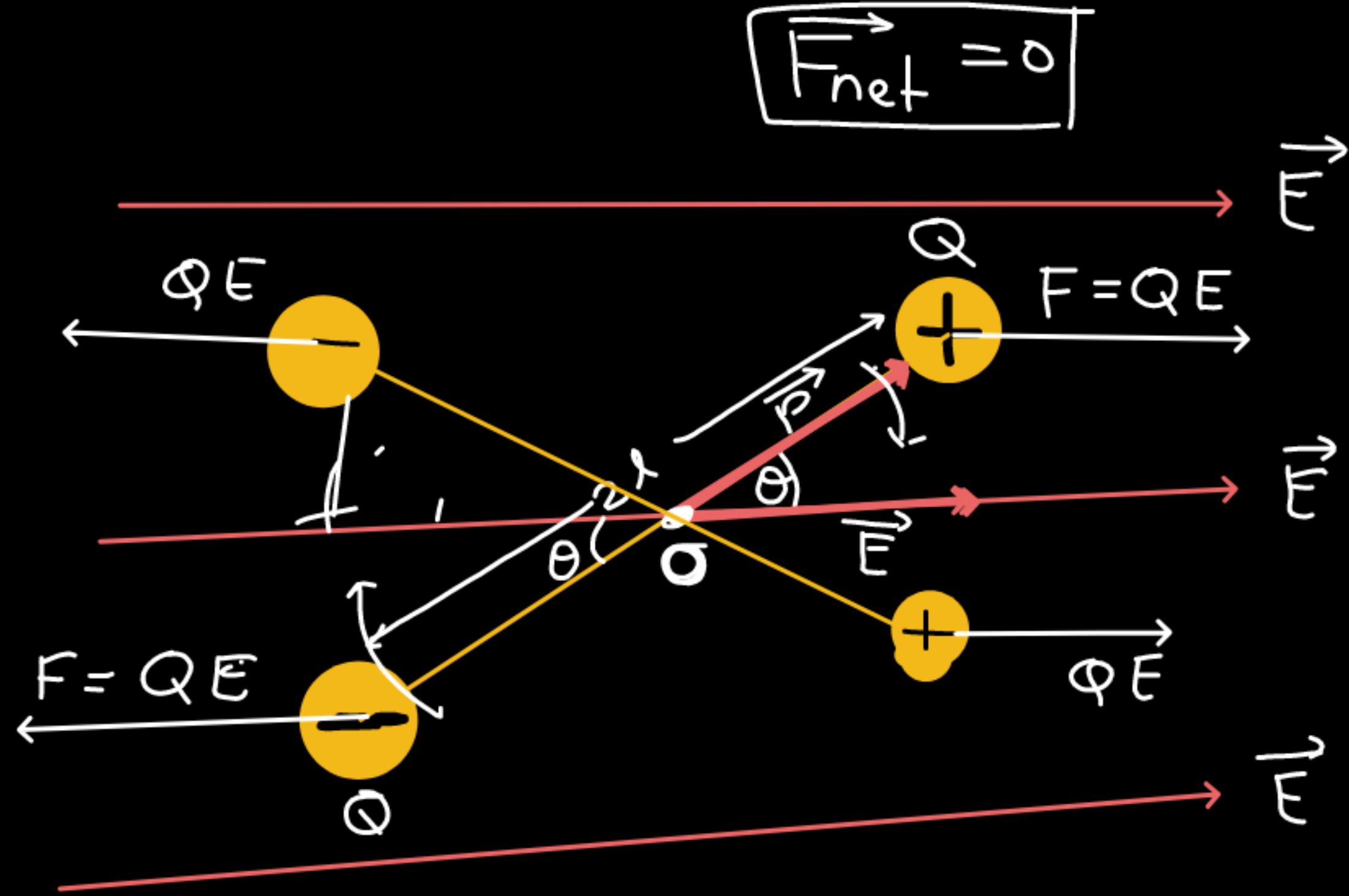


समरूप | समान विद्युत क्षेत्र में विद्युत द्विध्रुव

Electric dipole in external uniform field



टॉर्क (बल आघूर्ण)

