

Mon Oct 21 HW by Spm

Electric forces and charges

We have seen that objects such as pieces of tape can exert forces that cannot be described by gravitational forces (or spring forces).

DEMO: Suspended ball

- 1) neutral rod near ball
- 2) rubbed rod " "
- 3) touched rod to ball

Such interactions are described in terms of electric forces. These forces can be exerted and experienced by objects that are electrically charged (or charged). All evidence indicates that there are two basic types of charged objects.

- 1) positively charged \oplus
- 2) negatively charged \ominus

The basic rules of interaction are:

Objects with like types of charge repel each other
 Objects with opposite types of charge attract each other.

Quiz! 80% - 80%

The exact details of the force were determined by Charles-Augustin de Coulomb (in 1785). These require an additional detail - the amount of charge carried by the particles. Measuring this is complicated. The idea however, is that charge is a property of an object not of its state of motion.

The units of charge are

Coulombs $\sim C$

So we might find that a metal ball contains a particular amount of charge. The charge of this object can only change if the object can transfer or receive charged objects from another object and for the situations that we consider this will only occur when the objects are in contact.

Quiz 70%

Coulomb's law for the force states that

$$\text{Force} = \text{constant} \times \frac{(\text{charge one object}) \times (\text{charge second object})}{(\text{distance between objects})^2}$$

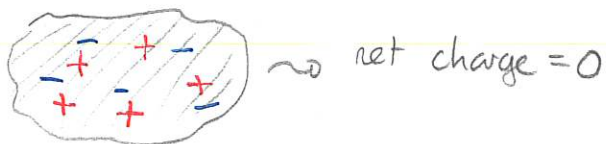
Conservation of charge

Any material object consists of many small constituent objects (atoms, molecules, ...)
Then

The total charge of an object = add up charges of all constituents

If the object consists of an equal number of positively charged constituents and negatively charged constituents then it is possible that there is just as much positive as negative charge and the sum could give zero.
Then we say

An object is neutral \Leftrightarrow total charge of the object is zero



In any isolated system or object, charge can move around but can never be gained or lost. This is the conservation of charge

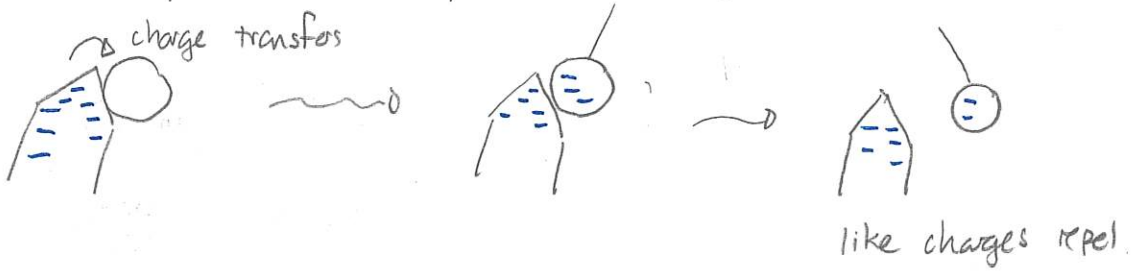
In any isolated system the total charge stays constant as time passes.

Conductors

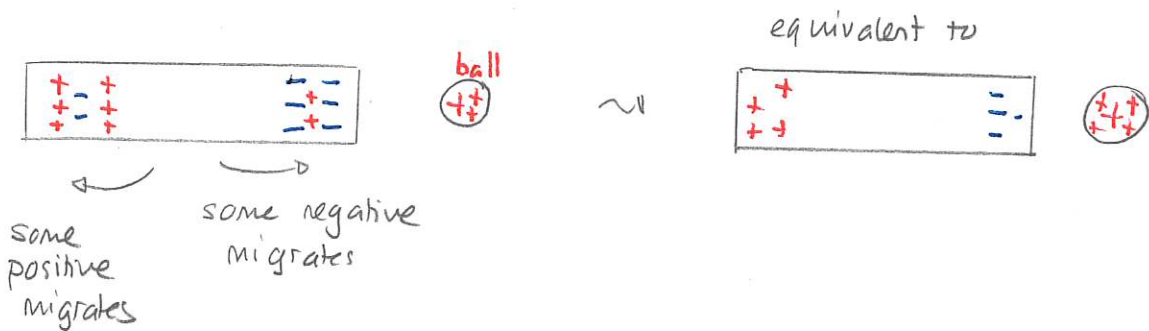
A conductor is a type of material where charge can easily move. Charges within conductors will readily move within a conductor and are easily transferred between conductors.

