16 REVIEW

17. 91 N (repulsive)

18. 1.00×10^{-7} N, 12° below the positive x-axis

19. 1.48×10^{-7} N, along the $+x$ direction

20. $y = 0.8$ m

21. 18 cm from the 3.5 nC charge

22. See the definition in Section 3 of this chapter.

23. $E = \frac{F_{electric}}{q_0} = \frac{k_C q q_0}{r^2 q_0} = \frac{k_C q}{r^2}$

24. Answers should agree with the discussion in Section 3 of this chapter.

25. Lines should originate from the $+q$ charge and end on the $-3q$ charge, and the ratio of lines from $+q$ to lines ending on $-3q$ should be $\frac{1}{3}$.

26. magnitude of the charge; sign of the charge

27. **a.** where curvature is greatest; where curvature is least
b. where curvature is greatest

28. No, they are a tool used to visualize and analyze the electric field.

29. so the test charge does not significantly affect the charges responsible for the field

30. because at any point in space, **E** points in a single direction

31. Electric forces are equal and opposite; The proton's acceleration is less because it has a greater mass ($F = ma$).

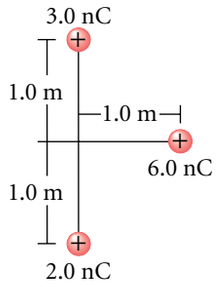
32. 12.0×10^3 N/C, toward the 30.0×10^{-9} C charge

33. 5.7×10^3 N/C, 75° above the positive x-axis

17. An alpha particle (charge = $+2.0e$) is sent at high speed toward a gold nucleus (charge = $+79e$). What is the electric force acting on the alpha particle when the alpha particle is 2.0×10^{-14} m from the gold nucleus?

For problems 18–19, see Sample Problem B.

18. Three positive point charges of 3.0 nC, 6.0 nC, and 2.0 nC, respectively, are arranged in a triangular pattern, as shown at right. Find the magnitude and direction of the electric force acting on the 6.0 nC charge.



19. Two positive point charges, each of which has a charge of 2.5×10^{-9} C, are located at $y = +0.50$ m and $y = -0.50$ m. Find the magnitude and direction of the resultant electric force acting on a charge of 3.0×10^{-9} C located at $x = 0.70$ m.

For problems 20–21, see Sample Problem C.

20. Three point charges lie in a straight line along the y-axis. A charge of $q_1 = -9.0$ μC is at $y = 6.0$ m, and a charge of $q_2 = -8.0$ μC is at $y = -4.0$ m. The net electric force on the third point charge is zero. Where is this charge located?

21. A charge of +3.5 nC and a charge of +5.0 nC are separated by 40.0 cm. Find the equilibrium position for a −6.0 nC charge.

THE ELECTRIC FIELD

Review Questions

22. What is an electric field?

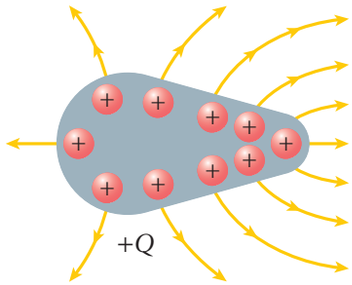
23. Show that the definition of electric field strength ($E = F_{electric}/q_0$) is equivalent to the equation $E = k_C q/r^2$ for point charges.

24. As you increase the potential on an irregularly shaped conductor, a bluish purple glow called a *corona* forms around a sharp end sooner than around a smoother end. Explain why.

25. Draw some representative electric field lines for two charges of $+q$ and $-3q$ separated by a small distance.

26. When electric field lines are being drawn, what determines the number of lines originating from a charge? What determines whether the lines originate from or terminate on a charge?

27. Consider the electric field lines in the figure below.
a. Where is charge density the highest? Where is it the lowest?
b. If an opposite charge were brought into the vicinity, where would charge on the pear-shaped object "leak off" most readily?



28. Do electric field lines actually exist?

Conceptual Questions

29. When defining the electric field, why must the magnitude of the test charge be very small?

30. Why can't two field lines from the same field cross one another?

31. A "free" electron and "free" proton are placed in an identical electric field. Compare the electric force on each particle. How do their accelerations compare?

Practice Problems

For problems 32–33, see Sample Problem D.

32. Find the electric field at a point midway between two charges of $+30.0 \times 10^{-9}$ C and $+60.0 \times 10^{-9}$ C separated by a distance of 30.0 cm.

33. A +5.7 μC point charge is on the x-axis at $x = -3.0$ m, and a +2.0 μC point charge is on the x-axis at $x = +1.0$ m. Determine the net electric field (magnitude and direction) on the y-axis at $y = +2.0$ m.