Chapter 17.
Static Electricity

New Words

Charge discharge electron proton neutron atom

Static electricity

Can you think of any phenomenon that is related to electricity? More specifically static electricity/electrostatics? What is static electricity?

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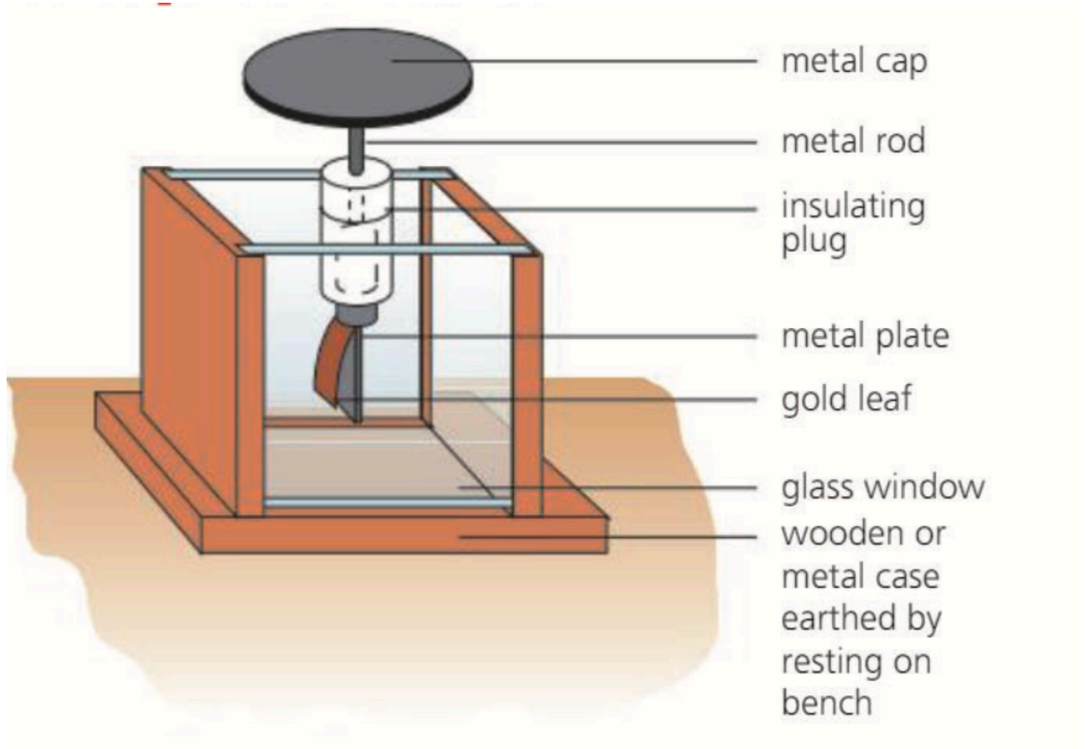
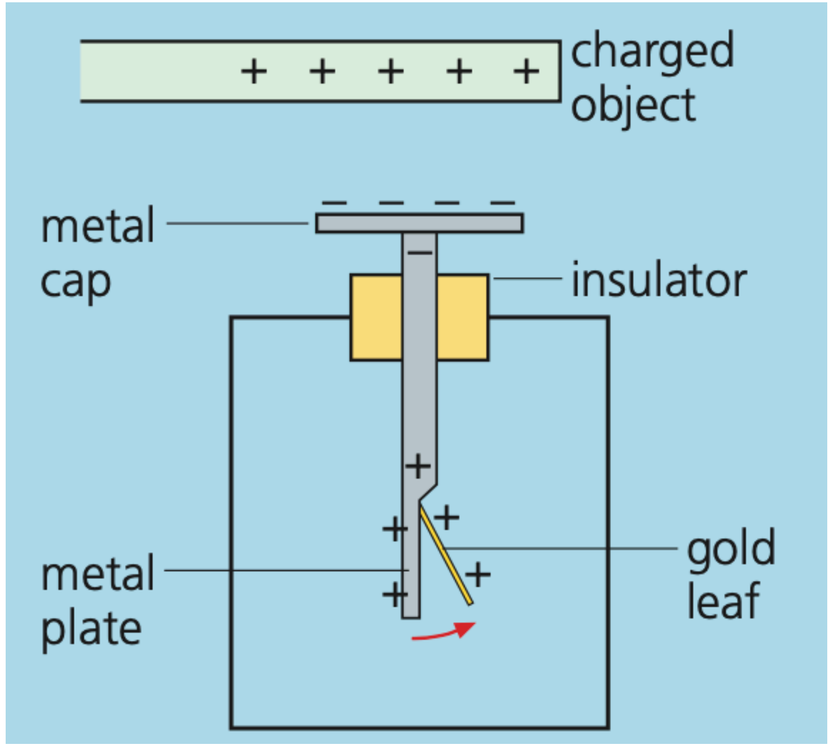
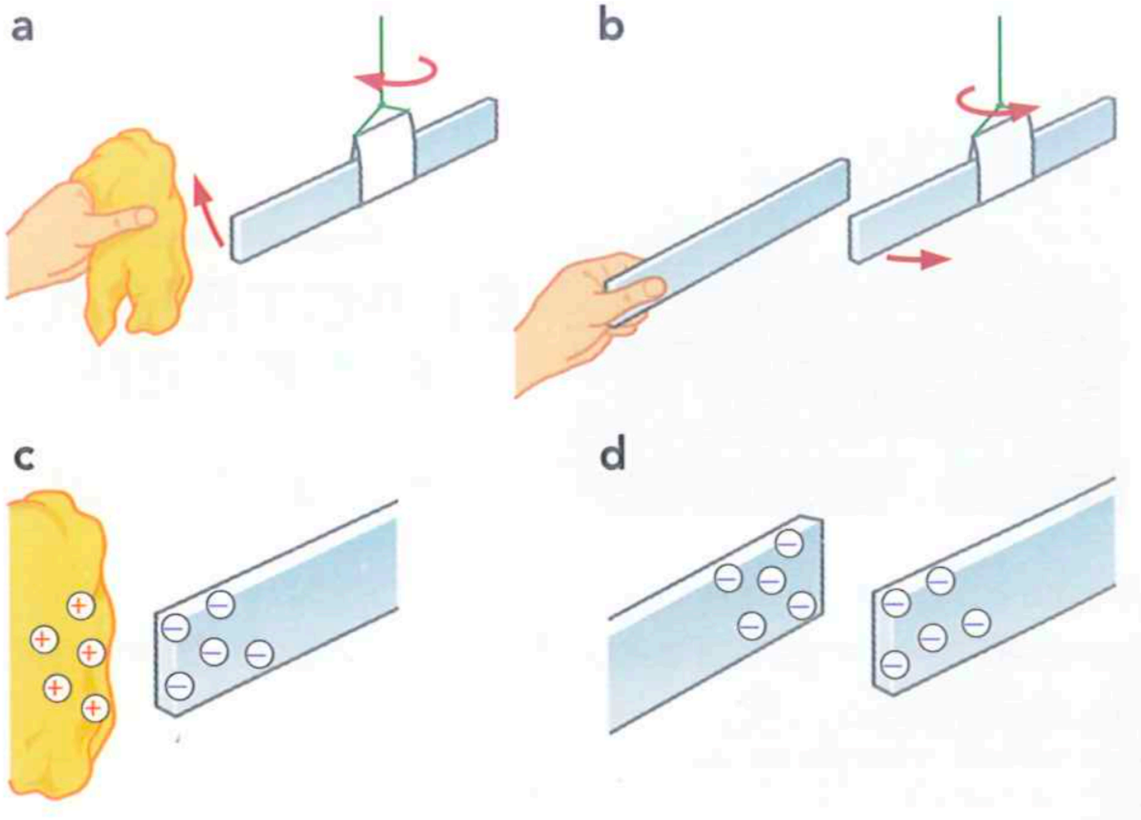
Electroscope



