Chapter # 10

General Wave properties

Q 1. Define the following

1. **Wave:**
   A method transport energy from one point to another point without transfer of matter is called wave.
2. **Crest:**
   Crest is a point on a surface wave where the displacement of the medium is at a maximum.
3. **Trough:**
   Trough is a point on a surface wave where the displacement of the medium is at a minimum.
4. **Amplitude:**
   Amplitude is the maximum displacement moved by a point on a vibrating body from the rest or mean position.
5. **Compression:**
   compression Rarefaction Compression, in the longitudinal waves this is a region where turns of the coil or particles are closer together than average.
6. **Time period:**
   Time Period is the time taken for any one point on the wave to complete one oscillation.
7. **Frequency:**
   Frequency is the number of complete waves produced by a source per unit of time.
8. **Wave front:**
   The Wavefront is an imaginary line on a wave that joins all points that are in the same phase.

Q 2. **What do you know about Rarefaction of wave, Reflection of wave,** Diffraction of wave?

1. **Reflection of wave:**
   Bouncing back of waves into same medium by striking other medium surface is called reflection.
2. **Refraction of wave:**
   When a wave enters from a region of deep water to a region of shallow water at an angle, the wave will change its direction, this phenomenon is known as refraction of the wave.
3. **Diffraction of wave:**
   The spreading of the waves near an obstacle is called diffraction.

Q 3. Differentiate between Transverse wave and Longitudinal Wave

Longitude Wave	Transverse wave
Particles in the medium vibrate parallel to the direction of propagation of the wave,	Particles in the medium vibrate perpendicular to the direction of propagation of the wave,
The wave travel in the form of condensation and rarefactions	The wave travel in the form of crest and troughs

One condensation and a rarefaction constitute one wave	One crest and one trough constitute wave
This cannot be polarized	This wave can be polarized

Q 4. Differentiate between mechanical and electromagnetic wave

Mechanical waves	Electromagnetic waves
Mechanical waves are such waves that need a medium for propagation.	Electromagnetic waves are such waves that do not need a medium for propagation.
Mechanical waves are produced by vibratory motion in the respective medium	Electromagnetic waves are produced by a changing of electric and magnetic fields
Sound waves, water waves, and seismic waves are examples of mechanical waves.	Radio waves, microwaves, some light waves, U.V waves and infrared waves are Some examples of electromagnetic
Mechanical waves consist of transverse as well as Longitudinal waves.	Electromagnetic waves are only comprised of a transverse waves wave in nature
Mechanical waves cannot travel through the vacuum.	Electromagnetic waves travel through the vacuum speed of 3×10^8 m/s.
All mechanical waves travel through their media at different speeds depending upon the physical properties of the respective medium.	All electromagnetic waves can travel through transparent media at different speeds depending upon the refractive index of the respective medium.

Q 5. What is damped system? What is damped oscillation?

Damped System:
An oscillating system in which friction has an effect is a damped system.

Damped oscillation
The oscillations of a system in the presence of some resistive forces are damped oscillations.

Q 6. Define Wave length, Wave speed. Derive $V = f\lambda$

Wave length:
Wavelength (λ) is the linear distance between two successive crests or troughs in a transverse wave and two Successive compressions and rarefactions in a longitudinal wave. Its SI unit is meter (m).

Wave speed:
It is defined as the distance travelled by a given point on the wave, such as a crest in a given interval of time.

Mathematical
Let us consider a wave,
Distance travelled = λ

Time take = T

Then

$$V = \frac{s}{t}$$

Hence S = λ

t =T

$$V = \frac{\lambda}{T} \qquad \text{But } f = \frac{1}{T}$$

V = fλ

Q 7. What is periodic motion.

Periodic Motion

A motion repeating itself in an equal time interval is referred to as periodic or oscillatory motion.

Q 8. Waves are the means of energy transfer without matter. Justify this statement with the help of everyday life examples.

Waves are means of energy transfer without transfer of matter

"The wave is a disturbance in a medium that transfers energy from one place to another"
Waves transfer energy over a distance. Can waves move matter the entire distance? For example, a tide can Fig: 10.10 Longitudinal travel many kilometres. The water moves up and down- a disturbance that travels in a wave, transferring energy, not matter.

Q 9. What is a ripple tank, and explain its working?

Ripple Tank

A ripple tank is a shallow glass tank of water used to demonstrate the basic properties of waves.

Working:

A ripple tank is a shallow glass tank of water used to demonstrate the basic properties of waves. It is a particular type of wave tank. The ripple tank is usually illuminated from above so that the light shines through the water to visualize the wave being produced.
In the laboratory, we can produce water waves with the ripple tank. In the ripple tank, a small vibrator moves up and down the water surface, resulting in the water particles at the surface that are in contact with the dipper being made to move up and down. This up and down motion soon spread to other parts of the water surface in the tank in the form of ripples; fig. Here the water is the medium through which the ripples travel or propagate.

Q 10. What are the necessary conditions for a body to execute simple harmonic motion?

