Year 11 Physics

Electricity

Electrostatics

- Static electricity – result of transfer of electrons
- Objects acquire equal and opposite charges
- Study of the causes & effects of static charges

Electric Charge

- Only 2 types of charges (+ -)
- +ve objs have a deficiency of e
- -ve objs have excess of e
- Like charges repel
- Unlike charges attract
- +ve & -ve objs attract neutral conductors

Electrostatic Forces

- Charges objs exert forces on each other
- Known as electrostatic forces
- Can act at a distance (deps on nature & magnitude of charges & distance)

The Basics

- The charge on an object is represented with the symbol q

Charge, Q, is measured in **coulombs** (**C**) and is a **scalar** quantity. 6.25×10^{18} electrons are needed to make up one coulomb of charge. Each electron therefore carries only a tiny fraction of a coulomb, i.e. the charge carried by each electron is -1.6×10^{-19} C.

- The charge on a single proton or electron is known as an elementary charge (e)

elementary charge = $1.60217646 \times 10^{-19}$ coulombs

Type	*Symbol*	*Charge* (C)	*Mass* (kg)
Electron	e^-	-1.602×10^{-19}	9.109×10^{-31}
Proton	p	1.602×10^{-19}	1.673×10^{-27}
Neutron	n	0 (neutral)	1.675×10^{-27}

electric force *completely* overwhelms gravity.

The amount of charge on each object. The greater the charge the greater the force of attraction or repulsion.

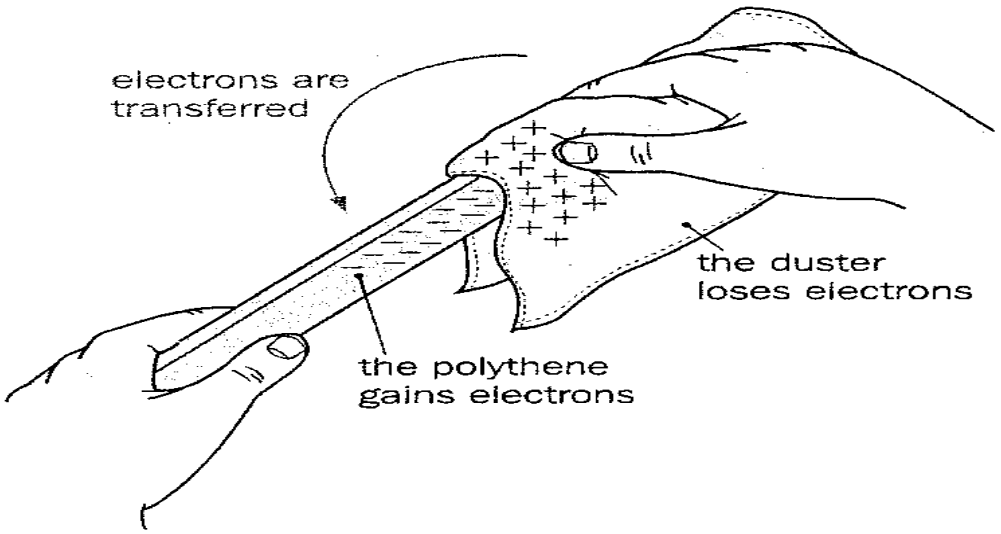
The distance between the objects. The greater the distance the less the force of attraction or repulsion.

Electric Fields

- Can be detected in the space around a ve obj
- Known as an electric field

How are objects charged?