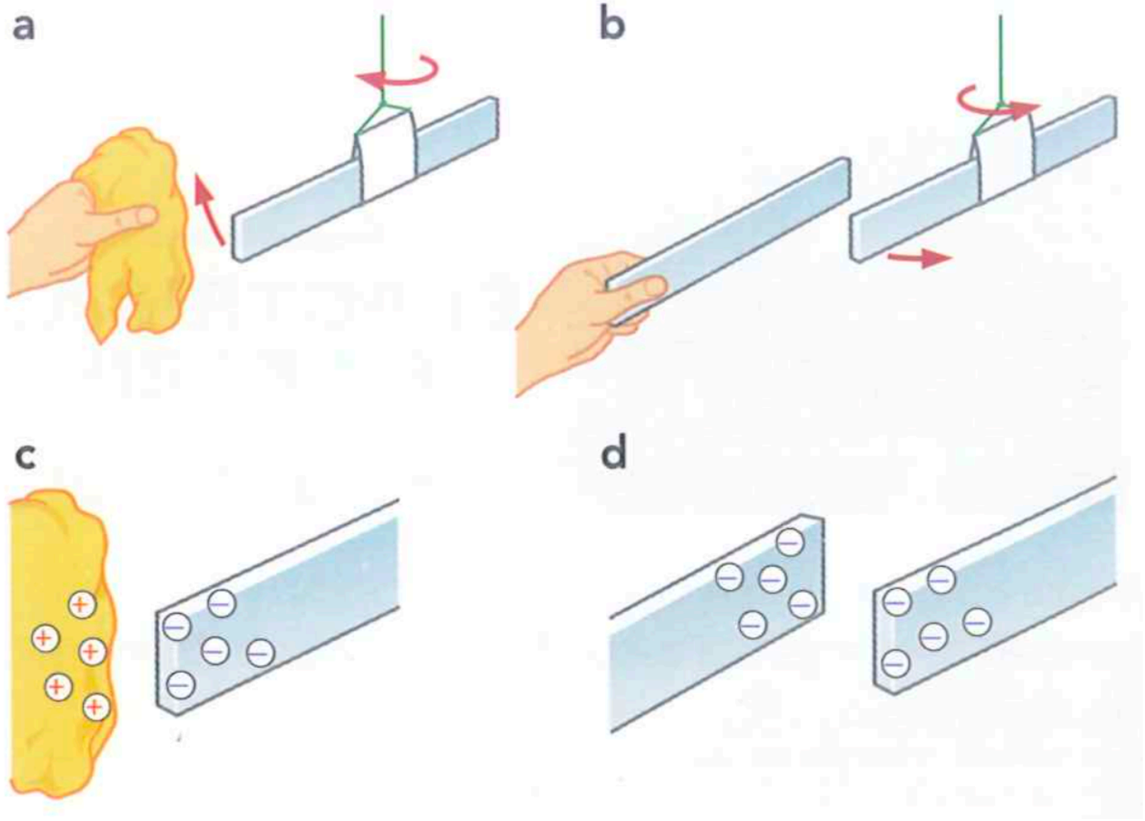


Charging by friction

How do you explain the opposite turning results?



