

Date: 9/6/20

Tuesday

# STATIC ELECTRICITY

→ all objects are made of matter & its smallest part is atom

→ an object is conductor or insulator by nature

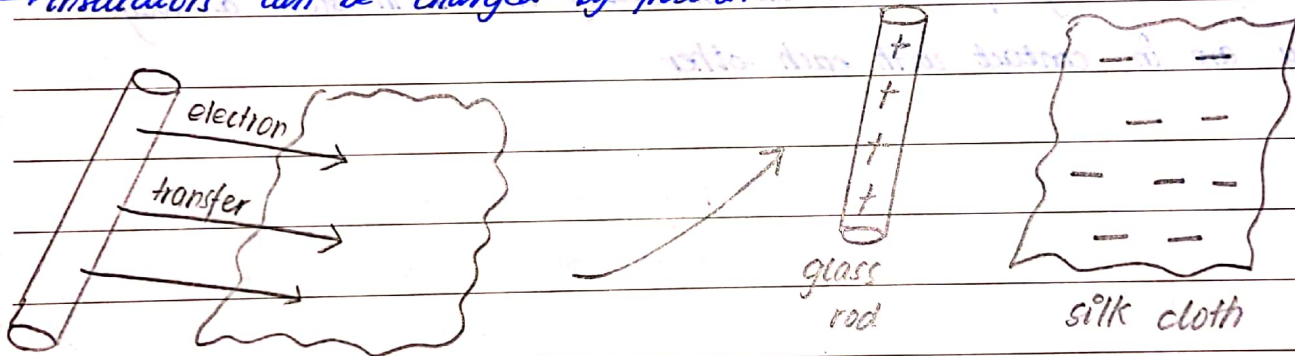
free electrons: a loosely bound electron of an atom which can come out of atom and can freely move within the material, either within atoms, from one atom to another, or just moving around

conductors: materials which have free electrons

insulators: materials which have no free electrons

## Charging of Insulators:

→ insulators can be charged by friction



→ if two insulating materials are rubbed against each other, one of the material loses electrons and the other gains it

↳ +ve charge

↳ -ve charge

→ like charges will repel each other

→ unlike charges will attract each other

Charging of a conductor:

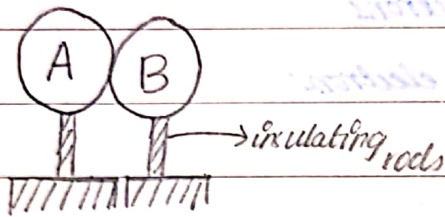
→ Electrostatic Induction is used to charge a conductor

uncharged

electrostatic induction: a process in which an uncharged conductor is charged by placing a charged conductor near it

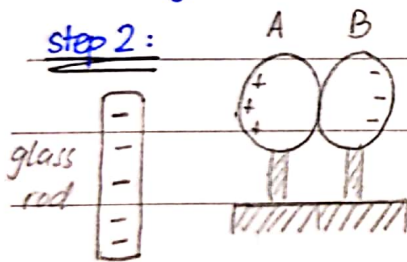
(i). Two conductors

step 1:



⊖ place two conducting spheres on insulating stands in such a way that they are in contact with each other

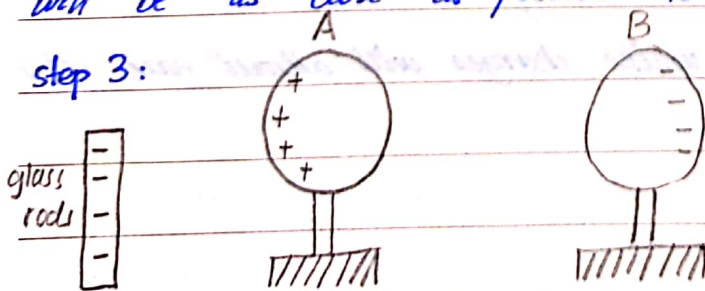
step 2:



⊖ place a negatively charged glass rod near sphere A

⊖ b/c of the negative charge of glass rod, the -ve charge in sphere B will move to the other side of sphere B, the +ve charge in sphere A will be as close as possible to the glass rod

step 3:



⊖ keep the glass rod near sphere A and move sphere B slowly to the

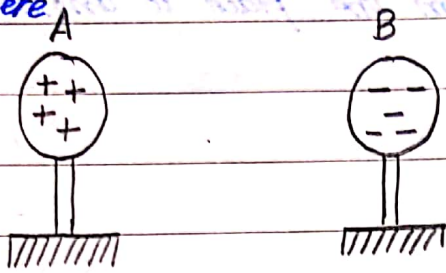


other side (out of contact with sphere A)

step 4:

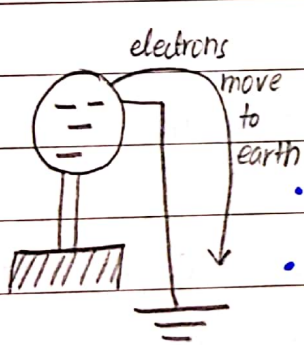
⊖ remove negatively charged glass rod

⊖ the charge  $+$  in sphere A and  $-ve$  charge in B spreads all over the sphere

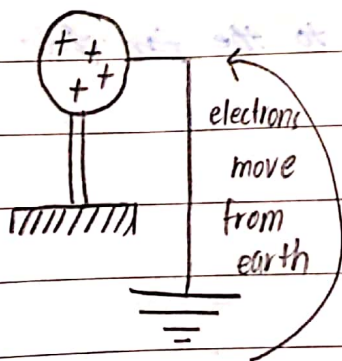


→ earth itself is a conductor

G & remains neutral no matter what, even if electrons are removed or added



- if this  $-ve$  charged sphere is connected with Earth through metal wire
- it means it is given earth/ground connection
- the charge in metal sphere flows to earth & it becomes neutral



- if this  $+ve$  charged sphere is connected with Earth through metal wire
- the electrons will as a result move to the sphere to neutralize it from earth

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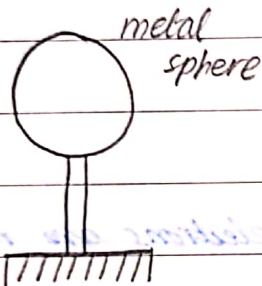
→ insulating stands were placed to avoid earth connection & neutralization

→ only electrons (-ve charge) moves b/c positive charge is always contained inside nucleus

↳ electrons need v. little energy to move from one place to another

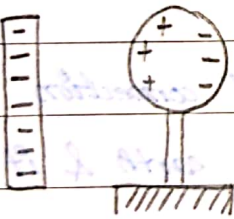
(ii) Single conductor

Step 1:



⊖ a metal sphere is placed on an insulating stand

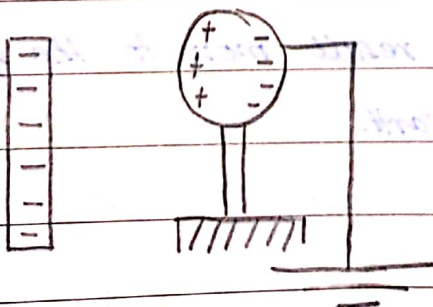
Step 2:



⊖ place a -vely charged glass rod near the metal sphere

⊖ +ve charge near side of rod and -ve charge moves to the far side of the sphere

Step 3:

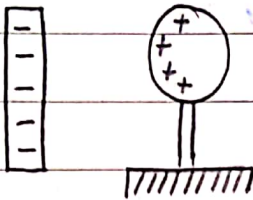




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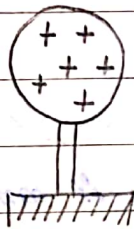
- ⊖ while keeping glass rod in original position and give the far side of the metal sphere Earth connection
- ⊖ the -ve charge flows to ground

step 4:



- ⊖ remove the Earth connection, the glass rod remains at its place
- ⊖ there is only positive charge left in sphere

step 5:

