

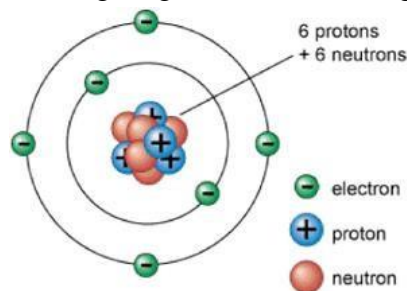
Chapter – 11: Chemical Effects of Electric Current

Static Electricity

- Remove synthetic clothes – hear crackling sound – if its dark – tiny sparks visible
- Woollen, synthetic clothes – gets charged – rubbed against skin – static electricity
- Walk on thick nylon carpet – touch a metal door – same effect
- 1st observed – Thales – Greek scientist – 2500 years ago
 - Noticed – amber rubbed with silk – tiny feathers attracted
- Activity –
 - Take a comb – rub it in your hair – tiny pieces of paper attracted

Electric Charges

- Rub 2 things together – both gets charged – opposite charges
- 2 types of charges – positive (+) and negative (-)
- 18th century – American scientist – Benjamin Franklin – realized these charges
- Universe – everything made of tiny atoms – all persons, chairs, tables, food, air, etc
- Each atom – charged particles – middle of atom – nucleus – positive charge (protons)
- Negative charge (electrons) – revolve around protons
- Like solar system – electrons like planets – revolve around – proton like sun
- Atoms – uncharged – remain neutral – balance between positive and negative charges
- This balance – disturbed – atoms – charged particles
- Atom – loses electron – positive charge – gains electron – negative charge



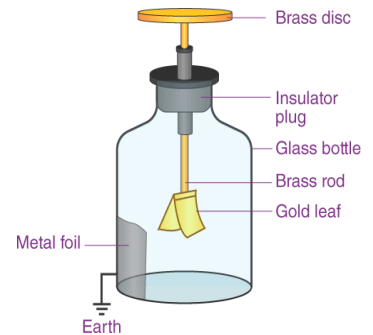
Charging of Bodies

- Charged by –
 - Friction –
 - One body – rubbed on other – different materials – transfer of charges
 - This energy – frictional electricity
 - Rub flannel over glass rod – flannel – negative – glass rod – positive
 - Conduction –
 - Neutral body – touches charged body – charges transfer
 - Induction –
 - Neutral body brought near charged body – electrons in neutral body – forced to move
 - This energy – induced electricity
- Charged bodies – following properties – fundamental laws of charges at rest

- 2 types of charges – positive and negative – charged body attracts neutral body
- Like charges – repel – unlike charges – attract
- Repulsion – sure test – determine (check for) charge
- Activity –
 - Take 2 balloons, 2 piece of threads, a woollen cloth, 1 broom handle
 - Blow up the balloons – hang them from broom handle
 - Rub the balloons – woollen cloth – repel each other

Electroscope – Charging by Conduction

- Device – detect, test – small charges
- Consists – metallic rod, metallic disc or cup
- Foot of the rod – metal plate – thin metal leaves
- Rod – held by insulating plug – transparent case – protect the leaves
- Rub glass rod – silk cloth – touch the disc
- Charges – transferred to metal leaves – they diverge (move away from each other)



Electric Current and Conductivity

- Flow of charge – electric current or electricity
- Electricity – most convenient, flexible energy
- Generated, stored, distributed – easily
- Easily convertible – heat, light, sound, energy
- Many practical applications – lives of people – changed so much
- Industrialised countries – people – use many electric devices
- Many materials – conduct electricity – allows electricity to pass
- How much conduction – depend on conductivity
- Conductors –
 - Materials – allow electricity to flow – easily
 - All metals, graphite, etc
- Insulators –
 - Materials – do not allow electricity to flow
 - Rubber, wood, glass, etc

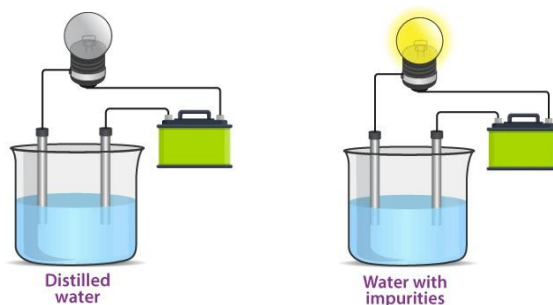
Conduction in Liquids

- Conduct electricity – metals require – lots of mobile (moving) electrons
- Some liquids – conduct electricity