$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$\vec{\tau}_0 = \lambda QE \sin\theta (-\hat{k}) + \lambda QE \sin\theta (-\hat{i})$$

$$= 2\lambda QE \sin\theta (-\hat{k})$$

$$= (Q \cdot 2a) E \sin\theta (-\hat{k})$$

$$\vec{\tau}_0 = PE \sin\theta (-\hat{k})$$

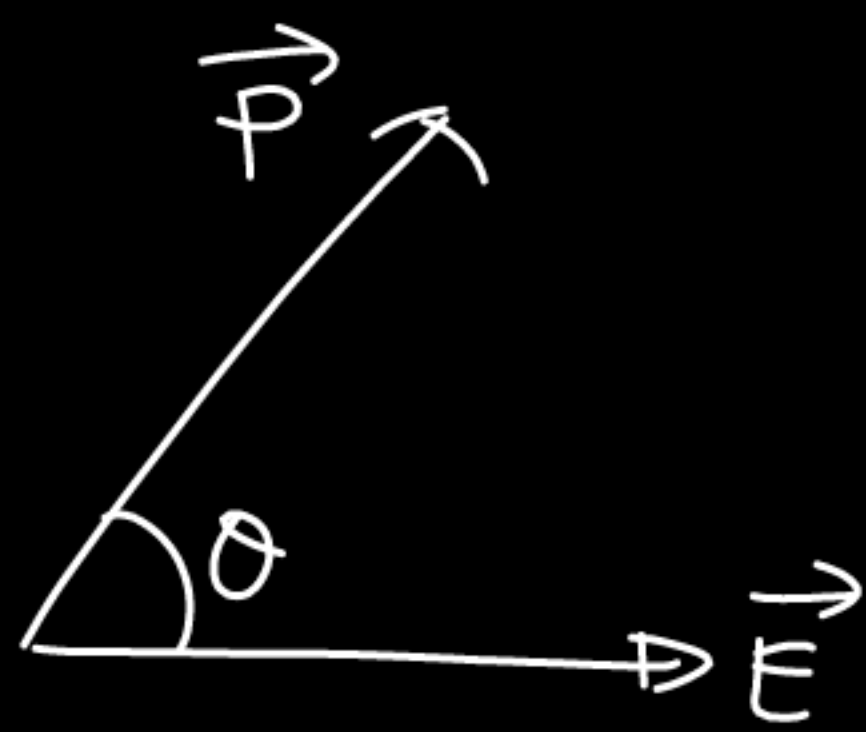
जब एक समान विद्युत क्षेत्र में द्विध्रुव हो तो उसपर लगने वाला कुल विद्युतीय बल का मान 0 होता है।

$$\vec{\tau}_0 = \vec{P} \times \vec{E}$$

Torque (बल आघूर्ण)

