7.11: Capacitance (Answers)

Check Your Understanding

8.1. $1.1 \times 10^{-3} m$

8.3. 3.59 cm, 17.98 cm

8.4. a. 25.0 pF;

b. 9.2

8.5. a. $C = 0.86pF, Q_1 = 10pC, Q_2 = 3.4pC, Q_3 = 6.8pC$;

b. $C = 2.3pF, Q_1 = 12pC, Q_2 = Q_3 = 16pC$;

c. $C = 2.3pF, Q_1 = 9.0pC, Q_2 = 18pC, Q_3 = 12pC, Q_4 = 15pC$

8.6. a.$4.0 \times 10^{-13} J$; b. 9 times

8.7. a. 3.0; b. $C = 3.0C_0$

8.9. a. $C_0 = 20pF, C = 42pF$;

b. $Q_0 = 0.8nC, Q = 1.7nC$;

c. $V_0 = V = 40V$; d. $U_0 = 16nJ, U = 34nJ$

Conceptual Questions

1. no; yes

3. false

5. no

7. $3.0\mu F, 0.33\mu F$

9. answers may vary

11. Dielectric strength is a critical value of an electrical field above which an insulator starts to conduct; a dielectric constant is the ratio of the electrical field in vacuum to the net electrical field in a material.

13. Water is a good solvent.

15. When energy of thermal motion is large (high temperature), an electrical field must be large too in order to keep electric dipoles aligned with it.

17. answers may vary

Problems

19. 21.6 mC

21. 1.55 V

23. 25.0 nF

25. $1.1 \times 10^{-3} m^2$

27. 500 µC

29. 1:16

31. a. 1.07 nC;

b. 267 V, 133 V

33. $0.29\mu F$

34. 500 capacitors; connected in parallel

35. $3.08\mu F$ (series) and 13.0μ (parallel)

37. $11.4\mu F$

39. 0.89 mC; 1.78 mC; 444 V

41. $7.5\mu J$

43. a. 405 J; b. 90.0 mC

45. 1.15 J

47. a. $4.43 \times 10^{-9} F$;

b. 0.453 V;

c. $4.53 \times 10^{-10} J$;

d. no

49. 0.7 mJ

51. a. 7.1 pF;

b. 42 pF

53. a. before 3.00 V; after 0.600 V;

b. before 1500 V/m; after 300 V/m

55. a. 3.91;

b. 22.8 V

57. a. 37 nC;

b. 0.4 MV/m;

c. 19 nC

59. a. $4.4\mu F$;

b. $4.0 \times 10^{-5} C$

61. $0.0135 m^2$

63. $0.185\mu J$

Additional Problems

65. a. 0.277 nF;

b. 27.7 nC;

c. 50 kV/m

67. a. 0.065 F;

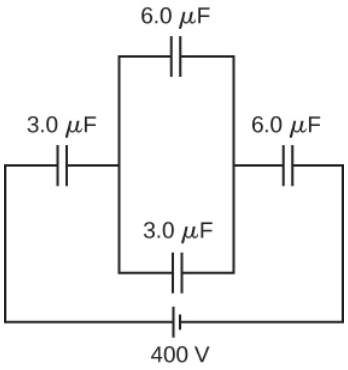
b. 23,000 C;

c. 4.0 GJ

69. a. $75.6\mu C$; b. 10.8 V

71. a. 0.13 J;

b. no, because of resistive heating in connecting wires that is always present, but the circuit schematic does not indicate resistors



73. a. $-3.00\mu F$;

b. You cannot have a negative C_2 capacitance.

c. The assumption that they were hooked up in parallel, rather than in series, is incorrect. A parallel connection always produces a greater capacitance, while here a smaller capacitance was assumed. This could only happen if the capacitors are connected in series.

75. a. 14.2 kV;

b. The voltage is unreasonably large, more than 100 times the breakdown voltage of nylon.

c. The assumed charge is unreasonably large and cannot be stored in a capacitor of these dimensions.

Challenge Problems

77. a. 89.6 pF;

b. 6.09 kV/m;

c. 4.47 kV/m;

d. no

79. a. 421 J;

b. 53.9 mF

81. $C = \varepsilon_0 A/(d_1 + d_2)$

83. proof

Contributors and Attributions

Samuel J. Ling (Truman State University), Jeff Sanny (Loyola Marymount University), and Bill Moebs with many contributing authors. This work is licensed by OpenStax University Physics under a Creative Commons Attribution License (by 4.0).