# Ch 2 – Equipotential surfaces

# Equipotential surfaces:

- An equipotential surface is a surface on which the electric potential is the same at every point.
- **Properties:**

(i) Potential difference on an equipotential surface is zero.

$(\Delta V = V2 - V1 = 0)$

# Properties of equipotential surfaces:

(ii) Work done in moving a test charge on an equipotential surface is zero.(we know, potential difference is work done per unit charge)

- $W_{ext} = q\ \Delta V$

  $= q\ (v_2 - v_1)$

  $= q\ (0)$

  $= 0$

moving a test charge along an equipotential surface requires no work, as there is no change in electric potential

# Properties of equipotential surfaces:

(iii) Electric field is always normal (perpendicular) to the equipotential surface at every point.

$dw = F.\ dr$

$= q\ E.\ dr$

Electric field is always perpendicular to the surface, that is displacement($\theta = 90^{\circ}$)

Therefore, $dw = 0$

$W = 0$

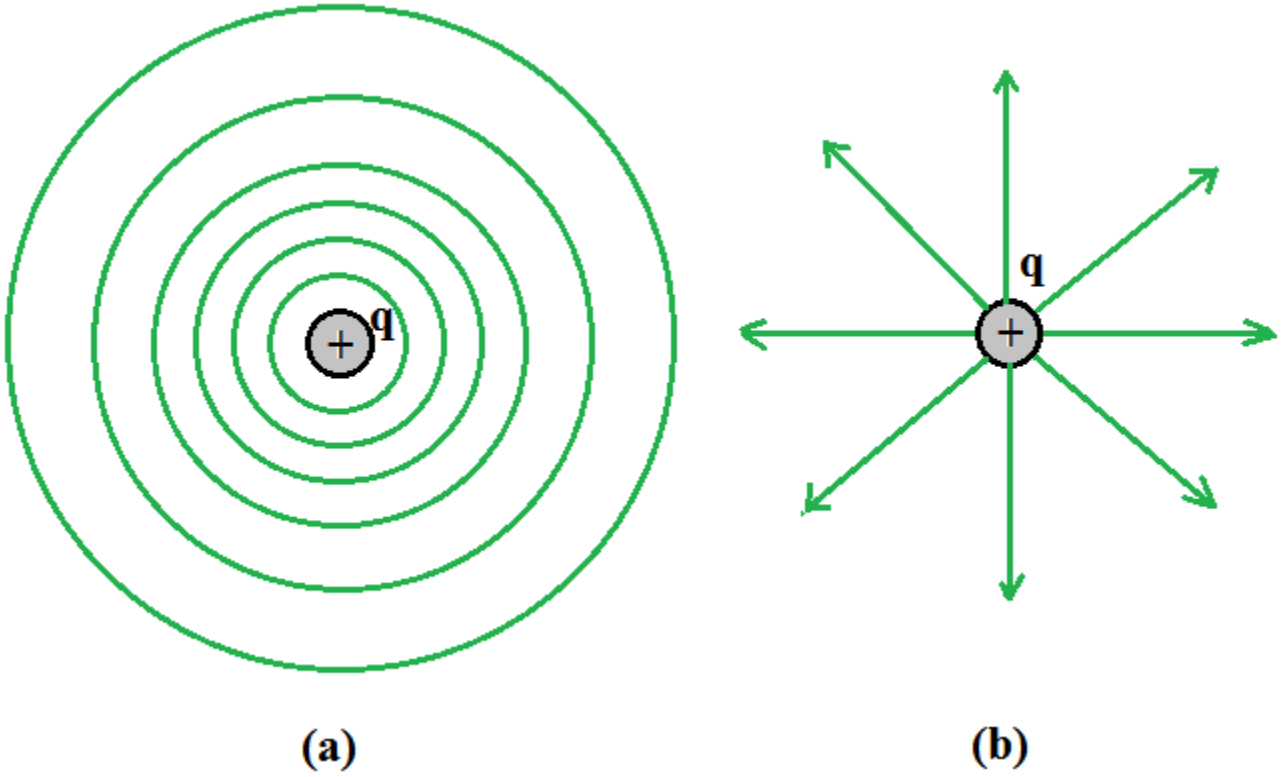
# Properties of equipotential surfaces:

(iv) No two equipotential surfaces can intersect each other. Because at the same point, no two electric field lines can lie.

(v) Equipotential surfaces are closer together in regions of a strong field and further apart in the regions of a weak field.