$$\vec{\tau} = \vec{p} \times \vec{E}$$

$$\vec{\tau} = pE \sin \theta (-\hat{k})$$

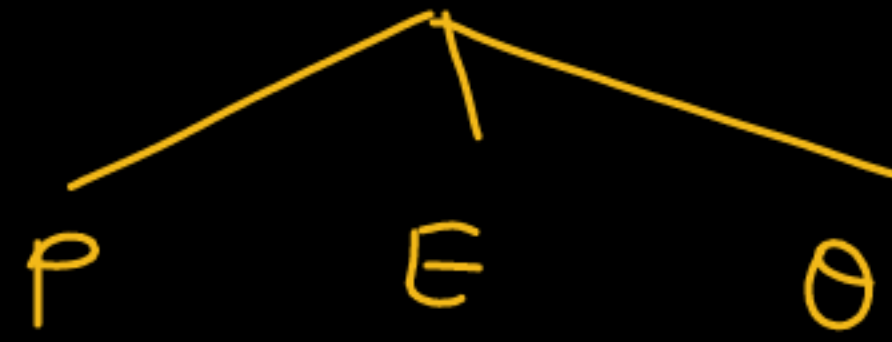


Magnitude of torque
बल आघूर्ण का परिमाण

$$|\vec{\tau}| = pE \sin \theta (-\hat{k})$$

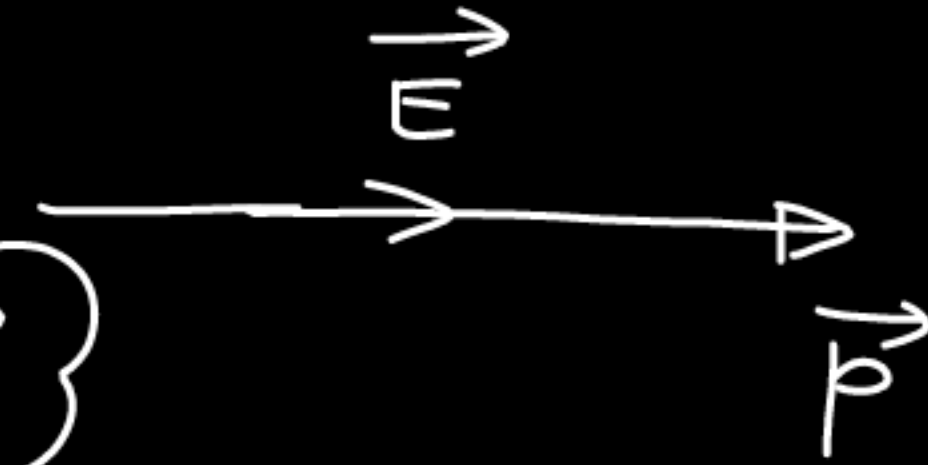
$$\tau = pE \sin \theta$$

बल आघूर्ण



