Gravitation

GF – the force which pulls us towards the earth.
- GF hold all planets in its orbit.

Newton's law of Gravitation
- every particle in the universe attracts every other particle with a force that is F = G. $\frac{Mm}{r2}$ (is directly proportional to the product of their masses and inversely proportional to the square of the distance b/w them)

Centripetal force:
- force directed towards the centre.
- may be GF, frictional force etc.

Centrifugal force
- acts outwards equal & opposite to centripetal force
- @ poles – weight increase, @ equator – weight decreases
  1. earth shape 2. rotation causes – centrifugal force
  causes – centrifugal force @ poles – 0, @ equ – max.
  If rotation stops – weight increase
  If rotation increases – weight decreases

Mass
- measure of quantity of matter contained in it.
- mass of a body – constant quantity.
- whereas weight varies from p-p
- surface of the moon = g $\rightarrow \frac{r}{6}$th of that an earth g = 9.8m/s²
- ex. lift – accelerate – upward downward cable cut.
- W = mg W – weight; mg – mass accel. due to gravity

Centre of gravity:
- In a spaceship – state of weightless ness.
- Centre of gravity of a body is the point where the whole weight of the body can be considered to act.
- If the vertical through the cg passes through the base of a object then it is stable.
- racing cars, river in a boat, person bend in uphill & downhill.

Artificial satellites
- principle the stone with such tremendors speed that radius of its path become a little greater than the radius of the earth, the stone would never full on the earth & would keep revolving around it.
- centripetal force = GF.
- $\frac{mv2}{r} = \frac{GMm}{r2}$ = r = $\sqrt{\frac{Gm}{r}}$
- $\frac{mv2}{r}$ = mg ; v = $\sqrt{rg}$
- speed of the satellites does not depend on its mass or at a particular distance from the earth, all objects would here the some speed of revolution.
- If gaseous molecules have escape velocity < 11.2 km/sec they cannot escape from the earth's field.
- satellite launches @ equator & in eastward direction.
- Total energy of a satellite negative –then only it may be followed circular /elliptical orbit.
- Escape velocity – the min. velocity to escape away from Earth's gravitational field is 11.21 km/s

Kepler laws
1. All planets move around the sun the elliptical orbits having sun @ one force.
2. The area speed of planet around the sun's constant.
3. The square of the period of revolution α the cube of its mean distance from the sun T^2 α 9^3

Geo-statimary satellites – 36,000 km – 24 hrs – time period
polar satellites – 700 – 900 km = 102 mh
Uses of satellites – commn., weathering, remote sensing, Navigation

Indian space prog:
- 1960 started with extant, of Thymbaeverstorial (rocket launching)
- Father of Indian space – prog – Dr. VikramSarabha
- Ist by DAFE (Atomic Energy)
- now carried out by Do. Space since 1972
- Ist state – Aryabhatta – 1975 (April)
- Baskara, Rohini

TEMPERATURE

heat& temp lift 61st ex. hot spoon with warm water.

Internal energy (it)
- Iron rail with hammer
- water fall below.

Heat
- form of energy unit – cal/joule (J)
- It transferred from the body to another due to temp. difference. 1 cal = 4.18 joule

Temp:
- the measurement of hotness / coldness of a body.
- heat always flows from a body @ higher temp to lower temp. body.
- To measure – Thermometer.

Scales of temp.measurement:

	Centigrade	Fahrenheit	Reavmur	Kelvin scales
Upper point	100°C	212°F	80°R	373 k
Lower point	0°C	32°F	0°R	273 k

Relation b/w diff. scales.

$\frac{c}{5} = \frac{F-32}{a} = \frac{R}{4} = \frac{k}{5}$

1. -40° - the temp @ which Celsius & Fahrenheit scales read same.
2. 0 – the temp @ which Celsius & Reaumur scale read same
3. @ farenheit& kelvin = +574.25
4. @ Farenheit @ Revenue = -25.6
5. normal temp. of a body 37°c / 98.4°F
6. clinical thermomter reads 96°F to 110°F 35°c to 43°c (or)

Triple points of water – A substance is found to exist in 3 states. (solid, liquid, Gas) is 273.16 K

Y mercury in thermometers
1. does not stick to glass & does not vapourise much.
2. good conductor of heat
3. opaque& shining.

Meters
- Bolometer – measures heat radiation.
- Calorimeter – measures quantity of heat.
- Beckmann thermometer – measures small changes in temp (as small as 0.01)
- cyrometer – measure low temp
- pyrometer – measures very high temp. [> 800°C]
- measures temp. by measuring the radiation emitted by the body.s

Thermostat – regulates the temp @ a particular point (ex. ovens) refrigerators)
- Freezing point & mercury is - 39°C ; hence to measure temp below this freezing point of alcohol is - 11°C

Specific heat: - The amount of heat required to raise the temp of a unit mass of the substance of 1° C unit – J/kg° -C
- specific heat of water is maximum mercury – has low SH
- gold – 130 J/kg° C
- specific heat increase with rise in temp. but specific heat decrease with rise in temp from 0° C to ≈ 40° c after which it increase with temp.

Latent heat – The amount of heat absorbed / given mt by a unit mass of a substance to change its state without change in temp.
- unit = J/ kg $L = \frac{Q}{m}$ Q = amount of heat; m = mass of substance.
- ex. hot water, burns are less severe than steam water (has high LH)
- Latent heat of fusion of ice 80 cals.
- Latent heat of vapourisation of water its 536 cals.
- Melting point decreases on adding impurity

Boiling point
- increase on adding impurity
- increase on increase pressure – ex cooker, ice, cast iron.

Super cooling
- cooling a liquid below freezing point without turning it to a solid. ex. water can be supercooled to temp as low as -12°c

Super heating
- Heating a liquid above its boiling point without converting it vapour state ex. water can be heated upto 137° C w/o boiling.

Heating curve of a solid
Thermal expansion
- increase in size on heating A solid can indigo 3 types.

i) Linear expansion (in length)
ii) superficial expansion (in area)
iii) cubical expansion (in volume)
ex. 1.pendulum runs faster in winter, slower in summer b'coz its length increase in summer.

2. Bridge rail track
hence @ 4° C, water has its min. volume & max. density.
Almost every liquid expands with the increase in temp bt. when temp of water is increased from 0° to 4° c. it volume decrease (After this volume increase)

Transmission of heat:
1. conduction
- heat transferred w/o bodily movt. of the particles.
- medium required.
- In solid mercury also
- particles do not leave their mean position.
- slow process
- Irregular

2. convection
- by the bodily movt due to difference in densities of diff. parts of medium.
- medium required
- In all liquid & gases erupt mercury. ex. ventilators, chimneys land, sea breezes.
- particles leaver their positions.
- slow
- irregular

3. Radiation
- quick way of transmission of heat
- no medium
- ex. heat from the sum reaches the earth
- no particles involved.
- In this, heat transferred at the speed of light.
- straight line.

Perfectly black body:
- Body which neither reflects nor transmits the radiation falling on it.
- absorbs all radiations falling on it.

Kirchhoff's law
- Signifies that good absorbers are good emitter.

Newtons law of cooling
- The rate of loss of heat by a body ∝ The difference in temp b/w the body & the surrounding.

Stefan's law
- $E \propto T^4$; $E = \propto T^4$
- The radiant Energy emitted by a black body per unit area per unit true ∝ 4^{th} power of its absolute temp.

- All metals are good conductors of heat silver – best conductor.
- good conductors of heat are good conductors of electricity eruption silica – good conductor of heat, bad conductor of electricity.
- Bad conductors of heat – ex.; Air, wood, ebonite, rubber.
- In winter wooden chair appears hot, than metal chair.
- highly polished surfaces are bad absorbers emitters but they are good reflectors.
- cooling utensils are made of aluminium, Brass & steel.
- These have low SH & high conductivity.
- In deserts, sand that very low SH. day-hot night-cold
- Ice in tumbler, hotter in cloudy night in woollen blanket.
- human breath is visible in winter – air is cold from nose WV – condense & making it visible

Wave Motion (WM)

- Light & sound – propagated in the form of waves WM – the transfer of energy without the net transfer.
  Ex.string tied @ one end of free @ the other end. In then case wave motion of the particles - perpendicular to wave motion. (transverse waves)

  Wave frequency = $\frac{vibration}{sec}$ Hertz (Hz)

Longitudinal waves - parallel to the wave motion.

