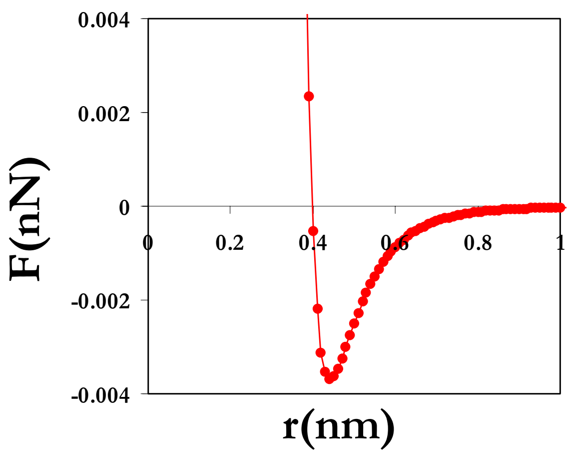
ROBLEM SET 7
DUE FRIDAY NOVEMBER 7th

MOHR'S CIRCLE

1. Given a plane with stresses σ_x and σ_y and τ_{xy}, draw the Mohr's circle if the plane rotates 45º clockwise to the current axes. Hint: τ_{xy} **< 0 and** σ_x **>** σ_y
2. Given a plane with stresses σ_x and σ_y and τ_{xy}, draw the Mohr's circle if the plane rotates counterclockwise to the current axes between 45-90degrees.
   Hint: τ_{xy} **> 0 and** σ_x **<** σ_y
3. Given a plane with stresses σ_x and σ_y and τ_{xy}, draw the Mohr's circle if the principle axes are clockwise to the current axes and between 45-90 degrees away.
   Hint: τ_{xy} **< 0 and** σ_x **<** σ_y
4. Given a plane with stresses σ_x and σ_y and τ_{xy}, draw the Mohr's circle if the principle axes are aligned with current axes. Hint: τ_{xy} **= 0 and** σ_x **>** σ_y

LENNARD-JONES POTENTIAL

5. Two atoms interact at T=0ºK via a van der Waals Lennard-Jones potential with $A=4.7\bullet10^{-78}$ Jm^6. The interaction force versus separation distance plot is given in the following figure.



(a) Calculate the binding energy (k_BT) and the bond stiffness (N/m).
(b) The two atoms are held at a particular separation distance r using an atomic force microscope so that the *attractive component* of the force is equal to -0.003 nN. At this distance are the atoms attracted to each other or repelled away from each other ? Justify your answer with a numerical calculation.

6. Draw the following Common Potential Functions based on the information given. The capital Gammas represent your Potential functions U(r) that was discussed in class. (Note: some may be impossible)

1) Ideal Gas

$$\Gamma(r) = 0$$

2) Hard Sphere

$$\Gamma(r) = \infty \; (r \le \sigma)$$
$$\Gamma(r) = 0 \; (r > \sigma)$$

3) Point Repulsion

$$\Gamma(r) = dr^{-\delta}$$

δ = index of repulsion;

$$9 < \delta < 15$$

If $\delta = 4 \Rightarrow$ "Maxwellian molecules"

4) Square Well

$$\Gamma(r) = \infty \quad (r \le \sigma)$$
$$\Gamma(r) = -\varepsilon \quad (\sigma < r \le R\sigma)$$
$$\Gamma(r) = 0 \quad (r > R\sigma)$$

5) Sutherland

$$\Gamma(r) = \infty \quad (r \le \sigma)$$
$$\Gamma(r) = -cr^{-\gamma} \; (r > \sigma)$$

Typically, $\gamma = 6$

6) Lennard-Jones

$$\Gamma(r) = 4\varepsilon\left[\left(\frac{\sigma}{r}\right)^{12} - \left(\frac{\sigma}{r}\right)^{6}\right]$$

7) Buckingham

$$\Gamma(r) = b\exp(-ar) - \frac{c}{r^6} - \frac{c'}{r^8}$$

- 4-parameter
- exponential form for repulsive (theoretically better)
- includes induced dipole / induced dipole & induced dipole / induced quadrupole
- numerically difficult