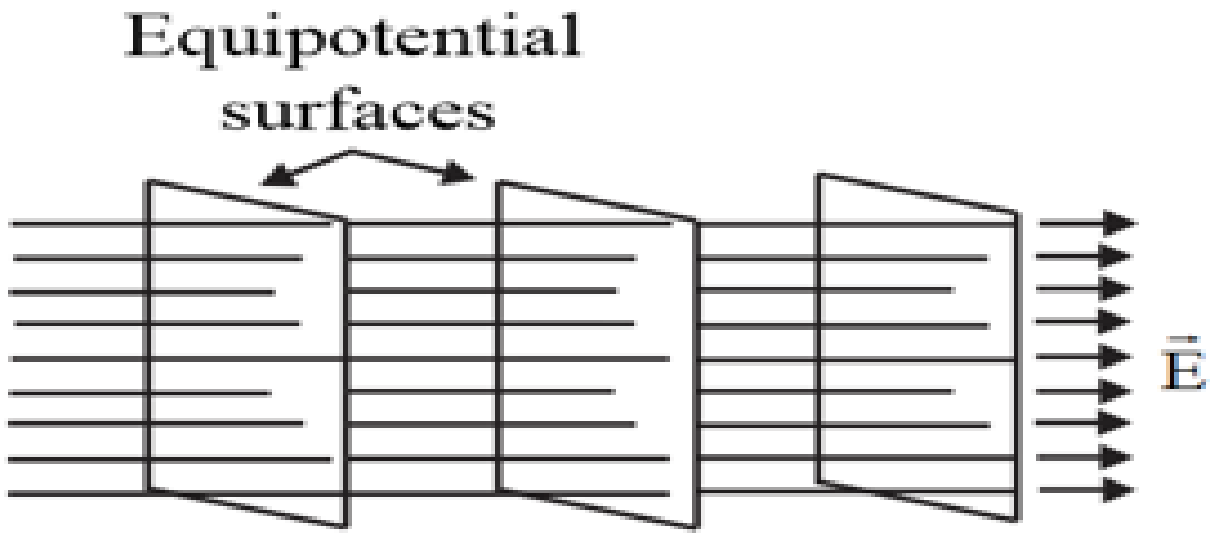
$$dr \alpha \ 1/E$$

# Equipotential surfaces of a point charge(As the field gets weaker, distance between equipotential surfaces become larger)



- As we move from one surface to the other surface, the electric potential decreases along the direction of the electric field.
- $V = kq / r$ (Note: The relation between V and r)