Conductivity of water

- Pure, distilled water – mobile electron – no conduction
- Add some table salt – conductivity changes
- Tap water – added chemicals – conduct electricity
- Never use, touch – electrical devices – near water or with wet hands
- Electric current – may pass through body – electric shock

- Activity –
 - Fill a beaker – distilled water – make a circuit – instead of switch – dip both free ends in water – bulb does not glow
 - Dissolve some salt – bulb starts to glow



Conductivity of other liquids

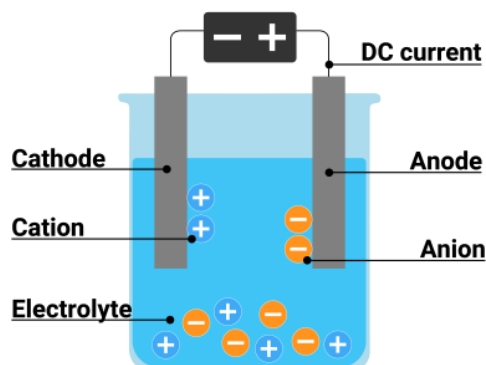
- Other liquids – also conduct electricity
- Many liquids – lemon, vinegar – conduct electricity – good conductors
- Some liquids – cooking oil, kerosene – bad conductors
- Bad conductors – may conduct electricity – specific conditions
- Sometimes – liquids – conduct electricity – not that good – bulb does not glow – weak electric current
- In such case – use LED – instead of bulb
- LED – works in weak current – 2 long wires – unequal lengths – longer one – connected to positive battery terminal – shorter one – connected to negative battery terminal

Chemical Effects of Current

- Electric current – through liquids – chemical action – electrolysis
- Example – water – current passed – breaks into hydrogen and oxygen
- Liquid – contains metals – electrolysis – breaks up solution – metal removed
- This process – useful – coating metal on objects – refining, purifying metals
- Liquids – break up into charged particles – conduct electricity – electrolytes

Process of electrolysis

- 2 solid electrical conductors – metal or graphite rod – placed in electrolytic solution
- These rods – electrodes – connected to battery
- Electrolyte – allows electric current to flow
- Electrode – connected to negative battery terminal – cathode – carries electrons – battery to solution
- Electrode – connected to positive battery terminal – anode – carries electrons – solution to battery
- Reaction – depends on – electrodes, electrolytes



Electrolysis of copper sulphate solution

- Copper plates – used as electrodes
- Current – passed through copper sulphate – divides into copper ions, sulphate ions
 - $\text{CuSO}_4 \rightarrow \text{Cu}^{2+} + \text{SO}_4^{2-}$
- At anode – copper metal – lose electrons – produce copper ions
 - $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$
- Positive copper ions – move to cathode – gain electrons – deposit there
- Loss of copper in solution – equal copper dissolved in solution
- This way – entire anode – dissolved in solution
- Sulphate ions – does not take part – copper – keeps depositing on cathode
- This process – used for purification
- Electrolysis – used for many things – production and purifying
- Example – electrolysis of Sodium Chloride (NaCl) – produce caustic soda

Electroplating

- Deposit layer of metal on another metal – surface more decorative, resistant to corrosion – electroplating
- Steel – strong metal – used for many things
- BUT – steel rusts – protect by covering it with something
- Either paint it – OR – coat chromium on it – chromium plating
- Electroplate spoon with silver – dissolve Silver Nitrate (AgNO_3) in water
- Spoon – connected to negative terminal – become cathode
- Silver bar – attached to positive terminal – become anode
- Current passed into solution – divides into silver ions (positive) and nitrate ions (negative)
- Silver ions – attracted by spoon – sticks to it
- Nitrate ions – attracted by anode – silver bar
- Loss of silver – silver dissolved from bar to solution
- This process – continue till spoon is covered in silver
- 2 main advantages –
 - Protects metal from corruption
 - Provides shiny finish to surface
- Uses –
 - Manufacture – PCB (printed circuit board) – televisions, computers, etc
 - Jewellery – made of cheaper materials – coated with gold, silver
 - Water taps – electroplating – looks shiny – protected from rusting, wear and tear
 - Cans – made of iron – may react to food – coated with tin
- Electroplating – done in many factories – waste product disposed – very harmful

