



Cambridge IGCSE Physics Electricity & Magnetism

By: Chaoyang Chu

● Learning objectives

4.1 Magnetism	4.1.1 Permanent magnets 4.1.2 Magnetic fields
4.2 Static electricity	4.2.1 Charging and discharging 4.2.2 Explaining static electricity 4.2.3 Electric fields and electric charge
4.3 Electrical quantities	4.3.1 Current in electric circuits 4.3.2 Electrical resistance 4.3.3 More about electrical resistance 4.3.4 Electricity and energy
4.4 Electric circuits	4.4.1 Circuit components 4.4.2 Combinations of resistors 4.4.3 Electronic circuits 4.4.4 Electrical safety
4.5 Electromagnetic forces	4.5.1 Magnetic effect of a current 4.5.2 How electric motors are constructed 4.5.3 Force on a current-carrying conductor
4.6 Electromagnetic induction	4.6.1 Generating electricity 4.6.2 Power lines and transformers 4.6.3 How transformers work

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Section
4.2

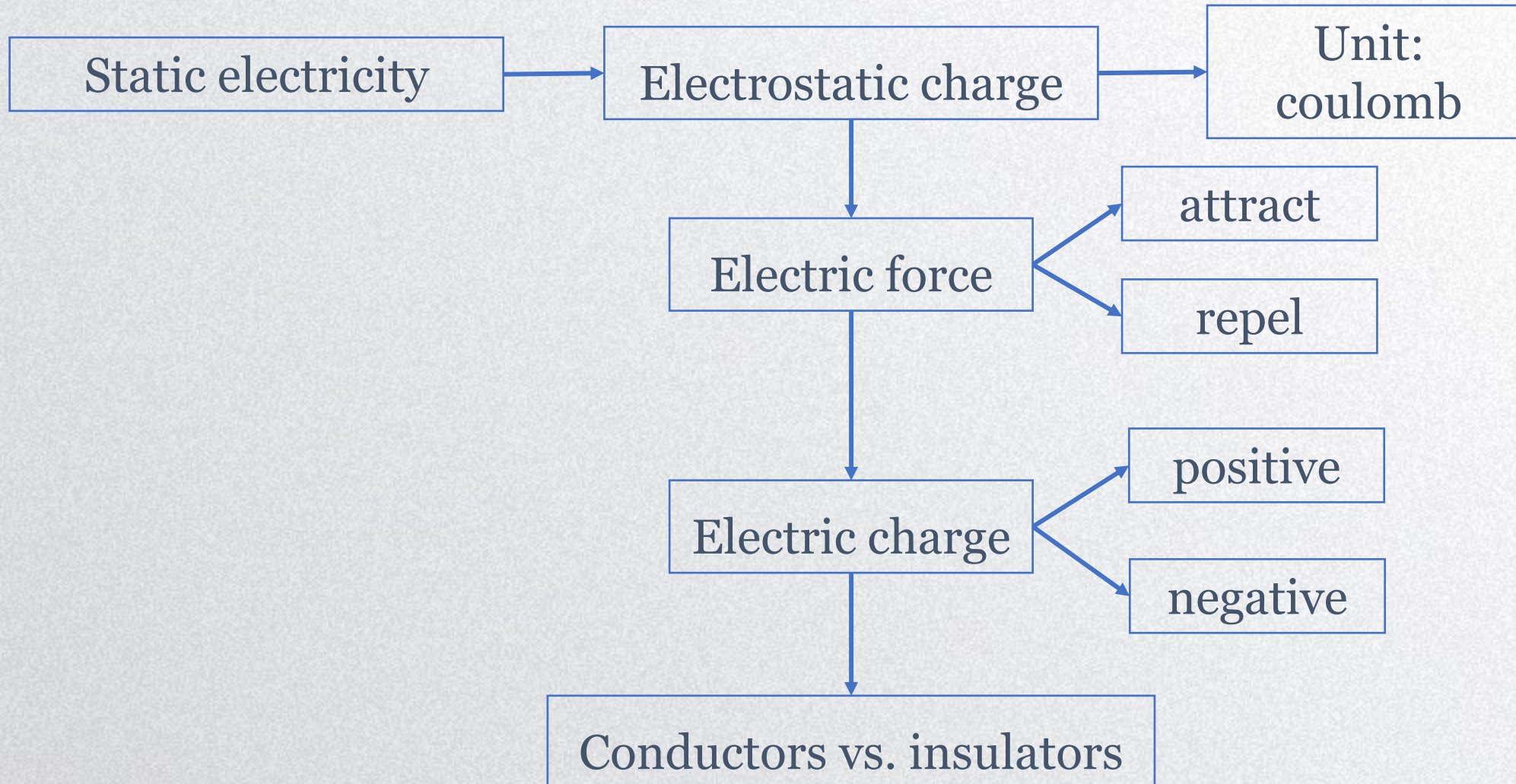
Static electricity

4.2.1 Charging and discharging

4.2.2 Explaining static electricity

4.2.3 Electric fields and electric charge

● Learning Objectives



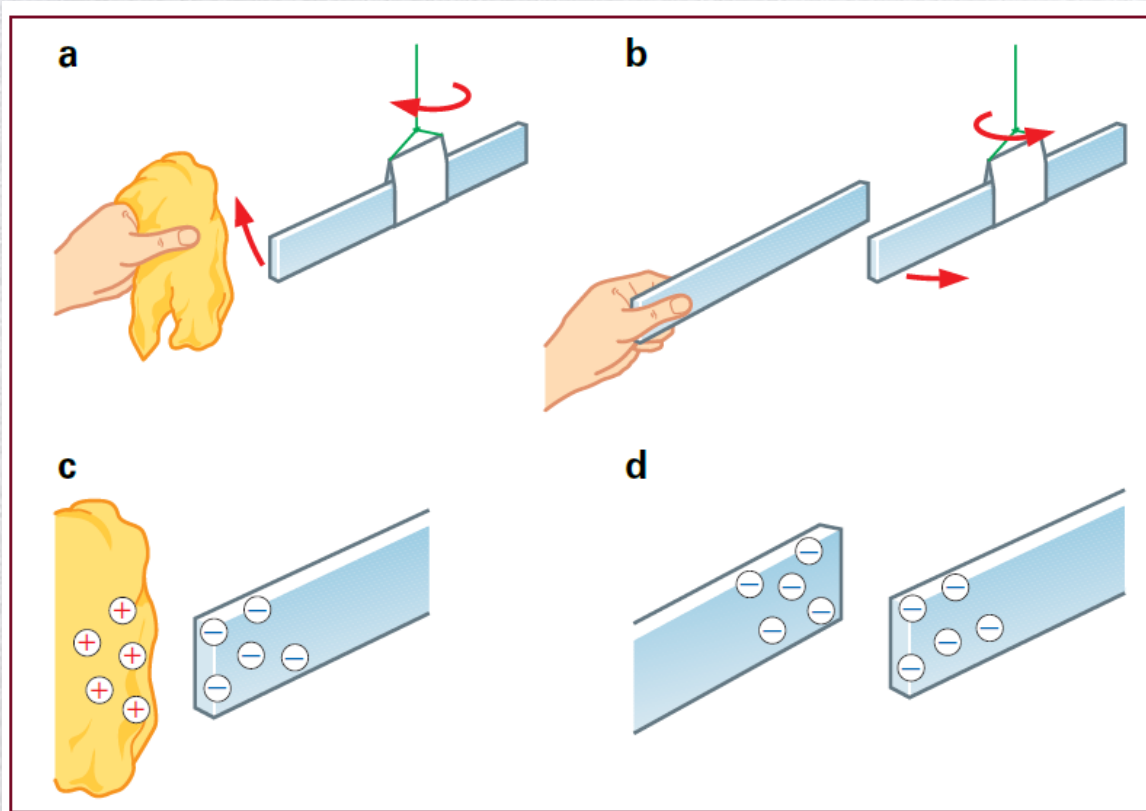
● Keywords

- **Static electricity** : electric charge held by a charged insulator
- **Electrostatic charge**: a property of an object that causes it to attract or repel other objects with charge
- **Two types of charges**: positive (+ve) charge and negative (-ve) charge
- Electric charges exert on each other:
 - ✓ **like charges repel**
 - ✓ **unlike charges attract**