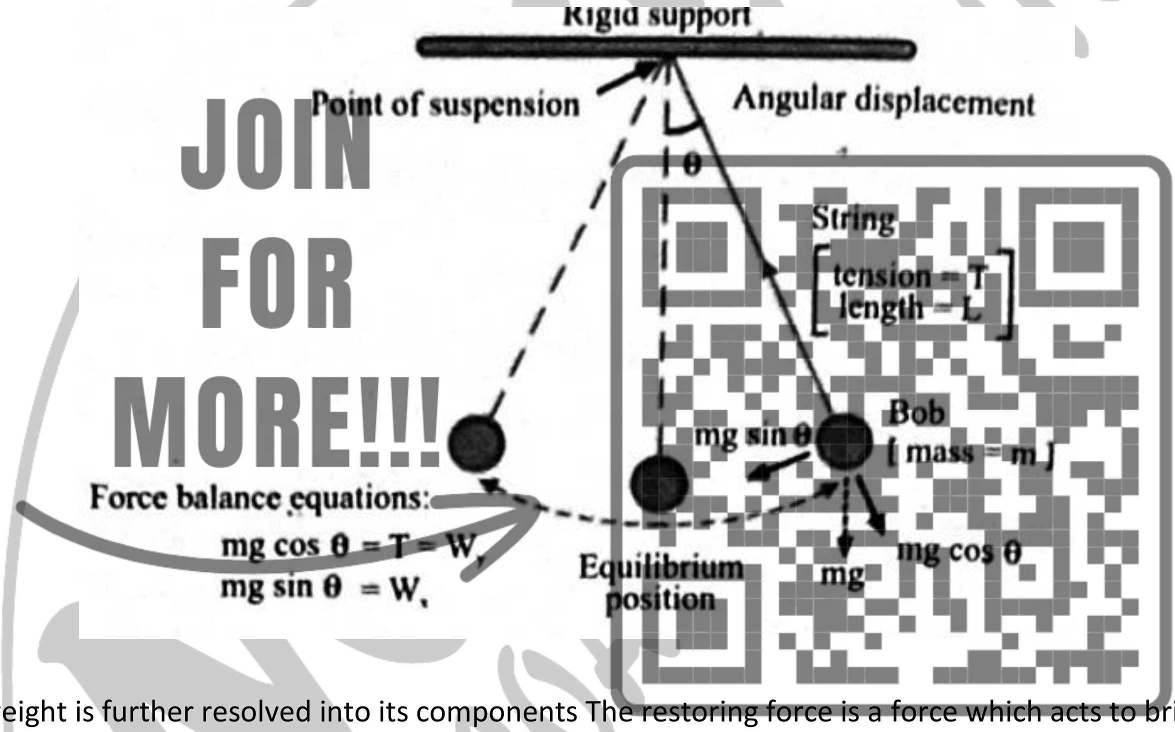
CHARACTERISTICS OF SIMPLE HARMONIC MOTION

I. A restoring force must act on the body.
II. Body must have acceleration in a direction opposite to the displacement and the acceleration must be directly proportional to displacement.
III. The system must have inertia (mass).
IV. SHM is a type of oscillatory motion.
V. It is a particular case of periodic motion

Q 11. **What are the forces acting on simple pendulum? With the help of a diagram, explain SHM in the pendulum.**

Forces acting on a displaced pendulum

When the bob of the pendulum is displaced at a small angle "θ" to an extreme position. The forces that act upon it are as given underneath:
Tension "T" along the direction of the string.
Weight W= mg, acting vertically downwards.



The weight is further resolved into its components The restoring force is a force which acts to bring mg sinθ and mg cosθ.
A simple pendulum consists of a small metallic bob of mass 'm' suspended from a light inextensible string of length "l" fixed at its upper end.
At the mean position 0, a pendulum is in its equilibrium position. If no external force were applied, the bob of a pendulum would naturally settle
The curve path s is the distance the bob of a pendulum travels. The weight mg consists of the component's mg cosθ along the string and mg sinθ perpendicular to the arc. For each given string, the component mg cos perpendicular to the string is exactly cancelled by the tension in the string. The resulting net force, which is directed back toward the equilibrium point, is tangential to the arc and equals mg sinθ.

Q 12. **What will be the effect of the period if there is an increase in its length and mass?**

Effect of length

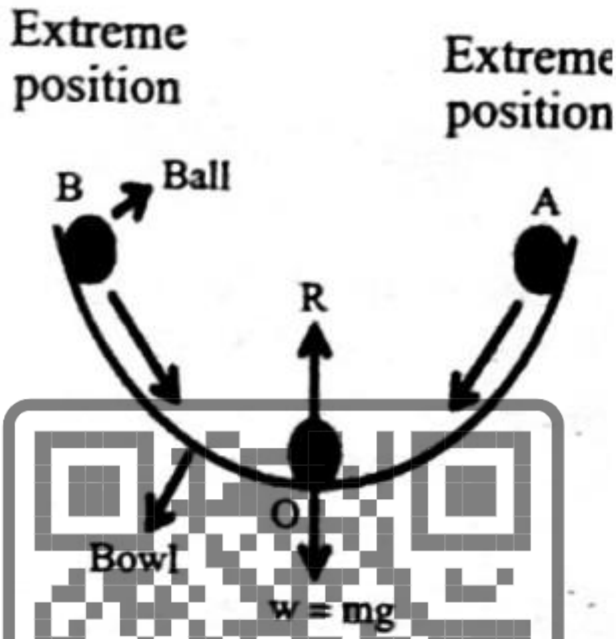
Simple pendulum period is affected by length and gravity acceleration.

Effect of mass

The period is independent of mass and amplitude.

Q 13. With the help of a diagram, explain SHM in the ball and bowl system.

Ball and bowl system and SHM



The motion of a ball in the bowl executing Simple Harmonic Motion

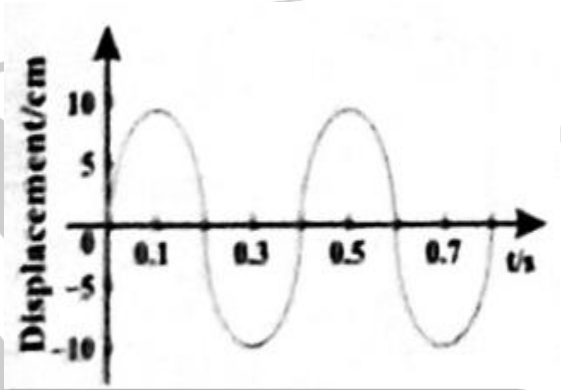
Let us examine that the motion of a ball placed in a bowl executes simple harmonic motion. When the ball is placed at the mean position "0' as shown in figure, that is, at the centre of the bowl. In this position, the net force acting on the ball is zero. Hence there is no motion.

Now, what if we displace the ball to an extreme position "A' and then release it? The ball starts moving towards the mean position O' due to the restoring force caused by its weight component. At position 0' the ball gets maximum speed and due to inertia, it moves towards opposite extreme position 'B' with the restoring force that acts towards the mean position, the speed of the ball starts to decrease. The ball stops for a while at "B' and then again moves towards the mean position 'O'. This ball's to and fro motion continues about the mean position 0'. This result shows that the acceleration of the ball is directed towards O. Hence, the ball's to and fro motion about a mean position placed in a bowl is also an example of simple harmonic motion.

