

O Level Physics

Tutorial 13: Static Electricity

Syllabus :

(a) state that there are positive and negative charges and that charge is measured in coulombs

1. State the unit for electric charge. State the two types of charges.

(b) state that unlike charges attract and like charges repel

2. State two charges attract or repel in each of the following cases :

- (i) positive and positive,
- (ii) positive and negative,
- (iii) negative and negative.

(c) describe an electric field as a region in which an electric charge experiences a force

3. State the definition of an electric field.

(d) draw the electric field of an isolated point charge and recall that the direction of the field lines gives the direction of the force acting on a positive test charge

3. (i) Draw the electric field of an isolated, positive point charge.

(ii) What does the direction of the a field line mean?

(e) draw the electric field pattern between two isolated point charges

4. Draw the electric field pattern between two isolated point charges for each of these cases:

- (i) two positive charges,
- (ii) one positive and one negative charge.

(f) show an understanding that electrostatic charging by rubbing involves a transfer of electrons

5. When we rub two different materials, there is often some transfer of electrons from one to the other. The following are some examples arranged in order of tendency to gain charges:

rabbit fur	← tends to gain positive charge
glass	
human hair	
wool	
aluminium	
paper	
cotton	
steel	
wood	
hard rubber	← tends to gain negative charge

If I rub a piece of paper on a glass, which one gains a positive charge?

If I use a wooden comb to comb my hair, which one gains a negative charge?

(g) describe experiments to show electrostatic charging by induction

6. A small aluminium ball hangs on a non-conducting string. A wooden rod with some negative charge is brought near the ball.

(i) What happens to the ball? Why?

(ii) Then I touch the ball. What happens to the overall charge in the ball now?

(h) describe examples where electrostatic charging may be a potential hazard

7. In dry countries, it is common to get a few small electric shock a day – when we open a door, comb our hair, touch a table, and so on. It often feels like a needle prick, which suggests sparking from accumulation of electric charge up to kilovolts. It is usually harmless because the amount of charge flow involved is tiny.

Give two examples where such electrostatic charging can become dangerous.

(i) describe the use of electrostatic charging in an electrostatic precipitator and apply the use of electrostatic charging to new situations.

8. According to Wikipedia :

“An electrostatic precipitator (ESP) is a filterless device that removes fine particles, such as dust and smoke, from a flowing gas using the force of an induced electrostatic charge minimally impeding the flow of gases through the unit.”

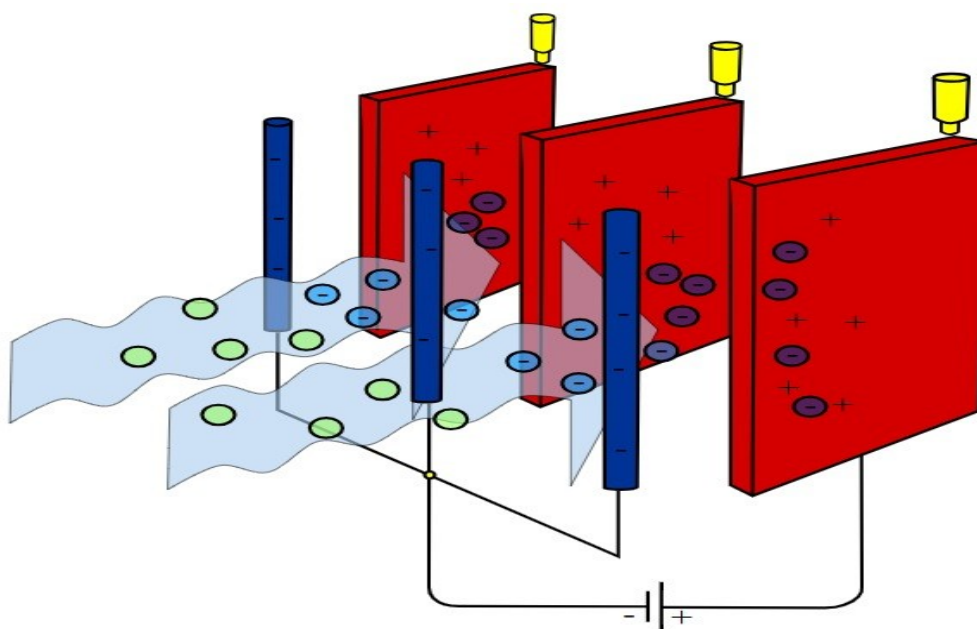


Figure 13-1 (from Wikipedia)

The above figure shows dust particles from the left. They flow past negatively charged rods and gained some negative charge. Then they pass close to the positively charged plates.

- (i) Use the understanding from question 6 to explain how induced charges on the smoke particles can cause it to be trapped.
- (ii) When a lot has been collected, suggest how they may be easily removed.