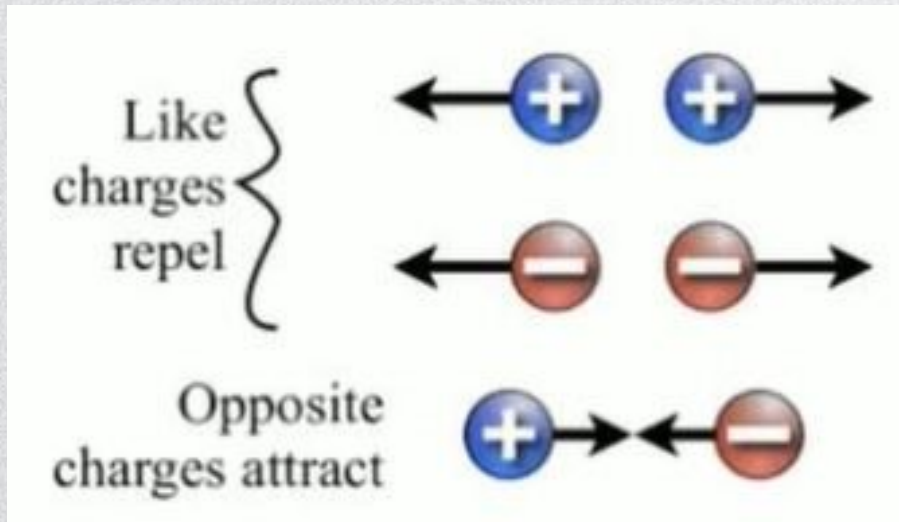
● Electric Charge

Two experiments to show **the existence of two opposite types of static electricity.**

- a. The charged rod and cloth attract one another.
- b. The two charged rods repel one another.
- c. The rod and the cloth have opposite electric charges.
- d. The two rods have electric charges of the same sign.



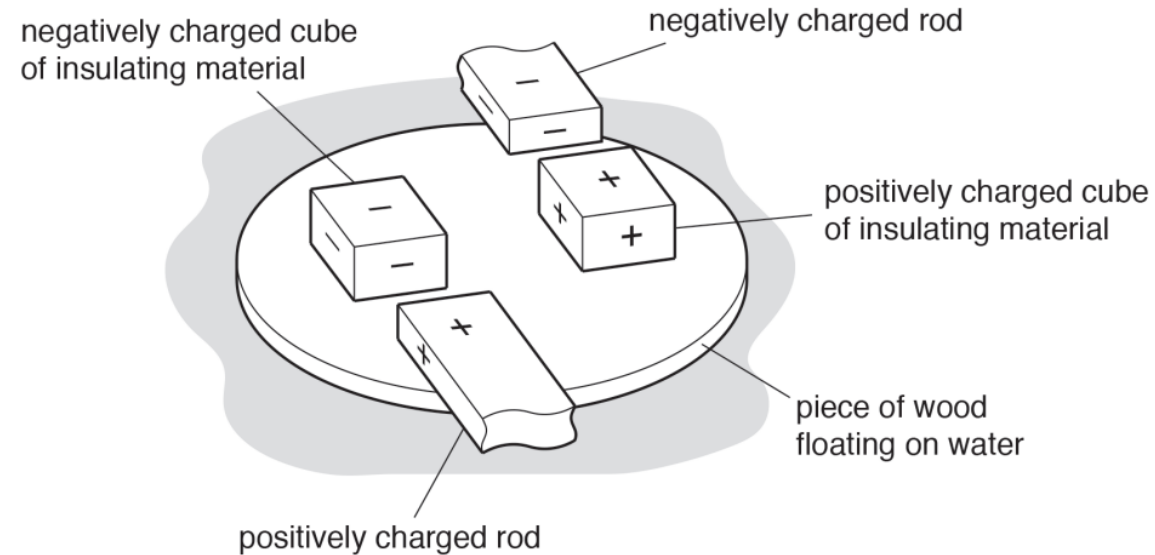
● Electric Charge



- Electric charge is the **physical property** of matter that causes it to experience a force when placed in an electromagnetic field.
- The unit for charge is **coulombs**.
- The **electric force** between two charged objects is one of the fundamental forces of nature. (The force of gravity between two masses is another fundamental force.)
- **The electric force holds the particles that make up an atom together.** It holds atoms together to make molecules, and it holds molecules together to make solid objects.

● Study question #1

The diagram shows two cubes of insulating material. One is positively charged and the other is negatively charged. The cubes are fixed to a piece of wood that is floating on water. Charged rods are held above the piece of wood and brought close to the cubes, as shown.



State and explain any movement of the piece of wood.