Numerical

Book Work Examples

1. The given figure shows the displacement vs the time of a wave traveling to the right with a speed of 4 m/s.



(a) What is the time Period and frequency of the wave?
(b) Calculate the wavelength of the wave?
(**Ans:** 1.6m)

2. A fisherman notices that his boat is moving up and down regularly due to waves on the surface of the water. It takes 4.0s for the boat to travel from the highest to the lowest point, a total distance of 3.0 m. The fisherman sees that the wave crests are spaced 8.0 m apart.
(a) What is the period, frequency, amplitude, and wavelength of the waves?
(b) How fast are the waves moving?
(**Ans:** 8s, 0.125Hz, 1.5m and 8m)

3. Find the period and frequency of a simple pendulum 1.0 m Simple Harmonic long at a location where g=9.8 ms^{-2}.
(**Ans:** 2.01s, 0.50Hz)

4. Pendulum clocks with a pendulum measuring out the passing of a second. How long of a pendulum is required to have a period of 1 second? g = 9.8 m/s^2. (**Ans:** 0.25m)

Book Numerical

1. What is the wavelength of a radio wave broadcasted by a radio station with a frequency of 1300 kHz? Where $1K=10^3$, and the speed of the radio-wave is $3x\ 10^8\ m/s^2$.
(**Ans:** 230.76m)
2. The waves moving in the pond have a wavelength of 1.6 m, and a frequency of 0.80 Hz. Calculate the speed of these water waves.
(**Ans:** 1.28m/s)
3. If 50 waves pass through a point in the rope in 10 seconds, what are the frequency and the period of the wave? If its wavelength is 8 cm, calculate the wave speed. Explain the type of wave produced.
(**Ans:** 5Hz, 0.2s, 0.4m/s)
4. A slinky has produced a longitudinal wave. The wave travels at a speed of 40 cm/s and the frequency of the wave is 20 Hz. What is the minimum separation between the consecutive compressions?
(**Ans:** 0.002m)
5. Suppose a student is generating waves in a slinky. The student's hand makes one complete forth and back oscillation in 0.40 s. The wavelength in the slinky is 0.60m. For this wave, determine a. Period and frequency b. Wave speed
(**Ans:** 0.40s, 2.5Hz, 1.5ms)
6. If 80 compressions pass through a point in spring in 20 seconds. Calculate the frequency and the period? If two consecutive compressions are 8 cm apart, calculate the wave speed.
(**Ans:** 4Hz, 0.25s, 0.32m/s)
7. Waves on a swimming pool propagate at 0.9-0 m/s. If you splash the water at one end of the pool, observe the wave go to the opposite end, reflect, and return in 30.0 s. How far away is the other end of the pool?
(**Ans:** 0.033Hz,27m)
8. A simple oscillating pendulum has a length of 80.0 cm. Calculate its a. Period b. Frequency When g 9.8 m/s^2
(**Ans:** 1.794s, 0.557Hz)

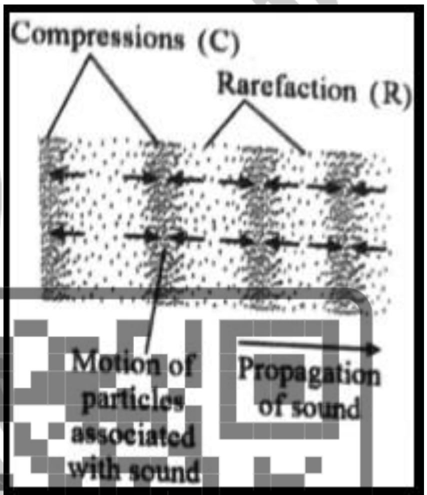
CHAPTER # 11
SOUND

Q 1. How is the sound produced?

Ans. Sound is produced by vibrating sources placed in a medium.

Q 2. With the help of a diagram, describe how compressions and rarefactions are produced in the air near a source of the sound.

<u>Ans</u>. we can consider that the compressions and rarefactions of sound waves are due to a slight change in the air pressure. Compressions are regions where air pressure is slightly higher than surrounding air pressure and rarefactions are regions where air pressure is slightly lower than the surrounding air pressure. This rising and falling of air pressure take place Continuously as long as the drum produces the sound. Thus, We can illustrate the region where the sound travels through air as in figure.



Q 3. Discus the electric bell jar experiment.

Ans. <u>**ELECTRIC BELL JAR EXPERIMENT**</u>

Take an electric bell and an airtight glass bell jar and then suspend the electric bell inside the jar. Connect the bell jar to a vacuum pump. When you switch on the electric bell, you can hear the sound of the bell coming from inside air and glass material. Now start the vacuum pump as the air in the jar is gradually pumped out, the sound becomes fainter, although the same current is passing through the bell and hammer that strikes the gong. After a while, you will hear the faintest sound, when there is less air.

Q 4. What happens when the air is completely removed? Will you still be able to hear the sound of the bell?

The electric bell still produces the sound, but now we cannot hear it. This is because sound waves always need a medium to propagate sound energy. In the bell jar, it was a vacuum hence sound waves cannot travel. This experiment makes sure that the bell does not touch glass and that the connecting wires used are thin. This prevents the sound energy from being transmitted through the glass and wires to the outside of the jar as the hammer vibrates vigorously.

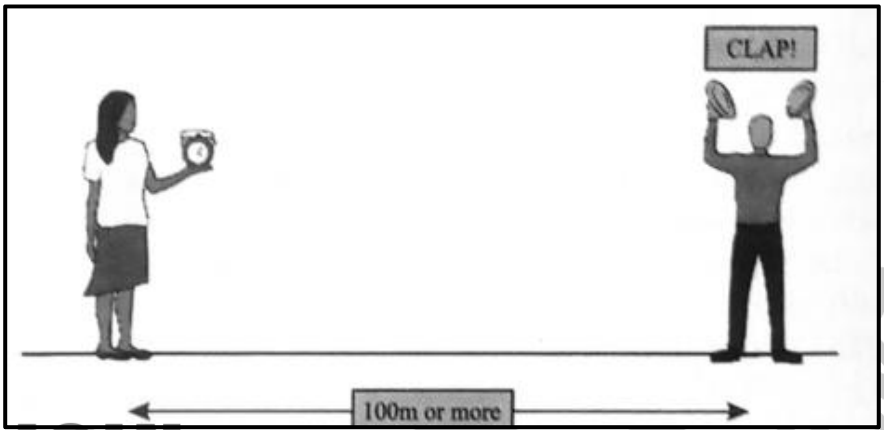
Q 5. Discus two method to determine speed of sound

