Chapter 10
Capacitance

Calculating the Capacitance

Q1. A parallel-plate capacitor having square plates of side 10 cm separated by a distance of 1 mm. If the capacitor is charged to 12 V, what is the magnitude of the charge found on each plate?Ans:1.06 nano-C

Q2. A parallel-plate capacitor has a plate area of 0.2 m^2 and a plate separation of 0.1 mm. If the charge on each plate has a magnitude of 4.0×10^{-6} C the electric field between the plates is approximately Ans:2.3×10^{6} V/m.

Q3. A parallel-plate capacitor (with plates A and B) has circular shape of radius 6.0 cm separated by 2.0 mm. Find the total charges on both plates (A and B) when a 12 V battery is connected.Ans:zero

Capacitors in Parallel and in Series

Q4. How many 60 micro F capacitors would need to be connected in series in order to store a charge of 2.0×10^{-4} C with a potential of 100 volts across the capacitors, see Figure (3)?Ans: Ans:30.

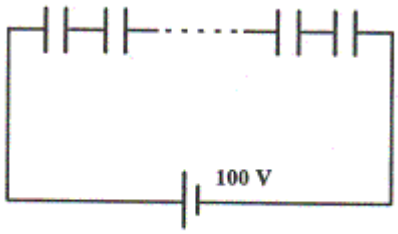

Figure # 3

Q5. If V_{ab} is equal to 50 V, find the charge stored and the potential difference across the 25 micro-F capacitor shown in Figure 5.Ans: 250 micro-C and 10 V

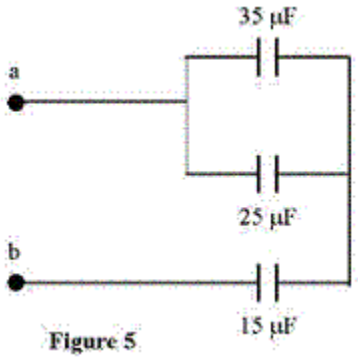

Figure 5

Q6. A 30 micro-F capacitor charged to 3.0 V and a 50 micro-F capacitor charged to 4.0 V are connected to each other, positive plate to positive plate and negative to negative. What is the charge on the 50 micro-F capacitor after the two are so connected and equilibrium is reached?Ans:181 micro-C

Q7. Fifty capacitors of equal capacitance are connected in parallel. The equivalent capacitance of the combination is 120 micro-F. What is the capacitance of each capacitor?Ans: 2.4 micro-F

Q8. An isolated capacitor, C_1 = 20.0 micro-F has a potential difference of 26.0 V. When an uncharged capacitor C_2, of unknown value, is connected across C_1, the potential difference becomes 16.0 V for both. What is the value of C_2?Ans: 12.5×10^{-6} F.

Q9. Figure 5 shows six capacitors each having a capacitance of 6-microFarad. The capacitance between points a and b is:Ans:4 micro-Farad

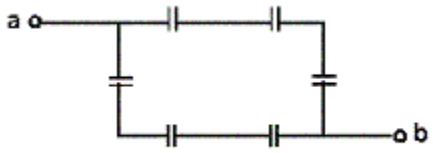

Figure 5

Energy Stored In an Electric Field

Q10. If C = 24 micro-F and V_{ab} is equal to 20 V, what is the total energy stored by the group of capacitors shown in Figure 4?Ans:3.2 mJ

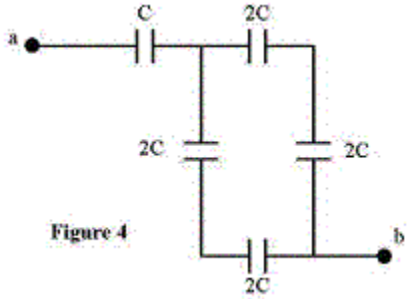

Figure 4

Q11. A 9.0-V battery is connected to three capacitors as shown in Figure 6. What is the energy stored in the 6 micro-F capacitor?Ans: 27 micro-J

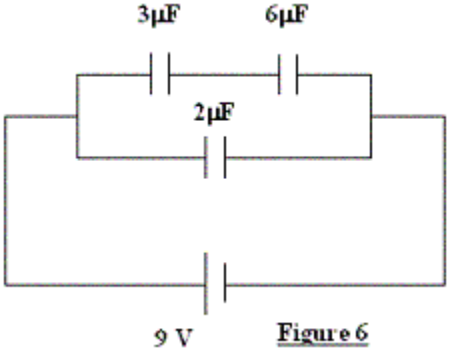

Figure 6

Q12. In Figure 5, if C_1= 40 micro-F, C_2= 30 micro-F, C_3= 36 micro-F,C_4= 52 micro-F, and V_0= 20 V, what is the energy stored in capacitor C_3?Ans: Ans:749 micro-J

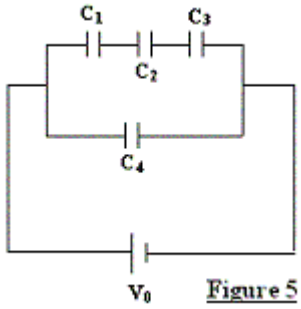

Figure 5

Q13. In figure 6: V = 100 V, C_1 = 10.0, C_2 = 5.00, C_3 = 4.00. All capacitor values are in micro-Farads. What is the energy stored in C_1?Ans: Ans:5.56 mJ

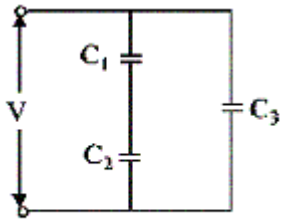

Figure 6

Q14. For the system of capacitors shown in figure 4, what is the total energy stored by the capacitors? Ans: 13.5 mJ

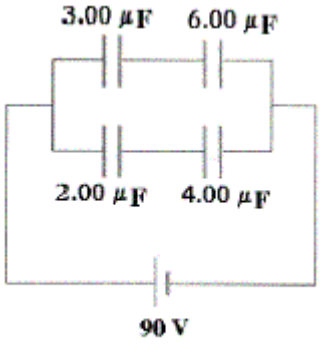

FIGURE 4

Capacitor with a Dielectric

Q15. A certain air filled parallel-plate capacitor is connected across a 20 V battery. When the battery is disconnected and a dielectric slab is inserted into and fills the region between the plates, the voltage across the plates drops by 12 V. What is the dielectric constant of the slab?Ans:2.5

Q16. A parallel-plate capacitor is to be constructed using paper as a dielectric. If the maximum voltage before breakdown is 3.2×10^3 V, what thickness of dielectric is needed? (The dielectric strength of paper is 16×10^6 V/m).Ans: 0.2 mm

Q17. A 72-V battery is connected across a 0.50 micro-F, air filled, parallel-plate capacitor. With the battery still connected, the space between the plates is filled with a dielectric, whereupon the charge on the capacitor is increased by 90 micro-C. What is the dielectric constant of the dielectric?Ans: 3.5

Q18. A 6-micro-F air filled capacitor is connected across a 100 V battery. After the capacitor is fully charged, it is immersed in transformer oil (dielectric constant of 4.5). How much additional charge flows from the battery if it remains connected during the immersion process? Ans: 2.1 mC

Q19. A parallel-plate capacitor, of capacitance 1.0×10^{-9} F, is charged by a battery to a potential difference of 12.0 volts. The charging battery is then disconnected and oil with dielectric constant = 4.0 fills the inside space between the plates. The resulting potential difference, in volts, between the plates is:Ans:3.