Grade 9 Science

Electricity

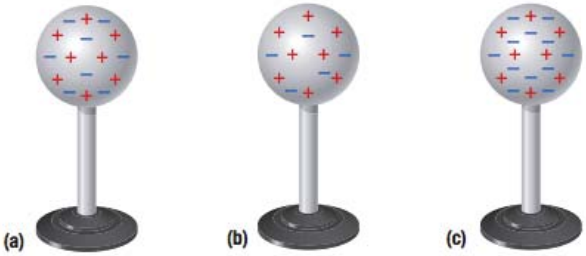
Class 10

Overall Expectations

- Assess some of the costs and benefits associated with the production of electrical energy from renewable and non-renewable sources, and analyse how electrical efficiencies and savings can be achieved, through both the design of technological devices and practices in the home;
- Investigate, through inquiry, various aspects of electricity, including the properties of static and current electricity, and the quantitative relationships between potential difference, current, and resistance in electrical circuits;
- Demonstrate an understanding of the principles of static and current electricity.

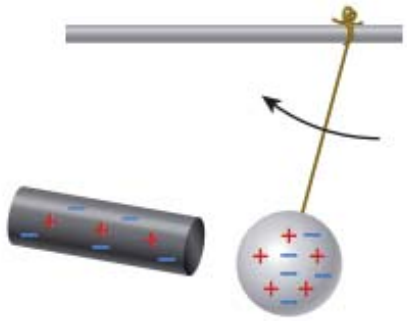
Static Electricity

- Neutral object = equal number of protons and electrons
- Positively-charged object = object with less electrons than protons
- Negatively-charged object = object with more electrons than protons

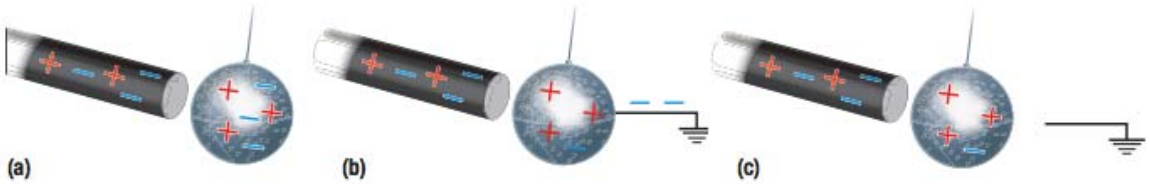


Static Electricity

- The imbalance of charge on the surface of an object
- Law of Electric Charges
  - Like charges repel
  - Unlike charges attract
  - A charged object exerts an electric force, which depends on the charge of the object and the distance between the objects



- **Charging by Induction**
  - **Charged object + Neutral object**
  - Charged object induces a shift in the electrons
  - Side facing the charged object will attract
  - Note: no electrons were gained/lost; only shifted
  - Electrons will return to normal positions when objects are separated; temporary



- **Charging by Induction (Permanent)**
  - **Charged object + Neutral object + Grounding**
  - Excess negative charges on one side are grounded so when you disconnect the grounding, the pith ball has a permanent positive charge

Table 1 Electrostatic Series

Material	Charge tendency
human skin	+ (weaker tendency to gain electrons)
rabbit fur	
acetate	
glass	
human hair	
nylon	
wool	
cat fur	
silk	
paper	
cotton	
wood	
amber	
rubber balloon	
vinyl	
polyester	
ebonite	– (stronger tendency to gain electrons)

- **Charging by Friction**
  - **Neutral object + Neutral object**
  - Objects rub against each other and electric charges are transferred from one object to another
  - Whether an object becomes positively/negatively-charged depends on the **electrostatic series**

Checkpoint

Table 1 Electrostatic Series

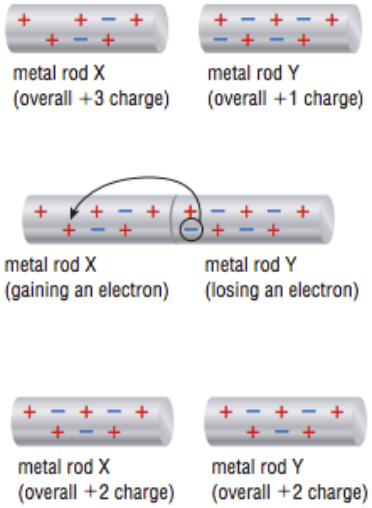
Material	Charge tendency
human skin	+ (weaker tendency to gain electrons)
rabbit fur	
acetate	
glass	
human hair	
nylon	
wool	
cat fur	
silk	
paper	
cotton	
wood	
amber	
rubber balloon	
vinyl	
polyester	
ebonite	– (stronger tendency to gain electrons)