Ans. **METHOD 1: MEASURING SOUND BETWEEN TWO POINTS**

MEASURING THE SPEED OF SOUND DIRECTLY BETWEEN TWO POINTS

1. Two people stand a distance of around 100 m apart
2. The distance between them is measured using a trundle wheel
3. One person has two wooden blocks, which they bang together above their head
4. A second person with a stopwatch starts watch when he hears one of the claps and ends timing after 20 Claps.
5. This is then repeated several times and an average Value is taken for the time.
6. The speed of sound can then be calculated using the equation:

$$Speed\ of\ sound = \frac{distance\ traveled\ by\ sound}{time\ taken}$$

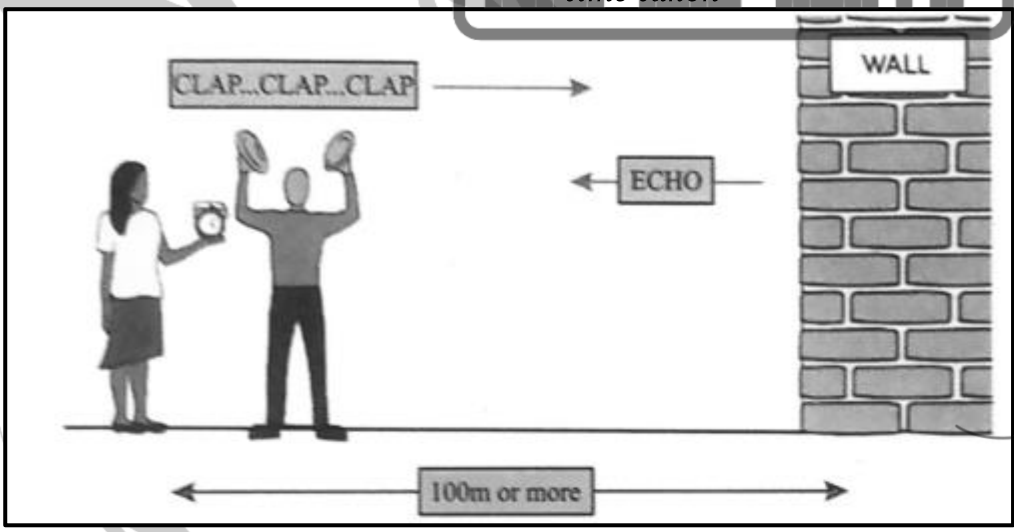


METHOD 2: USING ECHOES

MEASURING THE SPEED OF SOUND USING ECHOES

1. A person stands about 50 m away from a wall (or Cliff using a trundle wheel to measure this distance the person claps two wooden blocks together and listens for the echo
2. The person then starts to clap the blocks together repeatedly, in rhythm with the echoes
3. A second person has a stopwatch and starts timing when they hear one of the claps and stops timing 20 claps later
4. The process is then repeated and an average time calculated
5. The distance travelled by the sound between each clap and echo will be (2 x 50) m
6. The total distance travelled by sound during the 20 Claps will be (20 x 2 x 50) m
7. The speed of sound can be calculated from this distance and the time using the equation

$$Speed\ of\ sound = \frac{2 \times distance\ of\ wall}{time\ taken}$$



Q 6. Define speed of sound and derive V=fλ

SPEED OF SOUND

The speed of sound is defined as the distance which a point on a wave, such as a compression or a rarefaction, travels per unit of time.

MATHEMATICAL EXPRESSION

Since,

Velocity = $\frac{\text{Distance}}{\text{time}}$ **Distance =** λ

$V = \frac{\lambda}{T}$ **But** $\frac{\lambda}{T} = f$

$V = f\lambda$

Q 7. Define quality, loudness, pitch, acoustic intensity.

PITCH:

It is the quality of sound that distinguishes between a shrill and a flat sound.

QUALITY:

It is defined as the characteristic of sound by which we can distinguish between two sounds of the same loudness and pitch.

LOUDNESS:

It refers to the ability to distinguish between a Loud and a quiet sound.

ACOUSTIC INTENSITY OR SOUND INTENSITY:

It is defined as the power carried by sound waves per unit area in a direction perpendicular to that area.

Q 8. Write short note on speed of sound in solid, liquid and gases.

SPEED OF SOUND IN SOLIDS, LIQUIDS, AND GASES.

Sound waves are mechanical waves. Any medium that contains particles can transmit sound. The speed of sound is not the same in all mediums. Sound waves travel at different Speeds in different in mediums. Remember that the speed of sound depends on the properties such as temperature, Pressure and density of the medium through which it travels.

Sound moves faster in solid because the molecules/ particles of solid are very close to each other, as compare to liquid and Gases.

The speed at which a sound wave travels depends upon the Medium and state of the medium (steel, water, air). The rate at sound wave travel decreases when we go from solid to the gaseous state.

Q 9. Discus the factor effecting speed of sound.

EFFECT OF TEMPERATURE

Heat is a form of energy that depends upon the Kinetic energy of molecules. Molecules of the medium at Higher temperatures have more energy. Thus, they can Vibrate at a higher rate. As the molecules vibrate Faster, sound waves can travel more quickly.

The speed of Sound in air is directly proportional to the square root of the

Thus, the temperature of the Air increases, so the speed will also increase.

EFFECT OF HUMIDITY:

Humidity also affects the speed of sound in the air the effect of water vapor on the speed of sound is minimum than that of dry air. The presence of moisture in air replaces oxygen and nitrogen gases that reduce the density of air because the molecular mass of water vapors (Molecular mass=18) is less than that of oxygen (Molecular Mass = 32) and nitrogen (Molecular Mass 28) gases since the speed of sound in gases are inversely related to the square root of its density

Thus, humidity increases, the density of the air decreases and sound travels faster.

Q 10. Distinguish between noise and music.

NOISE	MUSIC
Noise is those types of sounds that appear unpleasant to hear.	Music appears pleasant to hear.
Noise is random.	Music is ordered.
Noise is a type of sound that has a continuous structure.	Music is a kind of sound that has a discrete structure.
Listening to noise for a long time can irritate and frustrate people	Even after listening to music for hours, people enjoy it.
Noise is constituted of low frequency, irregular wavelength and waveform.	Music is constituted of harmonious wavelength, waveform and frequency.
Examples of noise is the sound produced by vehicles and crackers.	Examples of music are the sounds produced by flute, piano, guitar.

Q 11. Define echo, ultrasound, audible frequency range, infrasonic.

ECHO

The repetition of the sound after reflection is known as an echo.

ULTRASOUND

Ultrasound is the sound with frequencies above the upper limit of the human Range of audibility. The range of audibility is the range of sound frequencies that a person can hear. The normal human ear, the lower limit of audible frequency is 20 Hz, and the Upper limit is 20K Hz.

INFRASONIC

having or relating to a frequency below the audibility range of the human ear

Give uses of ultrasonography

USES OF ULTRASONOGRAPHY

1. It is a technique that uses an instrument ultrasound scanner.
2. This scanner uses high-frequency sound waves to obtain Images of the internal organs of the human body and to examine the fetus during pregnancy.
3. A sonologist visualize the organs of the patient, such as the liver, gall bladder, Uterus kidney. Etc.
4. It helps the doctor to identify Abnormalities, such as stones in the gall bladder and kidney or tumours and abnormalities in different organs.

