27. The tree is likely to be hit because it provides a path of less resistance between the cloud overhead and the ground. The tree and the ground near it are then raised to a high potential relative to the ground farther away. If you stand with your legs far apart, one leg on a higher-potential part of the ground than the other, or if you lie down with a significant potential difference between your head and your feet, you may find yourself a conducting path. That, you want to avoid!

31. An ion polarizes a nearby neutral atom, so that the part of the atom nearer to the ion acquires a charge opposite to the charge of the ion, and the part of the atom farther from the ion acquires a charge of the same sign as the ion. The side of the atom closer to the ion is then attracted more strongly to the ion than the farther side is repelled, making for a net attraction. (By Newton's third law, the ion, in turn, is attracted to the atom.)

33. The forces on the electron and proton will be equal in magnitude, but opposite in direction. Because of the greater mass of the proton, its acceleration will be less than that of the electron, and be in the direction of the electric field. How much less? Since the mass of the proton is nearly 2000 times that of the electron, its acceleration will be about 1/2000 that of the electron. The greater acceleration of the electron will be in the direction opposite to the electric field. The electron and proton accelerate in opposite directions.

34. The electron will have the greater speed on impact. The force on both will be the same, but the electron experiences more acceleration and therefore gains more speed because of its smaller mass.

37. Charge will be more concentrated on the corners. See Figure 22.21.

38. 10 joules per coulomb is 10 volts. When released, its 10 joules of potential energy will become 10 joules of kinetic energy as it passes its starting point.

40. Voltage \( = \frac{0.5 \ J}{0.0001 \ C} = 5000 \ V. \)

Chapter 22 Problem Solutions

7. Energy is charge x potential: \( PE = qV = (2 \ C)(100 \times 10^6 \ V) = 2 \times 10^8 \ J. \)

8. Potential is defined as energy per unit charge, so \( V = PE/q = (0.1 \ J)/(1.0 \times 10^{-6} \ C) = 1 \times 10^5 \ V, \) or 100,000 V.

9. a. From \( E = \frac{F}{q} \) we see that \( q = \frac{F}{E} = \frac{mg}{E} = \frac{(1.1 \times 10^{-14})(9.8)}{1.68 \times 10^5} = 6.4 \times 10^{-19} \ C. \)

b. Number of electrons = \( \frac{6.4 \times 10^{-19} C}{1.6 \times 10^{-19} C/\text{electron}} = 4 \text{ electrons.} \)

10. a. \( \Delta V = \frac{12 \ J}{0.0001 \ C} = 120,000 \ \text{volts.} \)

b. \( \Delta V \) for twice the charge is \( \frac{24 \ J}{0.0002} = \text{same 120 kV.} \)