Name:

Physics 1320-(4,5,6) – Due March 14, 2024 – HW7 (Written)

Capacitors and Resistors

Instructions:

The TA's did problems 31, 36, and 53 in recitation. You should answer all of these (including those done by the TA)

All answers should be decimal numbers using scientific notation to three significant figures. SI units must be included on all answers.

RECITATION PROBLEM I:
Take 3 capacitors of different values and arrange them in three different ways.
IA: Arrange the capacitors for the largest possible capacitance value.
Draw a circuit diagram (label the component values), calculate what the value should be and also measure what it turned out to be. Your calculations should be within a couple percent of your measurements. Write them all down.
IB: Arrange for the smallest possible value. Draw a diagram. Calculate, measure, and report the values.
IC: Arrange the capacitors some other way ... then do thing.

RECITATION PROBLEM II:
Take 4 identical resistors.
Draw circuit diagrams of all the ways you can arrange them. (You don't need to label them because they are all the same.) Calculate the resistance and measure it.

19. What charge is stored in a $180.0\mu F$ capacitor when 120.0 V is applied to it?

21. Calculate the voltage applied to a $2.00\mu F$ capacitor when it holds $3.10\mu C$ of charge.

23. What capacitance is needed to store $3.00\mu C$ of charge at a voltage of 120 V?

25. The plates of an air gap parallel-plate capacitor of capacitance 5.0 pF are 2.0 mm apart. What is the area of each plate?

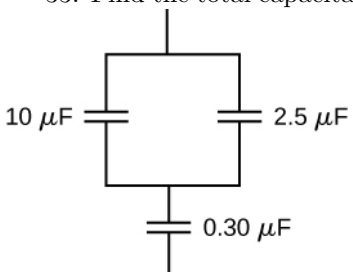
26. A 60.0-pF vacuum capacitor has a plate area of $0.010m^2$ What is the separation of the plates?

28. Consider Earth to be a spherical conductor of radius 6400 km and calculate its capacitance. (HINT: Use Q = CV and put a charge on earth and calculate it's voltage with respect to inf. The "other plate" is at infinity.

31. A 4.00-pF is connected in series with an 8.00-pF capacitor and a 400-V potential difference is applied across the pair. (a) What is the charge on each capacitor? (b) What is the voltage across each capacitor?

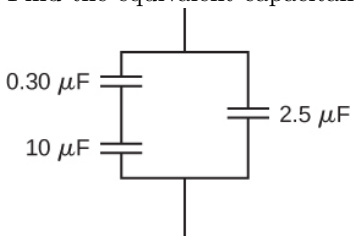
32. Three capacitors, with capacitances of $C_1 = 2.0\mu F, C_2 = 3.0\mu F, C_3 = 6.0\mu F$ are connected in parallel. A 500-V potential difference is applied across the combination. Determine the voltage across each capacitor and the charge on each capacitor.

33. Find the total capacitance of this combination of series and parallel capacitors shown below.



35. What effective capacitances can you make by combining a $5.00\mu F$ and a $8.00\mu F$ capacitor?

36. Find the equivalent capacitance of the combination of series and parallel capacitors shown below.



40. How much energy is stored in an $8.00\mu F$ capacitor whose plates are at a potential difference of 6.00 V?

41. A capacitor has a charge of $2.5\mu C$ when connected to a 6.0-V battery. How much energy is stored in this capacitor?

51. An air-filled capacitor is made from two flat parallel plates 1.0 mm apart. The inside area of each plate is $8.0cm^2$. (a) What is the capacitance of this set of plates? (b) If the region between the plates is filled with a material whose dielectric constant is 6.0, what is the new capacitance?

53. A parallel-plate capacitor has charge of magnitude $9.00\mu C$ on each plate and capacitance $3.00\mu F$ when there is air between the plates. The plates are separated by 2.00 mm. With the charge on the plates kept constant, a dielectric with $\kappa = 5$ is inserted between the plates, completely filling the volume between the plates. (a) What is the potential difference between the plates of the capacitor, before and after the dielectric has been inserted? (b) What is the electrical field at the point midway between the plates before and after the dielectric is inserted?