Homework Assignment #3v2
Due by online submission Wednesday 9/16/2015 (Thursday at 9am)

1. Estimate the electric field between two socks which stick together when you pull them out of the dryer. Assume that the socks are parallel plates separated by some small gap, g, with a friction-induced charge (triboelectric effect) on each side. If the mass of a sock per unit area is 1kg/m²
   a. estimate the minimum electric field between the socks
   b. if the distance between the charges on the socks is 10um, what is the voltage between them?

2. If you have two flat conductors separated by a gap of 0.1um with a potential of 150V between them,
   a. how much area is needed to support your weight? (if you prefer not to reveal your weight, you may use a mass of 50kg, or a weight of 500N).
   b. if the gap is 10um and the voltage is 1.5V, what area is needed? How much did the field change? What was the ratio of your answers to a and b? How is that related to the field?

3. In a three mask process (POLY0, CONT, POLY1) with only one structural polysilicon (POLY0 for wiring, and POLY1 for structures), sketch a 3 axis capacitive accelerometer. Can you do it with a single proof mass?

4. Here’s a picture of the ADXL50, the first commercial surface micromachined MEMS device.

Note the 100um scale bar at the bottom. If the gaps are 1.2um, estimate the no-acceleration capacitance to either of the differential capacitor outputs.

5. These are pictures of the ADXL202. Die photo (CMOS+MEMS), SEM of the MEMS device, detail SEM, and simulation of response to a vertical acceleration.
a. Using the scale bar, estimate the size of the proof mass, and the overall chip.
b. In the detailed SEM, identify the proof mass, support springs, proof mass anchor, over-acceleration mechanical stops, differential sense capacitors, actuation capacitors.