

We strongly recommend that you read about a topic before it is covered in lectures.

| Lecture Date | Topics Covered | Reading from Giancoli |
|--------------|--|--|
| #9 Mon 2/25 | Currents - Resistivity - Ohm's Law | Chapter 25 through Sect. 25-4 |
| #10 Wed 2/27 | Batteries - EMF - Energy Conservation - Power Kirchhoff's Rules - Circuits <i>Kelvin Water Dropper</i> | Sect. 25-5 through 25-8 Chapter 26 through Sect. 26-3 <i>(take notes in lecture)</i> |
| #11 Fri 3/1 | Magnetic field - Lorentz force - Torques Electric Motors (DC) Cathode Ray Tube, Oscilloscope | Chapter 27 through Sect. 27-7 Sect. 23-9 |

Due before 4 PM Friday, March 1 in 4-339B.

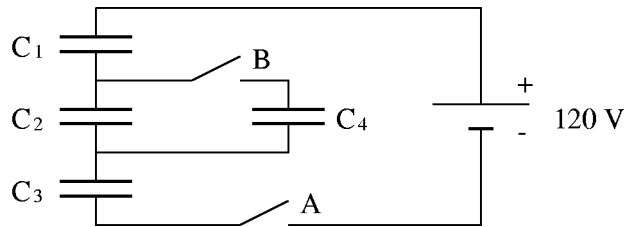
Problem 3.1

Capacitors in series and parallel.
Giancoli 24-23.

Problem 3.2

Switching Capacitors.

In the diagram below, the four capacitors have the same capacitance; the battery provides 120 V.



Consider two cases, starting in both cases with uncharged capacitors.

Case I.

- (a) While switch B is kept open, switch A is closed and then opened after C_1 , C_2 , and C_3 are fully charged. What is now the electric potential difference across each capacitor?
- (b) Subsequently switch B is closed. What is now the electric potential difference across each capacitor?

Case II.

- (c) Switch A is open. Switch B is first closed. What is now the electric potential difference across each capacitor?
- (d) Subsequently switch A is closed. What now is the potential difference across each capacitor?

Problem 3.3.

The effect of a dielectric medium on the capacitance.
Giancoli 24-60.

Problem 3.4*Comparing cylindrical and spherical capacitors.*

- (a) Compare the capacitance of a capacitor of 2 concentric spheres with $R_1 = 6$ cm and $R_2 = 9$ cm, with that of a cylindrical capacitor having the same radii and axial length of 15 cm. Why are the capacitance values nearly equal?
- (b) Show that, when R_1 and R_2 are nearly equal ($R_2 = R_1 + \delta$; $\delta \ll R_1$) the formulas for the spherical and cylindrical capacitors may be approximated by the formula for the parallel-plate capacitor, $C = \epsilon_0 A/d$ (eq. 24-2). *Hint: make use of Taylor's expansion in terms of δ/R_1 .*

Problem 3.5*The Van de Graaff*

The spherical dome of a Van de Graaff electrostatic generator has a radius of R m. A rubberized belt 50 cm wide travels at a velocity of 30 m/sec. The belt is given a surface charge density which produces a field of approximately 10^6 V/m on each side of the belt. (see Figure 23-37 on page 612).

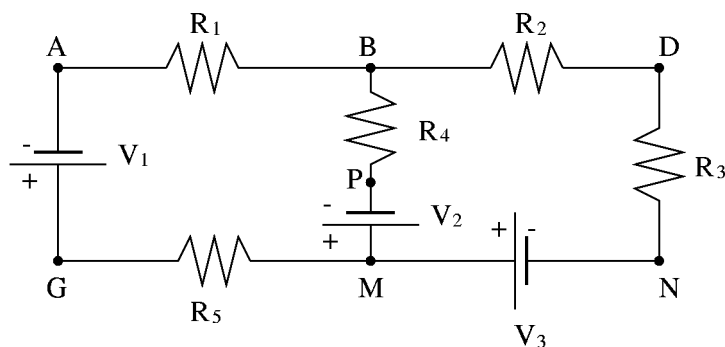
- (a) What is the current carried by the belt?
- (b) What is the maximum charge that the spherical dome can hold, and how long will it take to reach this value?
- (c) What is the maximum electrostatic potential of the spherical dome?
- (d) What are your answers under (b) and (c) for $R = 0.15$ and $R = 0.5$ m?

Problem 3.6*Resistor Circuit.*

Giancoli 26-25

Problem 3.7*Resistor Network.*

A circuit consists of 5 resistors and 3 batteries (see diagram); the connecting wires have all a negligible resistance. The values for R_1 , R_2 , R_3 , R_4 , and R_5 are $10\ \Omega$, $30\ \Omega$, $50\ \Omega$, $70\ \Omega$, and $100\ \Omega$, respectively. The batteries have a negligible internal resistance; their voltages V_1 , V_2 , and V_3 , are 12 V, 24 V, and 36 V, respectively (for their polarities, see the diagram).



- (a) Calculate the current (magnitude and direction) of the currents through each of the 5 resistors.
- (b) What is the potential difference (observe signs!) between the points A&P, P&N, and G&D.

Problem 3.8*Wire resistance.*

Giancoli 25-52.

Problem 3.9

Energy consumption of heater.

Giancoli 25-61.

Problem 3.10

Electric car.

Giancoli 25-72.

Recitations.

There are 28 recitation sections (see the 8.02 Website). If *for any reason* you want to change section, please see Maria Springer in 4-352.