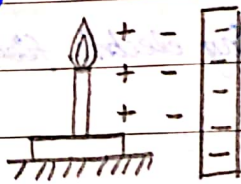


- ⊖ remove glass rod as well
- ⊖ the metal sphere is left positively charged

\* if the rod was +vely charged, when earth connection would be given to sphere, the electrons will flow from ground and neutralize all the +ve charge

### Discharging an Insulator

Heating method



- ⊖ placed charged insulator <sup>near</sup> a bunsen burner/flame



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- ⊖ flame removes an electron from air, the air becomes positive and electron becomes a -ve ion
- ⊖ b/c of its energy
- ⊖ numerous such ions are formed
- ⊖ the positive ion joins -ve charge and neutralizes

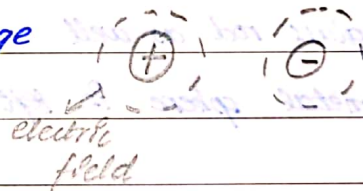
### Discharging a Conductor

Earth connection

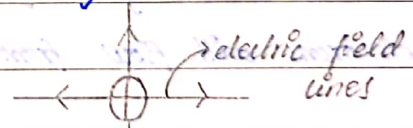
- ⊖ just simply give the charged object earth connection, depending on the charge of the object the electrons will either flow from or towards earth hence, neutralizing the object.

electric field: region around a charge within which it can exert a force on a unit +ve charge

- it is a charge's property

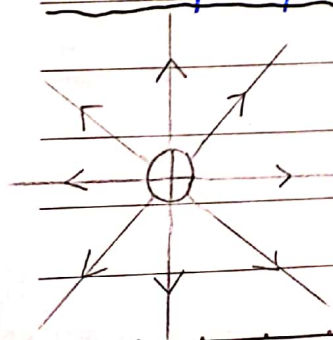


electric field line: path followed by a unit +ve charge within an electric field

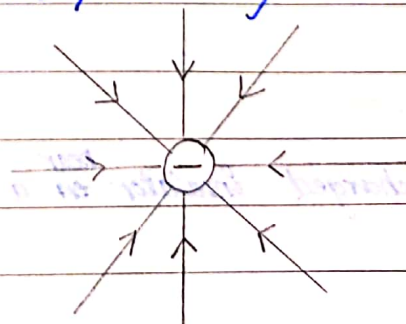


\* in diagrams always use electric field line instead of dotted circle

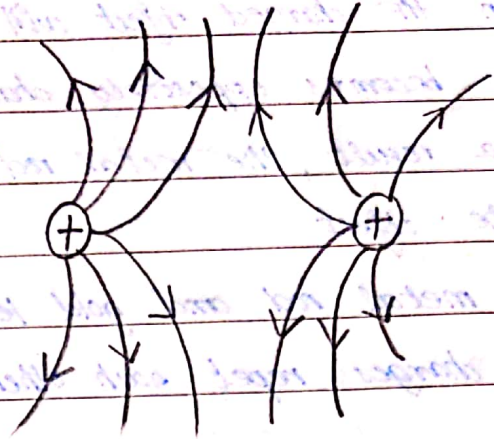
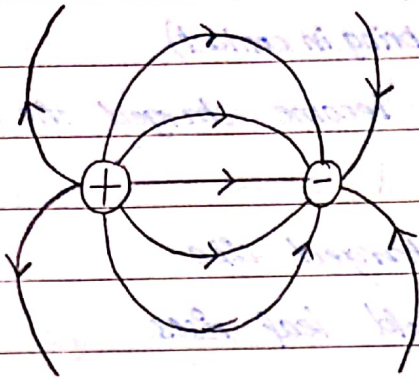
electric field pattern: representation of electric field using electric field line



