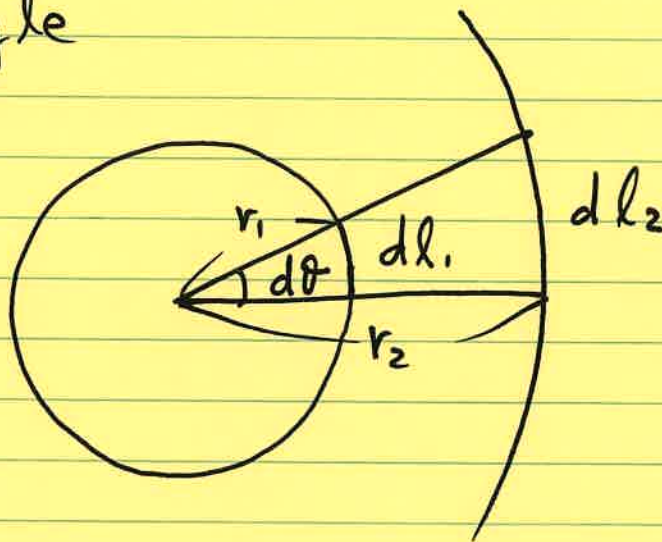


Solid Angle

①

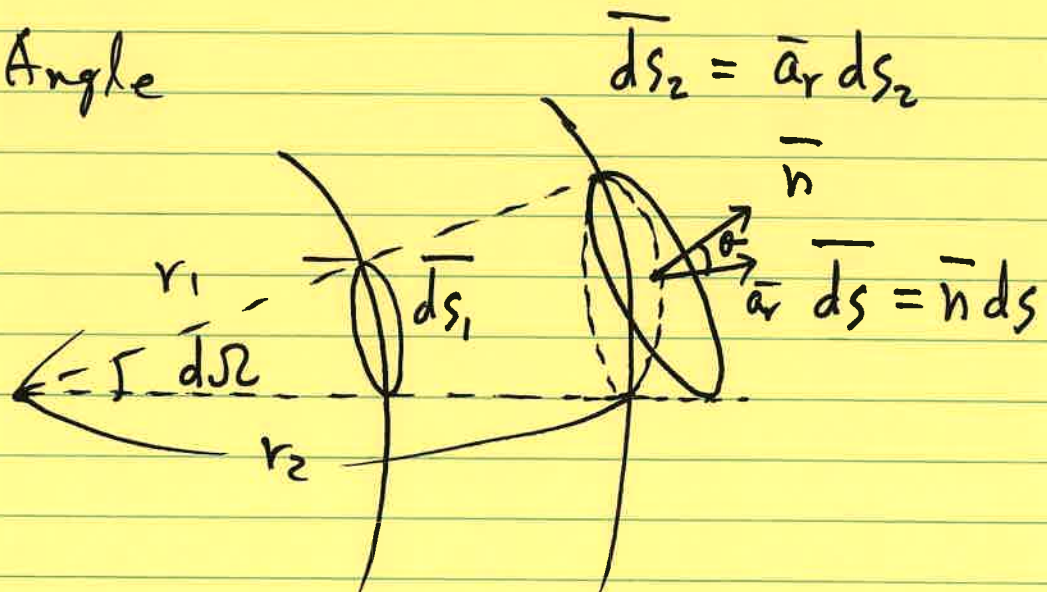
* Angle



$$d\theta = \frac{dl_1}{r_1} = \frac{dl_2}{r_2} = \frac{dl}{r}$$

$$\theta = \frac{2\pi r}{r} = 2\pi \quad [\text{radian}]$$

* Solid Angle



