

## Chapter 17. Static electricity

### Contents:

- 17.1 Charging and discharging
- 17.2 Electric field

### New word list:

#### 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

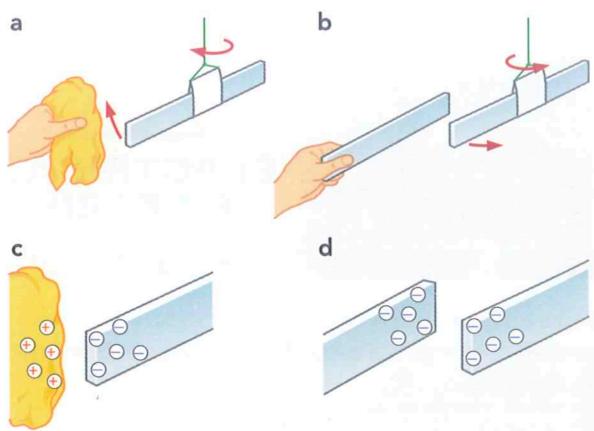
- 7 State that charge is measured in coulombs
- 8 Describe an electric field as a region in which an electric charge experiences a force
- 9 State that the direction of an electric field at a point is the direction of the force on a positive charge at that point
- 10 Describe simple electric field patterns, 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

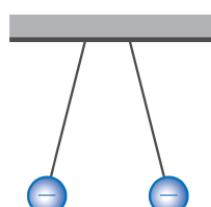
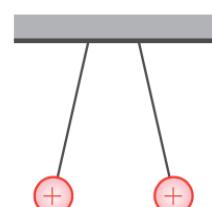
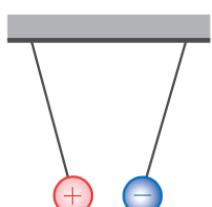
Can you think of any phenomenon that is related to electricity? What is static electricity?



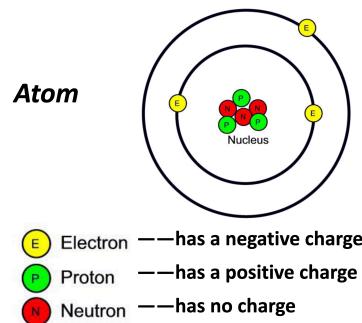
### 17.1.1. Charging by friction



Two types of charge:



### Explanation charging in terms of atoms:



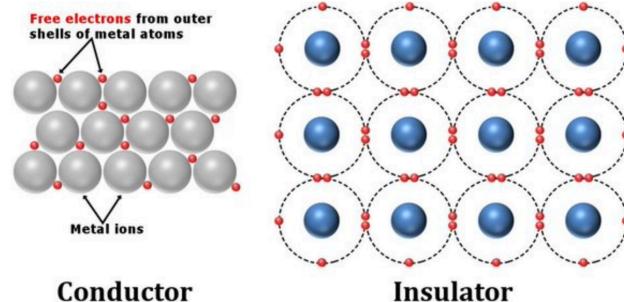
### Exercise 17.1:

Explain why charge by friction needs two different material.

### (Electrical) Conductors vs insulators

Conductors:

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.

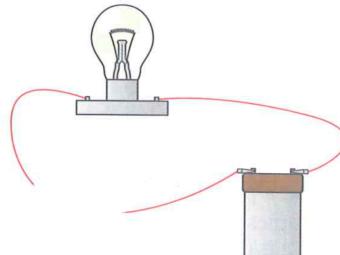


Figure 17.7: Circuit for testing materials.

##### 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.

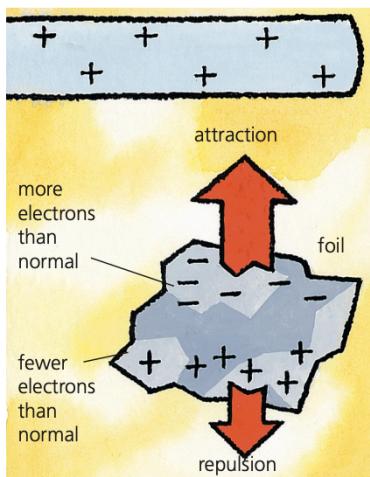
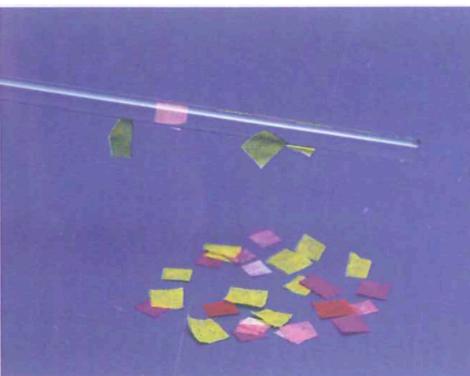
- 2 Using the crocodile clips, attach a material into the gap in the circuit.
- 3 Observe whether the lamp lights. If it does, it is a conductor, if not it is an insulator.
- 4 Record your results in a table.