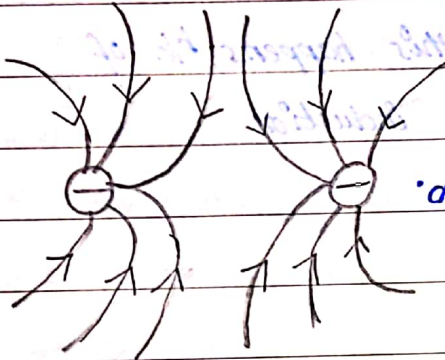
- straight e.f.l in both
- direction is different







direction away from charge



direction towards charge

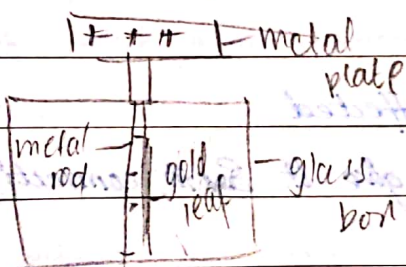
- strong electric fields have greater no. of l. per unit area
- weak " " " lesser no. " "
- strong ef = closer to each other - ef
- weak ef = further apart from each other - ef

NOTE :

①. ef are always directed from +ve to -ve charge

gold leaf electroscope :

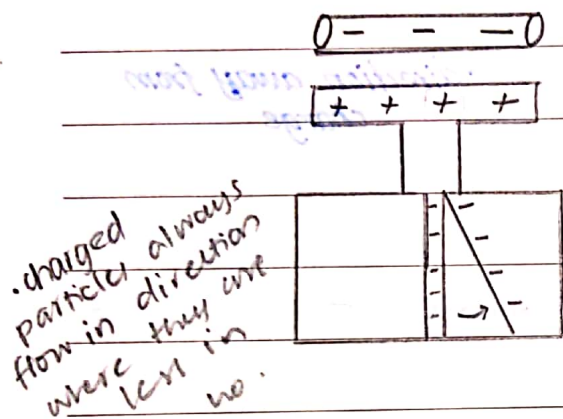
→ is used to detect presence of charge on an object



⊖ ⊖ ⊖ ⊖ ⊖ Glass rod / object to be detected

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- when the charged object will be placed near metal plate, the metal plate becomes oppositely charged (don't bring in contact)
- as a result, the metal rod & gold leaf become charged the same as the object
- the metal rod and gold leaf are charged like
- the charges repel each other and the gold leaf rises

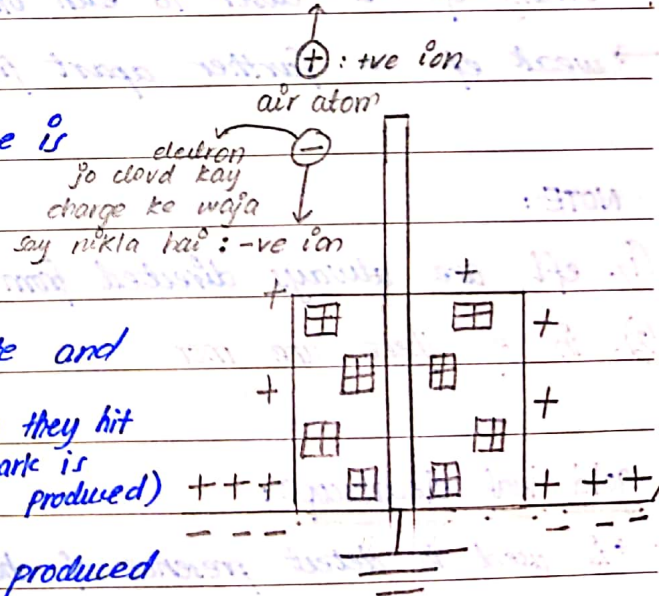
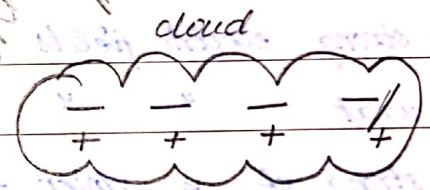


\* all of this happens b/c of electrostatic induction

### HAZARDS OF STATIC ELECTRICITY:

#### ①. Lightning ⚡

- friction b/w water & air molecules results in the cloud being charged
- b/c of cloud's charge, an opposite charge is induced on the ground
- the cloud ionizes air atoms
- the charge on the ground pulls its opposite and same thing happens in case of cloud (when they hit charge moves in air as a result spark is produced)
- b/c of movement of charge electricity is produced

