Chapter 21 Solutions

Q4. Clothing clings together because of static electricity, produced by rubbing together dissimilar materials. Some clothes will acquire a negative charge and some positive… you should expect less clinging if all clothes are of the same fabric.

Q6. Electrical forces are very strong… only a slight excess of electrons at the bottom of a piece of metal will repel the others, keeping "suspended" in the presence of gravity.

Q13. If you touch the sphere you will transfer some of the excess negative charge (electrons.) If you put a wire between the sphere and the ground, and then put your negatively charged object close to the sphere, you will charge by induction, the sphere will become positive. Disconnect the ground wire before moving your object away!

Q15. Forces are equal and opposite, and masses are the same, so acceleration is the same.

Q22. Let's speak precisely: the electric field E_1 is the field *that would be at P in the presence of q_1 alone.* The electric field E_2 is the field *that would be at P in the presence of q_2 alone.* Neither of these vectors is the electric field at P in the situation shown, with both charges. That field is the sum of these two vectors.

Furthmore, it is meaningless (and wrong) to say "two E field vectors cannot cross." What cannot cross are field lines, and field lines are drawn tangent to the total field.

21.58 next page.

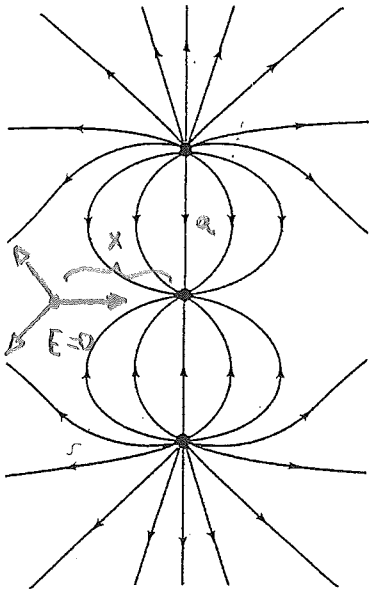
21.59. In general Field lines are NOT charged particle trajectories. F = ma, not mv, so the field line tells you the direction of acceleration, not the direction of motion. But in Figure 21.29a, the particle simply moves away from the source charge, so it will (if it starts from rest) follow a field line. In 21.29b, it will NOT.

21.62. Top & bottom charges +, middle charge -. Field lines diverge from + charges, converge at – charges. (Note that Y&F did a poor job of drawing lines! There are more lines diverging from the + charges than converging at the – charge, yet they are the same magnitude.)

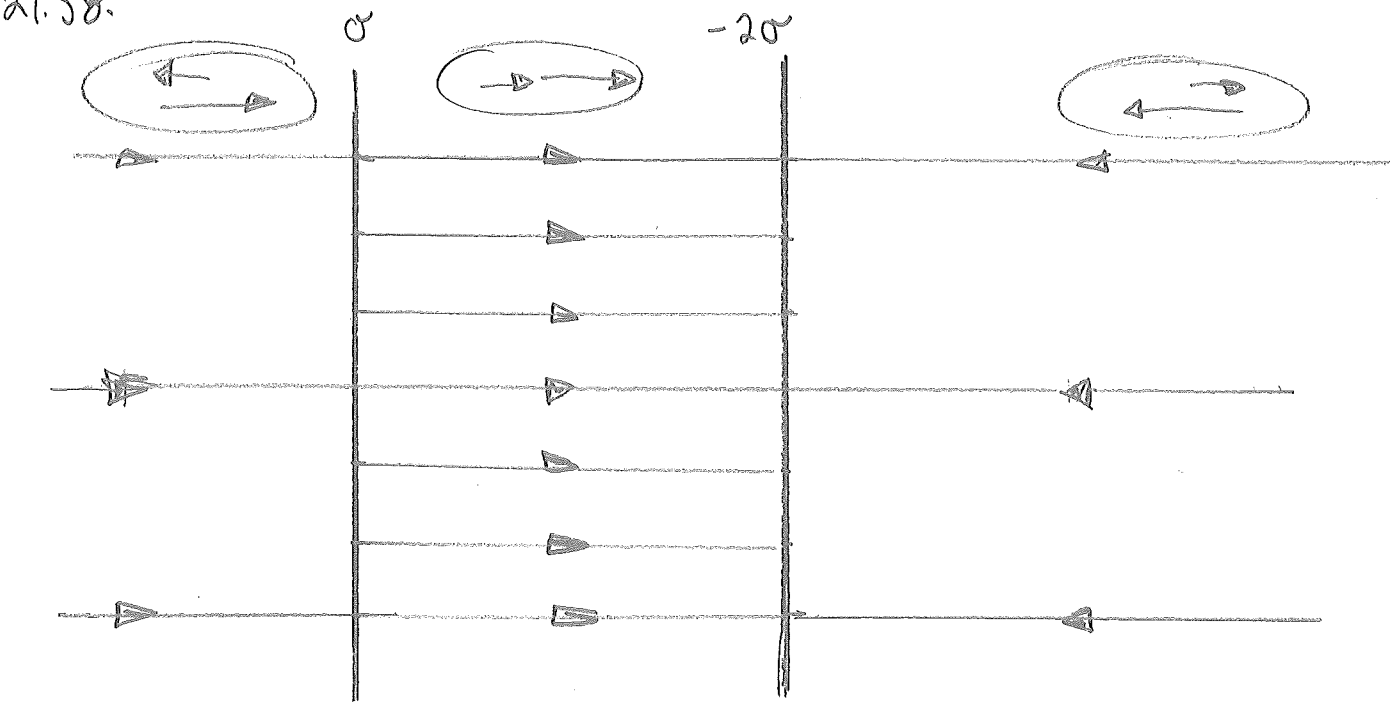
You can find exact spot x by setting $E_x = 0$

