Update: Homework Assignment #2
(due: Wednesday, September 5, 9 am)

1. Work-KE Theorem: Taylor 4.4 (5P)
   Hint: In (b) slowly means $\ddot{r} = 0$.

2. Two Interacting Particles: Taylor 4.49 & 4.50 (7P)

3. Many Particles: SiO$_2$ (6P)
   In class we have determined the force $\vec{F}_i$ on a particle $i$ for a system with Lennard-Jones interactions. These forces are the core of the molecular dynamics simulations I run and analyze in my research. Another system which I study is SiO$_2$, which is the main component of window glass. During the last ten years the following BKS Potential [Phys. Rev. Lett. 64, 1955 (1990)] has been shown to be a good model for real SiO$_2$:

   \[ U_{ij}(r_{ij}) = \frac{q_i q_j e^2}{r_{ij}} + A_{ij} \exp(-B_{ij} r_{ij}) - \frac{C_{ij}}{r_{ij}^6} \]

   where $r_{ij} = |\vec{r}_i - \vec{r}_j|$ and $q_i, A_{ij}, B_{ij},$ and $C_{ij}$ are constants. Similar to the calculation in class, determine the force $\vec{F}_i$ on particle $i$ due to all other particles $j = 1, \ldots, N$. \footnote{To tell the whole truth, since the Coulomb force is long ranged, the actual calculation of this term is in practice more complicated.}

4. Solid at Low Temperature: Taylor problem (5.19) (8P)
   Hints:
   (1) You want to show that $U = U_0 + k'r^2$
   (2) Use that $x$ and $y$ are small. You will have to use $\sqrt{1+z} \approx 1 + \frac{z}{2} - \frac{z^2}{8}$.
   Keep all terms up to order $x^2$ and $y^2$.

5. Overdamped Oscillator: Taylor problem (5.30) (5P)

6. Driven Damped Oscillator: (7P)
   6a. Reproduce Fig. (5.15) of Example (5.3) (pages 185/186)
   6b. Taylor problem (5.36)