Charge by friction



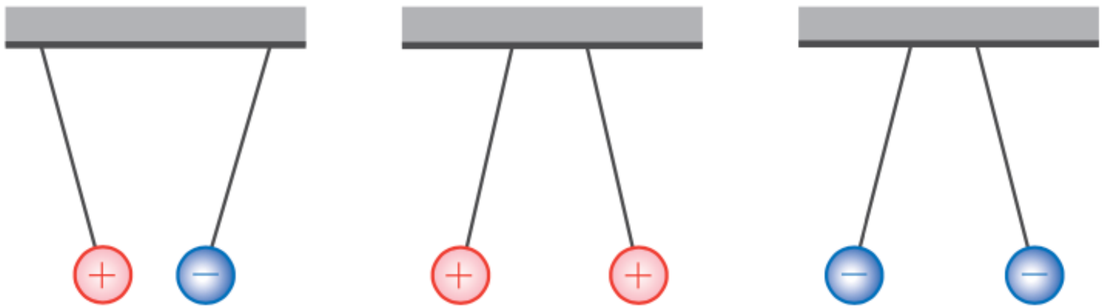
Two types of charge:

Positive & negative

Like charge repels

Unlike charge attracts

Charge by friction



Two types of charge:

Positive & negative

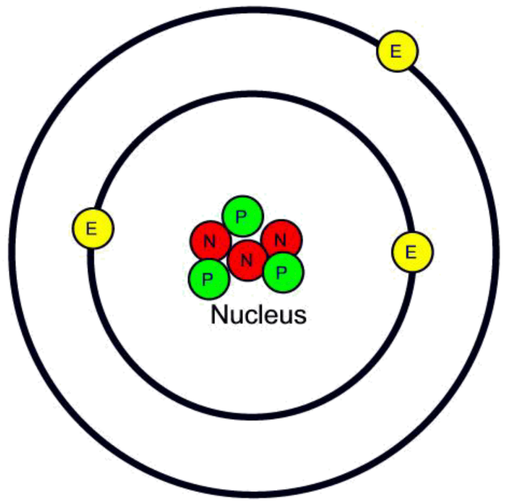
Like charge repels

Unlike charge attracts

Static electricity

Explanation charging in terms of atoms: electrons move from one object to the other

Atom



E Electron ——**has a negative charge**

P Proton ——**has a positive charge**

N Neutron ——**has no charge**

Exercise

Explain why charge by friction needs two different material.

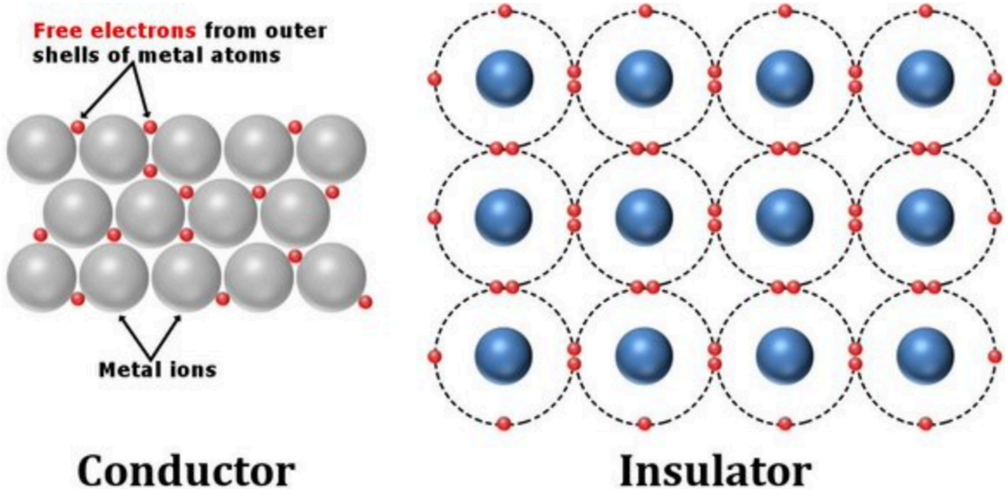
Exercise

Explain why glass rod carries positive charge after rubbed by a silk cloth.

(Electrical) Conductors vs insulators

Conductors: a substance that allows flow of electrons/ have **free electrons**

Insulators: a substance that inhibits flow of electrons



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.

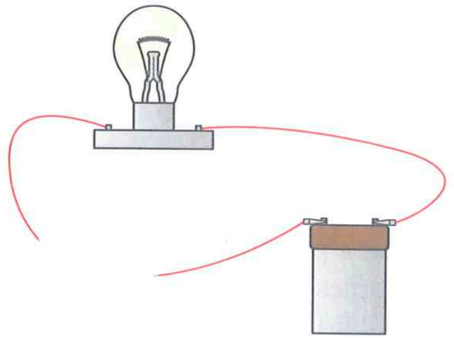


Figure 17.7: Circuit for testing materials.

