Phys 410
Fall 2014, Prof. Anlage
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Problem 1. Both the Coulomb and gravitational forces lead to potential energies of the form $U(\vec{r}_1 - \vec{r}_2) = \gamma/|\vec{r}_1 - \vec{r}_2|$, where $\gamma = kq_1q_2$ for the Coulomb force and $\gamma = -Gm_1m_2$ for gravity, and $\vec{r}_1$, and $\vec{r}_2$ are the positions of the two particles. Show in detail that $-\nabla_1 U(\vec{r}_1 - \vec{r}_2)$ is the force on particle 1 and $-\nabla_2 U(\vec{r}_1 - \vec{r}_2)$ is that on particle 2.

Hint: Define $\vec{r} = \vec{r}_1 - \vec{r}_2$ which is a vector that points from particle 2 to particle 1. The PE is $U = \frac{\gamma}{r}$ and the forces can be written as $\vec{F}_{12} = \frac{\gamma}{r^2}\hat{r}$ and $\vec{F}_{21} = -\frac{\gamma}{r^2}\hat{r}$.

Problem 2

A mass on the end of a spring is oscillating with angular frequency ω. At $t = 0$ its position is $x_0 > 0$ and I give it a kick so that it moves back toward the origin and executes simple harmonic motion with amplitude $2x_0$. Find the position as a function of time in the form $x(t) = A\cos(\omega t - \delta)$.