Case ①

$$\theta = 0^\circ$$



$$\text{Torque} = pE \sin \theta = pE \sin 0^\circ$$

$$\tau = 0$$

$$\vec{p} \times \vec{E} = 0$$

Case ②: \vec{E}

$$\theta = 180^\circ$$



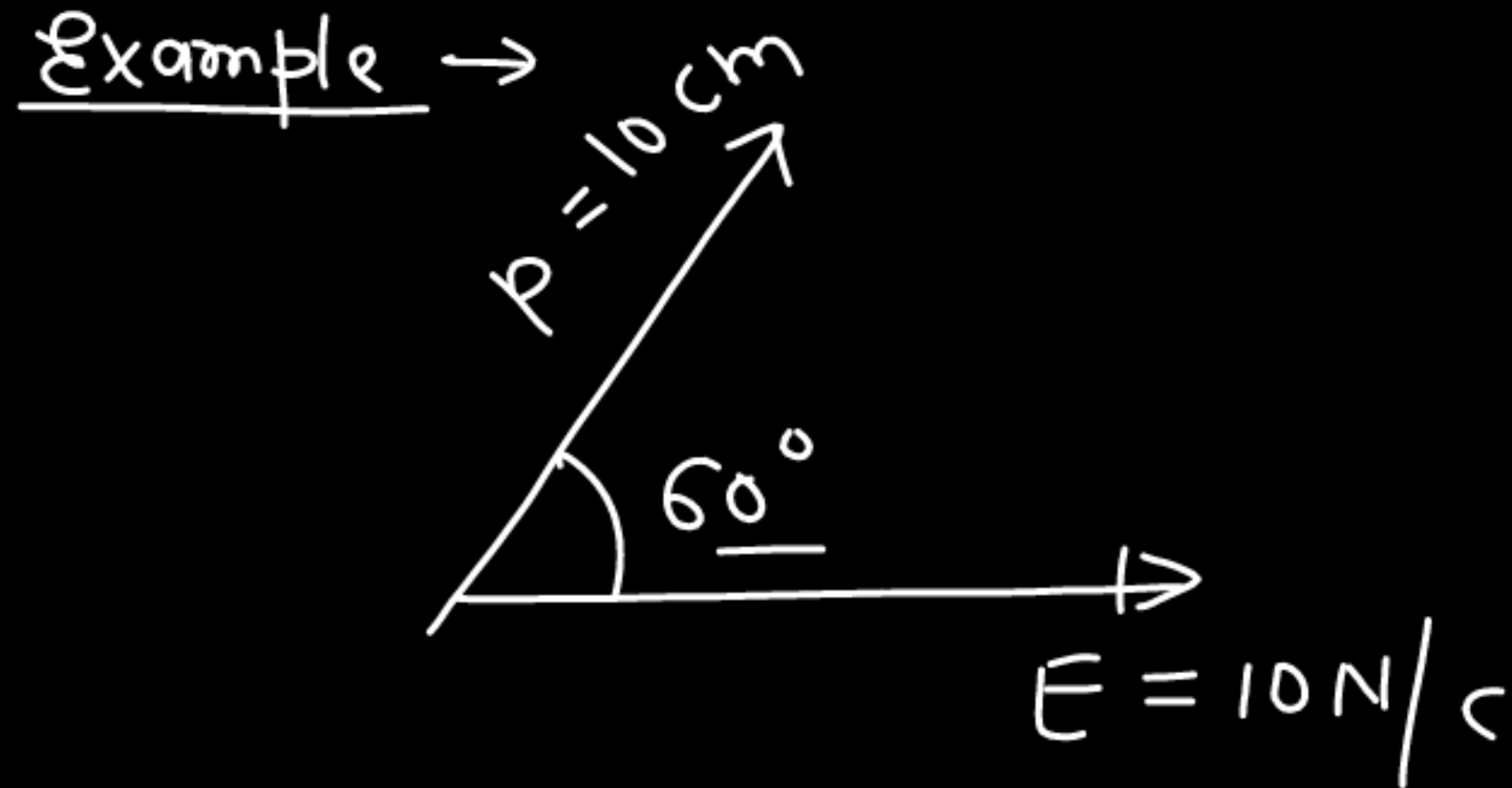
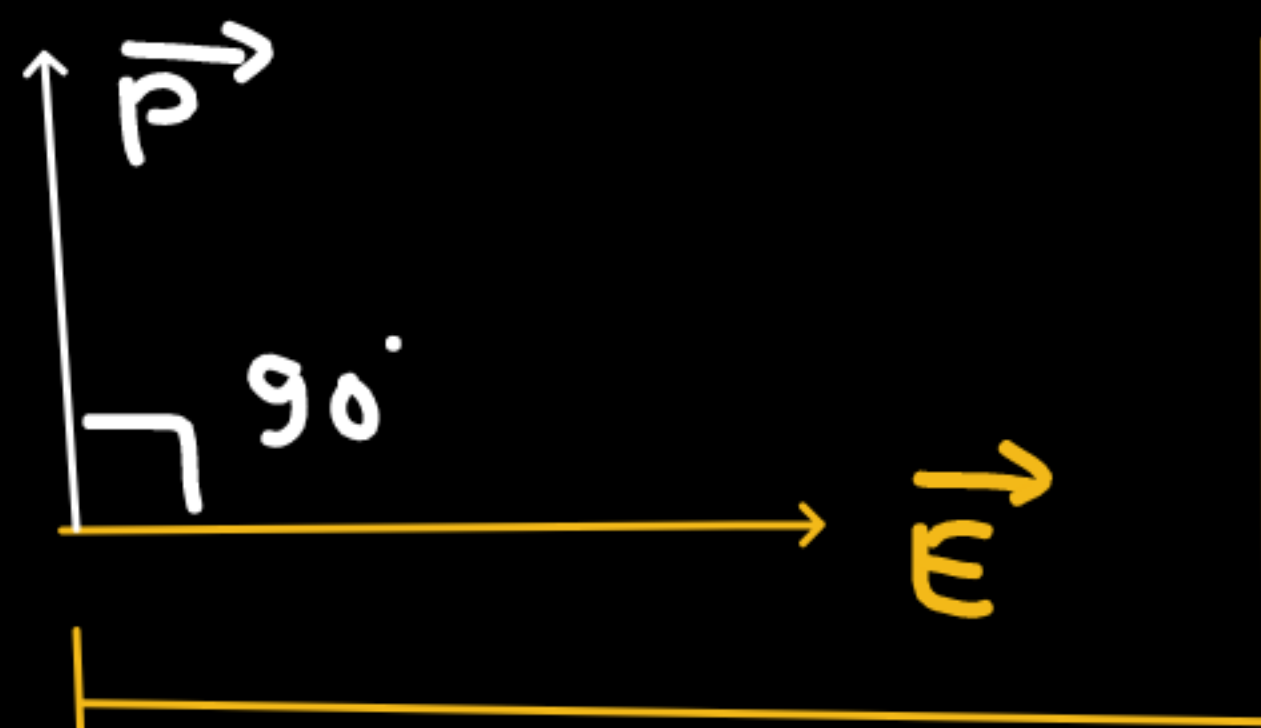
$$\tau = pE \sin 180^\circ = 0$$

