

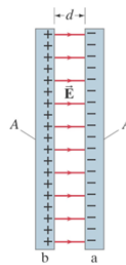
Seminar 7: Capacitance, electric current and resistance

Capacitors:

1. The charge on a capacitor increases by $26 \mu\text{C}$ when the voltage across it increases from 28 V to 78 V . What is the capacitance of the capacitor?

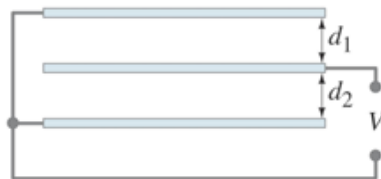
Determination of Capacitance:

2. An air-filled capacitor consists of two parallel plates, each with an area of 7.60 cm^2 , separated by a distance of 1.80 mm . A 20.0 V potential difference is applied to these plates. Calculate (a) the electric field between the plates, (b) the surface charge density, (c) the capacitance, and (d) the charge on each plate.
3. A large metal sheet of thickness l is placed between, and parallel to, the plates of the parallel-plate capacitor as shown in the figure below. It does not touch the plates, and extends beyond their edges. (a) What is now the net capacitance in terms of A , d , and l ? (b) If $l = 0.40 d$, by what factor does the capacitance change when the sheet is inserted?



Capacitors in Series and Parallel:

4. (a) Six $3.8 \mu\text{F}$ capacitors are connected in parallel. What is the equivalent capacitance? (b) What is their equivalent capacitance if connected in series?
5. Three conducting plates, each of area A , are connected as shown in the figure below. (a) Are the two capacitors thus formed connected in series or in parallel? (b) Determine C as a function of d_1 , d_2 , and A . Assume $d_1 + d_2$ is much less than the dimensions of the plates. (c) The middle plate can be moved (changing the values of d_1 and d_2), so as to vary the capacitance. What are the minimum and maximum values of the net capacitance?



Electric Energy Storage:

6. How much energy must a 28 V battery expend to charge a $0.45\ \mu\text{F}$ and a $0.20\ \mu\text{F}$ capacitor fully when they are placed (a) in parallel, and (b) in series? (c) How much charge flowed from the battery in each case?

Electric Current, Resistance, Ohm's Law:

7. A service station charges a battery using a current of 6.7 A for 5.0 h. How much charge passes through the battery?
8. A bird stands on a dc electric transmission line carrying 3100 A, as shown in the figure below. The line has $2.5 \times 10^{-5}\ \Omega$ resistance per metre, and the bird's feet are 4.0 cm apart. What is the potential difference between the bird's feet?



Resistivity:

9. How much would you have to raise the temperature of a copper wire (originally at 20°C) to increase its resistance by 15%? The temperature coefficient (α) for copper is 0.0068.
10. Compute the voltage drop along a 26 m length of household copper wire (used in 15 A circuits). The wire has diameter 1.628 mm and carries a 12 A current. The resistivity (ρ) of copper is 1.68×10^{-8} .

Electric Power:

11. (a) Determine the resistance of, and current through, a 75 W lightbulb connected to its proper source voltage of 110 V. (b) Repeat for a 440 W bulb.

Alternating Current:

12. A heater coil connected to a $240\ \text{V}_{\text{rms}}$ ac line has a resistance of $44\ \Omega$. (a) What is the average power used? (b) What are the maximum and minimum values of the instantaneous power?