Electric flux (ϕ):-

$$\phi = \vec{E} \cdot \vec{A}$$

$1\,cm = 10^{-2}\,m$
$1\,cm^2 = 10^{-4}\,m^2$

Q1) $\vec{E} = (2\hat{i} + 3\hat{j} - 5\hat{k})\,N/C$ & $\vec{A} = (2\hat{i} - \hat{j} - \hat{k})\,cm^2$ then find Electric flux in SI unit.

(a) 6
(b) 6×10^{-1}
(c) 6×10^{-2}
(d) 6×10^{-4} ✓

$$\phi = \vec{E} \cdot \vec{A} = EA\cos\theta$$

$$\phi = (2\hat{i} + 3\hat{j} - 5\hat{k})(2\hat{i} - \hat{j} - \hat{k}) \times 10^{-4}$$

$$= [2 \times 2 + (3 \times -1) + (-5 \times -1)] \times 10^{-4}$$

$$= (4 - 3 + 5) \times 10^{-4}$$

$$= 6 \times 10^{-4}\ N\text{-}m^2/C$$

ϕ SI unit $= \frac{N}{C} - m^2$
$= N\text{-}m^2/C$

$\hat{i} \cdot \hat{i} = 1$ $\quad \hat{i} \cdot \hat{j} = 0$
$\hat{j} \cdot \hat{j} = 1$
$\hat{k} \cdot \hat{k} = 1$