Worked Example 1 A sound wave has a frequency of 6 kHz and wave length 25cm. How long will it take to travel1.5 km?

Worked Example 2 Calculate the speed of sound in air at 30°C? Given that Speed of sound at 0°C is 331 m/s.

Worked Example3 A boy clapped his hands near a wall and heard the echo after 1.6 s. What is the distance of the wall from the boy if the speed of the sound, v is taken as 340 ms^{-1}.

BOOK NUMERICALS

1. Calculate the speed of sound in air at 50°C? Given that speed of sound at 0°C Is 331m/s. (360.0 ms^{-1})
2. A person has an audible range from 20 Hz to 20 kHz. What are the distinguishing wavelengths of sound waves in air corresponding to these two Frequencies? Take the speed of sound in air as 340 ms^{-1}
   (58.8mm and 58.82m)
3. A ship uses ultrasonic pulses to measure the depth of the submarine beneath the ship. A sound pulsing is transmitted into the sea, and the echo from the Sea-bed is received after 40 ms^{-1}. The speed of sound in seawater is 1480 m/s. Calculate the deepness of the submarine. (29.6 ≈ 30m)
4. At night, bats emit pulses of sound to detect their prey. The speed of sound in air is 340 m/s.

(i) A bat emits a pulse of the sound of wavelength 0.0080 m. Calculate the Frequency of the sound. (42.5Hz)

(ii) The pulse of sound hits its prey and is reflected in the bat. The bat receives The pulse 0.10 s after it is emitted. Calculate the distance traveled by the pulse of sound during this time. (17m)

(iii) Calculate the distance of prey from the bat. (8.5m)

CHAPTER # 12

ELECTROMAGNETIC SPECTRUM

Q 1. What is dispersion of light?

DISPERSION OF LIGHT

Splitting white light into its constituent colours when it passes through a glass prism is called dispersion of white light.

Q 2. Describe the dispersion of light when passing through glass prism.

DISPERSION OF LIGHT THROUGH A PRISM

When a narrow beam of white light splits, the colour sequence produced in the spectrum is indicated by the acronym V I B G Y O R which stands for Violet, Indigo, Blue, Green. Yellow, Orange, and Red. The speed and direction of white light vary depending on the wavelength. The red colour has a maximum speed in the glass prism, with the slightest deviation. In contrast, the violet colour has minimum speed, which with most deviation because colour has its own refracted path in the air and becomes distinct on the spectrum.

Q 3. What is spectrum?

SPECTRUM

The colour pattern produced in the dispersion is called a spectrum of light

Q 4. Explain how rainbow is produce in a rainy day or water droplet?

DISPERSION OF LIGHT THROUGH WATER DROPLETS

The rainbow is one of nature's most beautiful creations. When a rainbow appears, it serves as an excellent demonstration of light dispersion and further evidence that visible light has a spectrum of wavelengths, each of which is associated with a distinct colour. At an angle of approximately 40 degrees above ground level, you must look into an area of atmosphere with suspended droplets of water, or even a light mist, in order to see a rainbow in the sky. Every droplet of water acts as a tiny prism, dispersing and reflecting light to your eye. When you look at the sky, droplets emit wavelengths of light associated with a colour. There are several ways sun rays can enter through a drop. The bending toward and away from the normal is a defining characteristic of each and every path. The path of light as it enters the droplet, internally reflects, and then refracts out of the droplet is an important consideration when discussing rainbows.

Q 5. List the different color of wave length along with their wave length and refractive index.

COLOR	WAVELENGTH/ nm	REFRECTIVE INDEX
Red	650	1332
Orange	625	1.333

Yellow	575	1.334
Green	525	1.336
Blue	450	1.34
Indigo	425	1.342
Violet	400	1.344

Q 6. A ray of blue light deviates more than a ray of red when passing through a prism. Explain why?

Ans. Blue light deviates more than a ray of red when passing through a prism because blue light have smaller frequency then red light.

Q 7. Give the sequence of colours produced in the dispersion through a prism.

Ans.

1. Violet
2. Indigo
3. Blue
4. Green
5. Yellow
6. Orange
7. Red

which stands for V I B G Y O R

Q 8. Give the characteristics of electromagnetic wave.

<u>**CHARACTERISTICS OF ELECTROMAGNETIC WAVE**</u>

1. Electromagnetic waves are transverse waves in nature.
2. It can not carry electric charge.
3. It can travel through space, traveling at the speed of light 3×10^8 m/s.
4. It will travel through a transparent medium; however, they will slow down when traveling through a denser medium like water or glass.
5. It obeys the laws of reflection, refraction, and diffraction.
6. Its frequencies depend only on the source that produces the wave. Thus, frequencies do not change when it travels from one medium to another (air to glass).

Q 9. Discus the types of electromagnetic waves along with their source and application

TYPE OF ELECTRO MAGNETISE WAVE

RADIO AND TV

<u>**SOURCES**</u> Accelerating point charges

<u>**APPLICATION**</u>

Communications

remote control devices
Magnetic Resonance Imaging (MRI)

MICROWAVES

SOURCES Accelerating point charges and thermal agitations

APPLICATION

Communications
microwave ovens
radar

INFRARED

SOURCES Thermal agitations and electronic transitions

APPLICATION

Heating
Heat therapy
Thermal imaging

VISIBLE LIGHT

SOURCES Thermal agitations and electronic transitions

APPLICATION

All pervasive
optical fiber
Human vision,
Photosynthesis

ULTRAVIOLET

SOURCES Thermal agitations and electronic transitions

APPLICATION

Cancer Control
Sterilization
Sunbeds
Vitamin D production

X-RAYS

SOURCES Inner electronic transitions and fast collisions

APPLICATION

Imaging
Cancer Therapy
Medical diagnosis

GAMMA RAYS

SOURCES Nuclear decay

APPLICATION

Nuclear medicine

Radiography

Cancer therapy

Q 10. Define fluorescents

FLUORESCENT:

When absorbed in ultraviolet, some materials convert their energy into light and glow. This phenomenon is called fluorescence

Q 11. What do you know about sunbeds?

SUNBEDS

Ultraviolet lamps that emit UVA and UVB radiation are used in sunbeds for artificial tanning. It is popular in countries with long periods of limited sunlight. Under medically controlled supervision, sunbeds beautify, provide the body with vitamin D, and treat certain skin conditions

Q 12. Describe the sterilization

STERILIZATION

as ultraviolet kills harmful bacteria, strong UVB and UVC radiations are used to sterilize food and medical equipment in hospitals.

