(1) Find the capacitance of two concentric spheres of radii r and R respectively. Discuss the limits of (a) finite r, R $\to\infty$ and (b) (R - r) < < r.

Solution: Potential due to the large sphere is $V_R = \frac{Q}{4\pi\varepsilon_0 R}$ and for the small sphere is $V_r = \frac{Q}{4\pi\varepsilon_0 r}$. Therefore

$$V_r - V_R = \frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{r} - \frac{1}{R}\right] = \frac{Q}{4\pi\varepsilon_0}\left[\frac{rR}{(R-r)}\right]^{-1}$$

Therefore capacitance $C = \frac{Q}{V} = \frac{4\pi\varepsilon_0 rR}{(R-r)}$ For R $\to\infty$; $C = 4\pi\varepsilon_0 rR$

For (R- r) < < r ; r $\simeq$ R and (R - r) = d and $C = \frac{Q}{V} = \frac{4\pi\varepsilon_0 R^2}{d} = \frac{\varepsilon_0 A}{d}$