Chapter 17. Static electricity

Contents:

New word list:

Charge discharge electron proton neutron atom

4.2 Electrical quantities

4.2.1 Electric charge

Core

1 State that there are positive and negative charges

2 State that positive charges repel other positive charges, negative charges repel other negative charges, but positive charges attract negative charges

3 Describe simple experiments to show the production of electrostatic charges by friction and to show the detection of electrostatic charges

4 Explain that charging of solids by friction involves only a transfer of negative charge (electrons)

5 Describe an experiment to distinguish between electrical conductors and insulators

6 Recall and use a simple electron model to explain the difference between electrical conductors and insulators and give typical examples

Supplement

7 State that charge is measured in coulombs

8 Describe an electric field as a region in which an electric charge experiences a force

9 State that the direction of an electric field at a point is the direction of the force on a positive charge at that point

10 Describe simple electric field patterns, including the direction of the field:

(a) around a point charge

(b) around a charged conducting sphere

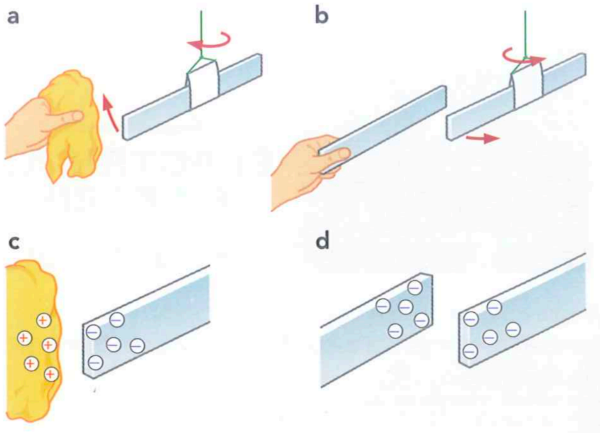
(c) between two oppositely charged parallel conducting plates (end effects will **not** be examined)

17.1 Charging and discharging

Can you think of any phenomenon that is related to electricity? What is static electricity?

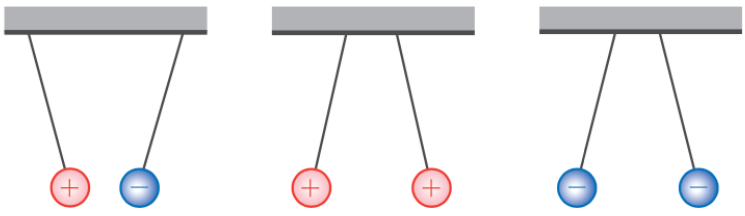
More specifically static electricity/electrostatics?

17.1.1. Charging by friction



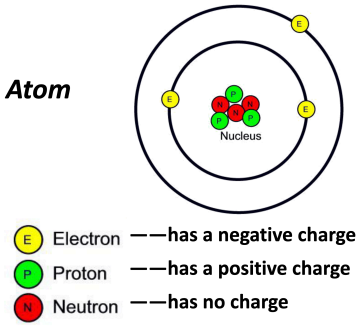
Two types of charge:

Positive & negative
Like charge repels;
Unlike charge attracts;



Explanation charging in terms of atoms:

Electrons *move from one object to another, causes imbalance of change*

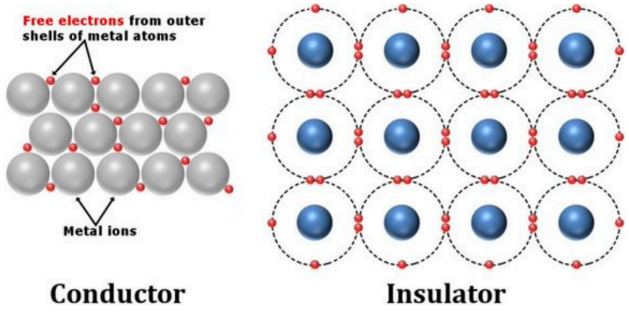


Exercise 17.1:

Explain why charge by friction needs two different material.

(Electrical) Conductors vs insulators

Conductors: a substance that allows flow of electrons
Insulators: a substance that inhibits flow of electrons



Exercise 17.2:

Explain why charge by friction only happens on insulators

Experiment: investigating conductors and insulators

EXPERIMENTAL SKILLS 17.2

Investigating conductors and insulators

In this experiment you will find test materials to find out which are conductors and which are insulators.

You will need:

- cell
- lamp
- wires with crocodile clips
- materials to test.

Getting started

Connect the cell and lamp in a simple circuit to make the lamp light.

Make a gap in the circuit by removing a wire. Explain why the lamp no longer lights and consider how placing materials in the gap will help you decide if they are conductors or insulators.