# Equipotential surfaces for a uniform electric field:(flat plane surface)

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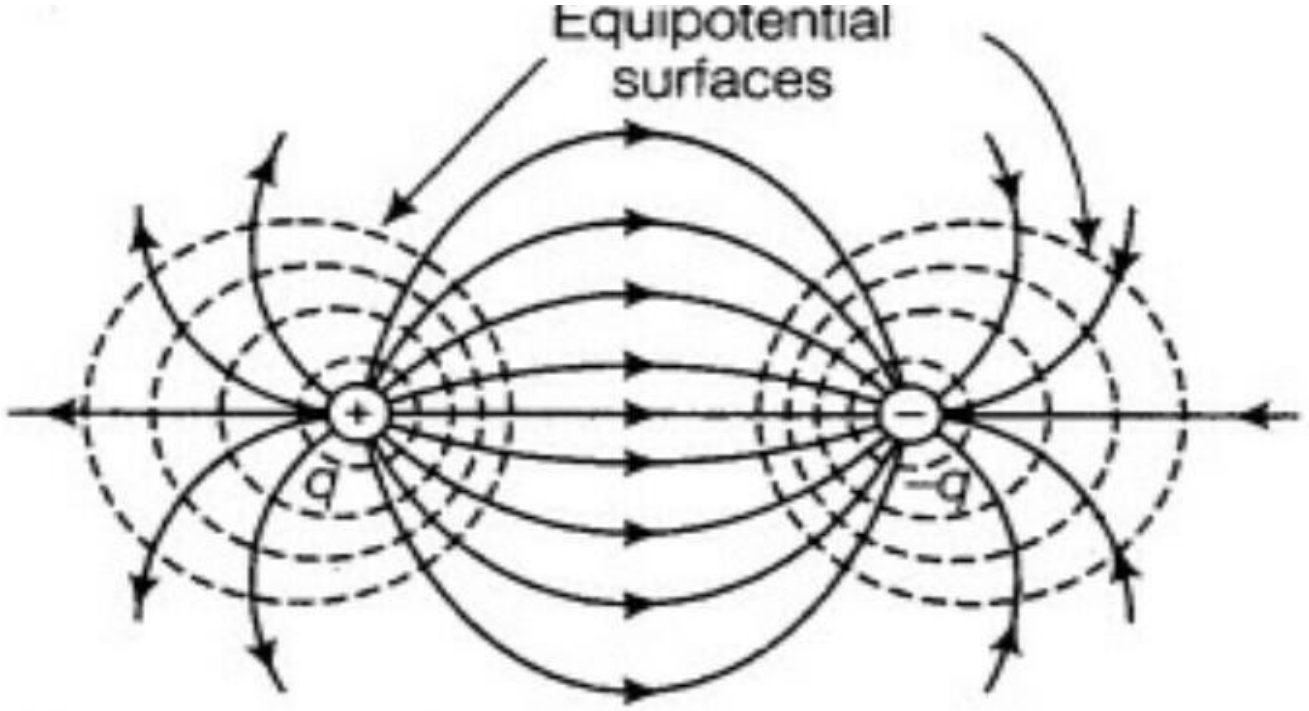
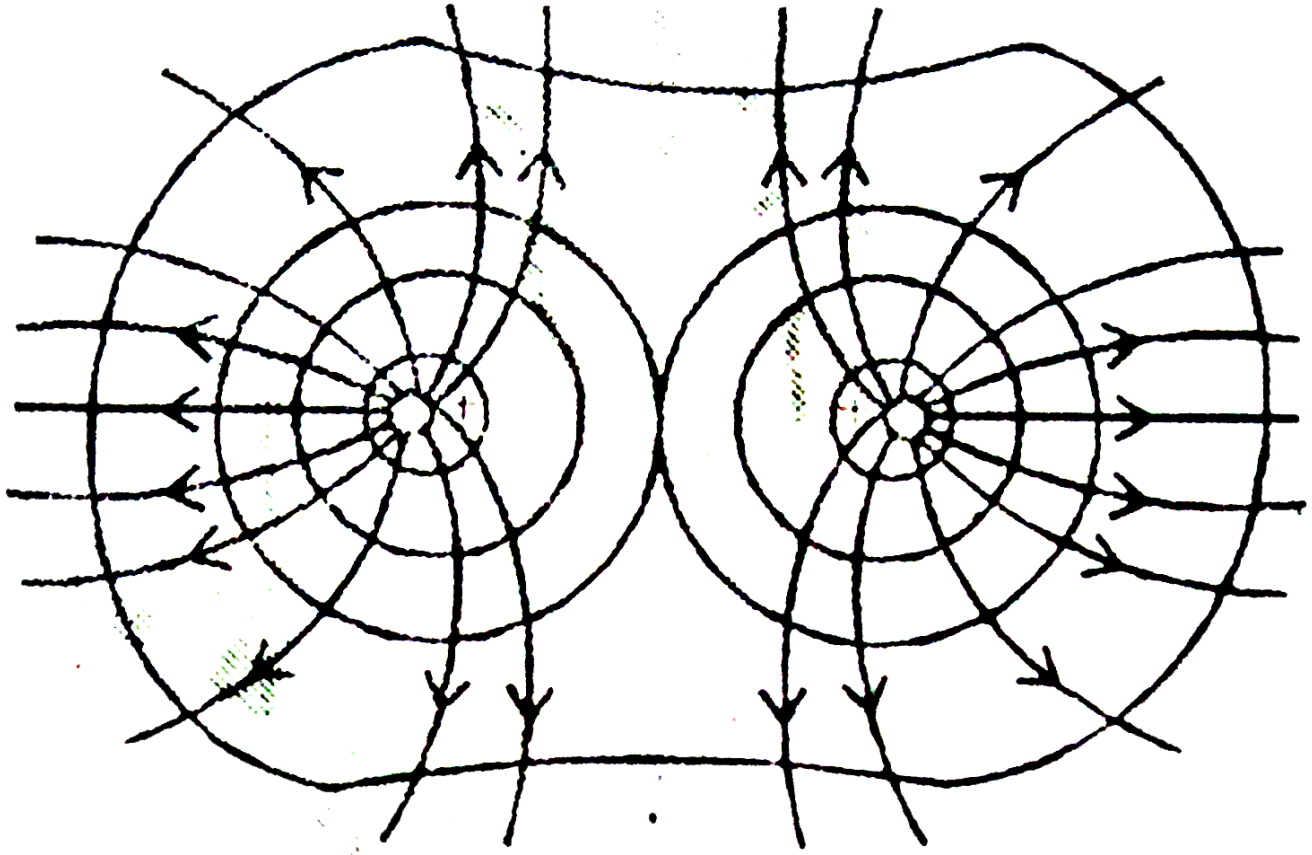
unifrom electric field