Q 13. Give some uses of electromagnetic waves

RADIO WAVES

1. Radio waves are also used in television communication.
2. Radio waves of very high-frequency VHF and ultra high-frequency UHF waves are used to telecast television programs.
3. These waves have shorter wavelengths, and they do not diffract around hills. So, there must be a straight path between the transmitting and receiving antenna for good reception.

MICROWAVES

1. Satellite phones use microwaves for communication, and satellite television uses microwaves to receive satellite television programs.
2. Microwaves can penetrate haze, light rain, clouds, and smoke as they have a higher frequency of all ranges of radio waves.
3. These waves are highly directional, the satellite dish and related components must be aligned appropriately, without any obstruction between the transmitted satellite signals and receiving satellite dish.

INFRA-RED

1. These rays are use in house hold electric appliances i.e. in wireless remote controllers etc.
2. These rays are used for security purposes, particularly in military technology.

ULTRA-VIOLET

1. These rays are use in sunbeds, fluorescent tubes, sterilization,
2. They are commonly used in lighting houses, shops, and offices for decorating purposes.
3. as ultraviolet kills harmful bacteria, strong UVB and UVC radiations are used to sterilize food and medical equipment in hospitals.

X -RAYS

1. x-rays to produce the x-ray images to diagnose the fracture in the bones or even tooth decay, tumours, and abnormal masses inside the body.
2. Computed Tomography (CT) scan is a computational diagnostic tool for detecting diseases and injuries. It uses a series of low-frequency X-rays and a computer to produce a 3D image of soft tissues and bones.
3. Industrial radiography is a technique of inspecting materials to detect inside defects by using high-frequency X-rays.

GAMMA RAYS

1. Gamma rays are used to treat cancer.
2. These high-energy rays are directed at the cancerous tumour to kill cancer cells in oncology.
3. Gamma rays are highly penetrating and can pass through metals; because of their extreme power, gamma rays used to radiograph holes and defects in metal castings and other structural parts.

Q 14. What do you know about PET?

Positron Emission Tomography (PET) is a functional medical imaging method.
In a PET scan, a short-lived positron-emitting radioactive sampling taken suitable for a particular function (e.g., brain function) is injected into the body. Radiated positrons quickly fuse with nearby electrons and lead to two gamma rays of 511-keV traveling in opposite directions. After detecting the gamma rays, a computer generates an image that highlights the location of the biological process being examined.

Worked Example 1

Ruby laser emits the beam of red light having a wavelength of 694.3 nm. Calculate its frequency.

Book Numerical

1. Electromagnetic radiation having a 15.0 μm wavelength is classified as infrared radiation. What is its frequency? Given that the speed of light is 3×10^{8} m/s. (2×10^{13} Hz)
2. What is the frequency of the 193-nm ultraviolet radiation used in laser eye surgery? (1.55×10^{15}Hz)
3. Calculate the wavelength of 100-MHz radio waves used in an MRI unit? (3m)
4. The distance from earth to sun is 1.49×10^{11} meters. How long a radio pulse radiated from the sun takes to reach on the earth? (496.67 sec)
5. Distances in space are often measured in units of light-years, the distance light travels in one year. Find the distance in kilometres in a light-year? (9.33×10^{12}Km)
6. What is the frequency of green light with a wavelength of 5.5×10^{7}m? (5.45Hz, 5.45×10^{14}Hz)
7. A typical household microwave oven operates at a frequency of 2.45-GHz What is the wavelength of this radiation? (0.1224m or 122.4mm)

CHAPTER # 13

GEOMETRIC OPTICS

Q 1. Define the following: Reflected ray, Refracted ray, Incident ray, Normal

INCIDENT RAY

It is the ray that falls on the surface

REFRACTED RAY

The ray which is refracted from the surface

REFLECTED RAY

The ray which is reflected from the surface

NORMAL

Perpendicular on the polished surface

Q 2. Differentiate between reflection and refraction

REFLECTION	REFRACTION
Reflection is the bouncing back of light when it strikes a smooth surface.	Refraction is the bending of light rays when it travels from one medium to another.
Generally occurs on shinny surfaces that only allow rebounding of light	This occurs in transparent surfaces that allow bending of the ray to a different medium.
When a light ray strikes the boundary of a shiny surface the speed of light ray does not vary.	The speed of light varies with the medium in which the ray undergoes bending.
The medium in which light propagates remains the same.	The medium of propagation gets changed.
The angle of reflection and angle of incidence is the same in the case of reflection.	In refraction, the angle of reflection and angle of incidence are not the same.

Q 3. Give laws of refraction

LAWS OF REFRACTION

FIRST LAW:

The angle of incidence in equal to the angle of reflection $\angle i = \angle r$

SECOND LAW:

The incident ray, reflected ray and the normal to the reflecting surface all lie in the same plane

Q 4. Give law of reflection

FIRST LAW:

Ratio of Sin of angle of incidence to sin or angle of reflection is constant know as refractive index.

SECOND LAW:

The incident ray refracted ray, and the normal to the reflecting surface all lie in the same plane.

Q 5. List some examples of reflection in your daily life

EXAMPLES OF REFLECTION

1. Reflection of light in mirror.
2. Reflection of light in spherical mirror.

3. Reflection of light in water pool.
4. Reflection of light on polished surface.
5. Object seen due to reflection of light.
6. Glowing of stars.
7. Lighting of moon at night.
8. Reflection from luminous object.
9. Reflection from non-luminous objects.

Q 6. Give uses of convex mirror

USES OF CONVEX MIRROR

(i) A concave mirror is used in a microscope to illuminate the object.
(ii) In a telescope it is used to concentrate the parallel beams of light coming from distant stars.
(iii) Concave mirrors are used by the doctors in ophthalmoscopes, for the medical examination of car, nose, throat, and eyes.
(iv) Concave mirrors are used in searchlights and spotlights.
(v) They are also used in the headlights of automobiles.