$$\tau = 0$$

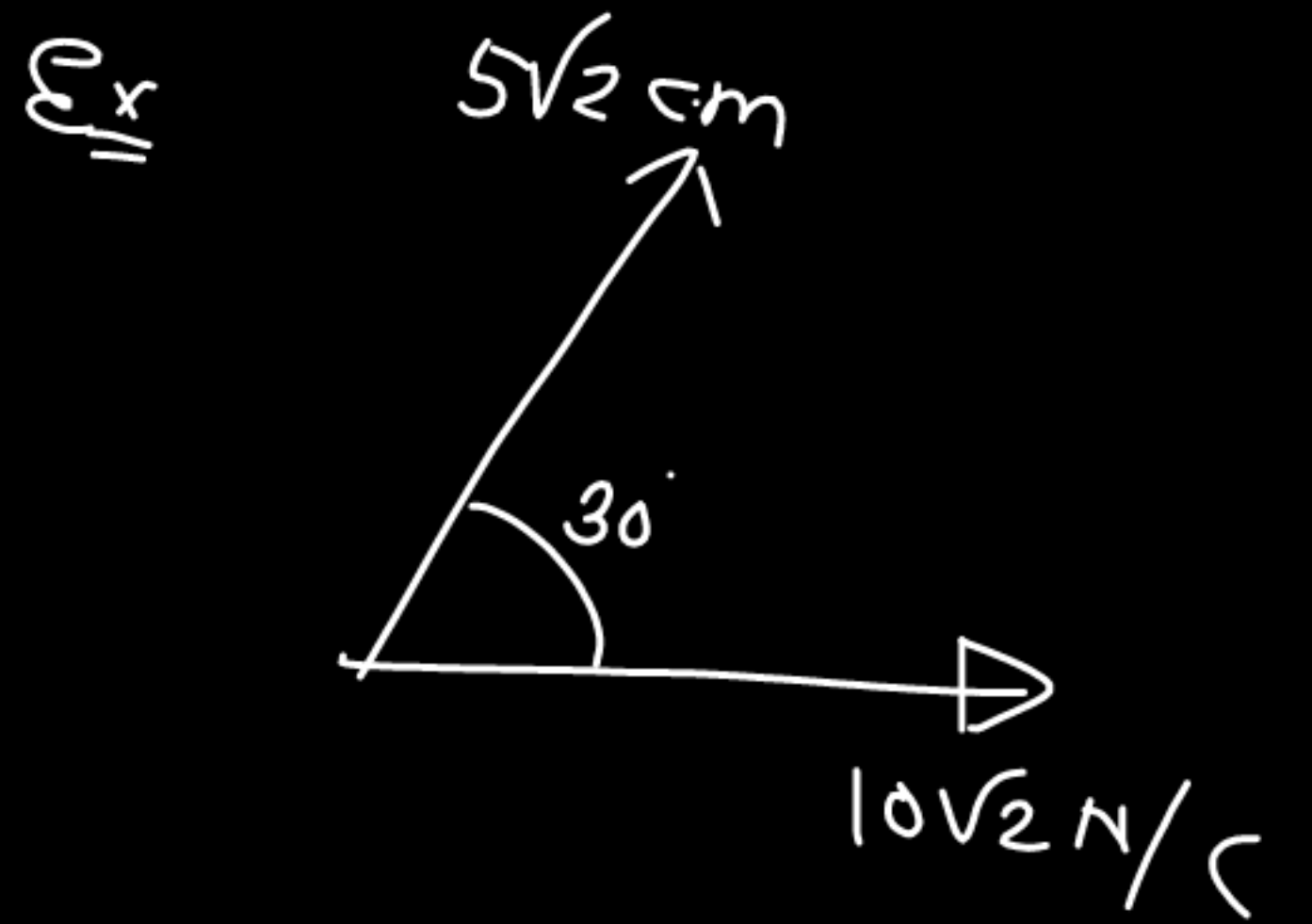
Case (11)

