PROBLEM 3

Two identical spheres of mass $m$ are hung from silk threads of length $L$, as shown in the figure below. Each sphere has the same charge, so $q_1=q_2=q$. The radius of the sphere is very small in comparison to the distance between the spheres, so they may be treated as point charges. Find the distance between the spheres if $\theta$ is small (HINT: if $\theta$ is small, then $\tan\theta = \sin\theta$).

\[ F_c = \frac{kq^2}{d^2} = \frac{kq^2}{d^2} \]

\[ \sin\theta = \frac{d/L}{L} \]

\[ \Rightarrow \quad \text{if } \theta \text{ is small, then } \tan\theta = \sin\theta \]

\[ \Rightarrow \quad \frac{F_c}{mg} = \frac{d}{2L} \]

\[ \frac{2kq^2 L}{mg d^2} = \frac{d}{2L} \]

\[ \frac{2kq^2 L}{mg} = d^3 \Rightarrow d = \left( \frac{2kq^2 L}{mg} \right)^{\frac{1}{3}} \]