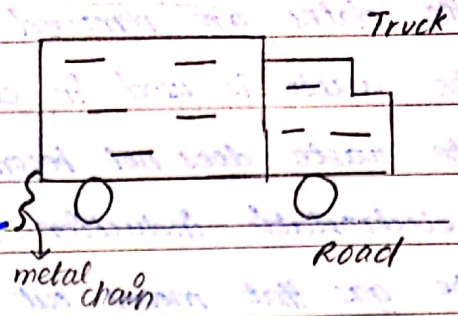


- \* → tall buildings and isolated structures are effected
- \* → pass a metal rod through the building and give it Earth connection



## ②. Electric discharge

- when a vehicle moves along a road
- b/c of friction b/w road and tyres
- the tyres are charged b/c of which the whole truck is charged
- spark may be produced in case of hitting of charges from ground to the ones in truck



- \* any flammable liquid or thing could catch fire
- \* otherwise, when touched by human beings an electric shock may be experienced (b/c the charge in truck is getting given earth connection through you)
- \* attach a metal chain which is being dragged with the truck which will help to give earth connection avoid charge accumulation in the truck

## USES OF STATIC ELECTRICITY

### ①. Electrostatic Precipitator

- fly ash is made up of dust and smoke particles
- ↳ produced by factories that use fuel
- an electrostatic precipitator is installed on the chimney of such factories as to avoid waste gas and fly ash to move into the air
- a -vely charged metal grid is placed in the middle of the electrostatic precipitator
- when the waste passes through the grid it becomes -vely charged
- at the top +vely charged plates are placed
- the waste is attracted & sticks to the metal plates at top
- the remaining gas that moves out of the precipitator is clean



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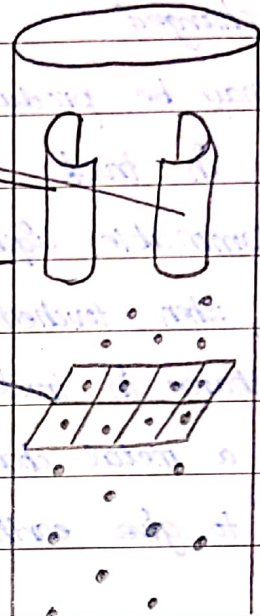
- the plates are removed & cleared
- the waste is used in cement for bonding material
- the waste does not become +vely charged b/c it is not a conductor & electrostatic induction is not taking place
- the gas that moves out is neutral

+vely charged metal plates

chimney

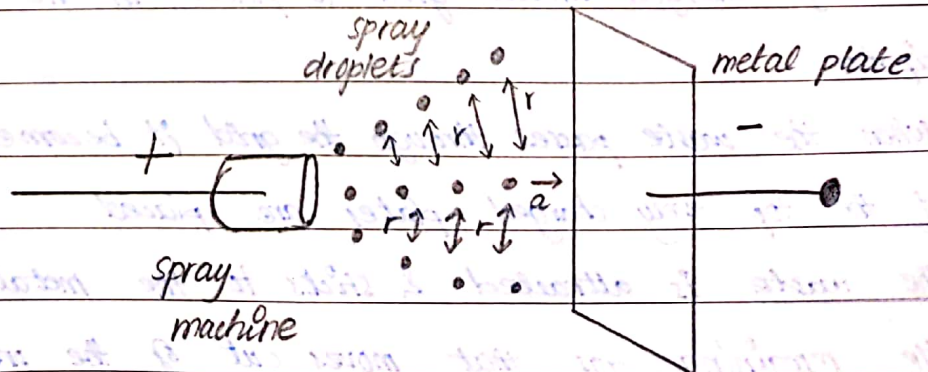
negatively charged metal grid/wire mesh

fly gas



## ②. Spray Painting

- a negative charge is given to a metal plate
- give the spray machine a +ve charge
- $\frac{1}{2}$  attraction hogi
- the droplets spread b/c of repulsion b/w them
- ↳ giving equal paint to whole plate
- the droplets are attracted to plate and none of them fall to the ground or waste





\* watch jach sherldrake video to see how photocopiers work