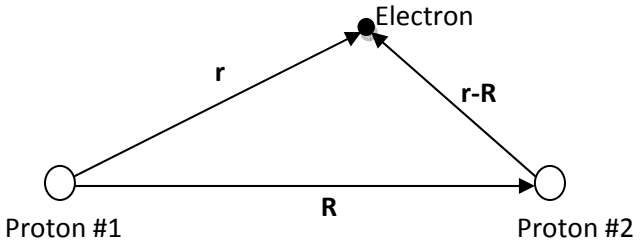
SEMICONDUCTOR PHYSICS **ECE 1336**

Problem Set #3: Atomic Bonding and Crystal Types

1. The figure below illustrates the hydrogen molecular ion, H_2^+, which consists of two protons, separated by a vector **R,** and one electron at a vector, **r**, away from the first proton.



(a) Write an expression for the potential energy of this system based on Coulomb interaction.

(b) Assume the electron lies along the line joining the protons and the distance between the protons is 0.75A. Using appropriate software (eg. MATLAB or Maple) plot the potential energy as a function of the distance, $|\mathbf{r}|$.

2. The total energy of two argon atoms, relative to their energy at infinite separation, is given by:

$$E = -C\left(\frac{a_o}{R}\right)^6 + B\left(\frac{a_o}{R}\right)^{12}$$

Where C = 2.35 X 10^3 eV, B = 1.69 X 10^8 eV, and a_o is the Bohr radius. The first term represents the energy due to the attractive force of the outer electrons while the second term represents the energy of core-core repulsion.

(a) Calculate the separation of the atoms at equilibrium.

(b) Calculate the cohesive energy when the system is at equilibrium.

3.

(a) Explain the differences and similarities between ionic bonding and Van der Waals bonding.

(b) What type(s) of bonding occurs in Graphite?

(c) Using you answer in (b) explain why Graphite has a very high melting point, ~3700^{o}C, and yet leaves a mark when scratched against paper.