Friday March 10, 2017

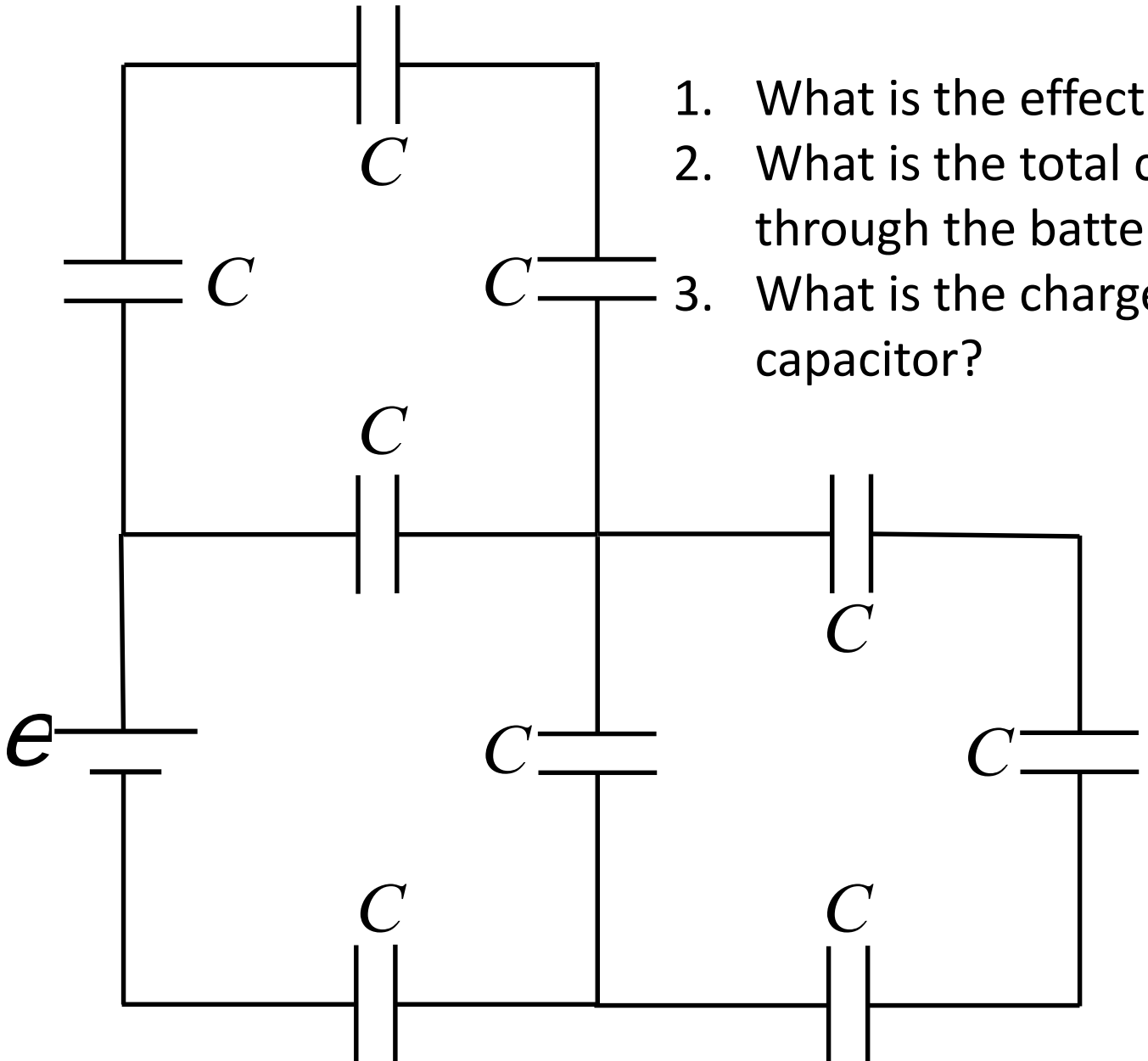
Last time:

- Linear dielectric materials: an atomic perspective
- Effect of dielectrics on capacitance
- Applications of dielectrics and capacitors

Today:

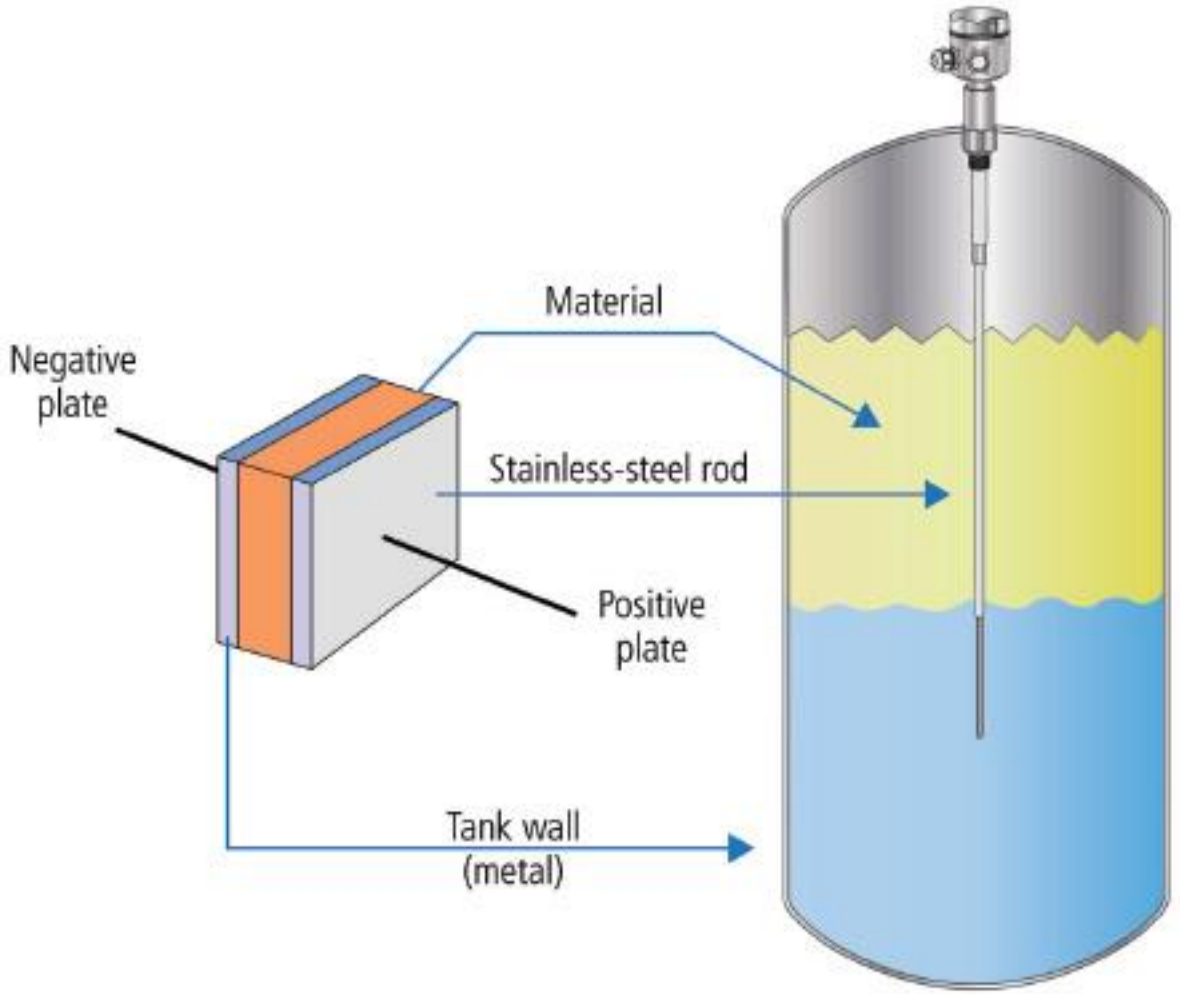
- Calculation of charge
- Applications of dielectrics and capacitors
- Group activity

On document camera



1. What is the effective capacitance?
2. What is the total charge moved through the battery?
3. What is the charge on each capacitor?

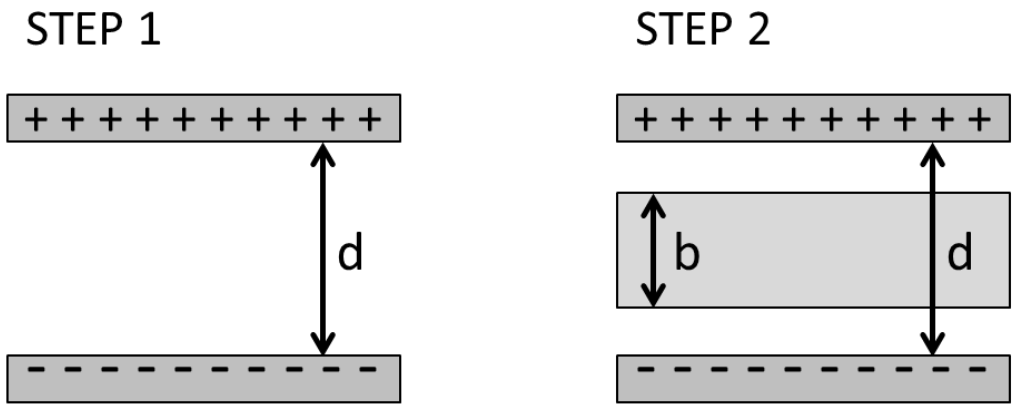
Application: Capacitive Fuel Gauge



https://www.youtube.com/watch?v=0du-QU1Q0T4

Group activity

(10 marks) Consider the following scenario depicted in the diagrams below. Step 1: A parallel-plate capacitor with surface area A and plate separation d is charged to an electric charge of q. Step 2: A dielectric slab of thickness b and dielectric constant κ is inserted between the capacitor plates. What is the ratio between the final and initial voltages measured across the capacitor?



1. **(1 mark)** What is the capacitance of the parallel-plate capacitor in Step 1 in terms of its dimensions and $\epsilon_\circ$?

2. **(1 mark)** What is the voltage, $V_\circ$, across the capacitor in Step 1 in terms of q, $\epsilon_\circ$ and the dimensions of the capacitor?

3. **(1 mark)** Is the charge on the capacitor in Step 2 the same as it was in Step 1? Explain.

4. **(2 marks)** If the electric field strength between the plates in Step 2 is $E_\circ$ in the region *outside* of the dielectric, and E_d *inside* the dielectric, what is the **voltage** across the capacitor in Step 2 in terms of $E_\circ$, E_d and the dimensions of the capacitor and the dielectric slab?

5. **(2 marks)** Use Gauss's law to find $E_\circ$ and E_d in Step 2, in terms of q, $\epsilon_\circ$, κ and the dimensions of the capacitor and the dielectric slab.

6. **(2 marks)** Using your result from Question 5, write the voltage, V, across the capacitor in Step 2 in terms of q, $\epsilon_\circ$, κ and the dimensions of the capacitor and the dielectric slab.