$$d\Omega = \frac{ds_1}{r_1^2} = \frac{ds_2}{r_2^2} = \frac{ds}{r^2}$$

$$\Omega = \frac{4\pi r^2}{r^2} = 4\pi \text{ [steradian]} \quad (2)$$

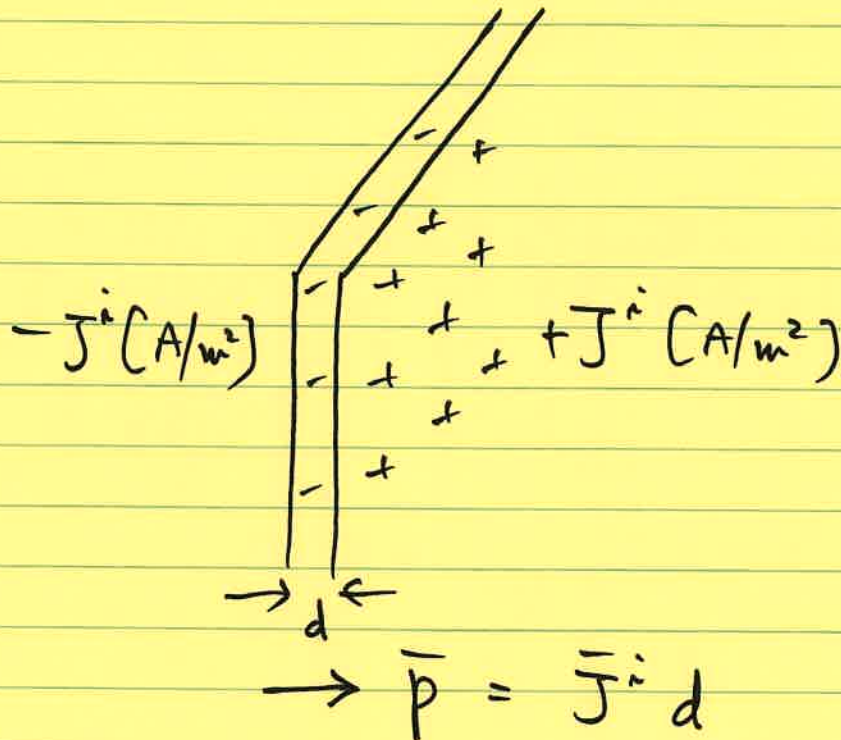
$$d\Omega = \frac{d\vec{s} \cdot \vec{a}_r}{r^2} = \frac{ds \cos\theta}{r^2}$$

