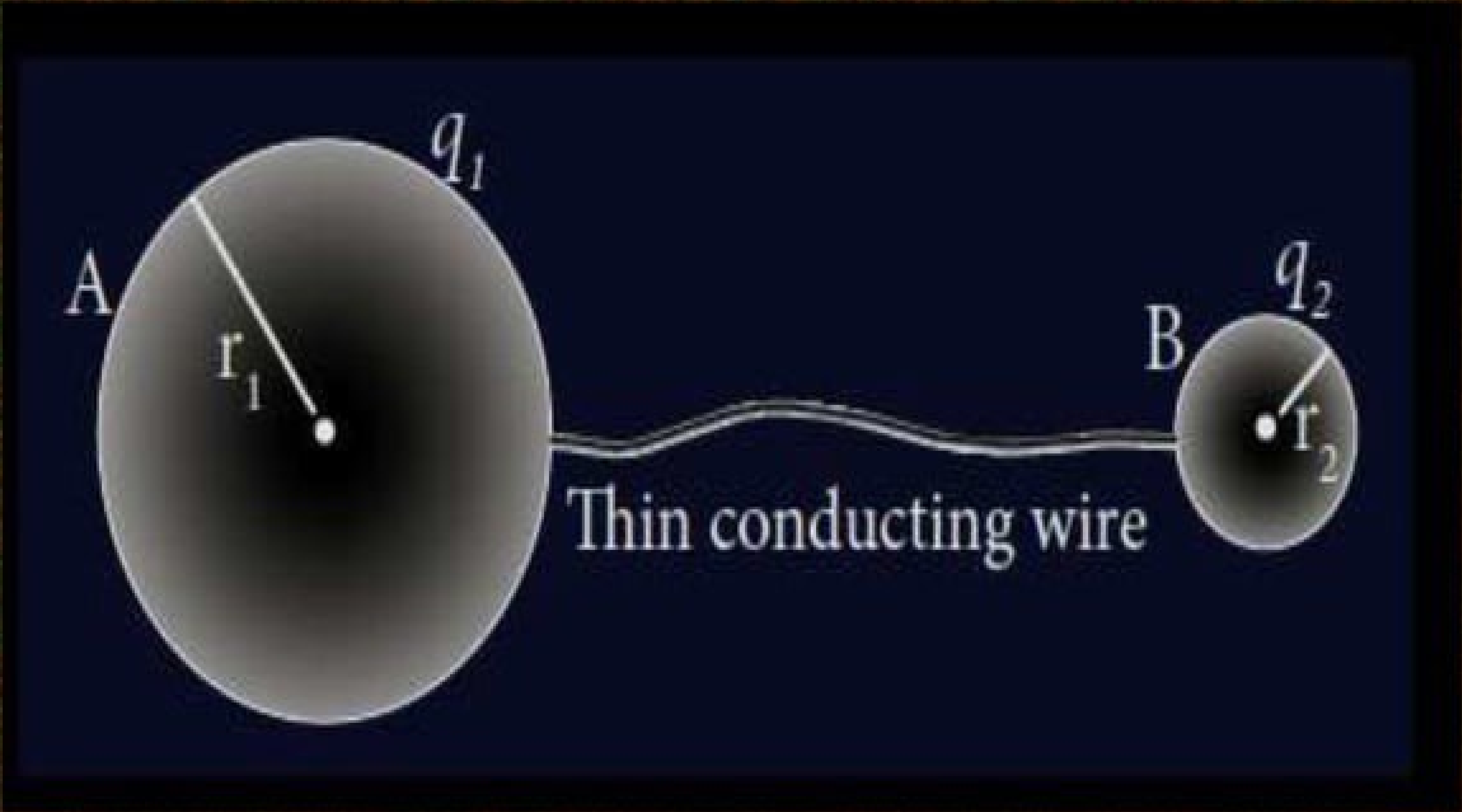
DISTRIBUTION OF CHARGES IN A CONDUCTOR AND ACTION AT POINTS

Distribution of charges in a conductor

- Consider two conducting spheres A and B of radii r_1 and r_2 respectively connected to each other by a thin conducting wire
- The distance between the spheres is much greater than the radii of either spheres.
- If a charge Q is introduced into any one of the spheres, this charge Q is redistributed into both the spheres such that the electrostatic potential is same in both the spheres.

- They are now uniformly charged and attain electrostatic equilibrium.
- Let q_1 be the charge residing on the surface of sphere A and q_2 is the charge residing on the surface of sphere B such that $Q = q_1 + q_2$.
- The charges are distributed only on the surface and there is no net charge inside the conductor.

Two conductors are connected through conducting wire



- The electrostatic potential at the surface of the sphere A is given by
$$V_A = \frac{1}{4\pi\varepsilon_\circ}\frac{q_1}{r_1}$$
- The electrostatic potential at the surface of the sphere B is given by
$$V_B = \frac{1}{4\pi\varepsilon_\circ}\frac{q_2}{r_2}$$
- The surface of the conductor is an equipotential.
- Since the spheres are connected by the conducting wire, the surfaces of both the spheres together form an equipotential surface

$$V_A = V_B$$

$$\text{or} \quad \frac{q_1}{r_1} = \frac{q_2}{r_2}$$

- Let us take the charge density on the surface of sphere A is σ_1 and charge density on the surface of sphere B is σ_2.
- This implies that $q_1 = 4\pi r_1^2\sigma_1$ and $q_2 = 4\pi r_2^2\sigma_2$.
- we get $\sigma_1 r_1 = \sigma_2 r_2$
- σr = constant
- The surface charge density σ is inversely proportional to the radius of the sphere.
- For a smaller radius, the charge density will be larger and vice versa