- but – in pond with stone complex waves – both transverse &longit. waves characteristics.

Waves
Mechanical waves

1. waves require medium for their propagation (solid, liquid, gas)
2. Types : Longitudinal, Transverse.
   Longitudinal – If the particles of the medium vibrate in this direction of propagation of a wave, that wave is longitudinal ex. sound waves in air waves on springs.

Amplitude – Max.displacement of a vibrating particle of medium from its mean position.

Velocity of wave- Freq x wavelength

Electromagnetic waves: (EM)

- These are produced by accelerating charges.
- do not require medium
- wavelength range 10^{-4}m to 10^{4} m
- as transverse wave in nature.
- travel in vaccum @ a speed of 3 x 10^{3}m/s

Hertz experiment in 1888

- An oscillating electric charge radiates EM waves.
- The energy of these waves is due to the kinetic energy of oscillating charge.

EM spectrum

- The orderly distance of EM waves according to their wavelength / freq.
- All EM waves travel with the velocity of light.

Name	Source	Wavelenght(m)	Freq (Hz)	Uses
γ rays	Nuclear reactions	10^{-14} – 10^{-10}	3 x 10^{22} – 3 x 10^{18}	Inform of nuclear structure & treatment of cancer.
x-rays	High energy	1 x 10^{-10} – 3 x 10^{-8}	3 x 10^{18} – 1 x 10^{16}	Diagnostic tool in medicine Study the crystal structure in solids
UV	Atoms & molecules in an electrical discharge	6 x 10^{-10} – 4 x 10^{-7}	5 x 10^{17} – 8 x 10^{14}	To destroy bacteria & sterilize surgical instruments detection of forced documents finger prints in forensic lab
Visible light	Incandescent solids fluorescent lamps	4 x 10^{-7} – 8 x 10^{-7}	8 x 10^{14} – 4 x 10^{14}	Provides information along the world
micro	Electronic device	10^{-3} – 0.3	3 x 10^{11} – 1 x 10^{9}	In radar commn. system ovens
Radio	Charges accelerated through conducting wires	10 - 10^{4}	3 x 10^{7} – 1 x 10^{4}	Radio &trcommn. systems AM band – 530 khz – 1710 khz TV waves – 54 Mhz – 80 mhz FM – band - 88 mhz-108 mhz
Infrared	Molecules of hot bodies	8 x 10^{-7} – 3 x 10^{-5}	4 x 10^{14} – 1 x 10^{13}	Cellular phones – ultra high freq. (UHF) band. In physiotherapy infrared

				lamps used. In weather forecasting infrared photos - infrared radiations are not abosorbed by air, log, mist etc they r used to take photograph of long distance objects. To study molecular structure

HIWI – detected disease drunker drive through / Radiation device.

Energy ∝ frequence
VIBGYOR – max. freq, max. energy.
lowfreq, low energy

AM – Amplitude modulation.
Radio broadcasting stating use sound crystals of quartz that vibrate hundreds of thousands of time each sound ensuring a constant radio frequency.

Radio & TV transmission
- ionosphere – reflects radio waves from stations.
- TV signals weaker b'coz of earth's curvature & unit geostationary satellites used.

DTH – digital – quality in picture & stereo sound tech.
Prog. Sources (channels) → broadcast centre→ true satellite – dush→ receives.
- improvement of vision in low-light environment.

Night Vision – uses in night driving /flying, night security & surveillance, wildlife observation, sleep lab monitoring, search & rescue etc. infrared used.

RADAR – Radio detection & ranging
- high free radio waves for detecting objects like ship & planes.
- The time interval b/w transmission & reception of pulses helps determine the distance (rotating and sends pulses)

Oven- Microwaves are generated in the oven @ the frequency of 2450 MHz. by means of magnetron.
- Microwve Utensils are made up of glass. not metals block mt. micro wves glass & papers do not absorb microwves& do not heat up.

Computed tomography – Used in diagnostic studies of internal body structures.

Work – when a body is displaced by applying a force on it, then works its said to be done. W – F.S – F.s. cosθ
F- Force s – distance. Unit – Joule
Positive Work done – Force it parallel to displacement ie horse pulse a cart on level road.
Negative work done – Force is opposite to displacement ie body slide over rough surface.
Zero work done – If either the force/displacement in zero iehelp of string body in circular path.

Energy: capacity of doing work / unit – joule
loss of PE – gain of KE
Mechanical Energy – potential – mgh – work – done on the system PE – increase ex. string compression stretching attract.
work done by the system PE – decrease stretching attract.

Kinetic: energy possessed by a body by virtue of its motion KE – ½ mv^2
momentum – P = mxv $P^2 \propto KE^4$
- KE of air is used to run wind on its of running water to run water mills.
- bullet filed from a gun.

Transformation of Energy
E- energy m – mass c- velocity of light
Einstein $E = mc^2$

Power = $\frac{work}{Time}$ i.e. time rate of doing work
unit = watt & also measured in horse power.
1 W = 1 J/S
1 KW = 10^3 W
1MW = 10^6 W
1 HP = 746 W
1 Watt second (w-s) = 1 J
1 Watt hour (W-h) = 3600 J
1 Kwatt hour (KW-h) = 3.6 x 10^6Js

SOUND

- Longitudinal & Mechanical waves.
- Requires medium, comparatively air is relatively poor conductor of sound.
- Audible – 20 Hz to 20,000 Hz.
- Sensitive to human ear
- Intrasonic< 20 Hz ⇙ elephants, whales
- Ultrasonic > 20,000 Hz ⇙ dog, cat, bat (80,000 Hz), mosquito can detect.
- Dolphins produce 1 lakh Hz : which enable then to locate each other under water.
- Ultrasonic Used For:
  1. Sending signals.
  2. Measuring sea depth
  3. Cleaning clothes & machinery parts of clocks
  4. Revamping lamb shoot from chimney of factories.
  5. Ultrasonography
  6. Detecting flaws in the interiors of solids
  7. Destroying micro organisms
  8. Mapping underground structures for oil & mineral deposits.
- Loudness ⇙ Related to the energy of the waves & depends on amplitude.
  - Loudness Measured in decibels (db)
  - Noise level > 85 db⇙ can impair / damage hearing
  - Increasing loudness by Increase mass of air
  - Instruments have sound boxes. when the box vibrates it mores a large amount of air & increase loudness.

Ex. Whisper – 20 db
Ordinary speech - 30 db
Traffic – 70 db
Thunder – 100 db
Amplified music – 120
Jet (30 m away) – 140 db

Speed of Sound

- In dry air, @ 0^0, the speed of sound is about 331 m/s(780 miles /h)
- Speed of sound ∞ humidity&sound ∞ temp
- Speed @ temp $V_t = V_o + 0.61\ t$
- Increase 0.61 m/s for every 1^0 C
- Speed of sound 1) depends on the medium more is solids & least in gases 2) depends upon elasticity & density of medium
- Speed remains unchanged by ↑ or ↓ of pressure
- Speed of sound < speed of light (3×10^8 m/s)

Medium	Speed
Air	331 m/s
Water	1450 m/s
Steel	5000 m/s

Ex. Thunder is heard much after the flash of lightening.

Echo

- When a sound wave is reflected by a distant substacle (wall/cliff) – echo is produced.
- Echo to be heard separately from the original sound, it must arrive 0.1 sec after the original sound is made.
- minimum distance required to be heard – 17 m
- If it is < 17 m, echo can't be distinguished more than one echo heard – **Reverberation** i.e. series of echoes due to more than one reflecting surfaces.
- In ultrasonics, echo used.

Refraction of sound:

When successing layers of air have diff. temp, the ability of sound to travel faster in warm air than in cold air causes bending of sound. This bending – Refraction.

Resonance:

Any vibrating object has a natural frequency, which depends on factors (electricity & shape of the object)

Whenever an object/system is set in oscillation at its natural frequency , as a result of impulses received from some other system vibrating with this same frequency, resonance said to have occurred .

Ex. Diver jumping on diving board, Suspension bridge – soldiers.

Doppler - Effect:

The change in frequency of a wave (sound/light) due to the motion of the source / observer

When the distance b/w the source & observer decreases the apparent frequency increases& vice-versa.

Ex. Train whistle.

