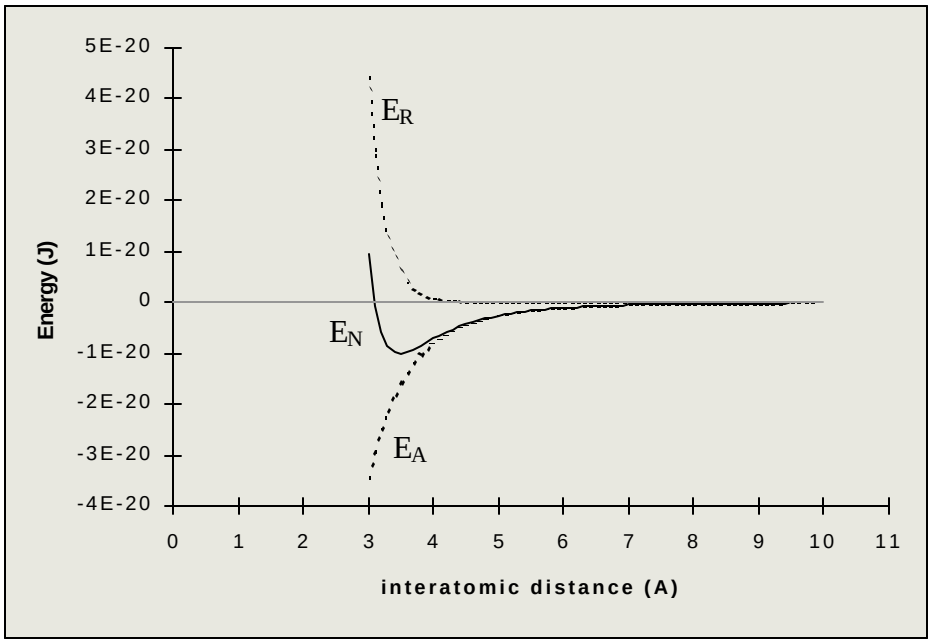
ENGR 240; HW#2 solution

1a)




1b) MINIMUM AT $F = \frac{dE}{dr} = 0$

$$\frac{dE}{dr} = \frac{+4.2 \times 10^{-17}}{r^6} - \frac{9.1 \times 10^{-13}}{r^{14}} = 0$$

$$r^8 = 2.17 \times 10^4$$

$$r = 3.48\ \text{Å}$$

1 c)

$E_0 = E$ at $r = 3.48\ \text{Å} =$

$$\frac{-8.4 \times 10^{-19}\ \text{J}\cdot\text{Å}^5}{(3.48\ \text{Å})^5} + \frac{7.0 \times 10^{-14}\ \text{J}\cdot\text{Å}^{13}}{(3.48\ \text{Å})^{13}} =$$

$$\boxed{-1.0 \times 10^{-20}\ \text{J}}$$ ok to leave off "−"

1 d) $$1.0 \times 10^{-20}\ \frac{\text{J}}{(\text{bond})} \left(\frac{6.02 \times 10^{23}\ \text{bond}}{\text{mol}}\right) = 6100\ \text{J/mol}$$

$$\boxed{6.1\ \text{kJ/mol}}$$

2) MgO ← higher density (ionic)

$PCl_5$ molecule has directional covalent bonds (these won't pack as well as Mg, O ions)

3) Ca ← metallic bonds, de-localized e⁻ give high conductivity

$CaF_2$ ← Ionic bonds, no free e⁻