$$\begin{aligned}\tau &= PE \sin \theta \\ &= PE \sin 90^\circ \\ &= PE \times 1\end{aligned}$$

$$\tau_{\max} = PE$$



$$\begin{aligned}\tau &=? \\ \text{अल आंघुवा (\tau)} &= PE \sin \theta \\ &= 10 \times 10 \times \sin 60^\circ \\ &= 100 \times \frac{\sqrt{3}}{2} \\ &= \underline{50\sqrt{3} \text{ J}}\end{aligned}$$



$$\tau = ?$$

$$\begin{aligned}\tau &= PE \sin \theta \\ &= 10\sqrt{2} \times 5\sqrt{2} \times \sin 30^\circ \\ &= 50 \times 2 \times \frac{1}{2} \\ &= \underline{50 \text{ J}}\end{aligned}$$

Question:-

एक समान विद्युत क्षेत्र 100N/C में विद्युत द्विध्रुव रखा गया है
& द्विध्रुव आधूर्ण तथा विद्युत क्षेत्र के बीच का कोण 90° हो तो

द्विध्रुव आधूर्ण का मान होगा।

A) 10cm

B) 100cm

C) 5cm

D) इनमें से कोई नहीं

$$E = 100\text{N/C}$$

$$\theta = 90^\circ$$

$$P = ?$$

$$\tau = ?$$

$$\tau = P E \sin \theta$$

Q यदि $\vec{P} = 2\hat{i} + 3\hat{j}$ और $\vec{E} = 3\hat{i} - 2\hat{j}$ हो तो
बल आघूर्ण का परिमाण होगा
 $\tau = ?$