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

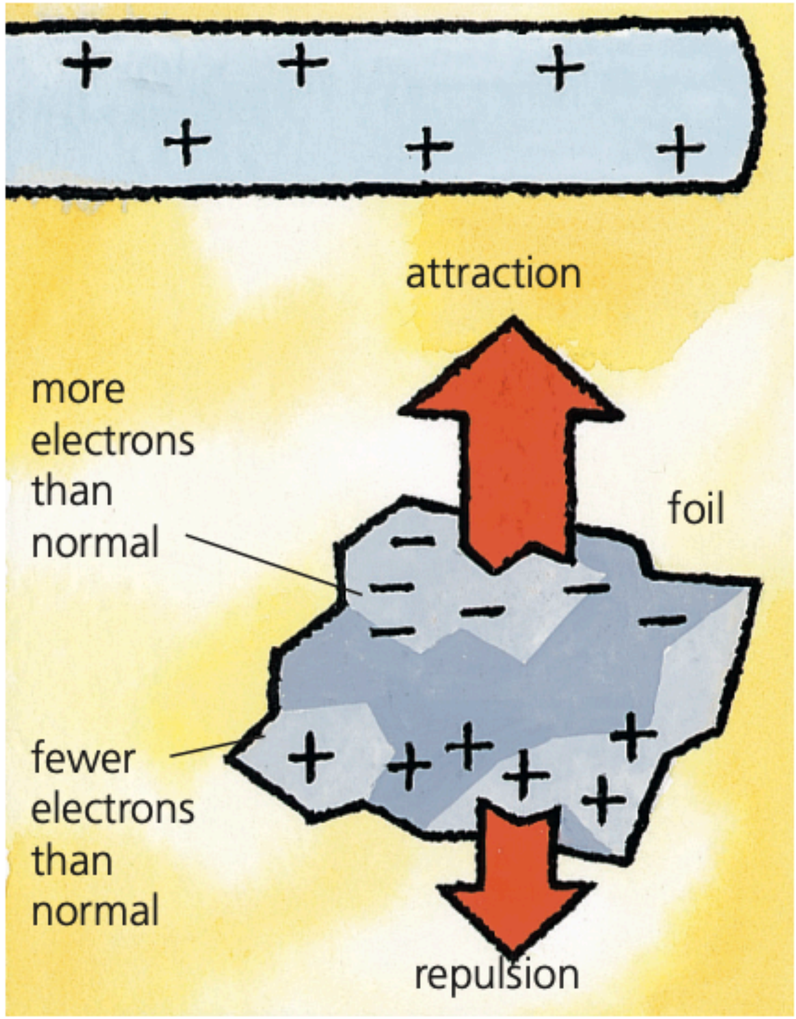
1 The wires you used are made of copper covered in plastic. Explain why these materials were chosen.

Charge by induction

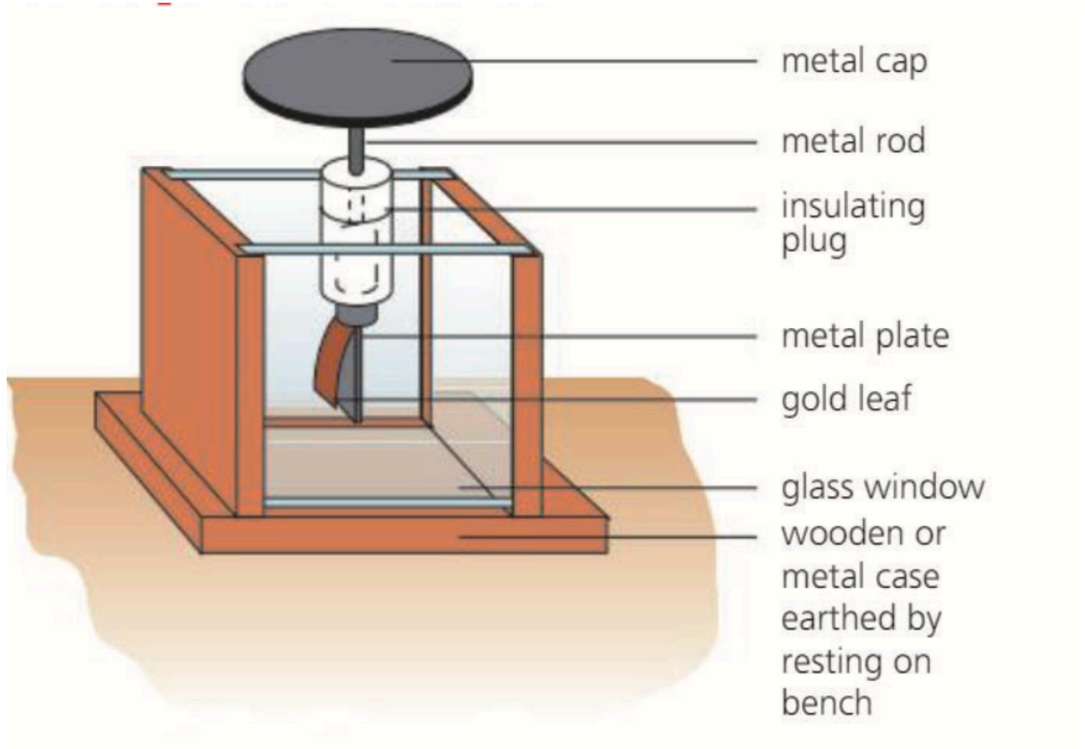
Why rubbed ruler can attract light objects?

