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:

$$U_{ij}(r_{ij}) = \frac{q_i q_j \mathrm{e}^2}{r_{ij}} + A_{ij} \exp\left(-B_{ij} r_{ij}\right) - \frac{C_{ij}}{r_{ij}^6}$$

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 F_i on particle i due to all other particles $j = 1, \ldots, N$. [2]

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)

[2] To tell the whole truth, since the Coulomb force is long ranged, the actual calculation of this term is in practice more complicated.