Electric flux :- $\phi = \vec{E} \cdot \vec{A}$

- Scalar quantity
- SI Unit - $\frac{N\text{-}m^2}{C}$
- dim $[\phi] = ?$

$\vec{E}$ → given Electric field Vector

$\vec{A}$ → Area Vector

$\bar{E} = (2i + 3j + 2k)\ N/c$

$\bar{A} = (i - j + k)\ m^2$

$\phi = \bar{E} \cdot \bar{A}$

$= (2i + 3j + 2k)(i - j + k)$

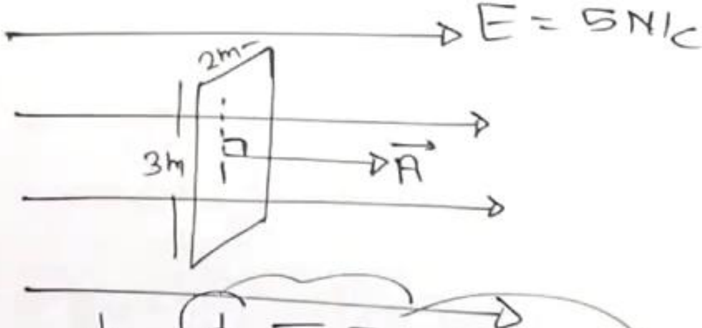
$2 \times 1 + 3(-1) + 2(1)$

$= 2 - 3 + 2 = 1\ N\text{-}m^2/c$

$|E|, |\bar{A}|, \quad \bar{E} \cdot \bar{A} = EA\cos\theta$

$\phi = EA\cos\theta$

$\theta \rightarrow$ Angle b/w $\bar{E}$ & $\bar{A}$



$$\phi = \phi = \vec{E}\cdot\vec{A} = EA\cos\theta$$

(a) Angle b/w area vector & Electric field vector

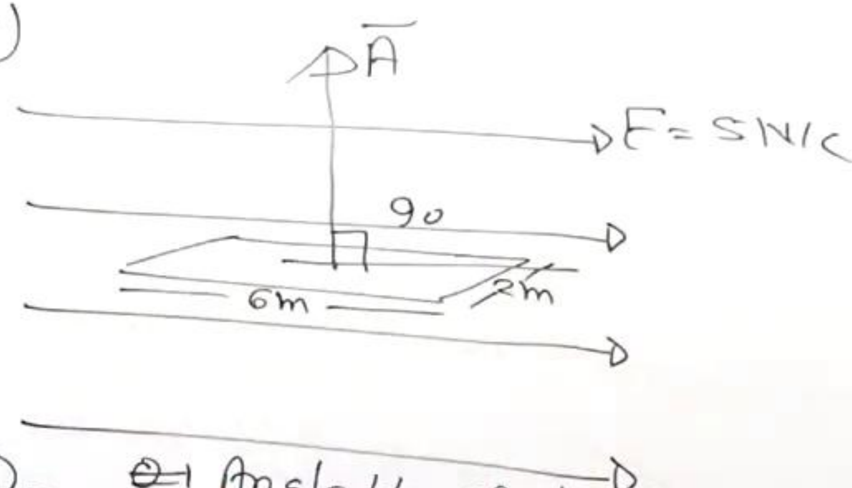
$\theta = 0$

$E = 5N$, $A = 2 \times 3\,m^2 = 6\,m^2$

$\phi = EA\cos 0$

$= 5 \times 6 \times 1 = 30\ N\text{-}m^2/C$

Q2)

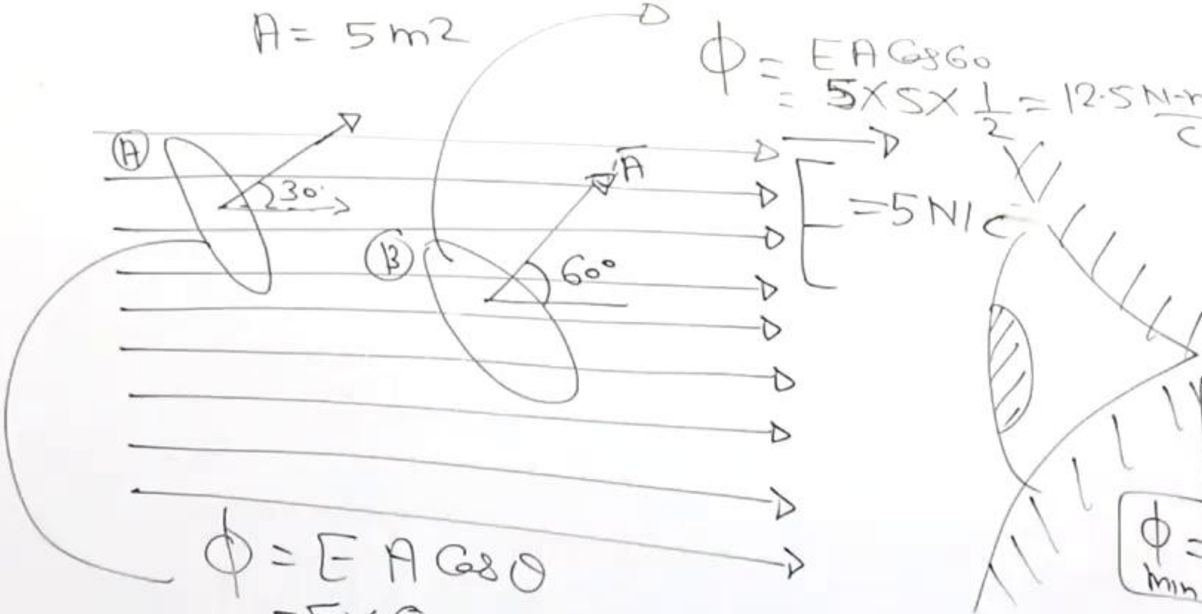


$\phi =$ θ → Angle b/w electric field & Area vector

$\theta = 90°$

$\phi = 5 \times 12 \cos 90°$

$\phi = 0$



$A = 5\ m^2$

$\phi = EA\cos 60 = 5 \times 5 \times \frac{1}{2} = 12.5\ \frac{N\text{-}m^2}{C}$