Q 7. State Snell's law

SNELL'S LAW

The law of refraction of light which state that ratio of Sin of angle of incidence to sin or angle of reflection is constant refractive index is also known as Snell's law

$$\eta = \frac{sin\angle i}{sin\angle r}$$

Q 8. What is total internal reflection and critical angle. Also show them by figure

CRITICAL ANGLE

When a ray of light passing through in a dense medium enters into a rare medium, it bends away from the normal. If the angle of incidence "$\angle I$" increases, the angle of refraction '$\angle r$ also increases. For a particular value of the angle of incidence, the angle of refraction becomes 90^0, The angle of incidence that causes the refracted ray in the rarer medium to bend through 90^o is called the critical angle

TOTAL INTERNAL REFLECTION

If a ray passes from a dense medium to a rare medium and its angle of incidence is greater than the critical angle, the incident ray is reflected into the dense medium. This phenomenon is called total internal reflection.

Q 9. Write short note on fiber optics

OPTICAL FIBERS

Optical fiber consists of hair-size threads made of flexible plastic er glass fitters that transmit light over long distance. An optical fitter comprises of two parts an inner part "core" with a high refractive index, coated with another material cladding. When a light ray enters the fiber and hits the cladding, it is reflected internally in the core as the incidence angle is larger than the critical angle. even if the fiber is bent Light rays entering the fiber ae continuously reflected a the interface between two refractive materials and cover long distances without energy loss

Q 10. What is lens. Discus its types

LENS

A lens is a piece of transparent material, such as glass or plastic, that refracts light in a regular way. These are bounded by one or two spherical Surfaces.

Two main types of spherical lenses are generally used. These are

Convex lens

Concave lens.

CONVEX LENSES

A convex lens is thick at the center and thin at the edges. It converges parallel beam of light at a point and hence is called a converging lens.

CONCAVE LENSES

A concave lens is thinner at the center and thicker at-the edges. It diverges a parallel beam of light. The rays after refraction through a concave lens appears to diverge from a point. The concave lens is thus called a diverging lens.

Q 11. Define power of lens. Give its formula and unit

POWER OF LENS

The power of a lens is defined as the reciprocal of its focal length, measured in meters inverse (m).

FORMULA

$$P = \frac{1}{f}$$

UNIT

The unit use for power id diopter D.

Q 12. What is projector. Discus it in brief

THE PROJECTOR

A projector uses a convex lens as a projection lens and pair of condenser lenses to produce a large, inverted, and real image on a screen. In the projector, an object or a film is positioned between f and 2f from the projection lens. A concave mirror is used to reflect the light from the lamp onto a pair of condenser lenses so that the light from the lamp is concentrated on the film or slide, illuminating it evenly and directing it through the film(object) to the projection lens. The image formed on the screen is inverted, real, and magnified.

As the image formed is inverted, must turn the film must upside down to maintain an upright picture on the screen. Move the lens from the screen to obtain a large image. The lens is moved forward or backward to get a sharp picture on the screen.

Q 13. What is photographic enlarger

THE PHOTOGRAPHIC ENLARGER

The photographic enlarger uses a convex lens to produce an inverted, real, and magnified image of the film on photograph paper.

An enlarger is a specialized transparency projector used to produce photographic prints from glass negatives or transparencies or microfilm. The photographic enlarger works on the same principle as a projector. In the case of the enlarger, object is placed at a distance greater than F but less than 2F. In this way, we get an inverted, real, and enlarged image.

Q 14. Differentiate between real and virtual image?

REAL IMAGE	**VIRTUAL IMAGE**
1. Real image can be obtained on screen	1. virtual image cannot be obtained on screen
2. real image is formed by actual meeting of rays after refraction	2. virtual image is formed by just extending the refracted rays backward.
3. real image is always inverted	3. virtual image is always erect

Q 15. What is resolving power and magnifying power?

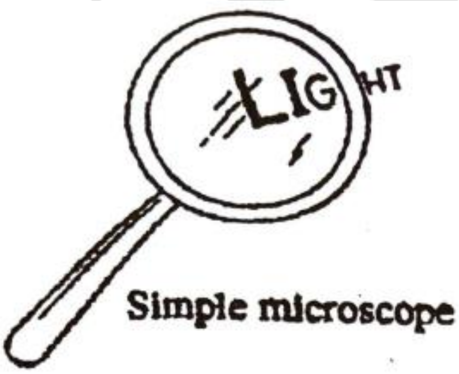
RESOLVING POWER:

The resolving power is usually taken as the smallest distance at which two points can be seen as distinctly when viewed through the optical instrument. The greater the resolving power, the smaller the minimum distance between points or lines that can still be distinguished.

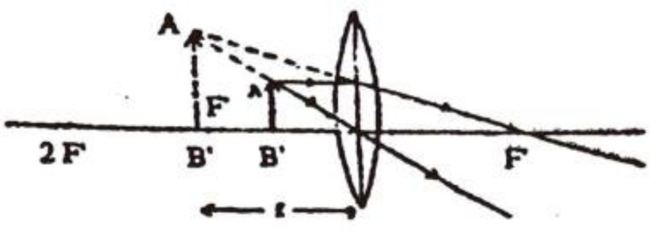
Q 16. What is magnification glass or simple microscope? Also give its formula for magnification. Draw a ray diagram for image formed by magnifying glass.

SIMPLE MICROSCOPE

A simple microscope uses a convex lens to produce magnified images of small objects. The object is placed nearer to the lens than the focal length produces an upright, virtual, and magnified image. It is also called magnifying glass.



Simple microscope



Formation of virtual image with a simple microscope.

MAGNIFICATION

$M = 1 + \frac{d}{f}$

Q 17. What is compound microscope. Give its construction and working. Also draw its ray diagram and give its formula for magnification.

COMPOUND MICROSCOPE

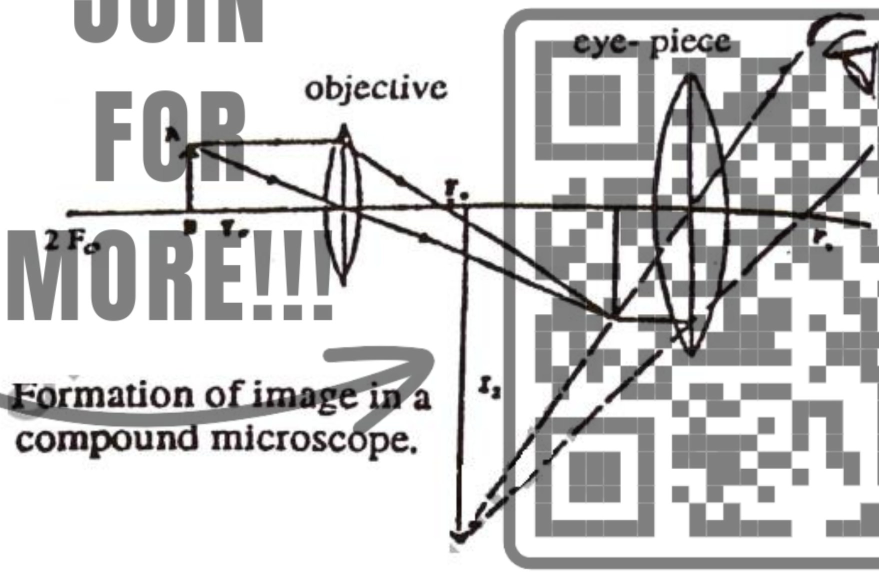
A compound microscope is an upright microscope that uses two sets of lenses (a compound lens system) to obtain higher magnification than a stereo microscope.