- By this effect
  i) Price used to measure speed of vehicles.

ii) In an astronomy

1. To find out star approaching US receding away from us.
2. Expanding universe.

LIGHT

- The form of energy which causes the sensation of vision
  Some are – self Luminas bodies – ex. Sun
  Some are – Reflecting bodies – ex: planets
- **Ray** – The direction of the path taken by light
  Represented by a live with an arrow on it
- **Umbra** – If a light from a small hole, the shadows obtained in a region of total darkness
- **Penumbra** – If an extended source of light is used the umbra is surrounded by a region of partial darkness.
  Ex: during Shadows, eclipses.
- The formation of shadows with sharp edges demonstrate the rectilinear propagation of light (i.e) the fact that light travels in straight lines.

Reflection:

- When a light in incident upon a surface part of its reflected.
- It certain surfaces (mirrors & polished metals) reflects almost all the light incident upon them.

Image formations characteristics

1. Virtual
2. Laterally inverted
3. Image is the same size of the object
4. It is as far behind the mirror as the object is in from of it.

- U do not see an images in wars like mirror – b'coz roughness & wall surface.
- In rough surface – reflected rays or scattered in all directions.

Diffuse reflection

Inclined mirror object is placed b/w 2 inclined mirrors, several images of the object – formed.

$$\text{No. of images} = \frac{360}{angle\ \frac{b}{w} mirrors} - 1$$

1. @ 90° - 3 images produced.
2. Parallel mirrors – infinite no. of images.

Kaleidoscope – in which multiple images are formed by 2 strips of plane mirrors place @ an angle of 60°
-Operates on the principle of multiple reflection

Curved mirrors

i) Concave ii) Convex

These mirrors made by **depositing vaporized aluminum on a glass surface** which would form a past of sphere.

Deposits outside – concave; Deposits inside – convex

Concave: It can be used as a burning glass. Used in

1. Solar coolers 2. Telescopes

Another type of concave – Parabolic mirror
When small bulb in at F, it reflects a parallel beam of intensity.

Ex. Headlamps of cars & search light

Convex: Produces virtual images (are erect & smaller than the objects)

Ex. Rear view mirrors in vehicles – creates wide view

But in plane mirror – narrow view

Refraction: light bends when it passes obliquely from one medium to another.

Ex.From air to water / glass.

It light enters the same medium does not bend
refractive index of a medium $= \frac{light\ speed\ in\ vaccum}{light\ speed\ in\ medium}$

Ex:
- Stone in pond
- Shortening of person's body
- Seeing sun horizon
- Twinkling of stars.

MIRAGE – effects of atmospheric refraction
Associated with hot deserts when an angle of incidence exceeds the critical angle and therefore total internal reflecting takes place.

Total Internal reflection

If the angle of incidence of light in the denser medium is greater than a particular angle

known as the critical angle for that medium. The light is not at all refracted into the rarer medium but it is totally reflected.

Optical fibre

Covers long distance in remote sensing as sensors.

Ex. - In endoscopy used tiny optical fibers to see the inside patient stomach
- mirage in deserts.

Dispersion:

- ❖ White light consists 7 colors (spectrum of white light - VIBGYOR)
- ❖ In vacuum–All these have same speed between in transparent medium – speed varies.
- ❖ Violet – slowest speed in glass but red faster due to different speed, colors refracted through different angles white light passes through a glass prison.

Ex. Rainbow- formationdue toTotal internal reflection & refraction by dispersion of light.

- seen opposite to the sun
-After a shower of rain
-Due to dispersion of sunlight by water droplets suspended in air after rain.
- In each droplet, these on dispersion & total internal reflection.

Mining coloured light

- ❖ White ⇙ Red + Green + Blue
- ❖ RGB ⇙**Primary colors.**
- ❖ 2 colors which put white when put together we called **complementary colors.**

G + M = White R + G = Yellow C + Y = Green
B + Y = White R + B =Magenta
C + M = Blue
R + C = White G + B = Cyan M + Y = Red

CRT – [Cathode Ray Tube**]**

consume lot of power, not good quality

LCD (Liquid Crystal Display)

Advantages – Lightweight construction, portability large screen size than CRT TVS low power consumption, battery powered electronic equipment.

Plasma Display Panel (PDB)

- Gas tubes
- Power consumes as much power as CRT TV
- Image very bright, wide view angle.

LENSES

- ❖ used in all optical instruments that produce images cameras,projectors, telescopes, microscopes)
- ❖ Used in spectacles to correct defects.
- ❖ Made mostly of common glass.
- ❖ Convex – (converging) ex. Microscope , forms a real image
- ❖ Concave – (diverging) image – erect, diminished Modem models @ a speed of 24 frames / sec.

Defects of vision

- ❖ Normal – about 25 cm
- ❖ Long sight (hypermetropia) – cannot see near object.
  - Use converging lens (Convex less)
- ❖ Short sight (Myopia) – cannot see long distance object
  - Use diverging lenses(concave lens)

Power of lens

Power of length reciprocal of its focal length in meters

$P = \frac{1}{f}$ Unit – Dioptre(D)

Lens Camera

- ❖ in front – lens
- ❖ more converging lens used to minimize the defects of the image
- ❖ shutter b/w lens & the film

Compound microscope

- ❖ for magnifying minute objects
- ❖ consists of 2 short focal length converging lens - objective , eye lens.
- ❖ Produces real & enlarged image & inverted magnification of distant object.
- ❖ In an astronomical telescope
  Objective lens (convex lens) - large focal length
  Eye lens(convex lens) - short focal length

- ❖ In an Galilean telescope

Eye-piece - concave lens of short focal length.
Objective lens -convex lens of large focal length.

Scattering of light – Red light scattered the more

Interface of light – The super position of 2/more waves of the same kind that pass the same point in space @ the same time.
Ex. Colors in soap bubbles &Oil films on water.

Diffraction of light – A failure of light to travel in a straight line.
Ex. CD is viewed in sunlight.

- Plastic disc, surface in coated with mirror like aluminum or gold film which has another protective over coating of clear plastic.
- Audio, video system / a computer reads the CD using a laser beam.
- Data stored in this form of bits arranged in a spiral - due to reflection & diffraction it appears rainbow colors.

MAGNETS

- The material which can attract the magnetic substances (cobalt, iron, nickel) – **magnet**
- The property of attracting the magnetic substances by a magnet – **magnetism**

Permanent magnets
- The magnets which do not lose their magnetism with normal treatment.
- made of certain alloys of nickel, cobalt, iron with some carbon.
- made in various shapes – bar, rod, disc, ring etc.

Hard magnetic material
- The material which retain their magnetism for a long time.
- When a magnet is freely suspended it aligns itself in the geographical N-S direction.
- Similar poles repel each other & dissimilar poles attract each other.

Magnetic field
- The area surrounding the magnet in which another magnet experience a force on it.
  Unit – newton / ampere - metre (or) weber/m^2 / testa

On the basis of magnetic properties materials classified into
- **Diamagnetic –** These substances are those in which the individual atoms/ions/molecules do not possess any net magnetic moment as their own.
  Ex. Bismuth, zinc, copper, silver, gold, diamond, water, mercury, etc.
- **Paramagnetic –** These substances are those in which each individual ions/molecules has a net non-zero magnetic moment on its own.
  Ex. Aluminum, platinum, Manganese, sodium, oxygen
- **Ferromagnetic** each individual /ions/ molecules has a non-zero magnetic moment on its own.
  Ex. Iron, cobalt, nickel, torric chloride
- **Curie temperature:**As temp ↑ , the magnetic property of ferromagnetic substance decreases &

above a certain temperature the substance changes into paramagnetic substances.
For soft iron curie temp is 1000K

Transformer

- A device which converts low voltage AC into high voltage AC & vice versa
- It is based on electro-magnetic induction and microphone also converts sound energy into electrical energy & vice versa.
- Electromagnets, cores of transformers, telephone diaphragm armatures of dynamos & motors are made of soft iron, mu-metal & stalloy.

MRI [Magnetic Resonance Imaging]

- A non-invasive medical test
- helps physician diagnose & treat diseases
- does not use X-rays
- Uses a powerful magnetic field, radio freq. pulses & a computer to produce detailed pictures of organs (heart given leading) bones, soft tissues & other internal body structures.

ELECTRICITY

Electricity produced by friction b/w 2 dissimilar objects.

i) one acquire positive charge
ii) the other an equal negative charge

Electrical Charge

- A body attaches when it loses/gains the electrons.
- Sign for electric charge by Benjamin , Franklin.

Ex.