$\phi = EA\cos\theta$

$= 5 \times 5 \cos 30$

$= 25 \times \frac{\sqrt{3}}{2} = 12.5\sqrt{3}\ \frac{N\text{-}m^2}{C}$

$\theta = 0°$

$\phi = EA\cos 0°$

$\phi_{max} = EA$

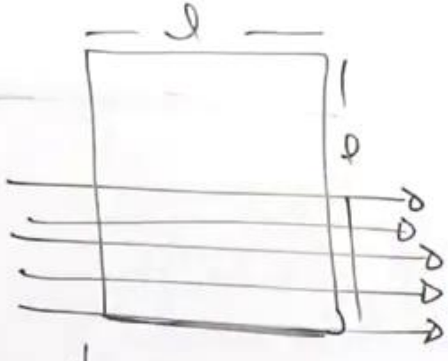
$\theta = 90$

$\phi = 0$

$\phi_{min} = EA\cos 90 = 0$

प्रश्न - AIPMT

①



$\theta = 90^\circ$

$\phi = 0$

$\phi =$

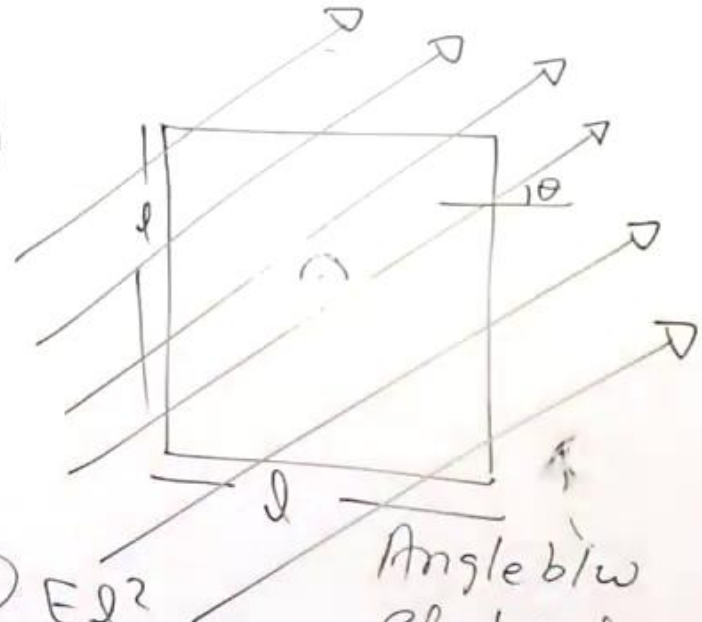
(a) $E \cdot l^2$

(b) $\frac{El^2}{2}$

(c) zero ✓

(d) $\frac{El^2}{4}$

Q2)



(a) El^2

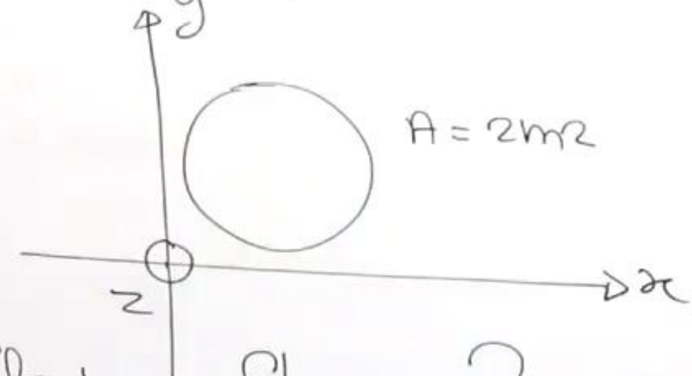
(b) $El^2 \cos\theta$

(c) zero

(d) $\frac{El^2 \cos\theta}{2}$

Angle b/w Electric field & $\bar{A}$ = 90°

Q) $\vec{E} = (2i + 3j + 5k)$ N/C

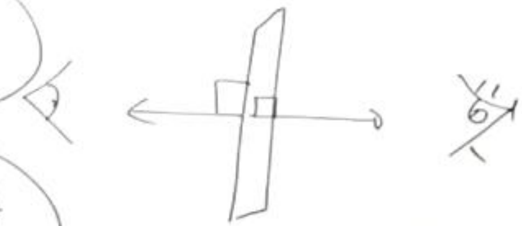


Electric flux = ?

