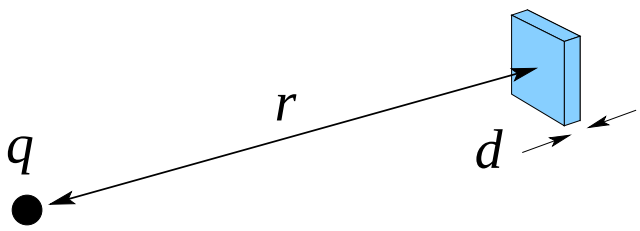
Small plate attraction

Uncharged metallic plate of area S and thickness d is distance r from a point charge q. Its surface is perpendicular to the vector $\mathbf{r}$. Find the force of attraction of the plate towards the charge. $d \ll \ell \ll r$ where $\ell \sim \sqrt{S}$.



Answer of problem **Small plate attraction**

The (almost uniform) field from the charge will induce $\mp Q$ charges on the front and back sides of the plate, so that the field inside metal is zero, and those charges will be attracted towards the point charge with force

$$\boxed{F = \frac{q^2 S d}{2\pi r^5}} \qquad (Gauss\ units) \qquad or \qquad \boxed{F = \frac{q^2 S d}{8\pi^2 \varepsilon_0 r^5}} \qquad (SI)$$