15. How does charge vary with potential difference applied to a capacitor? Sketch a graph of charge versus potential difference for a capacitor with charge on the vertical axis and potential difference on the horizontal.

16. For a group of series-connected capacitors, which capacitor will have the greatest effect determining the total capacitance—the one with the largest capacitance or the one with the smallest? Explain your answer from either a mathematical or an electrical viewpoint.

True or False (17–30)

17. Lines of force can actually cross each other where electrical fields are exceptionally strong.

18. Field lines point in the direction that a small, positively charged object would move in response to the electric field.

19. The electric field strength vector **E** is tangent to the field's lines of force and points toward the positive charge.

20. Every electric field line originates at a positive charge and terminates at a negative charge, even if the line is not visible beyond the edge of a diagram.

21. Electrical potential is measured with reference to an infinite position from a charge.

22. Field strength is the rate of change of electrical potential with distance in an electric field.

23. The sharper the curvature of an equipotential surface, the more concentrated the lines of force.

24. The thicker the lead coating in a Leyden jar, the greater the amount of charge that could be stored, assuming all other dimensions and materials were held the same.

25. Within limits, the greater the potential difference supplied to a capacitor, the greater the amount of charge that can be stored.

26. A large dielectric constant implies that more charge can be stored for a given potential difference between the plates.

27. The capacitance of a vacuum dielectric capacitor is greater than for a capacitor of the same dimensions having a glass dielectric.

28. Doubling the plate area of a capacitor doubles its capacitance.

29. Capacitance in SI base units is C^2/J.

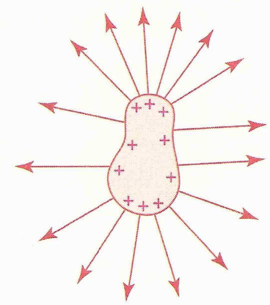
30. Doubling the number of identical capacitors connected in series doubles the amount of charge that can be stored by the entire circuit.

31. A large charged object exerts a force of 10^{-3} N on a 1 μC charge. What is the electrical field strength at the small charge's position?

32. A 3.00 μC charge has an electrical potential energy of 9.00×10^{-5} J. What is the electrical potential of its position?

33. A tiny spherical object with a charge of +1.00 mC rests far from all other charges.
    a. What is the electrical potential 0.0100 m from the object?
    b. What is the electrical potential 1.100 m from the object?
    c. What is the potential difference between these two positions?

34. Draw an equipotential line for the electric field in the figure below.



35. A parallel-plate, vacuum-dielectric capacitor has a plate area of 3.00×10^{-4} m^2 and has a distance of 3.00×10^{-2} m between the plates. What is the capacitance?

36. A round capacitor with a radius of 1.50×10^{-2} m has a vacuum dielectric. The distance between the parallel plates can be manually varied. The maximum distance apart is 1.00×10^{-2} m and the closest the plates can be is 5.00×10^{-4} m.
    a. What is the area of each plate?
    b. What is the capacitance at maximum plate separation?
    c. What is the capacitance at minimum plate separation?
    d. When the charge on the capacitor is 2.00×10^{-11} C, what is the potential difference across the capacitor at maximum separation?
    e. When the charge on the capacitor is 2.00×10^{-11} C, what is the potential difference across the capacitor at minimum separation?

37. A capacitor with square plates 5.00 cm on each side and a Pyrex glass dielectric has a separation distance of 5.00×10^{-3} m. What is its capacitance?

38. When a capacitor has a charge of 6.00×10^{-11} C, the potential difference between its plates is 20.0 V. What is its capacitance?

39. Two capacitors, one with $C_1 = 2.00$ μF and one with $C_2 = 3.00$ μF, are connected in parallel. What is the equivalent capacitance of the arrangement?

40. Suppose you have a box full of 1.50 pF capacitors and you need a capacitance of 1.00 pF. How could you connect capacitors to get the desired capacitance? (*Hint*: Try various combinations of series and parallel capacitors.)

41. Two 6.00 μF capacitors are arranged in series. What is the arrangement's capacitance?

42. You have three capacitors: two 4.00 pF and one 2.00 pF.
    a. What is the capacitance if you connect them in parallel?
    b. What is the capacitance if you connect them in series?
    c. What is the capacitance if you connect the two 4.00 pF capacitors in series?
    d. What is the total capacitance if you connect the series arrangement of the 4.00 pF capacitors in parallel with the 2.00 pF capacitor? (*Hint*: treat the two 4.00 pF capacitors as a unit.)