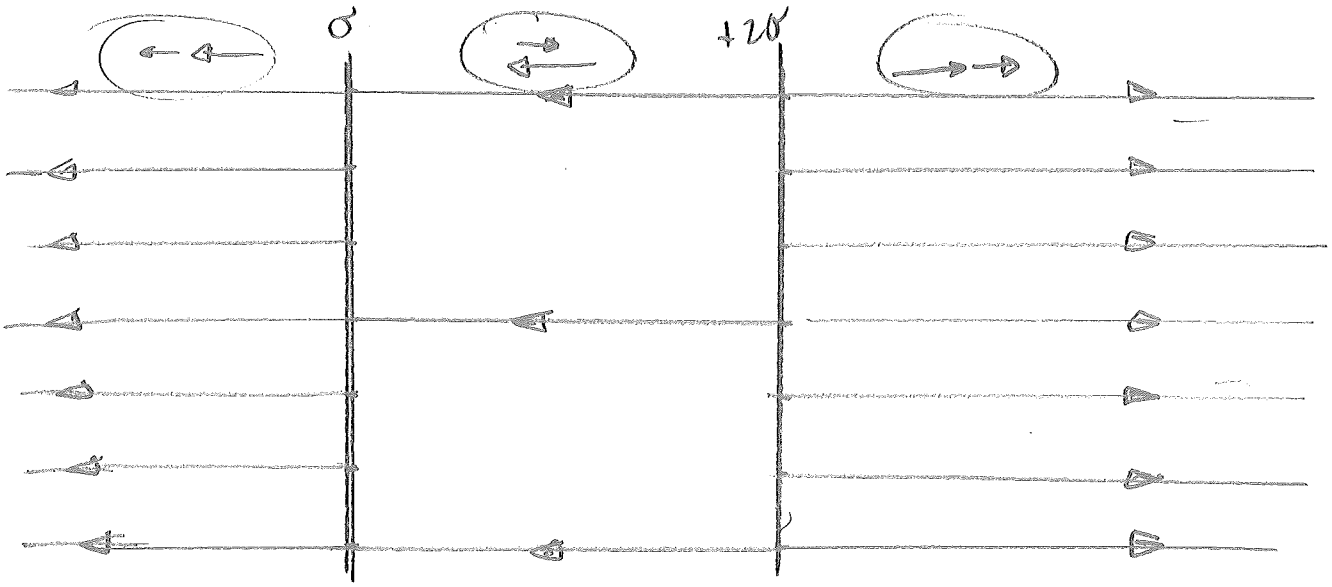
$$0 = \frac{-kq}{x^2} + \frac{2kq}{x^2+a^2}\cdot\frac{x}{(x^2+a^2)^{1/2}}$$

Exercise 21.62.



21.58.





Circled vectors show how I added fields.