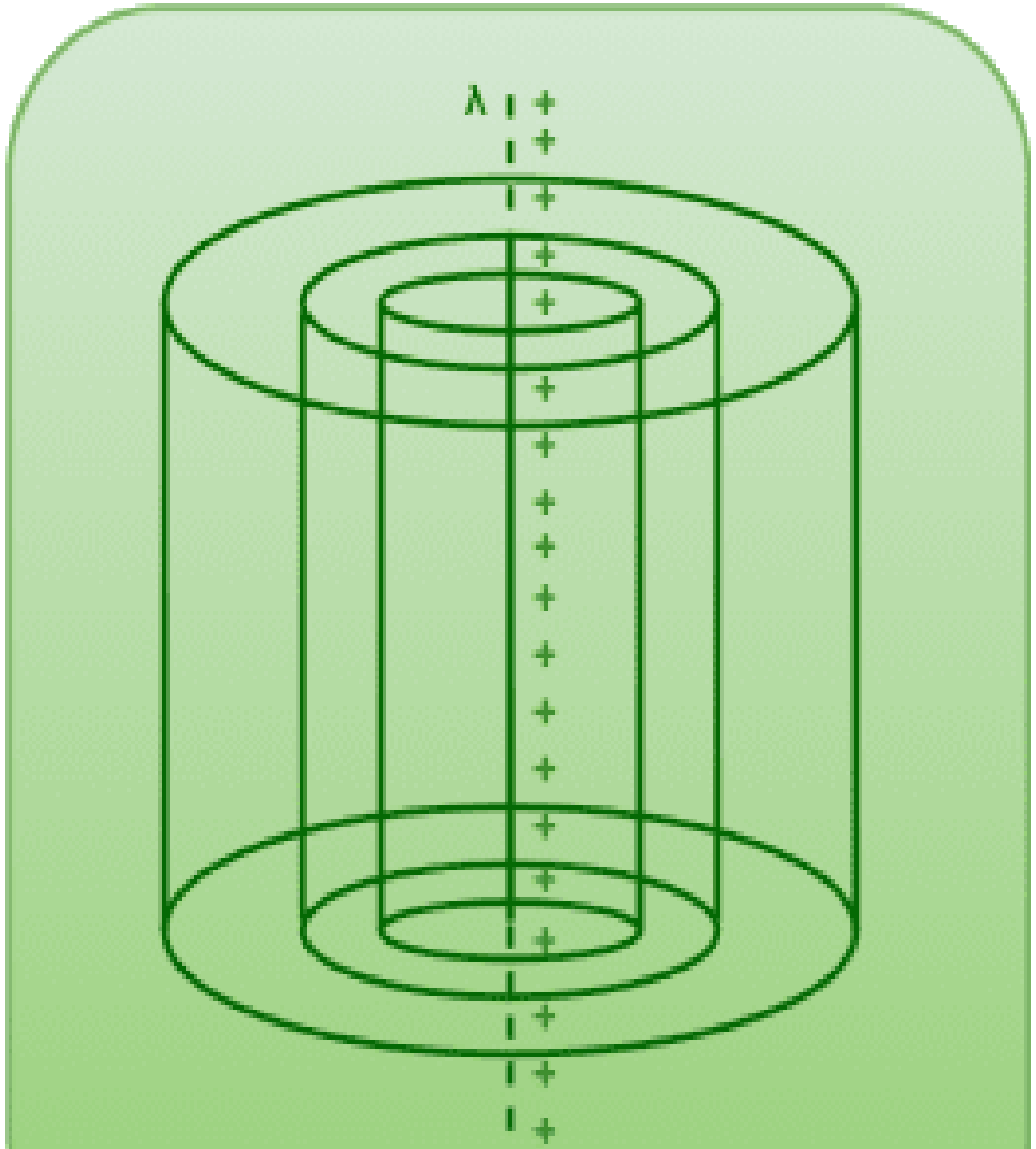
# Equipotential surfaces for an electric dipole:




Equipotential surfaces due to an electric dipole

# Equipotential surfaces of two equal positive point charges:






Equipotential Surfaces Due To An Infinite Long Line Charge