

Weds: Read 8.2 - 8.3

Group Exercise

Fri: HW by Spm

Electric forces

Newton's system of mechanics requires that one is able to describe the forces that act on any object. The first detailed description of forces involved:

- * gravitational forces - Newton (17th century)
- * spring forces - Robert Hooke (17th century)

However, there are phenomena that cannot be described by such forces.

DEMO: Suspended rod/ball

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

Depending on the situation, there may be repulsive forces and gravitational forces cannot describe these. We say that such forces are electric and result from electric charge, a property that certain objects have.

1 Tape and charges

Remove two strips of tape, each about 5–10 cm long from a roll of Scotch tape. Stick them to the desk and then rub your finger over each a few times.

- Remove each piece of tape moderately quickly from the table. Hold them near to each other. Do they repel or attract each other?
- Based on the way in which each piece of tape was prepared as they are removed from the table, will they have the same type of charge or different types of charge?

Now stick on piece of tape to the desk. Stick another piece of tape to the tape on the desk. Remove the lower piece of tape without separating the upper piece. While they are attached to each other, gently rub your fingers over the pair a few times.

- Separate the two pieces of tape. Hold them near to each other. Do they repel or attract each other?
- Based on the way in which each piece of tape was prepared as they are separated, will they have the same type of charge or different types of charge?
- Use your observations to provide a rule about whether similar types of charge attract or repel.
- Use your observations to provide a rule about whether different types of charge attract or repel.

Answers: a) They repel

b) They were prepared same way \Rightarrow same type of charge.

c) They attract

d) They were prepared differently - one shared smooth side, other sticky side
 \Rightarrow different types of charge

e) similar type \rightarrow repel

f) different types \rightarrow attract.

Electric charges

There are two basic types of charged particle/objects

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

The tape experiment illustrates

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

Quiz 1 90%

DEMO: Image of Franklin

The amount of charge that a charged object has can be quantified. The standard units of charge are:

Coulombs $\sim C$

The origin of charge in normal materials is from subatomic particles that comprise all ordinary matter:

electron \rightarrow negative \rightarrow charge = $-1.6 \times 10^{-19} C$

proton \rightarrow positive \rightarrow charge = $+1.6 \times 10^{-19} C$

Most ordinary objects contain many electrons and protons. These usually balance each other in number. Then the total charge is

total charge = add up charges of all constituent particles.

If the number of electrons exactly match the number of protons, then the total charge is zero. This leads to:

An object is neutral \Leftrightarrow total charge is zero

When the two pieces of tape were rubbed this removed excess charge and afterwards they became neutral.

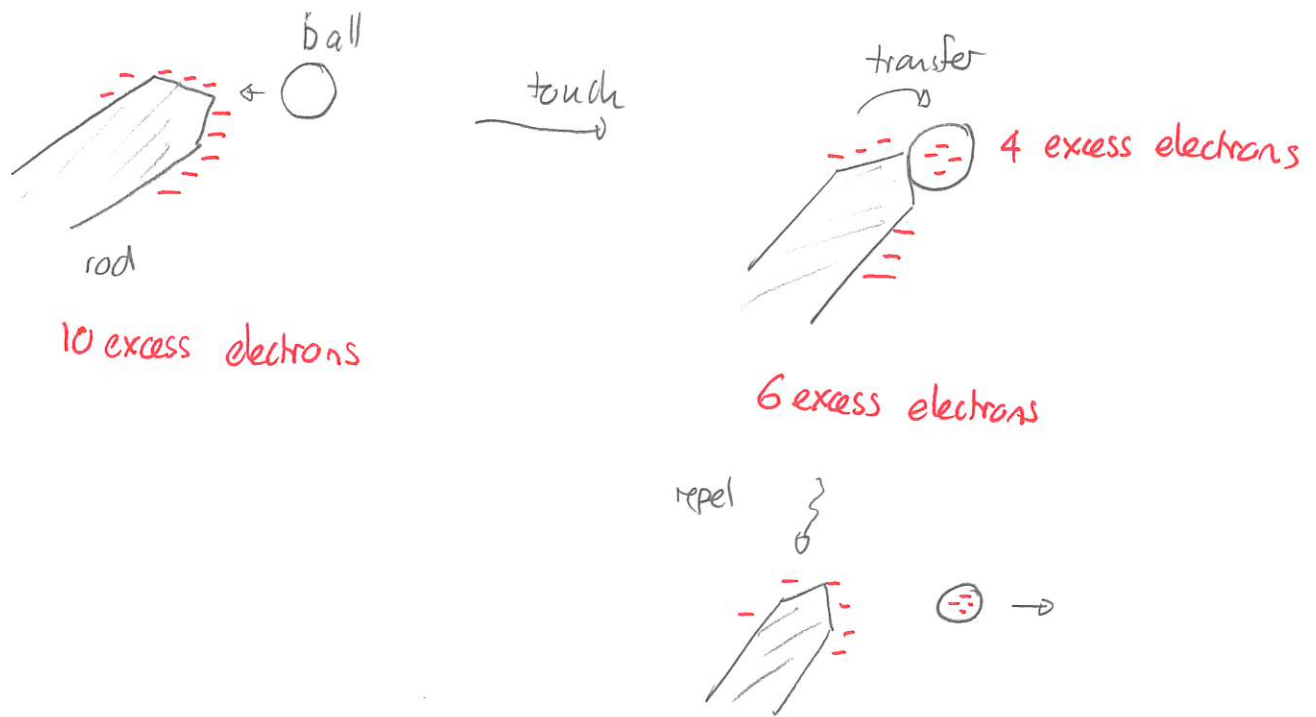
Quiz 2 90%

This is an example of the conservation of charge

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

The charges within a collection of objects can rearrange themselves. If the object is a conductor (e.g. a metal) the charges move easily and they rapidly rearrange. This explains one of

Quiz 3



There are subatomic processes in which charge can be destroyed or created. The total charge in such cases will always be conserved