A) 0 J

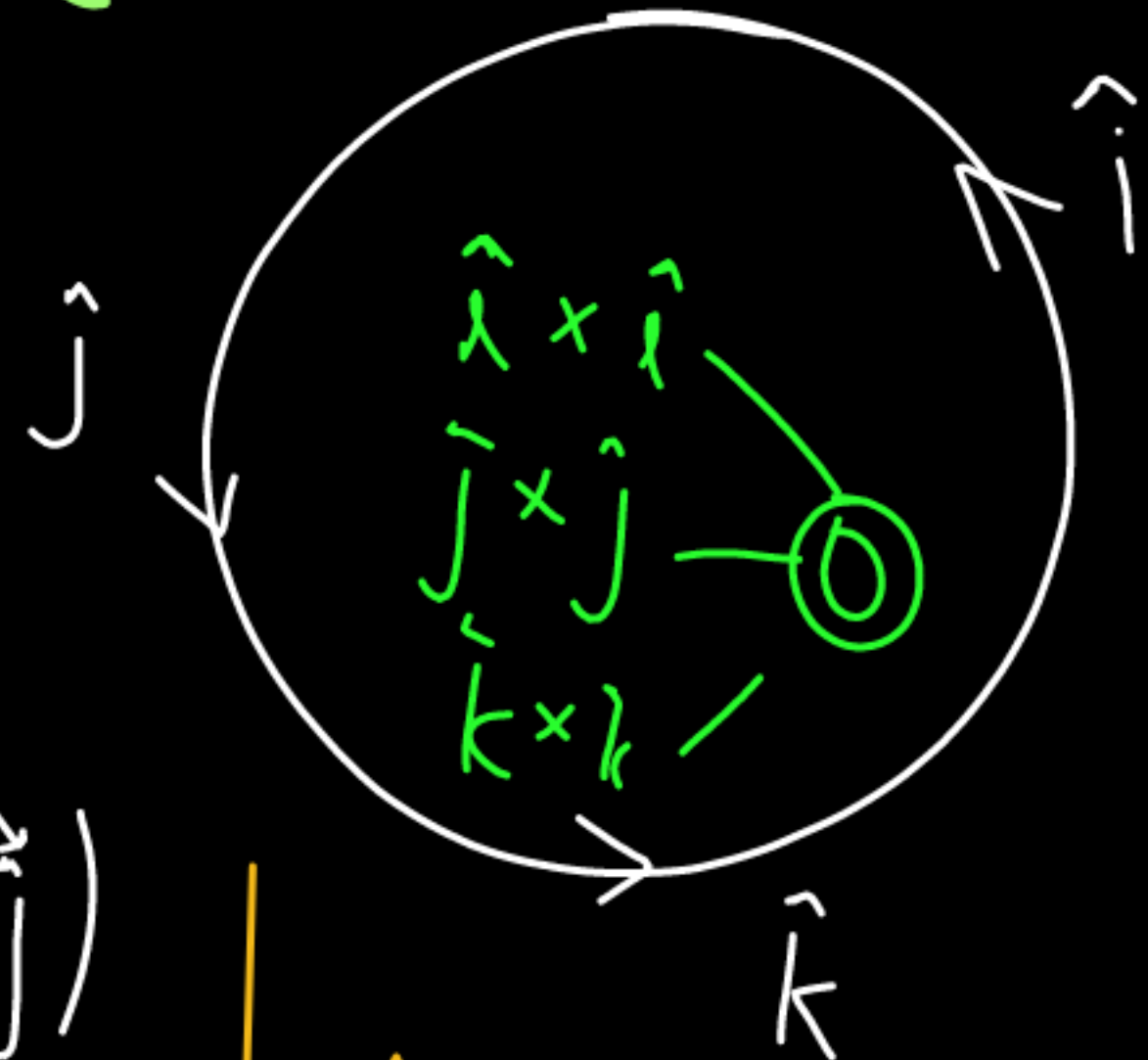
B) 90 J

C) 12 J

D) N.O.T

Soln: $\rightarrow \vec{\tau} = \vec{P} \times \vec{E}$
 $= (2\hat{i} + 3\hat{j}) \times (3\hat{i} - 2\hat{j})$
 $= 0 - 4\hat{k} + 9(-\hat{k}) - 0$
 $= -4\hat{k} - 9\hat{k}$
 $\vec{\tau} = -13\hat{k}$

$|\vec{\tau}| = 13$



$\hat{i} \times \hat{j} = \hat{k}$	$\hat{j} \times \hat{i} = -\hat{k}$
$\hat{j} \times \hat{k} = \hat{i}$	$\hat{k} \times \hat{j} = -\hat{i}$
$\hat{k} \times \hat{i} = \hat{j}$	$\hat{i} \times \hat{k} = -\hat{j}$

10

$$\vec{p} = (3\hat{i} + 4\hat{j}) \text{ cm}$$
$$\vec{r} = (4\hat{i} - 3\hat{j}) \text{ N/c}$$
$$\vec{\tau} = ?$$

$$|\vec{\tau}| = 25$$

$$\vec{\tau} = \vec{r} \times \vec{p}$$

$$= (3\hat{i} + 4\hat{j}) \times (4\hat{i} - 3\hat{j})$$

$$= 0 - 9\hat{k} - 16\hat{k} = 0$$

$$\vec{\tau} = -25\hat{k}$$

Question Match the Column:

C-1

C-II

1. आवेश \rightarrow P. $ML^3T^{-3}A^{-1}$
2. विद्युत क्षेत्र \rightarrow Q. $MLT^{-3}A^{-1}$
3. विद्युत फ्लक्स \rightarrow R. AT
4. विद्युत द्विध्रुव आघूर्ण \rightarrow S. ATL