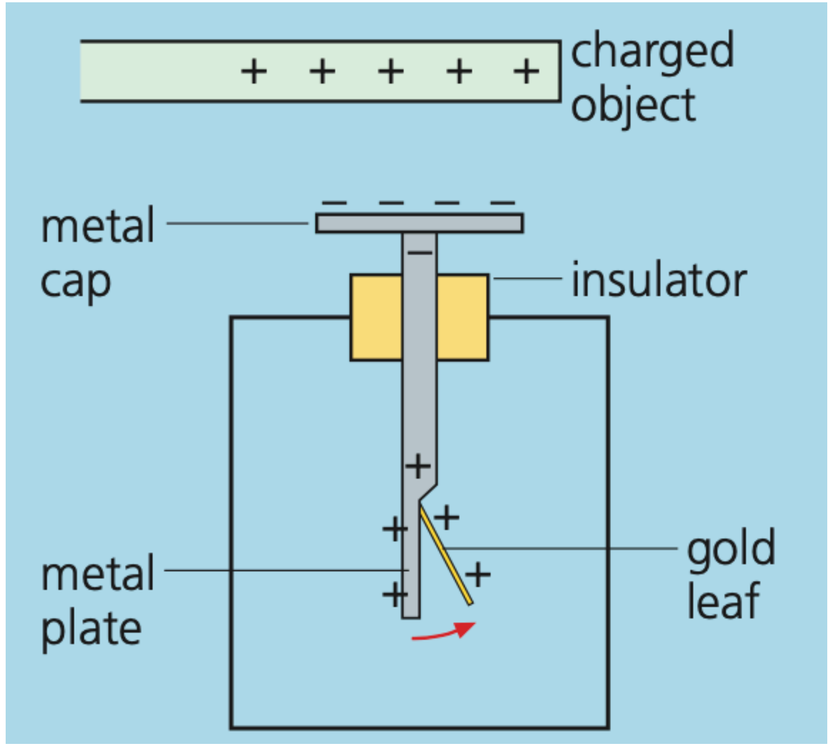
Charge by induction

Why rubbed ruler can attract light objects?

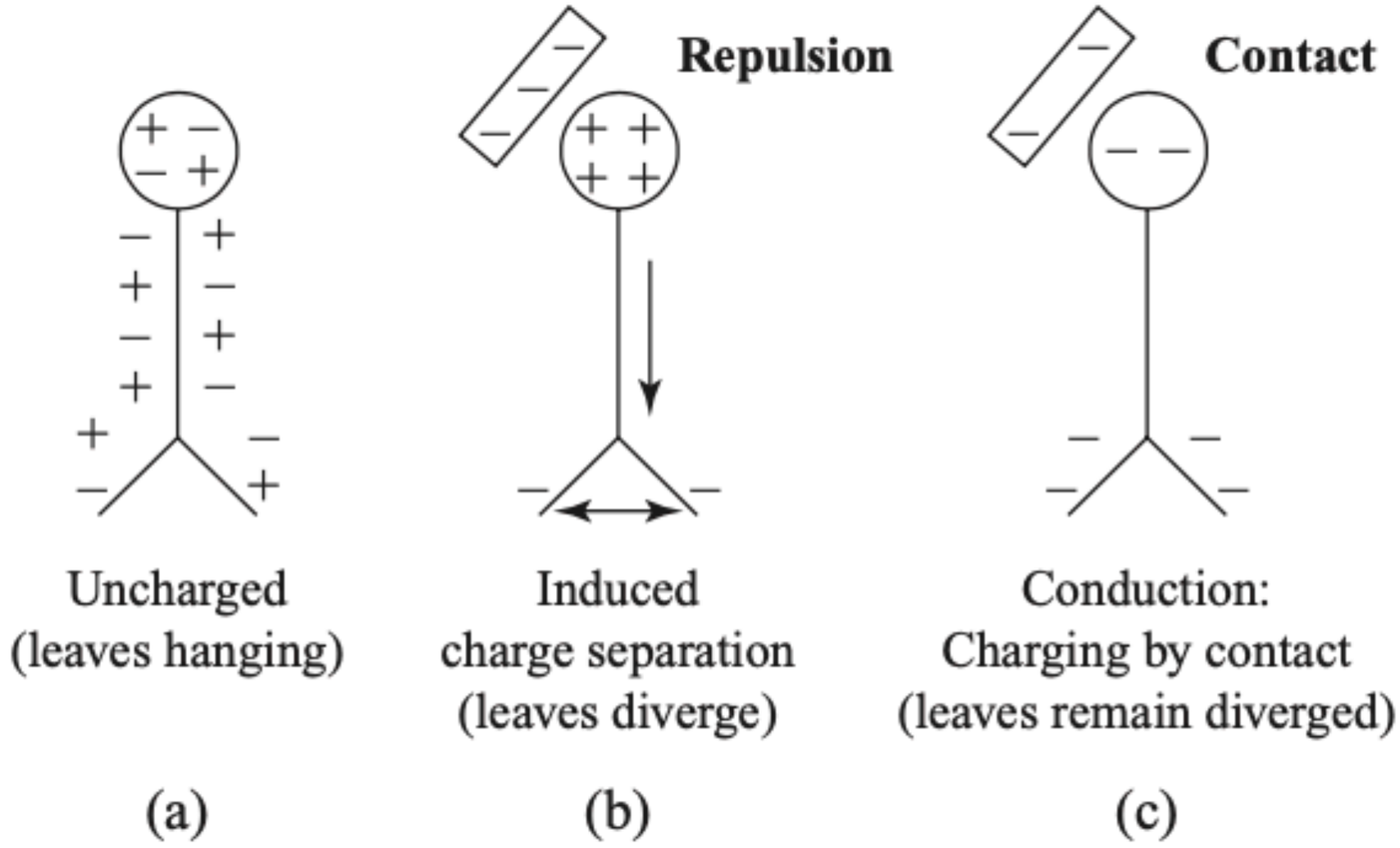


Electroscope





Electroscope



Exercise

How to charge two conductors without touching any one of them?