$$= -\nabla\left(\frac{1}{r}\right) \cdot d\vec{s}$$

$$-d\Omega = \nabla\left(\frac{1}{r}\right) \cdot d\vec{s}$$

Charge Double Layer

- Distributed dipole source



$$\phi_d = \phi_1 - \phi_2 = \bar{J}^i d$$

$[A/m] \leftarrow [A/m^2] \rightarrow [m]$

$$\bar{p} = \bar{J}^i d$$

$[A/m] \quad [A/m^2] [m]$

$$\bar{J}^i d v = \bar{J}^i d d s$$

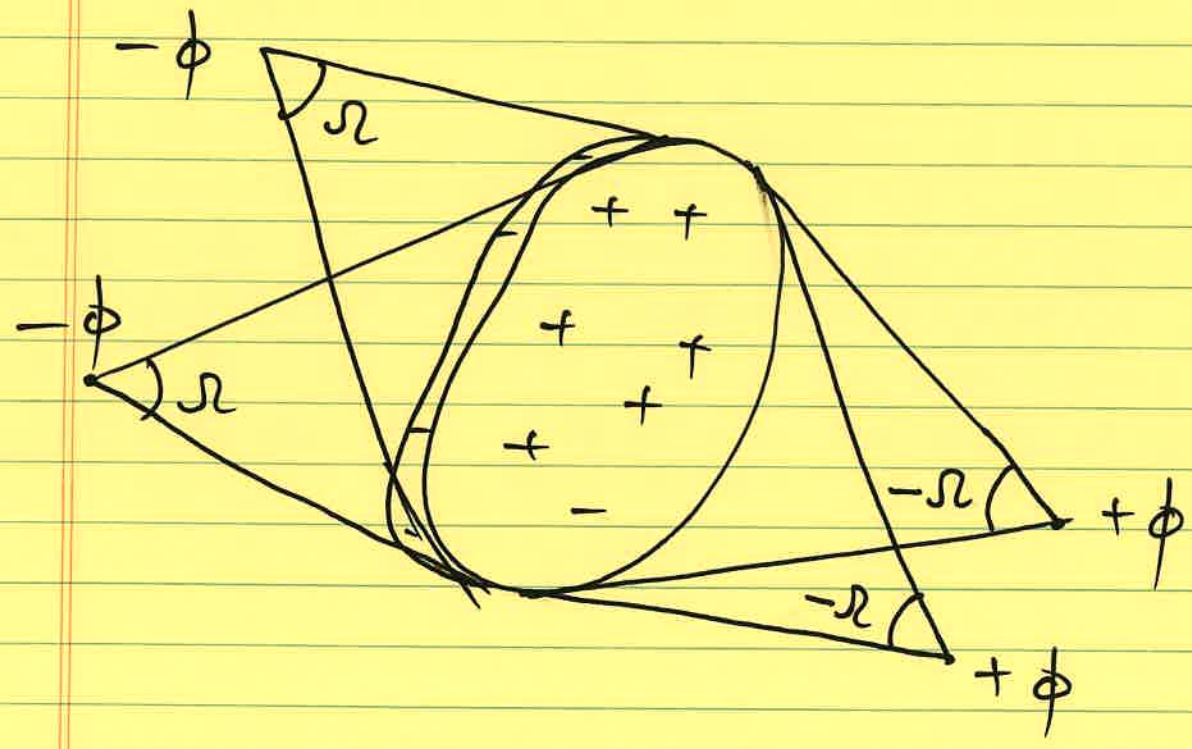
$$= \bar{p} d s$$

$$= p \bar{n} d s = p \bar{d} s$$

$$\begin{aligned} \phi &= \frac{1}{4\pi r} \int_V \bar{J}^i \cdot \nabla\left(\frac{1}{r}\right) dV \\ &= \frac{1}{4\pi r} \int_S p \nabla\left(\frac{1}{r}\right) \cdot \bar{dS} \\ &= \frac{1}{4\pi r} \int_S p (-d\Omega) \end{aligned}$$

* Uniform double layer

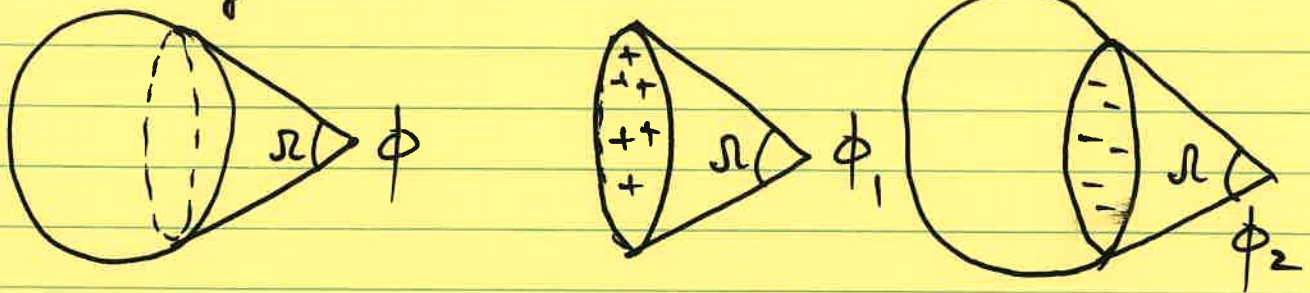
$$\phi = \frac{1}{4\pi r} p (-\Omega)$$



* closed double layer

(3)

Fig 11.3



$$\phi = \phi_1 + \phi_2 = 0, \quad \phi_1 = -\phi_2$$

- A closed uniform double layer generates a zero external potential.
- The potential of an open uniform double layer is determined by the rim of the opening.

See Fig 11.4