- If a glass rod (negative charge) is rubbed with silk (acquire positive charge)
- If an ebonite rod (negative charge) is rubbed with flannel (positive charge)
- Like charges repel & unlike charges attract

Lightening Conductor (LC)

- A gigantic electric discharge occurring between 2 charged clouds between a charged cloud & the earth.
- (LC) – used to protect fall buildings from lightening damage
- LC is a thick copper strip fixed to an outside wall of building.
- Upper end in the several sharp spikes lower end connected to a copper plate buried in the earth.

Conductors

- Those substances which allow passage of charge & here very low electrical resistance.
  Ex. 1. All metals silver – best
  2. human body & earth.
- **Super conductors** –At temp near absolute zero metals have almost zero resistance & become superconductor.
  i.e. The resistance of metals to flow of electricity reduces with decreasing temp under research – super conductivity at high temperature.
- **Semi-conductors-** Ex. Silicon & Germanium
  These have electrical resistivity intermediate b/w those of conductors & insulators. In their crystalline form – good insulators adding impurities – conductivity increases
- **Insulators** – are those substances which do not allow passage of charge.
  Ex. Rubber, wood, Mica, glass, ebonite.

❖ **n-type & p-type semiconductors -** After the addition of impurities semiconductors become n-type & p-type.

In transistor made by both type composition used in radios, TV, computer

❖ **Integrated Circuits (IC) -** An arrangement of multifunction semiconductor devices.
Consists of a single crystal-chip & SI nearly 1.5 mm^2 in cross section.

Coulomb's law:
The force of attraction / the force of repulsion acting b/w the 2 point charges is proportional to the product of the magnitudes of the 2 charges & inversely proportional to the square of the distance b/w them.

Electric field – The region in which electric effect experienced.

Electric potential – measured by amount of work done @ any point of the electric field.
Unit – volt

Potentiometer – used to measure the exact potential diff. b/w 2 points of electrical circuit / to measure the emf of a cell.

Electric current = $\frac{amount\ of\ flowing\ charge}{sec}$

Unit – ampere

Ohm's law -
If there is number charge in the physical state of conductor, then the ratio of potential difference across its ends & the current flowing through it is constant.

$\frac{v}{i}$ = R (Remittance of the circuit)

Resistance of a conductor is directly proportional to its length (l) & inversely proportional to its cross section area (A)

$R \propto \frac{l}{A}$

1. In metal = temp ↑∝ R ↑
2. In semiconductor = tem $\propto \frac{1}{R}$
3. In electrolytes = temp $\propto \frac{1}{R}$

Specific Resistance / Resistivity - Depends only on the material of conductor & its temperature.

1. Increases with temp.
2. Change with impurity

Ex: - Electric bulb filament is made of tungsten.
- Tungsten has a high melting point (3400°C) & can be heated to a high temp to emit light.
- Electric bulb makes a bang when if its broken – b'coz inside values rushing air produce noise.

Electric power= $\frac{The\ electric\ work\ done}{Unit\ time}$

P = $\frac{w}{t}$ Unit – watt

Kilowatt hour (KWH) – The unit of energy & is equal to the energy consumed in the rate of 1 kw (1000 J/s) for 1 hour.
1 kw = 3.6 x 10^6 Joule.

Ammeter
❖ advice – to measure electric current in circuit.
❖ connected in series in the circuit
❖ Resistance in zero

Voltmeter
❖ to measure the potential diff b/w 2 points in a circuit.
❖ connected in parallel in circuit.
❖ Resistance is infinite

Galvanometer
❖ Used to detect & measure electric current in a circuit
❖ can measure current up to 10^{-6}
❖ Galvanometer can be converted into a voltmeter by connecting a very high resistance in its series.

Electrical Fuse – A small conducting wire of alloy of copper, tin & lead hening low melting point.
- Protective device used in series.

CELL
Electrochemical cell is a device which converts chemical energy into electrical energy.
Types

1. Primary Cell - It its electrical energy obtained from its irreversible chemical reaction taking inside the cell.

After completing discharge, the primary cells become unserviceable.

Ex. Voltaic, Leclanche, Daniel, Dry cell.

Electrolyte – mixture of ammonium chloride & zinc chloride.

2. Lead cells - Secondary cells

- Storage cells / accumulators
- Low internal resistance & giving large currents
- can be recharged

Secondary cells (Alkaline Batteries) – Used in emergency lights.

Car Battery – combination of lead – acid secondary cells, each of voltage 2.04 v electrodes – lead plates / grids

Electrodes – lead plates / gridgs

Electrolyte – Sulphuric acid.

- to provide a large current for a short time.

Effects of Electric current

1. Electromagnets used in

1. Industry for lifting & transporting steel plates, girders etc.
2. Electric bells & telephone receivers.

2. Electrolysis: An electric current passed through a solution results in the decomposition of the solution –ve& +ve ions.

-ve ions collect @ the +ve electron (anode)

+ve ions collect @ the –ve electron (cathode)

1. Used in electroplating (coating of a base metal with a layer of more expensive metal).
2. Electroplating with gold & silver – common.
3. Important role in metallurgy.
4. Heating Effect – In room heater, oven etc. These have coils of nichrome (alloy of nickel & chromium) which are heated when current is passed.
5. Motor effect – If a current carrying rectangular coil is placed in a magnetic field, a couple acts on the coil & it starts rotating.
6. Generator – much energy into electrical energy.
7. Inverter – converts DC to AC

Fluorescent Tubes

- ❖ It contains mercury vapors @ low pressure, when the tube in switched on mercy vapors emits visible ultraviolet rays.
- ❖ These rays fall on the fluorescent coating on the inside of the tube & emit VC.

CFC [Compact Fluorescent Lamps]

4-6 time more efficient than bulbs.

Cost of Electricity

Consumption – measured in KWh.

Ex.100 w lamp will consume one unit of electricity in 10 hrs.

750 W electric iron consume 3 units in 4 hrs.

In TV remote – 1 R signal used

Cordless phone – 100 m distance covered

-46-48 MHz bands.

UNITS OF MEASUREMENT

QUANTITY	UNIT (SI)
Length	Metre, mil
Time	Second
Mass	Kilogram/ownice
Area	Square metre
Volume	Cubic metre
Velocity	Metre/second
Acceleration	Metre/second square
Density	Kilogram metre/cube
Momentum	Kg m/sec
Work	Joule
Energy	Joule
Force	Newton
Pressure	Pascal or Newton / sq.mtre
Frequency	Hertz
Power	Watt
Weight	Newton or Kilogram
Impulse	Newton-second
Angular Velocity	Radian/second
Viscosity	Poise
Surface tension	Newton/square metre
Heat	Joule
Temperature	Kelvin
Absolute temperature	Kelvin
Resistance	Ohm
Electric current	Ampere
Electromotive force	Volt
Electrical conductivity	Ohm/metre

Electric energy	Kilo watt hour
Electric power	Kilo watt or watt
Magnetic intensity	Orsted
Charge	Coulomb
Magnetic induction	Gauss
Luminous flux	Candela
Intensity of sound	Decibel
Power of lens	Dioptre
Depth of sea	Fathom
Luminous velocity	candela
Loudness	Phon
Volume / Capacity	Gallon
Electric charge	Coloumb
horse power	747.7 watts
Parsec	Astronomical unit of distance