- By Friction

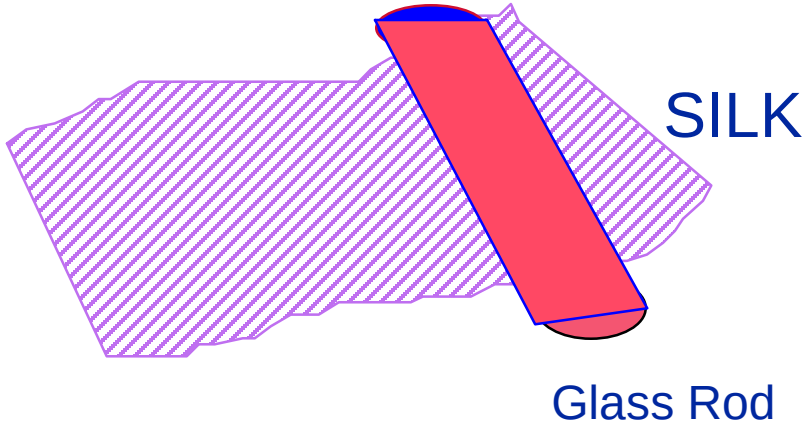


-

- Electrons (-) only are able to travel

Electric Charge

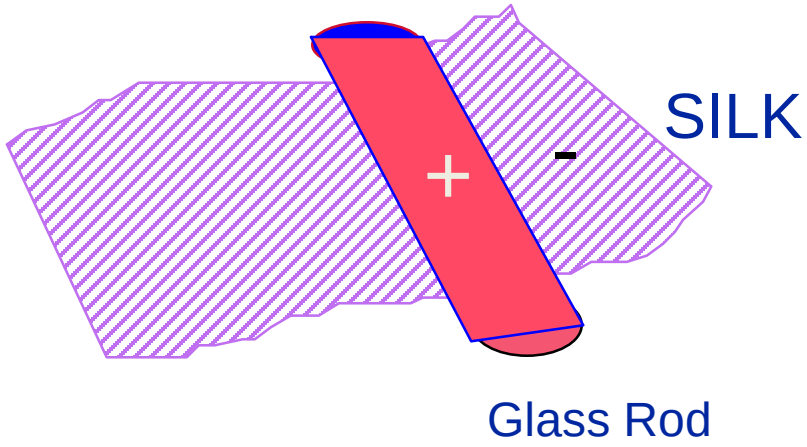
The Transfer of Charge



Some materials attract electrons more than others.

Electric Charge

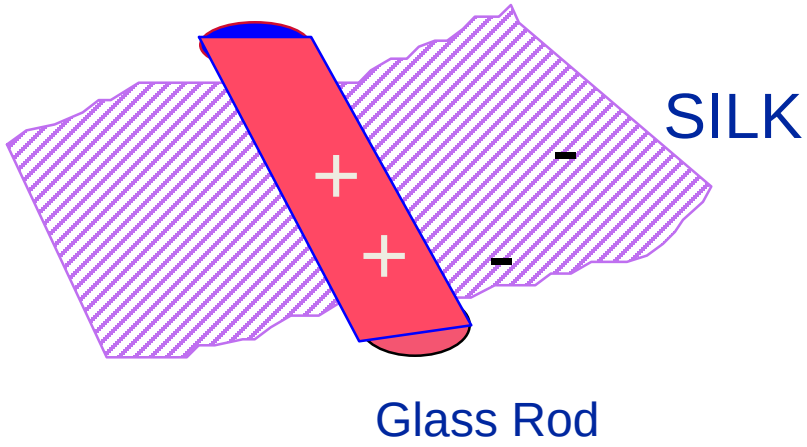
The Transfer of Charge



As the glass rod is rubbed against silk, electrons are pulled off the glass onto the silk.