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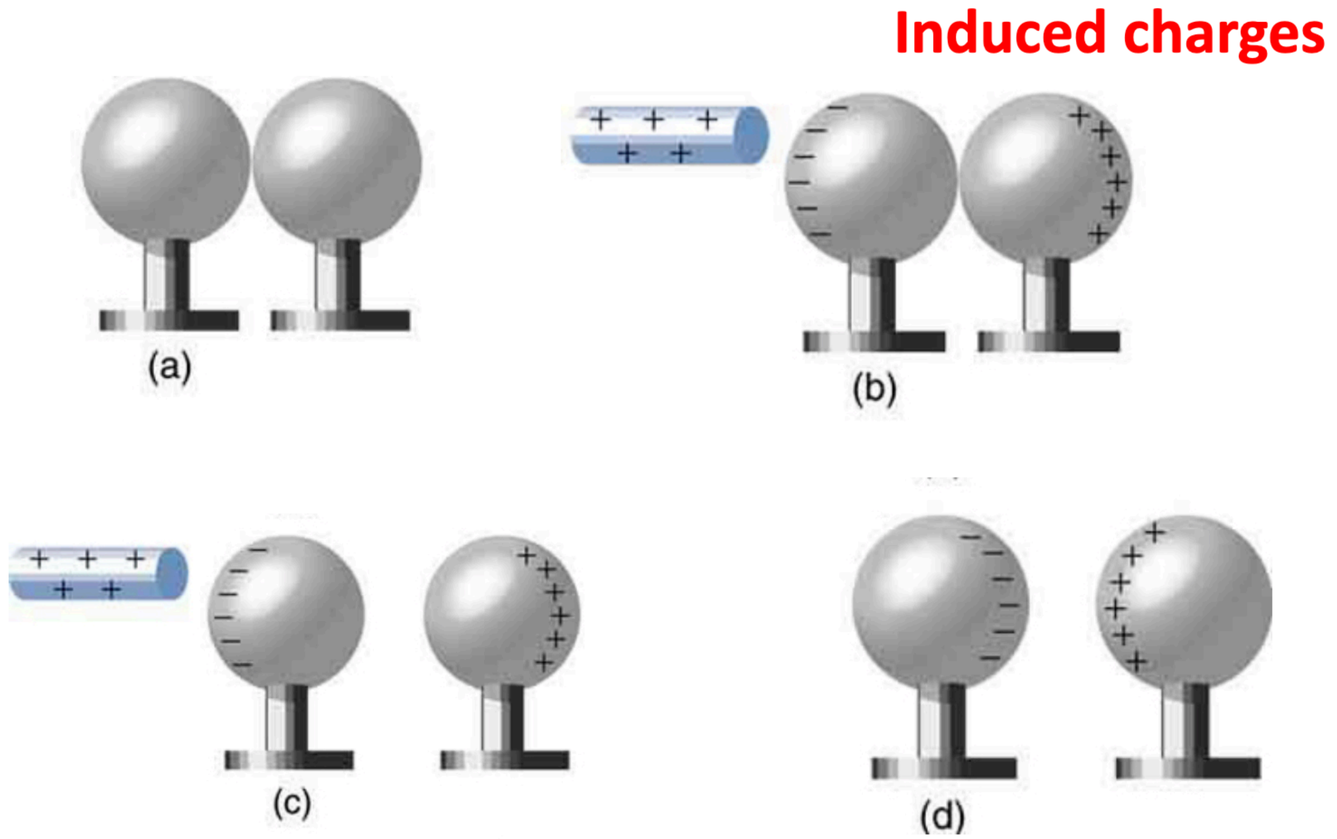
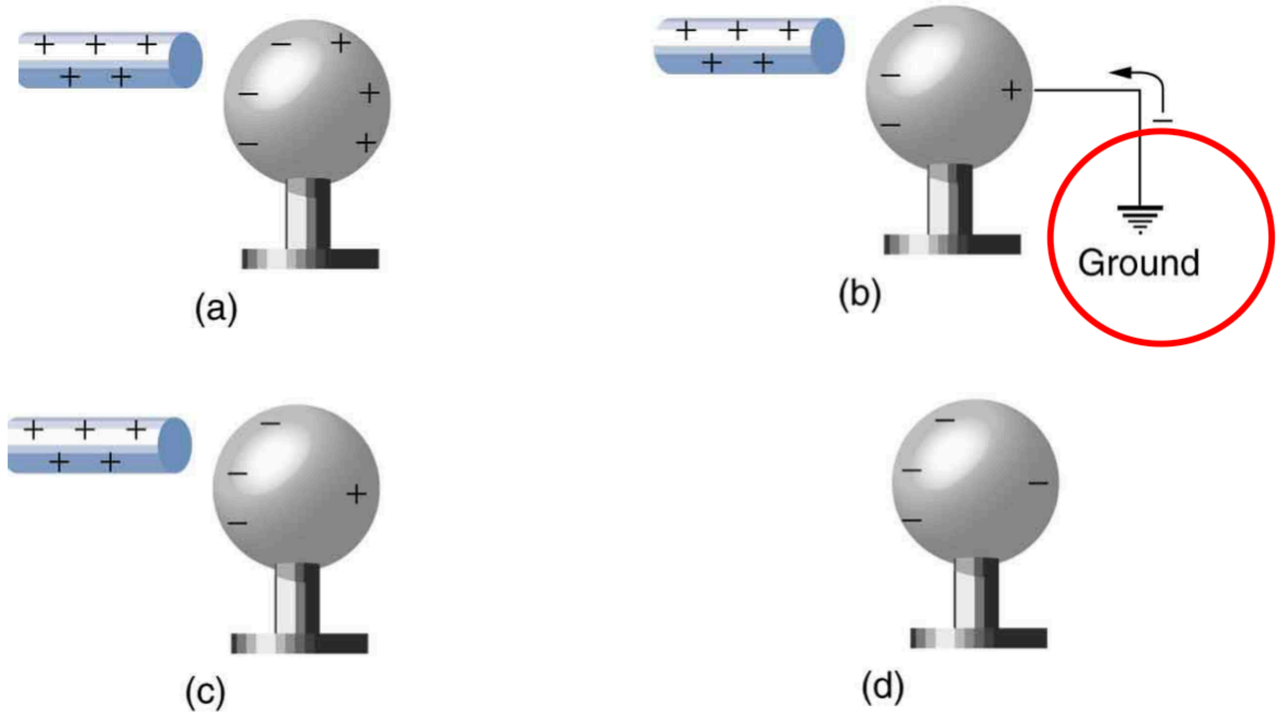