Method

1 Connect the circuit as shown in Figure 17.7.

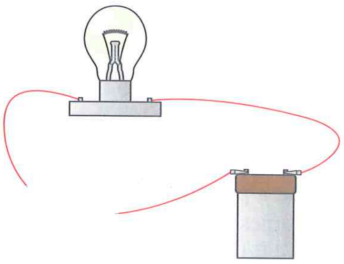


Figure 17.7: Circuit for testing materials.

2 Using the crocodile clips, attach a material into the gap in the circuit.

3 Observe whether the lamp lights. If it does, it is a conductor, if not it is an insulator.

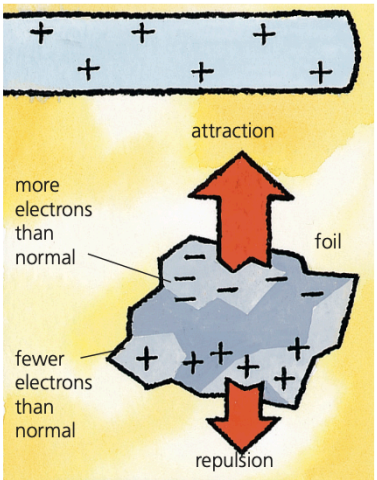
4 Record your results in a table.

Question

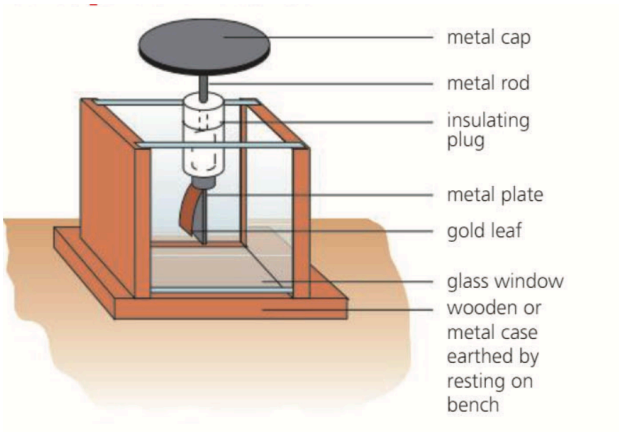
1 The wires you used are made of copper covered in plastic. Explain why these materials were chosen.

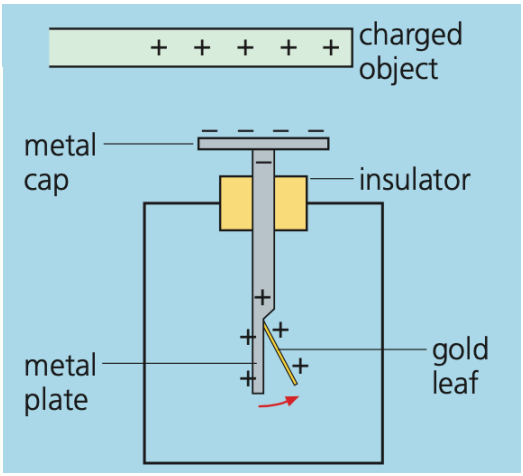
17.1.2. Charge by induction

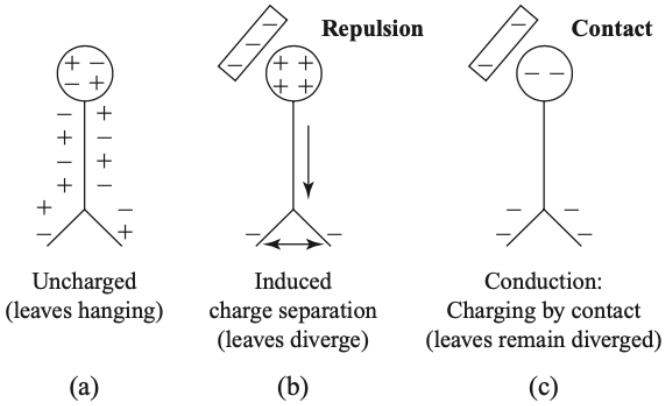
Why rubbed ruler can attract light objects?



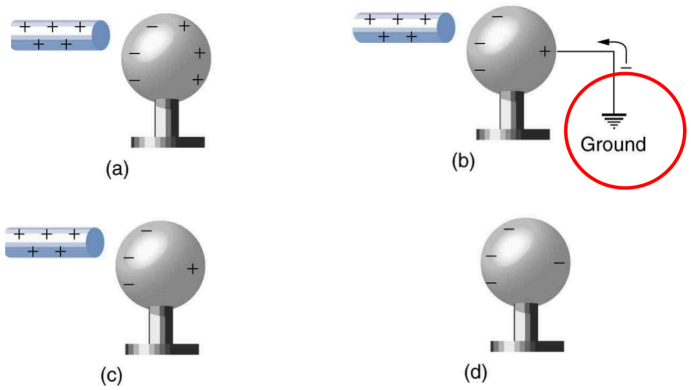
Electroscope:







Grounding/earthing: being connected to the ground by a conducting material so that the unwanted charge flows away.