IMPORTANT SCIENTIFIC INSTRUMENTS

Instrument	**Use**
Altimeter	It measure altitude and is used in aircrafts
Ammeter	It measures strength of electric current (in amperes)
Anemometer	It measures force and velocity of wind
Audiometer	It measures intensity of sound.
Audiophone	It is used for improving imperfect sense of hearing
Barograph	It is used for continuous recording of atmospheric pressure.
Barometer	It measures atmospheric pressure.
Binocular	It is used to view distant objects
Bolometer	It measures heat radiation
Calorimeter	It measures quantity of heat.
Carburettor	It is used in an internal combustion engine for charging air with petrol vapour.
Cardiogram	It traces movements of the heart, recorded on a cardiograph.
Chronometer	it determines longitude of a place kept onboard ship.
Cinematography	It is an instrument used in cinema making to throw on screen and enlarged image of photograph.
Crescograph	It measures the growth in plants.
Cyclotron	A charged particle accelerator which can accelerate charged particles to high energies.
Dynamo	converts mechanical energy into electrical energy
Dynamometer	It measures electrical power.
Electrometer	It measures electricity
Electroscope	It detects presence of an electric charge.
Endoscope	It examines internal parts of the body.
Eudiometer	A glass tube for measuring volume changes in chemical reactions between gases.
Actinometer	measures intensity of electromagnetic radiation.
Altazimuth	measures altitude & azimuth of celestial bodies.
Cryometer	measures low temp.
Pyrometer	measures very high temp.
Daisy meter	determines density of gas
plato meter	measures changes in volume of substances
Geiger Muller counter	– detection of radioactive radiations.
Fathometer	It measures the depth of the ocean
Galvanometer	It measures the electric current of low magnitude.
Hydrometer	It measures the specific gravity of liquids.
Hygrometer	it measures humidity in air.
Hypsometer	measures boiling point of liquids.
Hydrophone	It measures sound under water.
Kymograph	It graphically records physiological movements (Blood pressure & heart beat)
Lactometer	It determines the purity of milk.
Manometer	It measures the pressure of gases.
Mariner's compass	It is an instrument used by the sailors to determine the direction.
Microphone	It converts the sound waves into electrical vibrations and to magnify the sound.
Microscope	it is used to obtain magnified view of small objects.
Odometer	An instrument by which the distance covered by wheeled vehicles is measured
Ohmmeter	measures electrical resistance.
Phonograph	An instrument for producing sound.
Photometer	The instrument compares the luminous intensity of the source of light.
Periscope	It is used to view objects above sea level (used in sub-marines)
Potentiometer	It is used for comparing electromotive force of cells.
Pyrometer	It measures very high temperature.
Radar	It is used for detecting the direction and range of an approaching plane by means of radio microwaves.
Rain Gauge	An apparatus for recording rainfall at a particular place.
Radiometer	It measures the emission of radiant energy

Refractometer	It measures refractive index.
Saccharimeter	measures the amount of sugar in solution.
Seismograph	measures the intensity of earthquake shocks.
Salinometer	It determines salinity of solution.
Sextant	This is used by navigators to find the latitude of a place by measuring the elevation above the horizon of the sun or another star.
Spectrometer	It is instrument for measuring the energy distribution of a particular type of radiation.
Speedometer	to record its speed.
Sphygmomanometer	It measures blood pressure.
Spherometer	It measures the curvatures of surfaces
Stereoscope	It is used to view two dimensional pictures.
Stethoscope	An instrument which is used by the doctors to hear and analyse heart and lung sounds.
Straboscope	it is used to view rapidly moving objects.
Tachometer	An instrument used in measuring speeds of aeroplanes and mot boats.
Teleprinter	This instrument receives and sends typed messages from one place to another.
Telescope	It views distant objects in space.
Theodolite	It measures horizontal and vertical angles.
Thermometer	This instrument is used for the measurement
Thermostat	It regulates the temperature at a particular point.
Viscometer	It measures the viscosity of liquids.
venturimeter	It measures rate of flow of fluids.
Voltmeter	It measures the electric potential difference between two points.
Waltmeter	it measures the power of an electrical circuit.
Nephelometer	measures the scattering of light by particles suspended in a liquid.
Rectifier	device for converting AC into DC
Thermopile	for detecting & measuring heat radiations

Electro dynamometer – measures current, voltage / power in both DC & AC circuit.

Beckmann thermometer – measures small changes in temp.(small as 0.01)

Scientific Explanations of Common Phenomena

- Carbon monoxide is poisonous.
- The filament of an electric bulb is made of tungsten.
- A wick in a stove keeps burning continuously capillary action.
- The sky appears blue because the light of the Sun is spread or scattered by the dust particles in the air.
- Food cooks faster at high temperature.
- A man weighs more at the poles than at the equator because the polar radius of the Earth is less than the equatorial radius. Hence the gravitational pull is more at the poles that at the equator.
- The boiling point of sea water will be more than the boiling point of pure water.
- Soft iron is used as an electromagnet because it remains a magnet only while the current passes through the coil around it.
- An electric bulb makes a bang when it is broken because there is a vacuum inside the electric bulb.
- The rushing of air produces a noise generally referred to as the 'bang'.
- The launching of Earth satellite should be from a place near the equator to take the fullest advantage of the Earth's movements. The regions of the Earth closer to the equator are moving faster through space as compared to regions elsewhere.
- In deserts, day temperatures are very high and night temperatures are extremely low because the specific heat of sand is very low.
- The air escaping from a punctured tyre feels cold because the air escaping from a punctured tyre enters a region of low pressure and thus suffers a fall in temperature.
- It is hotter on a cloudy night that on a clear night because clouds prevent the heat radiated by the Earth from escaping into the sky.
- Ice wrapped in a blanket does not melt away quickly because woollen blanket is a bad conductor of heat.
- Steam causes more severe burns than boiling water because stem at the same temperature has more latent heat.
- We experience difficulty in breathing on mountains because the pressure of the air outside is less as compared to the pressure of air inside the lungs.
- When a gun is fired at a visible distance, the sound is heard a little after the smoke is seen because the velocity of light is much higher than that of sound.

PHYSICS

Invention	Year	Inventor	Country
Acetylene gas	1862	Berthelot	France
Adding machine	1642	Pascal	France
Adhesive tape, (Scotch)	1930	Richard Drew	U.S.A.
Aeroplane	1903	Orville & Wilbur Wright	U.S.A.
Air conditioning	1902	Carrier	U.S.A.
Airplane, (Jet engine)	1939	Ohain	Germany
Airship (Non-rigid)	1852	Henri Giffard	France
Aerosol spray	1926	Erik Rotheim	Norway
Artificial heart	1957	Willem Kolff	Netherlands
Atomic bomb	1945	J. Robert Oppenheimer	U.S.A.
Atomic numbers	1913	Moseley	Britain
Atomic theory	1803	Dalton	Britain
Automatic rifle	1918	John Browning	U.S.A.
Bakelite	1907	Leo H. Baekeland	Belgium
Ballistic missile	1944	Wernher von Braun	Germany
Balloon	1783	Jacques & Joseph Montgolfier	France
Ball-point pen	1888	John J Loud	U.S.A.
Barometer	1644	Evangelista Torricelli	Italy
Battery (electric)	1800	Alessandro Volta	Italy
Bicycle	1839-40	Kirkpatrick Macmillan	Britain
Bicycle tyres (Pneumatic)	1888	John Boyd Dunlop	Britain
Bifocal lens	1780	Benjamin Franklin	U.S.A.
Bleaching powder	1798	Tennant	Britain
Bunsen burner	1855	R. Willhelm von Bunsen	Germany
Burglar alarm	1858	Edwin T. Homes	U.S.A.
Calculus	1670	Newton	Britain
Camera (Kodak)	1888	Walker Eastman	U.S.A.
Canned food	1804	Appert	France
Car (steam)	1769	Nicolas Cugnot	France
Car (petrol)	1888	Karl Benz	Germany
Carburetor	1876	Gottlieb Daimler	Germany
Cassette, (Audio)	1963	Philips Co	Holland
Cassette (Videotape)	1969	Sony	Japan
Celluloid	1861	Alexander Parkes	Britain
Cement (Portland)	1824	Joseph Aspdin	Britain
Chemotherapy	1909	Ehrlich	Germany
Chronometer	1735	John Harrison	Britain
Cinema	1895	Nicolas & Jean Lumiere	France
Clock (Mechanical)	1725	I-Hsing& Liang Ling – Tsan	China
Clock (Pendulum)	1656	Christian Huygens	Netherlands
Cloning, (DNA)	1973	Boyer, Cohen	U.S.A.
Cloning (Mammal)	1996	Wilmut, et al	U.K.
Compact disc	1972	RCA	U.S.A.
Compact disc player	1979	Sony, Philips	Japan, Netherlands
Computer, (Laptop)	1987	Sinclair	Britain
Computer (Mini)	1960	Digital Corp.	U.S.A.
Crossword puzzle	1913	Arthur Wynne	U.S.A.
CT scan	1973	Hounsfield	Britain
Diesel Engine	1895	Rudolf Diesel	Germany
Disc broke	1902	Dr. F. Lanchester	Britain
Disc, (Video)	1972	Philips Co.	Holland
DNA, (Structure)	1951	Crick-UK, Watson –US, Wilkins- UK	U.K. / U.S.
Dynamo	1832	HypolitePixli	France
Electric flat iron	1882	H. W. Seeley	U.S.A.
Electric lamp	1879	Thomas Alva Edison	U.S.A.
Electric motor (DC)	1873	ZenobeGramme	Belgium
Electric motor (AC)	1888	Nikola Tesla	U.S.A.
Electric iron	1882	Henry W. Seely	U.S.A.
Electric washing machine	1906	Alva J Fisher	U.S.A.
Electro-magnet	1824	William Sturgeon	Britain
Electron	1897	Thomson J	Britain
Electroplating	1805	Luigi Brugnatelli	Italy
Electronic computer	1824	Dr. Alan M Turing	Britain
Facsimile machine	1843	Alexander Bain	Britain
Fibre optics	1955	Kepany	Britain
Film (Moving outlines)	1885	Louis Prince	France
Film (Talking)	1922	J. Engl, J. Mussolle& H. Vogt	Germany
Film (Musical sound)	1923	Dr Le de Forest	U.S.A.
Floppy disk	1970	IBM	U.S.A.
Frequency Modulation (FM)	1933	E.H. Armstrong	U.S.A.
Frisbee	1948	Fred Morrisson	U.S.A.
Fountain pen	1884	Lewis E. Waterman	U.S.A.
Galvanometer	1834	Andre-Marie Ampere	France
Glider	1853	Sir George Cayley	Britain
Gramophone	1878	Thomas Alva Edison	U.S.A.
Helicopter	1924	Etienne Oehmichen	France
HIV	1984	Martagnier	French
Holography	1947	Denis Gason	Britain
Hydrogen bomb	1952	Edward Teller	U.S.A.
Intelligence testing	1905	Simon Binet	French
Jet Engine	1937	Sir Frank Whittle	Britain
Laser	1960	Theodore Maiman	U.S.A.
Launderette	1934	J.F. Cantrell	U.S.A.
Lift (Mechanical)	1852	Elisha G. Otis	U.S.A.
Lighting conductor	1752	Benjamin Franklin	U.S.A.
Locomotive	1804	Richard Trevithick	Britain
Logarithms	1614	Napier	Britain
Loom, (power)	1785	E. Cartwright	Britain
Loudspeaker	1900	Horace Short	Britain