Grounding

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



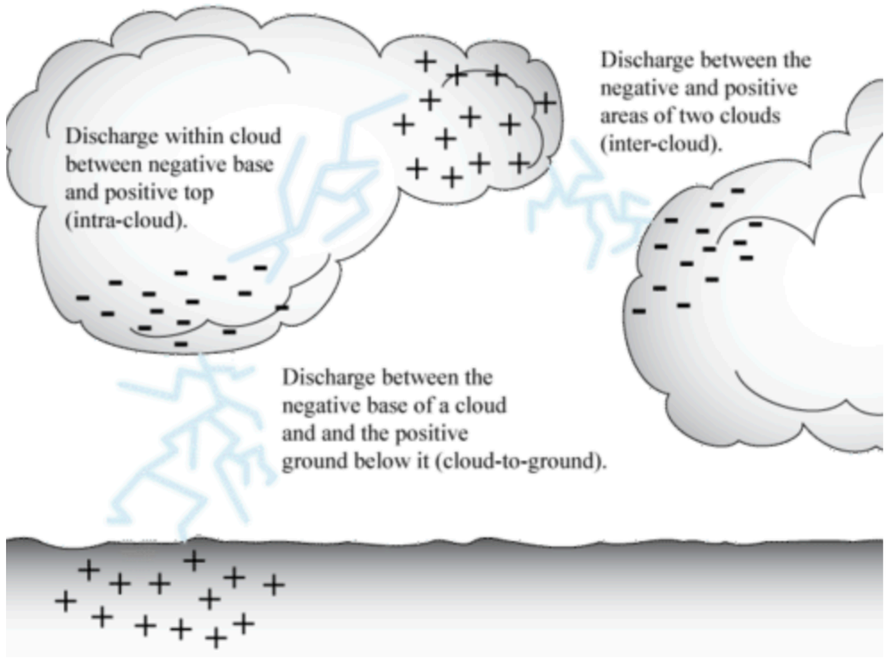
How to make a conductor sphere uniformly charged using a charged rod?

1. Put rod close to the sphere but not touching it
2. **Earth** the sphere with a metal wire/touch sphere with hand
3. **Remove wire/hand** and **then** remove rod

Discharging

Discharging

the release and transmission of electricity in an object



Charged particles

Unit: **coulomb**

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

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

Electrical Fields

Electric field: a region of a space in which an electric charge will experience a force

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

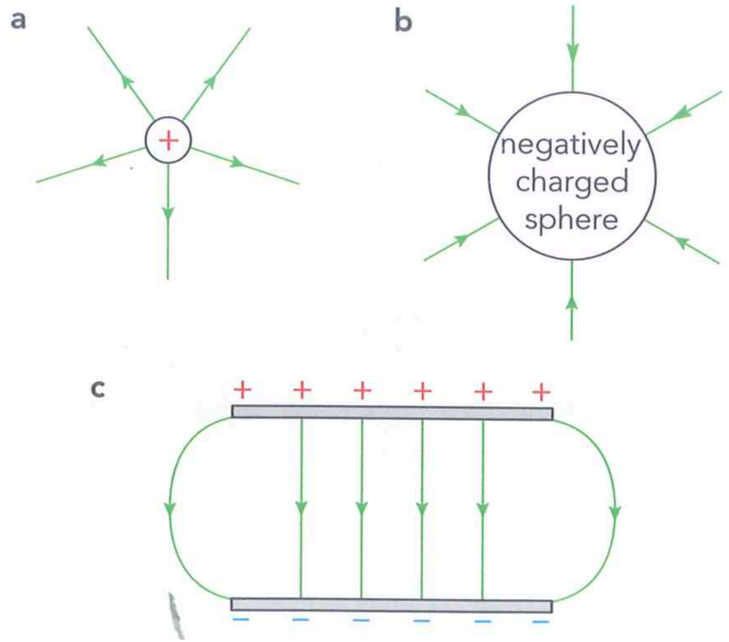
Direction of electric field: the direction of a field is the direction of the force a positive charge will experience