Discharging:the release and transmission of electricity in an object

17.2 Electric field

17.2.1. Charged particles

Unit: coulomb, C
Electron charge:
Proton charge:

Particle	Charge (coulombs, C)	Mass (kg)	Relative Charge	Relative Mass
Proton	$+1.60 \times 10^{-19}$	1.67×10^{-27}	+1	1
Neutron	0	1.67×10^{-27}	0	1
Electron	-1.60×10^{-19}	9.11×10^{-31}	–1	0.0005

Exercise 17.3

Calculate the number of electrons needed to give a charge of one coulomb.

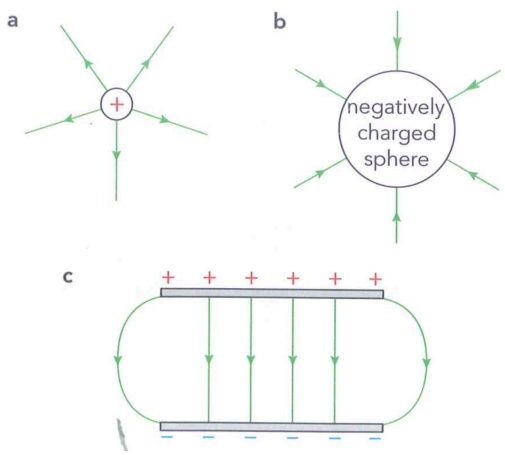
17.2.2. Electrical fields

Representing an electric field: electric **field lines**
Field lines coming out of a positive charge, going into a negative charge
Strength: how concentrated/far apart the lines represents how strong/weak electric field is
Direction: the direction of a field line is the direction of the force a positive charge will experience

Examples:
(a) around a point charge

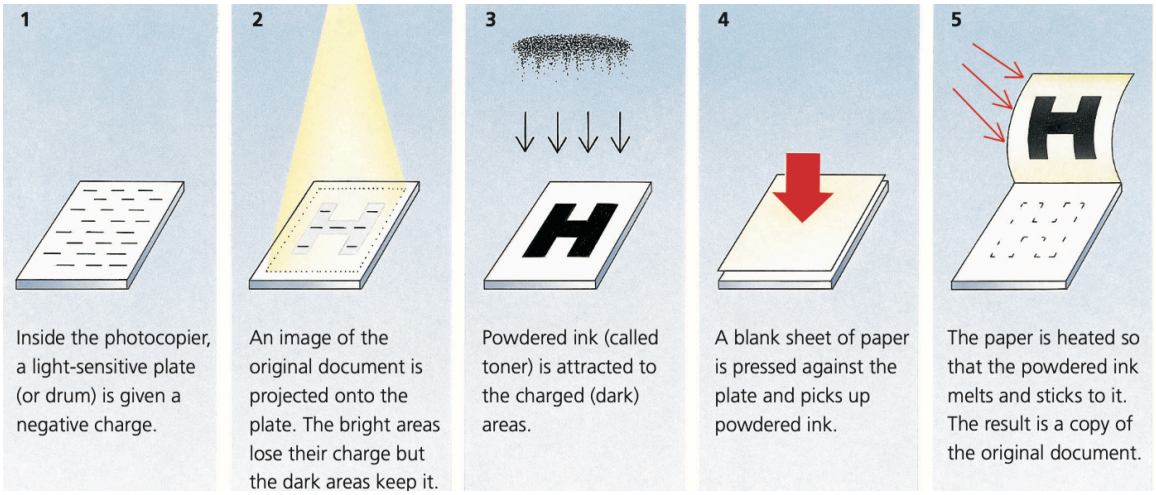
(b) around a charged conducting sphere

(c) between two oppositely charged parallel conducting plates (end effects will not be examined)

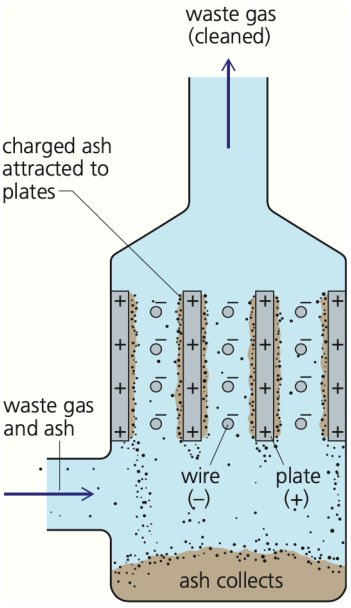


17.2.3. Applications of electrostatics

photocopier



Electrostatic precipitators



lightning conductor