Machine gun	1718	Richard Gatling	Britain
Magnetic recording tape	1928	Fritz Pfleumer	Germany
Match, (safety)	1826	John Walker	Britain
Microphone	1876	Alexander Graham Bell	U.S.A.
Microprocessor	1971	Robert Noyce& Gordon Moore	U.S.A.
Microscope (Comp)	1590	Z. Janssen	Nether lands
Microscope (Elect)	1931	Ruska knoll	Germany
Microwave oven	1947	Percy LeBaron Spencer	U.S.A.
Motor cycle	1885	G. Daimler	Germany
Movie projector	1893	Thomas Edison	U.S.A.
MRI	1971	Damadian	U.S.A.
Neon lamp	1910	Georges Claude	France
Neutron	1932	Chadwick	Britain
Neutron bomb	1958	Samuel Cohen	U.S.A.
Nylon	1937	Dr. Wallace H. Carothers	U.S.A.
Optical fibre	1955	NarinderKapany	Germany
Paper	A.D.105		China
Pacemaker	1952	Zoll	U.S.A.
Pasteurization	1867	Louis Pasteur	France
Pencil	1792	Lacques-Nicolas Conte	France
Periodic table	1869	Mendeleyev	Russia
Photocopier	1938	Carlson	U.S.A.
Photoelectric cell	1893	Julius Elster, Hans F Geitel	Germany
Photo film, (celluloid)	1893	Reichenbach	U.S.A.
Photo film, (Transparent)	1884	Goodwin Eastman	U.S.A.
Photography (On metal)	1826	J.N. Niepce	France
Photography (On paper)	1835	W.H. Fox Talbot	Britain
Photography (On film)	1888	John Carbutt	U.S.A.
Piano	1709	Cristofori	Italy
Pistol, revolver	1836	Colt	U.S.A.
Plutonium fission	1940	Kennedy, Whal, Seaborg, Segre	U.S.A.
Pop-up toaster	1927	Charles Strite	U.S.A.
Printing Press	1455	Johann Gutenberg	Germany
Printing (Rotary)	1846	Richard Hoe	U.S.A.
Printing (Web)	1865	William bullock	U.S.A.
Proton	1919	Rutherford	N. Zealand
Quantum theory	1900	Plank	Germany
Radar	1922	A.H. Taylor & Leo C. Young	U.S.A.
Radiocarbon dating	1947	Libby	U.S.A.
Radio telegraphy	1864	Dr. Mohlon Loomis	U.S.A.
Radio telegraphy (Trans Atlantic Rayon)	1901 1883	G. Marconi Sir Joseph Swan	Italy Britain
Razor (Electric)	1931	Col. Jacob Schick	U.S.A.
Razor (Safety)	1895	King C. Gillette	U.S.A.

Refrigerator	1850	James Harrison, Alexander catlin	U.S.A.
Relativity theory	1905	Einstein	Germany
Rubber (Latex foam)	1928	Dunlop Rubber Co	Britain
Rubber (Tyres)	1846	Thomas Hancock	Britain
Rubber (Vulcanised)	1841	Charles Goodyear	U.S.A.
Rubber (Waterproof)	1823	Charles Macintosh	Britain
Safety pin	1849	Walter Hunt	U.S.A.
Safety razor	1903	King Camp Gillette	U.S.A.
Seat belt	1959	Volvo	Sweden
Self-starter	1911	Charles F. Kettering	U.S.A.
Ship (Steam)	1775	I.C. Perier	France
Ship (Turbine)	1894	Hon Sir S. Parsons	Britain
Silk manufacture	50 B.C.		China
Skyscraper	1882	W. Le Baron Jenny	U.S.A.
Slide rule	1621	William Oughtred	Britain
Spinning frame	1769	Sir Richard Arkwright	Britain
Spinning jenny	1764	James Hargreaves	Britain
Spinning mule	1779	Samuel Crompton	Britain
Steam Engine	1698	Thomas Savery	Britain
Steam engine(Piston)	1712	Thomas Newcomen	Britain
Steam engine (Condenser)	1765	James Watt	Britain
Steel (stainless)	1913	Harry Brearley	Britain
Stethoscope	1819	Laennec	French
Submarine	1776	David Bushnell	U.S.A.
Super computer	1976	J.H. Van Tassel	U.S.A.
Synthesiser	1964	Moog	U.S.A.
Tank	1914	Sir Ernest D. Swington	Britain
Tape recorder	1899	Fessenden Poulsen	Denmark
Telegraph	1787	M. Lammond	France
Telegraph code	1837	Samuel F.B. Morse	U.S.A.
Telephone, (Cellular)	1947	Bell Labs	U.S.A.
Telephone (Imperfect)	1849	Antonio Meucci	Italy
Telephone (Perfected)	1876	Alexander Graham Bell	U.S.A.
Telescope	1608	Hans Lippershey	Netherla nds
Television (Mechanical)	1926	John Logie Baird	Britain
Television (Electronic)	1927	P.T. Farnsworth	U.S.A.
Television (Colour)	1928	John Logie Baird	Britain
Transformer	1831	Michael Faraday	Britain
Transistor	1948	Bardeen, Shockley & Brattain	U.S.A.
Transistor radio	1955	Sony	Japan
Uranium Fission,	1942	Szilard Fermi	U.S.A.

(Atomic reactor)			
Vacuum Cleaner (Elec)	1907	Spangler	U.S.A.
Video tape	1956	Charles Ginsberg	U.S.A.
Velcro (Hook and loop fastener)	1948	Georges de Mestral	Switzerland
Washing machine (Elec)	1907	Hurley Machine Co	U.S.A.
Watch	1462	Bartholomew Manfredi	Italy
Welder (Electric)	1877	Elisha Thomson	U.S.A.
Windmill	600	Persian Corn grinding	
Wireless (telegraphy)	1896	G. Marconi	Italy
X-ray	1895	W.K. Roentgen	Germany
Zip fastener	1891	W.L. Judson	U.S.A.