Electric Charge

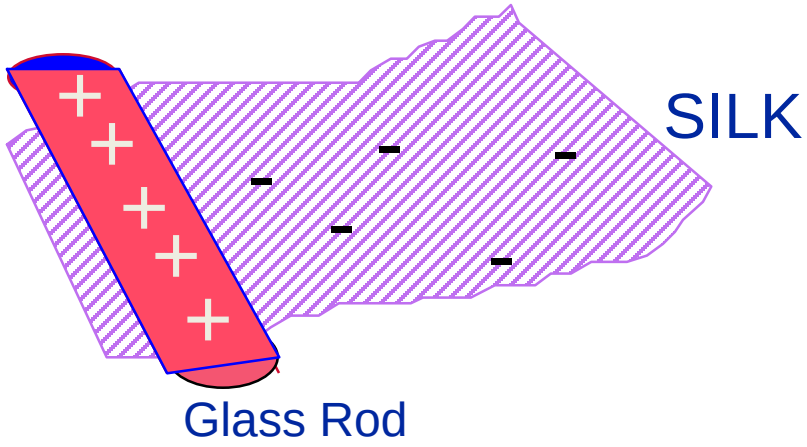
The Transfer of Charge



Usually matter is charge neutral, because the number of electrons and protons are equal. But here the silk has an excess of electrons and the rod a deficit.

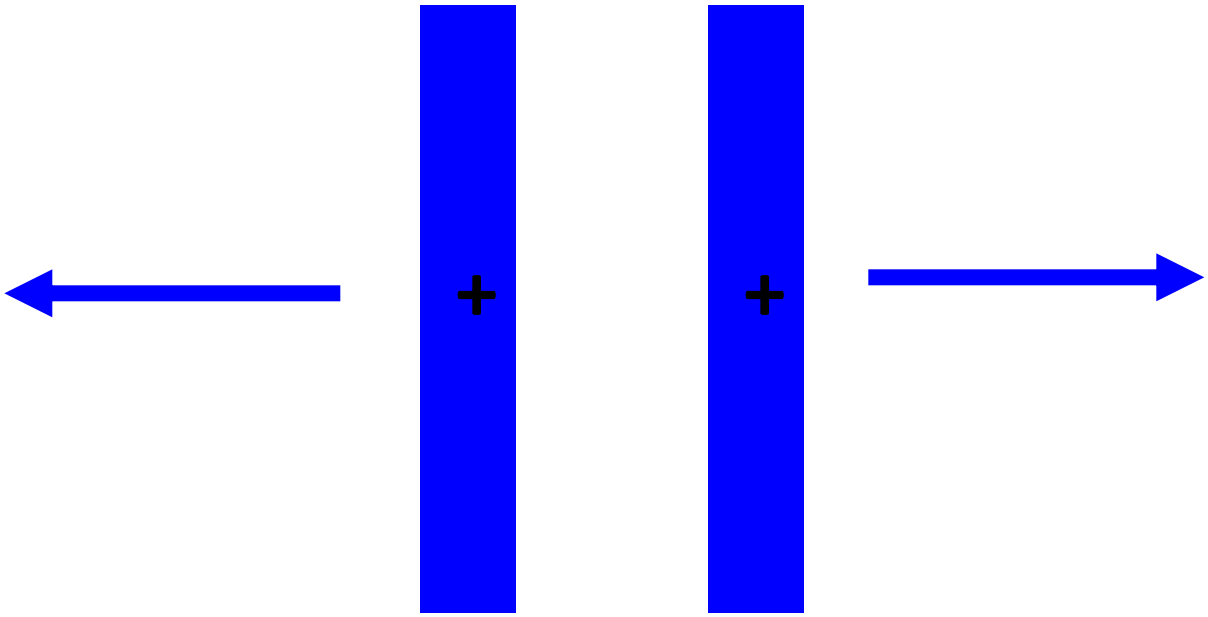
Electric Charge

The Transfer of Charge



Glass and silk are insulators:
charges stuck on them stay put.

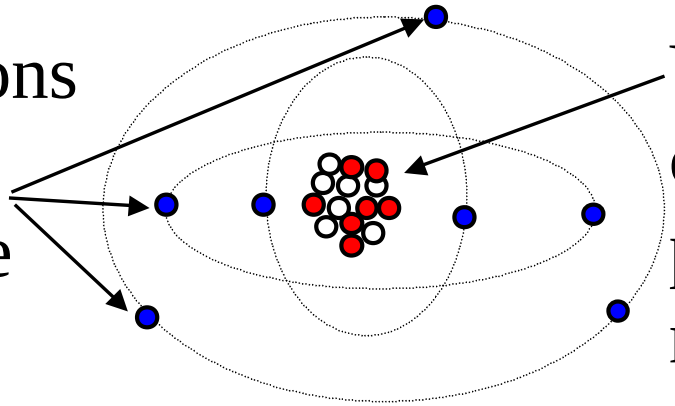
Electric Charge



Two positively charged rods repel each other.

