Physic 201- Fall 2002
Name: _______________________

**Capacitors**

October 4

1. Two very thin conducting plates are a distance D apart. The surface area of the face of each plate is A. A side view of the plates is shown.

The inner surface of one plate has a uniform charge density $+\sigma$ and the other has $-\sigma$. The charge density on the outer surface of each plate is zero.

At each labeled point, draw vectors to represent the electric field at that point.

Write expressions for the following quantities in terms of the given variables;

• The electric field at points 1, 2, 3 and 4.

• The potential difference between the plates.

2. The right plate is moved to the left as shown. Both plates are kept insulated. Describe how each of the following quantities will change (if at all). Explain.

The charge density on each plate.

The electric field both outside and between the plates.
The potential difference between the plates.

3. Write expressions for the following quantities in terms of $\sigma$ and $d$ (the new distance between the plates).

   The magnitude of the electric field between the plates.

   The potential difference between the plates.

4. Find the ratio of the net charge on one plate to the potential difference between the plates ($Q/\Delta V$).

   How, if at all, would this ratio change if the charge densities on the plates were $+2\sigma$ and $-2\sigma$?

5. Suppose the plates are discharged, then held a distance $D$ apart and connected to a battery.

   Write expressions for the following quantities in terms of the given variables. Explain your reasoning in each case.

   - The potential difference $\Delta V$ between the plates.
• The electric field at points 1, 2, 3, and 4.

• The charge density on each plate.

6. The right plate is moved to the left. Describe how each of the following quantities change (if at all). Explain.

The potential difference $\Delta V$ between the plates.

The electric field both inside and between the plates.

The charge density on each plate.

7. Write expressions for the following quantities in terms of $V$ and $d$ (the new distance between the plates).

The magnitude of the electric field between the plates

The charge density on each plate.
8. Find the ratio of the net charge on one plate to the potential difference between the plates ($Q/\Delta V$).

How, if at all, would this ratio change if the voltage of the battery was 2V?
9. Does capacitance depend on how much charge is on the plates? Does it depend on the voltage difference between the plates? Explain.

10. Would you place the plates of a parallel-plate capacitor closer together or farther apart to increase its capacitance? If the plates are isolated (so the charge remains constant on each plate) as you move them, does the voltage difference between the plates increase or decrease?

11. A parallel-plate capacitor has square plates of side 10cm separated by 1mm. What is its capacitance? If the capacitor is connected to a 12V battery, how much charge is transferred from one plate to another?