Name:

Physics 1320-(4,5,6) – Due March 11, 2024 – HW5 (Written)

Instructions:

The TA's did problems 19, 25, 40, 36, and 52 in recitation. You were responsible for the rest of these.

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

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 $3.00\mu F$ of at a voltage of 120 V?

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

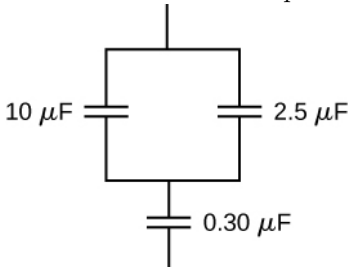
26. A 60.0-pF vacuum capacitor has a plate area of $0.010m^2$ What is the separation of the plates?

28. Consider Earth to be a spherical conductor of radius 6400 km and calculate its capacitance.

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?

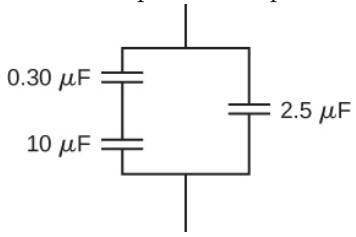
32. Three capacitors, with capacitances of $C_1 = 2.0\mu F, C_2 = 3.0\mu F, C_3 = 6.0\mu F$ are connected in parallel. A 500-V potential difference is applied across the combination. Determine the voltage across each capacitor and the charge on each capacitor.

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



35. What total capacitances can you make by 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?

52. A capacitor is made from two concentric spheres, one with radius 5.00 cm, the other with radius 8.00 cm. (a) What is the capacitance of this set of conductors? (b) If the region between the conductors is filled with a material whose dielectric constant is 6.00, what is the capacitance of the system?

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?

56. Two flat plates containing equal and opposite charges are separated by material 4.0 mm thick with a dielectric constant of 5.0. If the electrical field in the dielectric is 1.5 MV/m, what are (a) the charge density on the capacitor plates, and (b) the induced charge density on the surfaces of the dielectric?