Why is this?

-ve electrons orbiting around the nucleus.



Very dense nucleus consisting of +ve protons and neutral neutrons

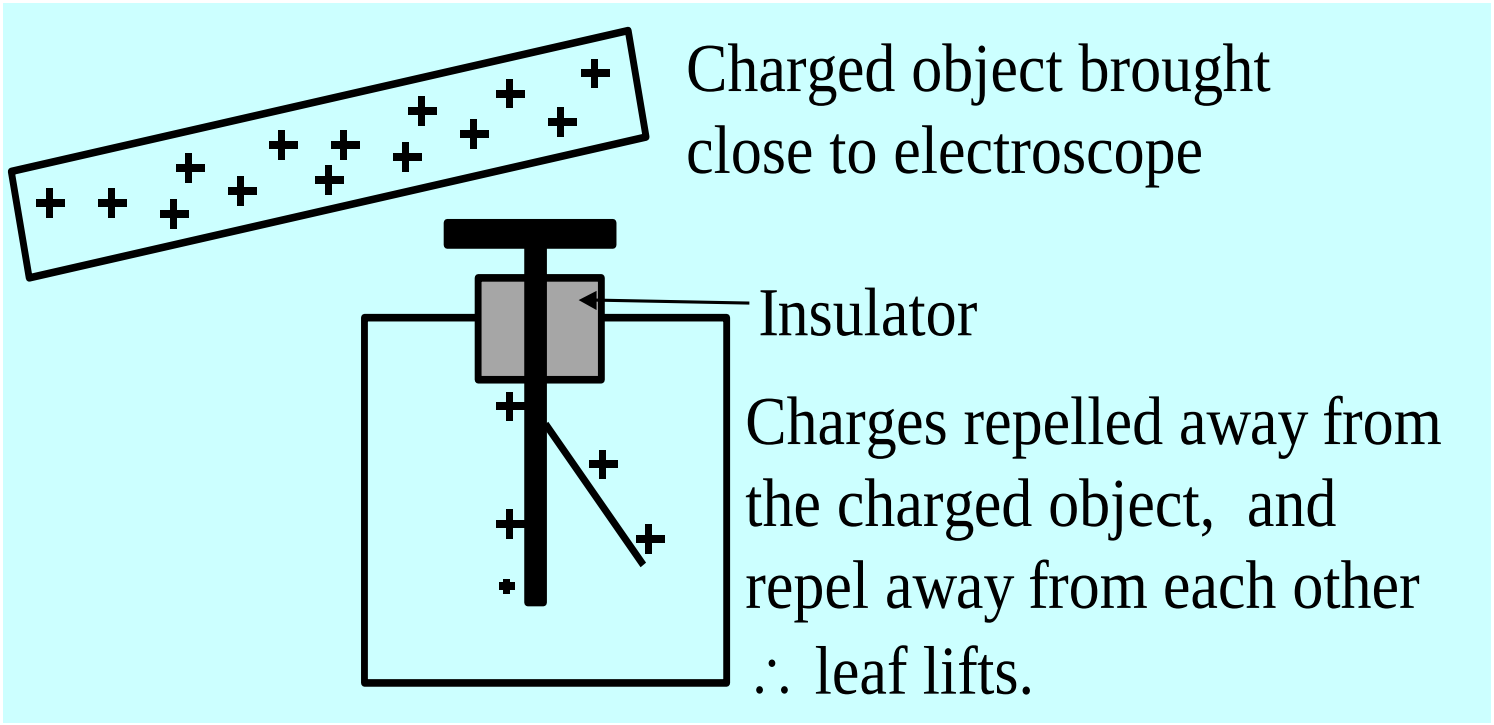
Note electrons are on the outside of the atoms.
Easier to get at
Electrons which move are known as ‘free electrons’
The positively charged nuclei don’t ‘flow’

So…….