பேரண்டம் - Universe

- அண்டம் - (includes) விண்மீன், சூரியன்,சந்திரன்,கோள்கள்,எரிமீன்கள் உள்ளடக்கியவை.
- மில்லியன் அண்டவெளிகள் உருமண்டலம் (Galaxies) உள்ளன.
- ஒருபிரபஞ்சவருடம் (cosmic year) - அண்டவெளியைச் (galaxy) சுற்றிவர சூரியன் எடுத்துக்கொள்ளும் காலம் (25 கோடிஆண்டுகள்)
- Geocentric concept – Ptolemy – (பூமியேபேரண்டத்தின் சமயம்)
- Heliocentric concept – copperniccus
- Keplar - சூரியன் பேரண்டத்தின் மையல்ல சூரியகுடும்பத்தின் மையம்.
- Hershell - சூரியக்குடும்பத்தைத் தாண்டிபலஉருமண்டலங்கள் உண்டு.
- E. Hubble – first demonstrated existence & galaxies beyond milkyway.
- our gateways (உருமண்டலம்) – பால் வீதிஆகாயகங்கை
  - Spiral (சுருள்வடிவஉருமண்டலம்)
  - our nearest Galaxy – Andromeda
- அண்டவெளியில் உள்ளஅனைத்தும் ஈர்ப்புவிசையினால் இணைந்துஉள்ளன.
- everything in the universe emerged from a part singularity
- பெருவெடிப்புக் கொள்கைப்படி (Bilog Bang theory) 15 bn years ago. take place 13.7 bn years ago.
- sun → 5 bn years ago.
- earth → 4 bbn years ago.
- pulsating (oscillating) theory – after explosition from primordial body, then contracts back & explodes again over immensely long cycles ad infinitum.

measurement units of space (வானியல் தொலைவிற்கானஅலகு)

1. Light year (ஒளிஆண்டு) – ஒருஆண்டுகாலத்தில் ஒளிக்கதிர் வெற்றிடத்தில் ஏறக்குறைய 3 x 10^8மீட்டர் வினாடிவேகத்தில் செல்லக்கூடியதொலைவுஒருஒளிஆண்டு

1 LY = 9.46 x 10^{12} km

2. Astronomical Unit (வானியல் அலகு) = பூமியிலிருந்து சூரியனின் தொலைவு. 1 AU = 1.496 x 10^8 km.

- சூரியனிலிருந்துபூமியைவந்தடையஎடுத்துக்கொள்ளும் காலம் 8mm 20 sec.
- சூரியனுக்குஅடுத்துஅருகாமையில் உள்ளstar.
- சூரியனுக்குஅடுத்துஅருகாமையில் உள்ளBrightest star – sirivs (Dog star)
- ஈர்ப்புவிசையினால் பிணைக்கப்பட்டஒளிரும் வாயிக்களைக் கொண்டஒருமிகப்பெரியவந்துபோன்றது

- pronimacentauri (4.2 LY)
- Alpha Centauri (4.3 LY)
- Barnard's star (5.9 LY)
- ஒருstar-y; 98% பங்கு – self luminars bodies 2% பங்கு – Interstellar / gallaztic gas & dust henuated term
- star forming clouds – 1000 times denser than the normal interstellar gas.
- star forming matter in richer than hydrogen & helium
- star's colour based on the temp of the surface
- Blue color – max. temp they comes yellow & Red etc.

Formation composition of galache gas & dust

- generates heat (Hydrogen converted into helium by nuclear fusion) emitting large amount of heat & light.

Black hole:stars having mass > 3 times that of bun. b'coz of their great gravitational power.

- contract & develop – super density of 1016 grams / cm^3
- It dense that nothing not even light can escape from its gravity.
- சூரியக் குடும்பம் - ஆரம் 5.6 x 10^9 km

கோள்கள் (Planets):

- தாமேஒளிராது, சூரியஒளியைப் பெற்றுபிரதிபலிக்கக் கூடியவை.

துணைக்கோள்கள் (Moons)

- கோளின் கார்ப்புவிசையால் அக்கோளைச் சுற்றிவரும் விண்பொருள்.

குறுங்கோள்கள் (Esteroids)

- செவ்வாய் &வியாழன் இடையில் நீள்வட்டப்பாதையில் பலஆயிரக்கணக்கானவிண்கற்கள் (They r different size)

எரிநட்சத்திரங்கள்

விண்வீழ்கழல் - விண்வெளியிலிருந்துபூமியின் மேற்பரப்பைவளிமண்டலத்தில் வழியாகஅடையும் பொருள்.
எரிநட்சத்திரம் / எரிகற்கள் (meters) – விண்கற்கள் பூமியின் வளிமண்டலத்திற்குஉள்ளேஅதிவேகத்தில் நுழையும் கோடுபோன்றஒளியுடன் வாழ்கின்றன.
இவற்றில் சிலஎரிந்துகாற்றில் கலந்துவிடுகின்றன.
(Meteoroids) – விழுகற்கள் - சிலபாதிஎரிந்தநிலையில் பூமியில் விழுகின்றன.

Meteorites: Asteroids மூலம்
Asteroids → Inner planets
Comets → from outer planets (Altu Jupiter)

Pluto – குள்ளக்கோள் (Dwarf Planets)
- 2006 ஆம் ஆண்டு
- கோள்கள் சுற்றுவட்டப்பாதையில் மற்றொருகோள் பங்குபெற்றமையால்

சூரியன் ஆயள் - 10 bn. yrs - 5bn yrs. over
படிப்பு – Heliology
core – (மையப்படுத்த/உள்ளகம்)
வெப்பநிலை/ 15 mm. kelvin/ 1, 50, 00, 000° C

Photosphere (ஒளிக்கோலம்)
- வெப்பநிலை – 5760 k
- சூரியனின் காணப்படும் கருமைவரிகள்,கரும்புள்ளிகள்
- சூரியன் - உலகின் ஆற்றல்மூலம்
- வெப்பநிலையைStephenson நான்மடிவிதி மூலம் கணக்கிடலாம்.
- சூரியனின் ஈர்ப்புவிசைபூமியினதைவிட 28 மடங்குஅதிகம்
- பூமியைவிட 109 மடங்குபெரியது.
- பூமி - சூரியன் distance – 150 mm km
- பிரான்ஹோர் வரிகள் (Fraunhoter)
- சூரியபுள்ளிகள் → வெப்பநிலை சூரியனைவிடகுறைவு

Sunspots (கரும்புள்ளிகள்) – cooler – temp - 1500° c
- periodically of 11 yrs.

கோள்கள் (planets)
பானற்கோள்கள்/உபகோள்கள் → இரும்புமற்றும் பாறைகளால் ஆனது.
பெருங்கோள்கள் / வெளிகோள்கள் (gaseous planets)- Hydrogen, He & CH_4. வாயுக்களால் ஆனது.

புதன் (mercury)
- மிகச்சிறியகோள்
- மிகவேகமாக (சூரியணைச் சுற்றிவரும்) வலம் வரும் கோள் (revolution 88 days)
- வளிமண்டலமும் துணைக்கோள்கள் → இல்லை.

வெள்ளி (venus) – (பூமியின் இரட்டை)
- ஒளிமிக்ககோள் / hottest
- வேறுபெயர்கள் காலைநட்சத்திரம் /மாலைநட்சத்திரம் /சூட்டி இடையனின் விளக்கு
- ஒருநாள் >ஒருவருடம் (Rotation period > Revolution period)
- atmosphere contains → Co_2 → 90 – 95%
- like Uranus rotates E → W

Mars (சிவப்புக் கோள்) செவ்வாய்
- Nitrogen + axgon, லேசானவளிமண்டலம்
- satellites phobos, deimos
- highest Mt. Nix Olympia

வியாழன் (Jupiter) (Lord of the heavens)
- மிகப்பெரியது
- வேகமாகசுழலும் கோள் (9.8 hrs)
- Atmosphere contains Hydrogen, He, CH_4, Ammonia
- களிமிட் (Gannymede) – largest satellite

சனி (saturn)
- நீரில் மிதக்கும் (b'cozநீரைவிடகுறைந்தஅடர்த்தி)
- மிகலேசானது
- satellite Titan – has nitrogen in its atmosphere.
- system of rings – well defined.
- There are separate particles that move indep. in circular orbits.
- space probe cassini.

Uranus (பச்சைக்கோள்)
- identical by William Herchel.
- Rotation – rolling – b'coz 98° inclined at an angle.
- satellites – Ariel, Miranda.

