Now, consider the positively charged conducting sphere in **Figure 8(a).** The field in the region surrounding the sphere could be explored by placing a positive test charge, q_0, in a variety of places near the sphere. To find the electric field at each point, you would first find the electric force on this charge, then divide this force by the magnitude of the test charge.

However, when the magnitude of the test charge is great enough to influence the charge on the conducting sphere, a difficulty with our definition arises. According to Coulomb's law, a strong test charge will cause a rearrangement of the charges on the sphere, as shown in **Figure 8(b).** As a result, the force exerted on the test charge is different from what the force would be if the movement of charge on the sphere had not taken place. Furthermore, the strength of the measured electric field is different from what it would be in the absence of the test charge. To eliminate this problem, we assume that the test charge is small enough to have a negligible effect on the location of the charges on the sphere, the situation shown in **Figure 8(a).**

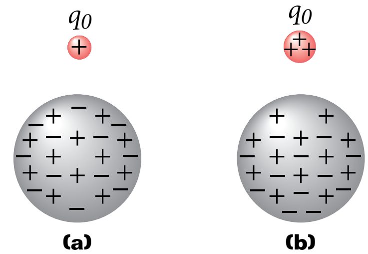

Figure 8
We must assume a small test charge, as in **(a),** because a larger test charge, as in **(b),** can cause a redistribution of the charge on the sphere, which changes the electric field strength.

Electric field strength depends on charge and distance

To reformulate our equation for electric field strength from a point charge, consider a small test charge, q_0, located a distance, r, from a charge, q. According to Coulomb's law, the magnitude of the force on the test charge is given by the following equation:

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

We can find the magnitude of the electric field due to the point charge q at the position of q_0 by substituting this value into our previous equation for electric field strength.

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

Notice that q_0 cancels, and we have a new equation for electric field strength due to a point charge.

ELECTRIC FIELD STRENGTH DUE TO A POINT CHARGE

$$E = k_C \frac{q}{r^2}$$

$$\text{electric field strength} = \text{Coulomb constant} \times \frac{\text{charge producing the field}}{(\text{distance})^2}$$

As stated above, electric field, **E,** is a vector. If q is positive, the field due to this charge is directed outward radially from q. If q is negative, the field is directed toward q. As with electric force, the electric field due to more than one charge is calculated by applying the principle of superposition. A strategy for solving superposition problems is given in Sample Problem D.

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