Quiz 3 70%

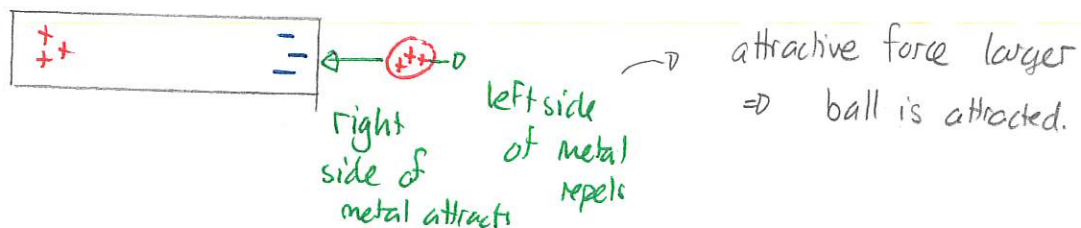
This explains the last part of the original demonstration



Quiz 4 70%



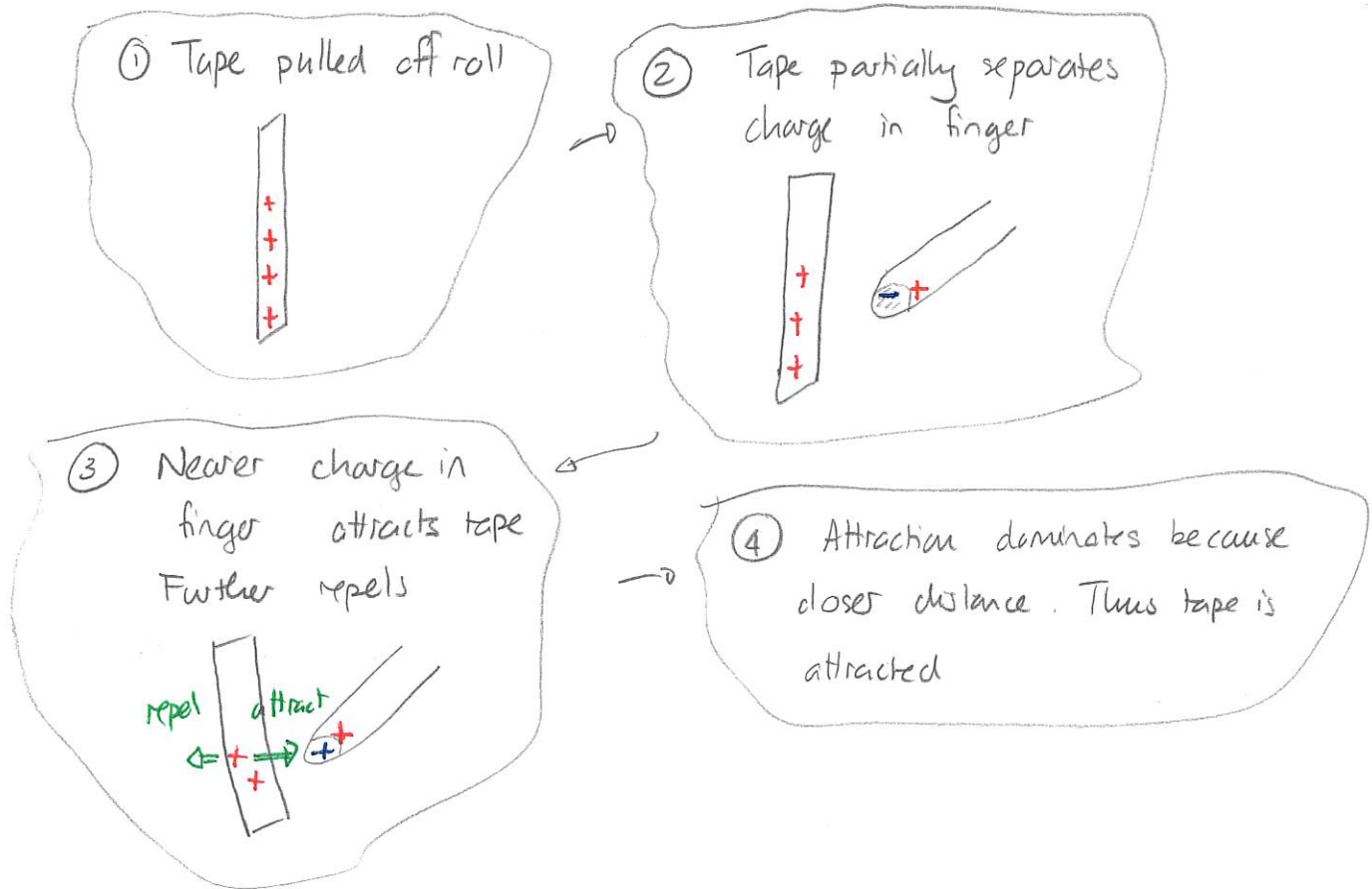
Quiz 5



Now consider a piece of tape that has been removed from a roll of tape. This process charges the tape.

DEMO: * Students pull strip of tape
* hold finger near end. + observe

The same process happens.



This means that there are electrical charges within human bodies. These electrical charges are responsible for all functioning of the body.

- * attracting charged objects
- * why one doesn't fall through a wall that one leans on
- * biochemistry and chemistry of the body.

In fact these are the dominant forces for all ordinary interactions between matter.

Quiz 6