$|\phi| = \text{flux}$

$\phi = \vec{E} \cdot \vec{A}$

$\phi = EA \cos\theta$



outgoing flux = +ive

$\cos 180° = -1$

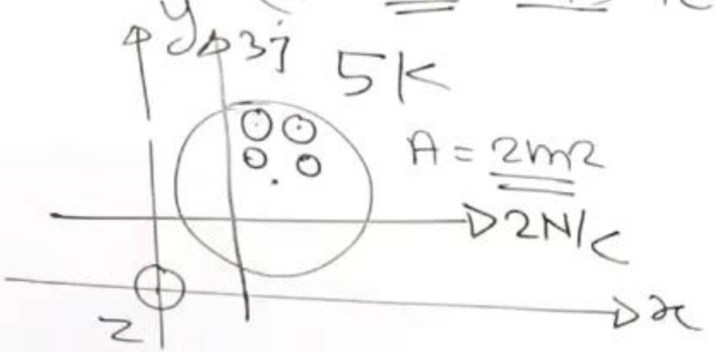
$\phi = 5 \times 10 \times -1$

$= -50$ N-m²/C

$\phi = EA \cos 0$

$\phi = 5 \times 10 = 50$ N-m²/C²

Q) $\vec{E} = (2\hat{i} + 3\hat{j} + 5\hat{k})\,N/C$



$\vec{E} = (2\hat{i} + 3\hat{j} + 5\hat{k})\,N/m$

$\vec{A} = (2\hat{k})\,m^2 = (0\hat{i} + 0\hat{j} + 2\hat{k})$

$\phi = \vec{E} \cdot \vec{A}$

$= (2\hat{i} + 3\hat{j} + 5\hat{k}) \cdot (2\hat{k})$

$= (2\hat{i} + 3\hat{j} + 5\hat{k})\,(0\hat{i} + 0\hat{j} + 2\hat{k})$

$0 + 0 + 10$

$= 10\,N\text{-}m^2/C$

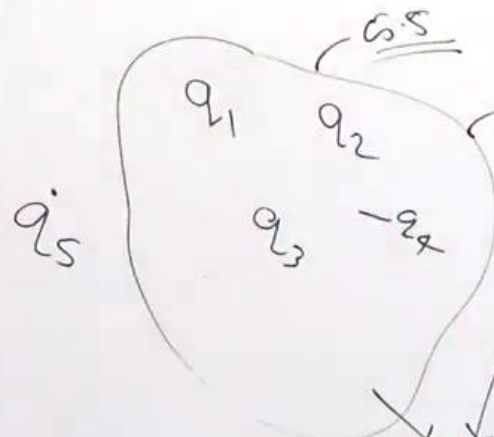
ε_0 = permitivity of free-space

$\varepsilon_0 = 8.85 \times 10^{-12} \frac{c^2}{N\text{-}m^2}$

$[\varepsilon_0]$ JEE mains 2013

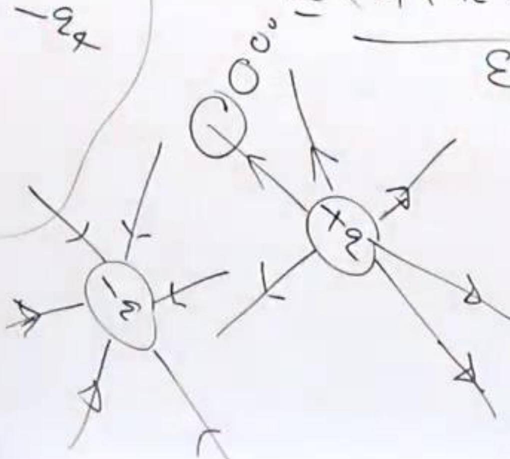
Q1) find flux through a Gaussian Surface if a dipole place inside the Gaussian for Surface.

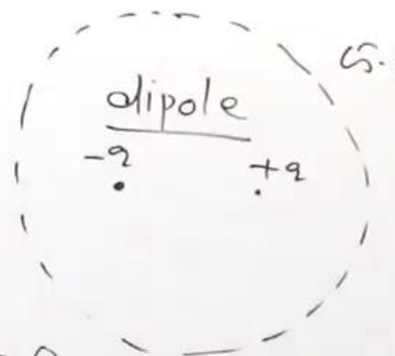
$\Rightarrow$



$$\phi = \frac{q_{in}}{\varepsilon_0}$$

$$= \frac{(q_1+q_2+q_3-q_4)}{\varepsilon_0}$$





$\phi = 0$

$$\phi = \frac{q_{in}}{\varepsilon_0} = \frac{q-q}{\varepsilon_0} = \frac{0}{\varepsilon_0} = \underline{\underline{0}}$$