When you rub each of the following together, which one will be positively-charged and negatively charged?

a) Rabbit Fur and Ebonite

b) Cat Fur and Glass

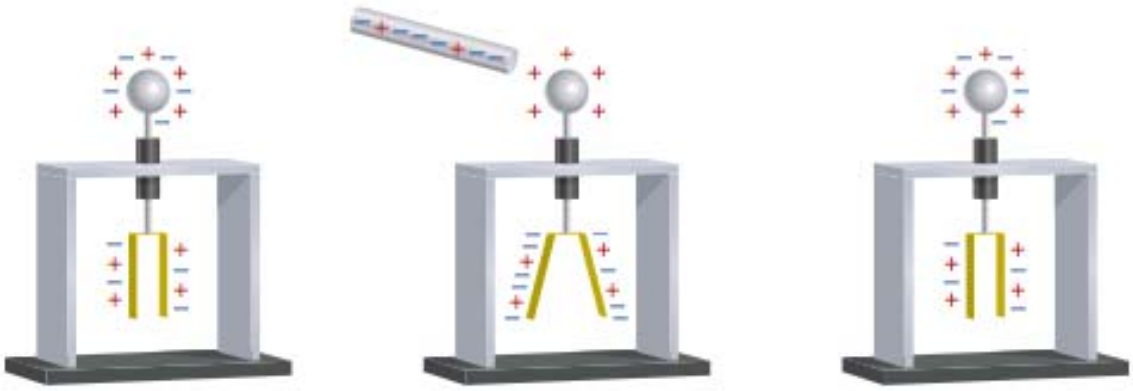
c) Wood and Vinyl



- **Charging by Conduction (Contact)**
  - **Objects with different amounts of electric charge**
  - Electrons move to the side with the smaller negative charge to balance out the negative charge

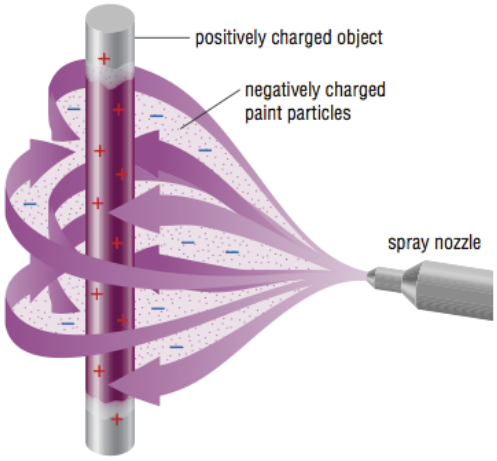
Detecting Static Electricity

- Pith-Ball Electroscope – tests presence of electric charge
  - Pith-ball will attract to the object if it is charged
- Metal Leaf Electroscope – tests presence of electric charge; more sensitive than pith-ball electroscope
  - Contact
  - Induction



Electrostatic Paint Sprayers

- Many industries use electrostatic paint sprayers to reduce the amount of wasted paint
- Paint is given a charge as it leaves the nozzle and the object that is being sprayed is given an opposite charge
- Useful for painting curved objects such the exterior of cars



Grounding

- Connecting any excess charge to a large object such as the Earth to remove the charge
  - Grounding a positive object – electrons from the ground move up to neutralize the (+) charge
  - Grounding a negative object – electrons move to the ground to neutralize the (-) charge

Conductors

- Objects that allow the movement of electrons
- Ex: Metals and some nonmetals

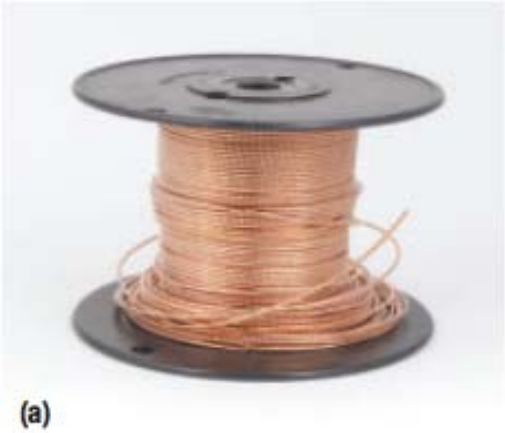

(a)