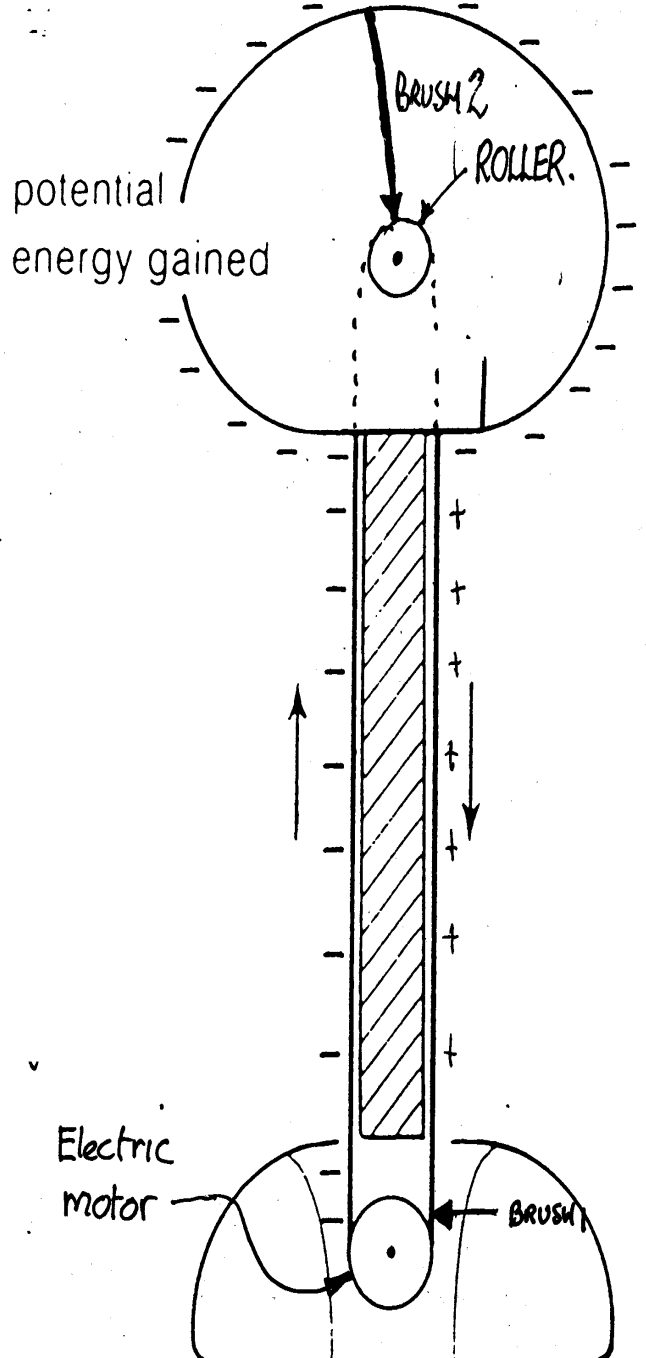
- An excess of free electrons means an object is negatively (-ve) charged
- A lack of free electrons means an object is positively (+ve) charged
- An electric current is a flow of -ve charged free electrons ALTHOUGH conventional current is treated as a flow of +ve charge (!)

How do we measure static charge?

The GOLD LEAF ELECTROSCOPE



Van Der Graaf Generator



- Belt rubs against lower brush
- electrons added to belt
- work done in moving electrons creating High voltage
- charge accumulates on dome

Electric Charge

History

600 BC	Greeks first discover attractive properties of amber when rubbed.
1600 AD	Electric bodies repel as well as attract
1735 AD	du Fay: Two distinct types of electricity
1750 AD	Franklin: Positive and Negative Charge
1770 AD	Coulomb: “Inverse Square Law”
1890 AD	J.J. Thompson: Quantization of electric charge - “Electron”