Electrical Fields

Electric field: (a) around a point charge

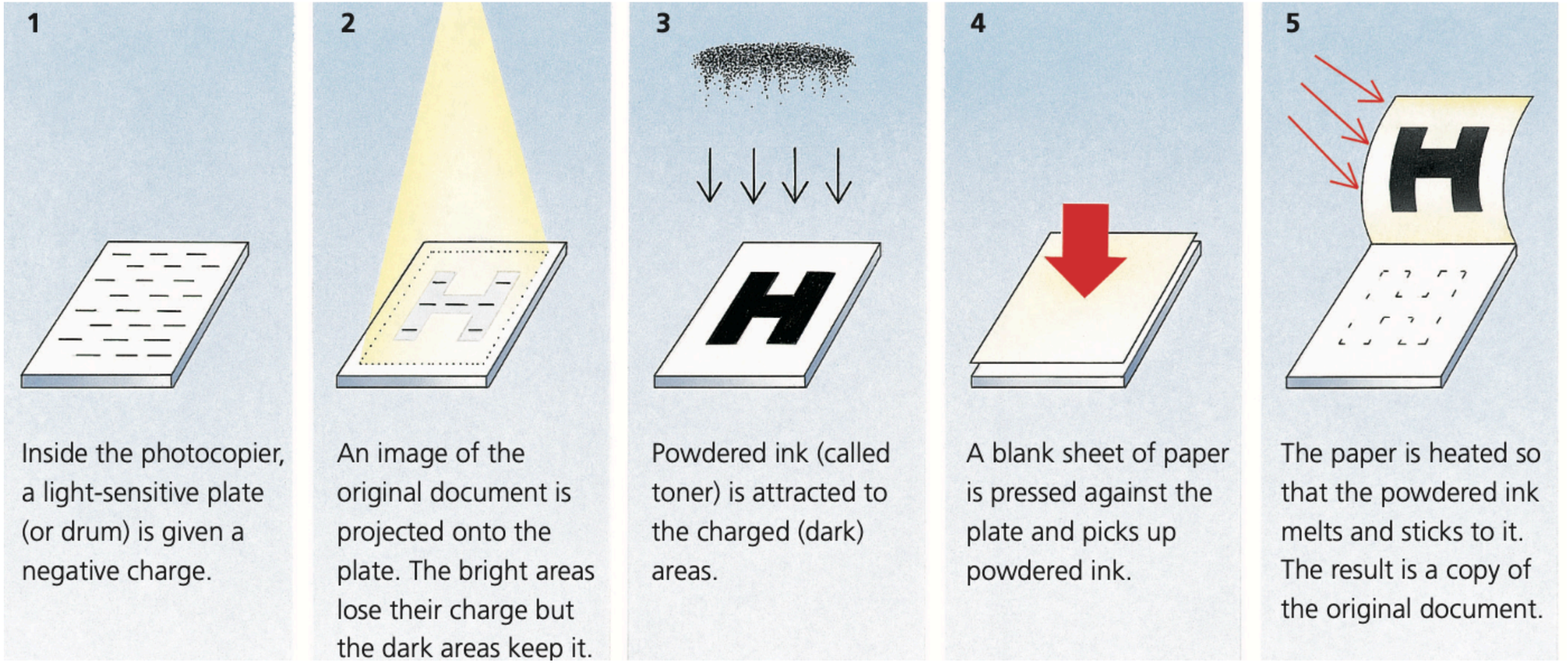
(b) around a charged conducting sphere

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



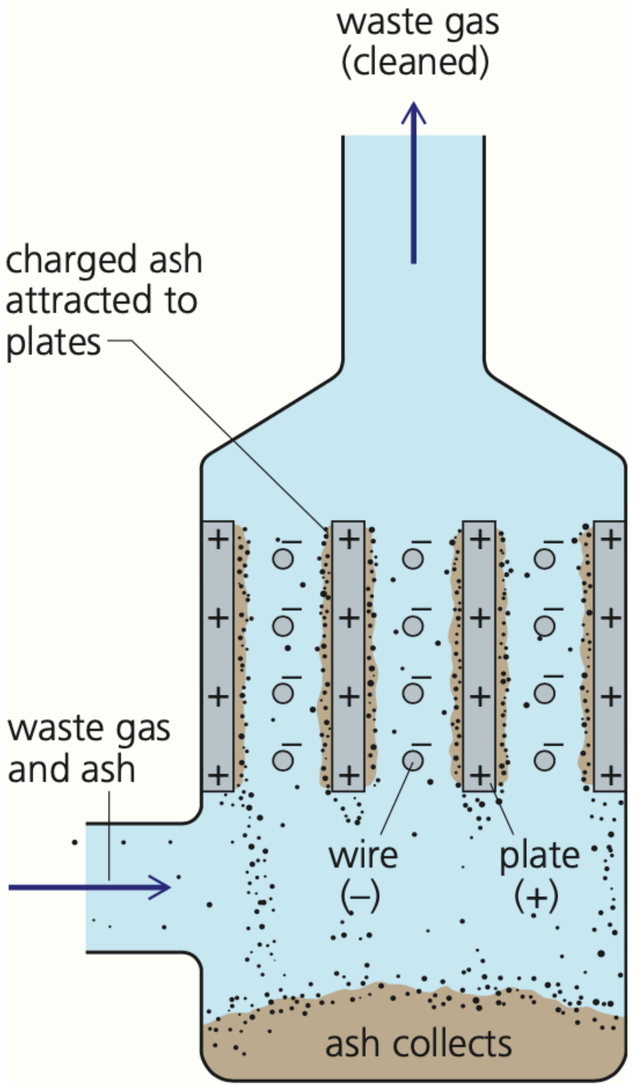
Applications of electrostatics

photocopier



Applications of electrostatics

Electrostatic precipitators



Applications of electrostatics

lightning conductor