Table 1 Common Conductors

Good conductors	Fair conductors
silver	graphite (carbon)
copper	nichrome
gold	the human body
aluminum	damp skin
magnesium	acid solutions
tungsten	salt water
nickel	Earth
mercury	water vapour in air
platinum	silicon
iron	germanium

Insulators

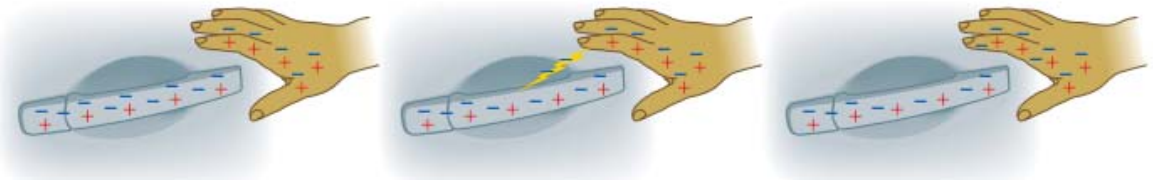
- Objects that prevent the movement of electrons
- Ex: Non-metals like plastic, wood, glass

Table 2 Common Insulators

Good insulators	
oil	plastic
fur	wood
silk	paper
wool	wax
rubber	ebonite
porcelain, glass	pure water

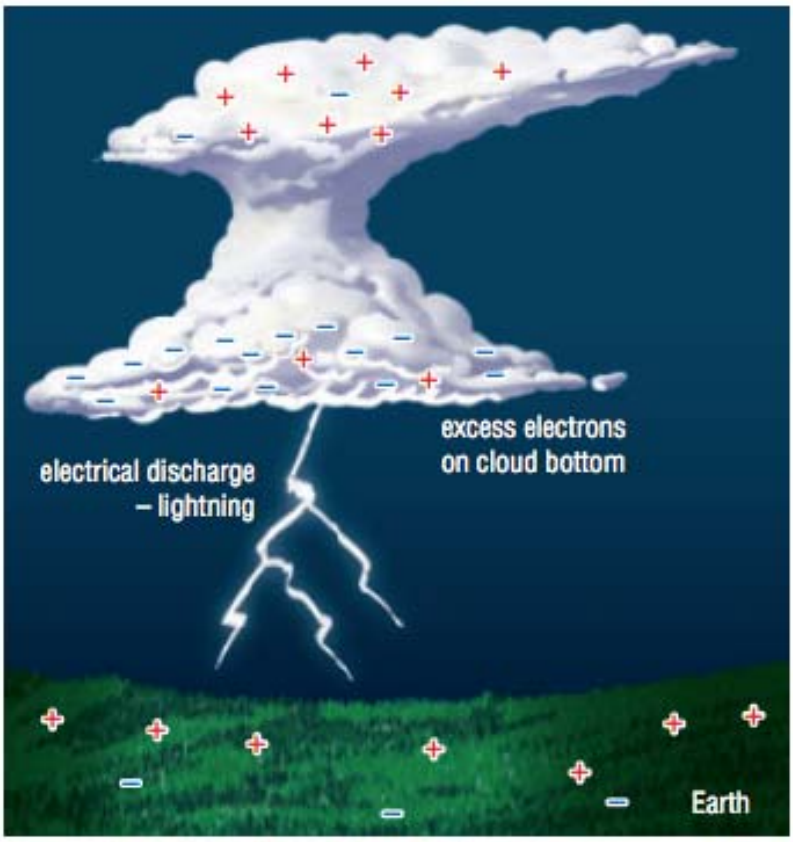
Electric Discharge

- The rapid transfer of electric charge from one object to another
- Electric Shocks
  - Your neutral hand reaches out to the negatively charged car door. Electrons transfer from car door to you causing a shock



Lightning

- Occurs due to an imbalance of electrons between clouds or between clouds and the ground
  - Negative charge on the bottom of the cloud repels the electrons on the Earth's surface
  - Charge imbalance causes the electrons from the cloud to transfer to the ground to produce lightning and thunder
  - Cloud to Cloud/Cloud to Earth/Earth to Cloud



Lightning Rods

- Provide a safe path for lightning to travel
- Lightning finds the easiest path to be grounded