##### Question

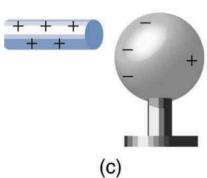
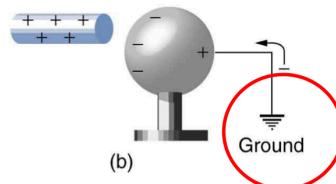
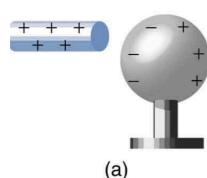
- 1 The wires you used are made of copper covered in plastic. Explain why these materials were chosen.

### 17.1.2. Charge by induction

Why rubbed ruler can attract light objects?



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



Discharging:

## 17.2 Electric field

### 17.2.1. Charged particles

Unit:

Electron charge:

Proton charge:

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

### Exercise 17.3

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

### 17.2.2. Electrical fields



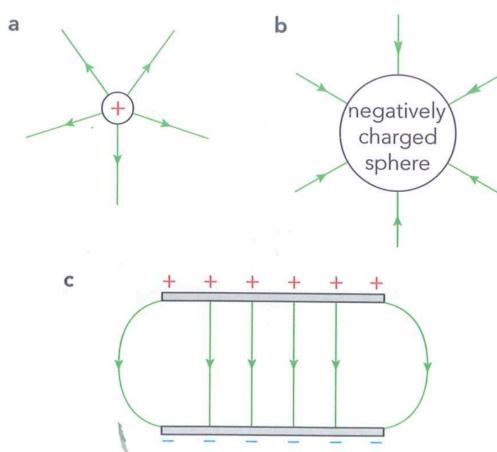
Representing an electric field: electric **field lines**

Strength:

Direction:

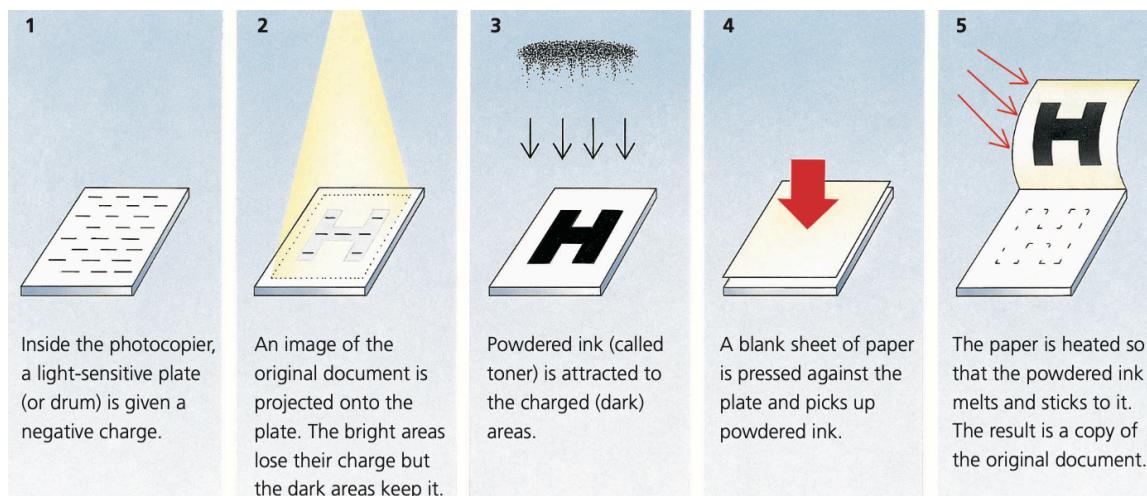
Electric field:

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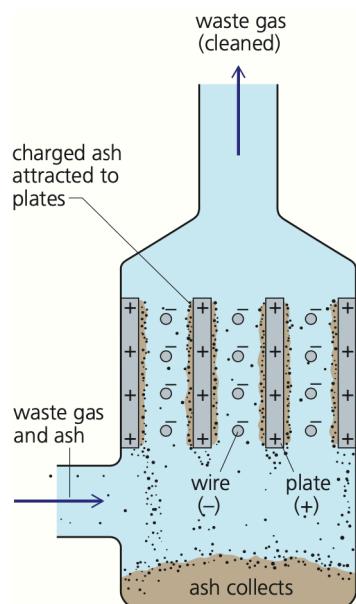


### 17.2.3. Applications of electrostatics

photocopier



Electrostatic precipitators



lightning conductor