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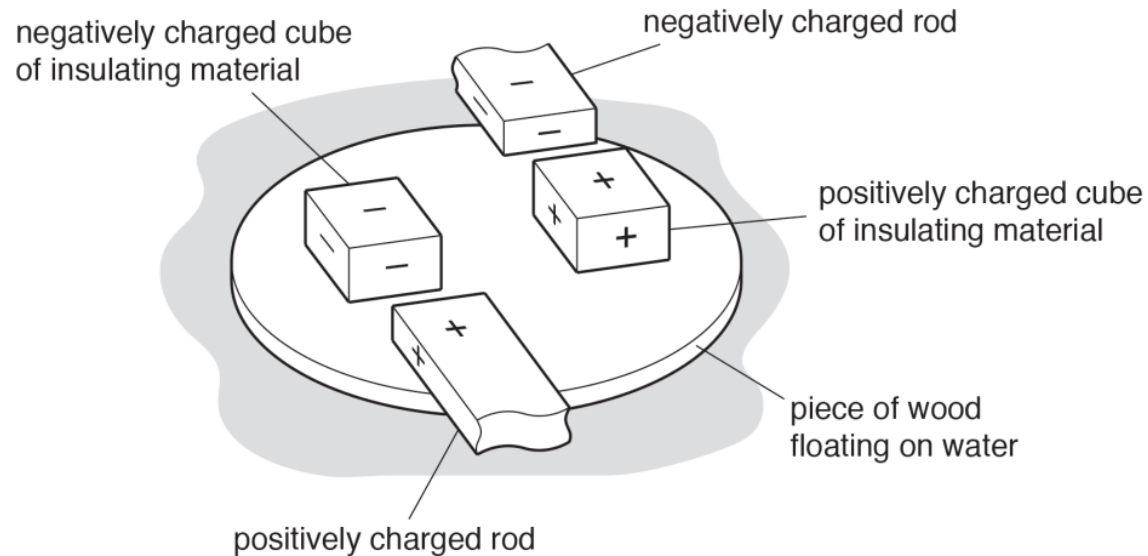
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[2]

[Total: 2]

● Study question #1

The diagram shows two cubes of insulating material. One is positively charged and the other is negatively charged. The cubes are fixed to a piece of wood that is floating on water. Charged rods are held above the piece of wood and brought close to the cubes, as shown.



The piece of wood rotates / turns / spins (1)

Unlike charges attract, so the two forces of attraction between the cube and rod cause moment / turning effect (1)

State and explain any movement of the piece of wood.

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[2]

[Total: 2]

● Electric charge

- Charge is measured in **coulombs (C)**, named after Charles-Augustin de Coulomb, a French physicist.
- The force between two charged objects depends on how big their charges are and on how far apart they are.
- An electron is a negatively charged particle. It is much smaller than an atom, and only weakly attached to the outside of the atom. It is held there by the attraction of the positively charged nucleus of the atom. The nucleus is positively charged because it contains positively charged particles called protons.

● Electric charge

- An electron has a very tiny amount of electric charge.
- The electron charge is so small that it takes over 6 million million million electrons to make 1 C of charge:
- **Electron charge** = $-0.000\ 000\ 000\ 000\ 000\ 000\ 16\ \text{C} = -1.6 \times 10^{-19}\text{C}$
- A proton has exactly the same size of charge as an electron, but positive.
Proton charge = $+0.000\ 000\ 000\ 000\ 000\ 000\ 16\ \text{C} = +1.6 \times 10^{-19}\text{C}$

● Conductors & Insulators

- A **conductor** is something which allows **electric current to flow** through it freely.
 - ✓ Conductors have **free flowing electrons** which allow the passage of electric current through the structure, i.e. metals
- An **insulator** prevents any electric current flowing through it.
 - ✓ Insulators have tightly bound electrons that are **not free to move** in the structure, i.e. rubber

● Conductors & Insulators

- Conductors:

- ✓ silver
- ✓ copper
- ✓ gold
- ✓ aluminum
- ✓ iron
- ✓ steel
- ✓ brass
- ✓ bronze

- Insulators:

- ✓ glass
- ✓ rubber
- ✓ oil
- ✓ asphalt
- ✓ fiberglass
- ✓ porcelain
- ✓ ceramic
- ✓ quartz

● Study question #2

State, in terms of their structure, why metals are good conductors of electricity.

[1]

[Total: 1]

● Study question #2

State, in terms of their structure, why metals are good conductors of electricity.

Metals contain free/mobile /delocalized electrons

[1]

[Total: 1]



THANK
YOU