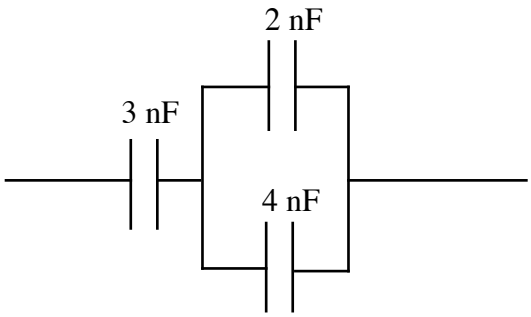
Physics 132
General Physics II
Grinnell College

Homework V-VI

Session V.2

1. What is the effective capacitance of the following network of capacitors?



2. For problem 1, imagine that the full network is connected to a 5 V battery.

a. Use the equivalent capacitance from problem 5 to find the total charge supplied by the battery.

b. Use charge conservation and $C = Q/\Delta V$ to find the charge on each of the capacitors (that is, the charge on the positive plate of each capacitor.

Session V.3

3. Just as batteries have internal resistances (effectively a resistance in series), so do capacitors--it is just as if the leads to the capacitor are really resistors rather than good conductors. This is particularly true of our green 0.47 F capacitors. You also may have noticed that to discharge them even with a wire, one has to hold the wire in contact with the capacitor for a few seconds. Explain how these effects are related. Then estimate the internal resistance to within a factor of two or three.

4. A 0.005 F capacitor is charge to 8 V. It is then discharged through a 10,000 Ω resistor. How long does it take for the voltage to drop to 2 V?

Session VI.1

5. A 1.5 volt battery is connected in series with a 100 Ω resistor. How much total charge in Coulombs passes through that resistor in one minute?

6. A 0.5 F capacitor is charged to 2 V over 20 seconds. What is the average electrical current flowing?

7. A capacitor of capacitance .04 F is charged by a 1.5 V battery through a resistor R = 200 Ω.

a) Estimate the average charging current as $\Delta V/R$. Is this reasonable?

b) How long does it take to charge the capacitor, assuming this current does not change (in reality it does)?

c) Use this method with an arbitrary R, C, and ΔV. Can you get an expression for the charging time in terms of R, C, and ΔV?

8. Does the charge stored on a capacitor tend to hold the two plates together, or to push them apart? In the process, explain the statement "While we say that a capacitor stores charge, in fact the net charge on the capacitor at all times is actually zero."