Neptune:
- Satellite Triton
- Coldest

All planets rotates W → E except Venus & Uranus
Comet shoemaker Levy – 9 – Jupiter (1994)

சந்திரன் (Moon)
- நிலவைப்பற்றியபடிப்பு (selenology)
- சுற்றளவுcircm – 11,000 km.
- விட்டம் diameter – 3475 km
- ஈர்ப்புவிசை 1/6th of the earth elliptical
- avg. distance 3, 82, 800 km
- moon in 1/4th size of this earth
- one revolution → 27 days 7 hrs. 43 min
- one rotation → 27.3
- so we see only one side of the moon (59% of its surface)
- moon has no atmosphere
- light takes 1.3 sec to reach earth.

- பிரதிபலிப்பு – low (albedo) only 7% but earth has 30% venus 70%
- July 2, 1969 → Apollo XI – foot on moon (அமைதிக்கடல்) spot – sea of tranquillity.
- shackleton crate (Moon impact probe)
- M3 – நிலவில் மூலக்கூறு உள்ளது.
- moon's size – 1/3 of the earth
- Mass – 1/8 th
- Gravitation – $1/6^{th}$
- density – ½ nd
- mineral (கணிமம்) → Titanium – move
- highest mts → 35,000 ft (Lielonitzmts) லீபிளிட்ஸ் மலைகார்.

Asteroids – very small planets / fragments

- not only b/w mars &Jup. (Asteroid belt)
- occur in everywhere but Jupiter வரைக்கும்
- no atmosphere b'coz small size
- alter Jupiter comets வால் நட்சத்திரம்
- Icy gas – ஆல் ஆனது
- வால் சூரியனுக்குஎதிர்திசையில் அமையும்
- Asteroids – Meteorites
- Meteors – remains & comets

1. Hailey's comet → 76 வருடத்திற்குஒருமுறைவரும் கடைசியாக 1986-ல்
2. comet smith tuttle – 2116-ல் பூமிக்குவரும் damage 1.6 Mn times of hydrogen bails.

கோள்களுக்கு- புது விளக்கம் (in 2006)

(Inter Astronomical Union)
சூரியச் குடும்பத்தில் கோள் என்பது
1. சூரியனைவலம் வருவதாகவும்
2. போதுமானநிறை&உருண்டையானஅமைப்புடையதாகவும் (hydrostatis equilibrium)
3. அதன் வலம் வரும் பாதையில் வேறுஉறவினர் இருக்கக்கூடாததாகவும்.

i) மட்டும் நிறைவேற்றினால் small solar System body.
i) & ii) மட்டும் நிறைவேற்றினால் Dwarf planet
(குள்ளக்கோள்/ குறளைக்கோள்)

கோள்	சூரியனுக் குமுள்ளத் தாலைவு	விட்டம்	துணைக் கோள்	சுழலுதல்	வலம் வருதல்
புதன்	5.79	4878	0	58.65 days	88 days
வெள்ளி	10.82	12102	0	257 days	225 days
Earth(பூவி)	14.96	12755	1	23 hrs 56 min 41 sec	365 d 5hr 48 min
செவ்வாய்	22.79	6787	2	Almost 24 hrs	687 d
வியாழன்	77.83	142800	63	9.8 hrs	12 yrs
சனி	142.70	120500	61	10.3 hrs	29 yrs
யுரேனஸ்	287.96	51400	27	10.8 days	84 yrs
neptune	497.06	48600	13	15.7 days	165 yrs

பூமி

சுற்றளவு – 40, 232 மஅ
Area – 510 mm km
distance from sun – 149 mm km
Perihelion(குறைந்தபட்ச தூரம் - 147 mm km)
Aphelim (அதிகபட்ச தூரம்) – 152 mm km

பூமியின் சுழல் அச்சுபூமி சூரியனைச் சுற்றிவரும் தளத்தின் நேர்கூத்திற்கு 23 1/2 சாய்ந்துள்ளது.

நிலநடுக்கோட்டுசுற்றளவு – 40, 067 km
கருவப்பகுதிசுற்றளவு – 40,000 km

பூமியின் நகர்வுகள்

சுழலுதல் (daily movt.)
W → E 23 hrs 56 mm 41 sec
velocity 1667 km/hr @ equator @ poles - zero
விளைவுகள் - பகல் இரவு

- 1 hr - 15° அப்பால்
- காற்றின் திசையைமாற்றும் நீரோட்டத்தின்
- பேரலைகளின் உயர்வு/தாழ்வு
- Equator day & nights – almost equal
- longest day (NH) – June 21
- Shortest day (NH) – Dec 22
- Vice versa m SH

சமநிலைநாள் (Equators)

- day & night equal
- sun directly over equ.
- mar 21 – vernal equinox
- sep 21 – Autumnal equinox

Solstice – ஒருவருடத்தில்

பகலுக்கானநேரத்திற்கும் இரவுக்கானநேரத்திற்கும் உள்ளவித்தியாசம் அதிகமாக இருக்கும் நேரம்.

சூரியன் - Tropics – ல் இருக்கும்போதுநிகழும்
Jun 21 – summer solstice
Dec 22 – winter solstice

Annual movt. (வலம் வருதல்)

365 days 5hr 48 mm
29 km/sec

விளைவுகள்

- பருவகாலமாற்றம்
- பகல் இரவுநேரமாற்றம்
- காற்றுப்பட்டைகளைநகர்த்தும்

பருவகாலங்கள்

spring – march 21
- sun - @ equ
- spring in NH

summer – Jun 21
- sun @ cancer
- NH – summer

Autumn – sep 23
- sun return to equator
- NH – autumn

Winter – Dec 22
- sun @ T.O. Capricorn
- NH – winter

ஆர்டிக் வட்டம்,அண்டார்டிக் வட்டம்

(நள்ளிரவு சூரியன்) பகல் 6 மாதம் இரவு 6 மாதம்
due to tilted angle 231/2° North pole – 21st March to 23rd Sep.

South pole – 23rdsep to 21st march

இருகோடுகள் - பூமியின் கோள் அளவு 360°
திரைபட்டமாகவரையப்படுவது – Latitudes அட்சக்கோடுகள்
செங்குத்தாகவரையப்படுவது - Longitudes தீர்க்கக்கோடுகள்
0° latitude – பூமத்தியரேகை – நிலஞ்கோடு

பூமியைவட&தென் அரைக்கோடாக
231/2°N - கடகரேகை(cancer)
231/2° S – மகரரேகை
631/2 ° N – ஆர்டிக் வளையம்
631/2 ° S – அண்டார்டிக் வளையம்

அட்சக்கோடுகள் 1° - 11.1 km
தீர்க்ககோடுகள் 1° - 4 min
0° longitude – முதன்மைதீர்க்கரேகை (GMT)

(Greenwich காசிநேரம்)
13T – 82 ½° - அலகாபாத் வழியே
5.30 hrs difference
90° N & S – point not a line
181 Latitudes – including equator

எல்லாம் வட்டமாக இருக்குஆனால் ஒருஅளவில் இல்லை.
இருlatiகிடைப்பது. தூரம் சமம்
- longitude semicircles.
- distance between 2 meridian not equal.
- 180° தீர்க்கக்கோடுசர்வதேசநாள்கோடு
- Earth divided into 24° longitudinal zones – each being 15° / 1 hr apart.
- **longitude & time**Russia – 11 time zones
  USA & Canada – 5 time zones

சர்வதேசநாள்கோடு

4 இடத்தில் வளைவு – Aleutian தீவுகள்,Fiji, Samoa, gilbert Islands

சூரியகிரகணம் (ஒளிமறைவு)

பாதியாகவும்/ முழுமையாகவும் இருக்கும் only in அமாவாசை(New Moon day)

Moons inclination னால் அமாவாசைஅன்றும் கிரகணம் வருவதில்லை.

சந்திரகிரகணம்
- occurs only in full moon (பௌர்ணமி)
- 1 hr 40 min வரைநிகழும்
- பூமியின் உள்ளமைப்பு – crust – SIAL mantle (கவசம்)
- core (கருவம்/மையப்பகுதி)
- Normal gain rate – every 32 m/ic

Endogenic – உள் இயக்கசக்தி
- Tectonic movt/ கண்டநார்வுகள்
- மெதுவாகவும்,திதேரனவும் ஏற்படும்
- இது இருவேறுசக்திகளால் ஏற்படும்.

Epienogenic
- கண்ட ஆக்கநகர்வு,மலையாக்கநகர்வு

Orogenicmovt – மடிப்புமலைகள் (fold mts)
focus – நிலநடுக்கமைடம்
epicentre – புள்ளிவெளிமையம்