HW4

When measuring dispersion forces between objects there is always charging up effects that lead to an additional, often dominating, force. This force has to be subtracted from the total force. We want to measure the Casimir force between two long parallel gold cylinders of radius a and length L in vacuum as a function of closest separation, d.

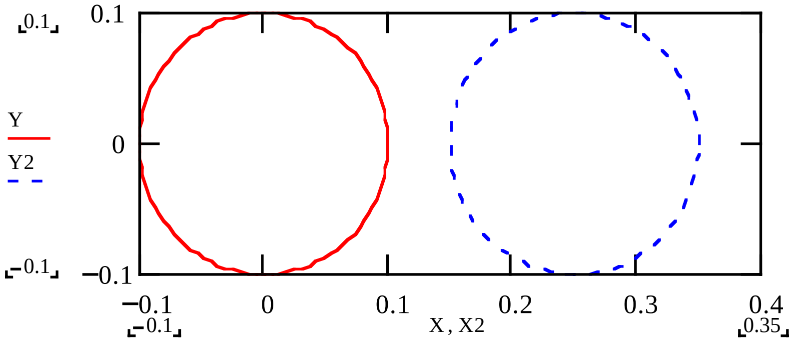
Determine the electrostatic force as a function of d. Let the cylinders have charge $\pm Q$. The charge is independent of d.

Hints: a) The energy stored in the electrostatic field is a function of the capacitance, $C(d)$, and Q.
b) The capacitance does not change when a conformal mapping is used.

The möbius transformation:

$$w(x,y) := a\cdot\frac{z(x,y) - A}{A\cdot z(x,y) - a^2}; \quad A := \frac{a^2 + (a+d)\cdot(3\cdot a+d) + \sqrt{\left[(a+d)^2 - a^2\right]\cdot\left[(3\cdot a+d)^2 - a^2\right]}}{2\cdot(2\cdot a+d)}$$

transforms the geometry (we have used a=.1, d=.05)



into two coaxial cylinders where the outer cylinder has radius unity and the inner radius is given by

$$Ro := \frac{(a+d)\cdot(3\cdot a+d) - a^2 - \sqrt{\left[(a+d)^2 - a^2\right]\cdot\left[(3\cdot a+d)^2 - a^2\right]}}{(3\cdot a+d) - (a+d)}$$