The objective lens has a shorter focal length “fo” than the focal length of eyepiece “fe”.

It is used to study the structure of small objects.

MAGNIFICATION BY COMPOUND MICROSCOPE

When rays of light from a point on a nearby object pass through an objective lens. The objective forms a small image “I_1” on the inside focal point of the eyepiece. This image behaves as an object for the eyepiece, and the larger image “I_2” is formed at the near point of the normal human eye. This final magnified virtual image makes an angle “ θI” at the eyepiece.



Formation of image in a compound microscope.

M = $\frac{L}{f_o}\left(1+\frac{d}{f_e}\right)$

Here,

F_o = focal length of objective

F_e = focal length of eyepiece

d = least distance of distinct vision

L = length of tube

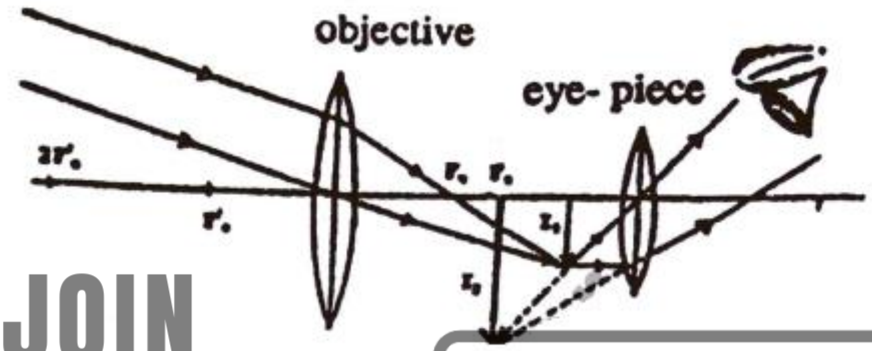
Q 18. What is telescope microscope. Give its construction and working. Also draw its ray diagram and give its formula for magnification.

TELESCOPE

The telescope is also an optical instrument that uses two convex lenses, the objective and the eyepiece. The objective lens has a larger focal length, “f_o” than the eyepiece, which has a focal length, “f_e”. Telescopes are helpful because they can gather far morelight than the human eye. It is used to form magnified images of distant objects.

MAGNIFICATION BY TELESCOPE

When parallel rays from a point on a distant object pass through the objective lens, a real image I1 is formed at the focal point for the objective lens. This image behaves as an object for the eyepiece. The eyepiece forms a magnified Virtual image I_2 a considerable distance from the objective lens. This enlarged virtual image makes an angle θi at the eyepiece.



The magnification of a telescope is given by the formula

M = $\frac{f_o}{f_e}$

Here,

F_o = focal length of objective

F_e = focal length of eyepiece

Q 19. List uses of telescope

USES OF TELESCOPES

1. Telescopes are used to collect and focus the light towards the eyepiece.
2. Telescopes have extended our sights to the universe.
3. They also showed mountains and carters on the moon.
4. Modem telescopes provide evidence of billions of galaxies each containing billions of stars.
5. Telescopes are now discovering planets around the stars and possible life over there.

Q 20. What do you know about myopia and hypermetropia? Give reason and state how they can be corrected.

SHORT SIGHTEDNESS(MYOPIA)

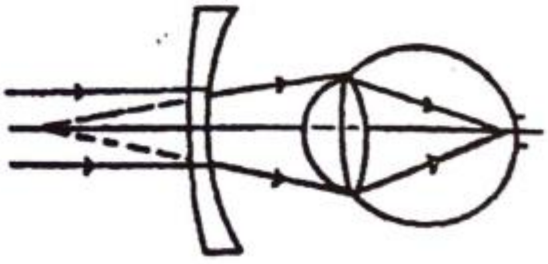
A short-sighted person can see near objects clearly but distant objects are not seen clearly.

REASON

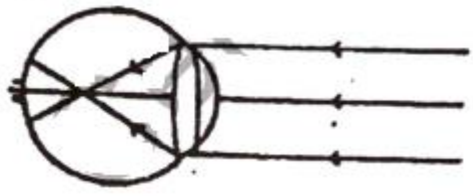
The reason for this defect is either the focal length of the eye lens is too short or the eye ball Is too elongated. This means that light rays from a distant object are focused in front of the retina.

CORRECTION

This defect can be corrected by wearing spectacles (or contact lenses) with concave lenses. These lenses diverge the rays of light so that the eye lens can focus the image clearly on the retina.



correction by a concave lens



short sightedness

LONG SIGHTEDNESS (HYPERMETROPIA):

A long sighted person can see distant objects clearly but cannot see near objects distinctly.

REASON

The reason for this defect is either the focal length of eye lens is too long or the eye ball is too short. This means that light rays Tom near objects are focused behind the retina.

CORRECTION

This defect can be corrected by wearing spectacles (or contact lenses) with convex lenses as these lenses Converge rays so that the eye lens can focus the image on the retina clearly.

Long sightedness

Correction by convex lens

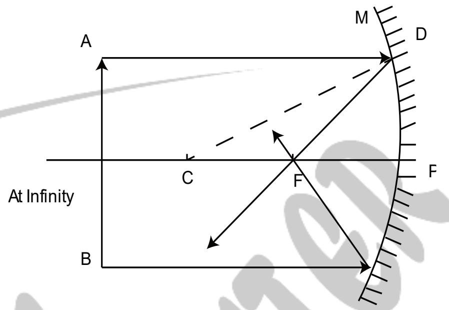
Q 21. Differentiate between simple microscope and compound microscope

SIMPLE MICROSCOPE	COMPOUND MICROSCOPE
Simple microscope is used at a basic level, where there is no rigorous requirement of research.	Due to an added lens to a compound one, professionals use this for research purposes
There is single lens in simple microscope.	There are 3 to 5 objective lenses in a compound which helps in magnifying algae, fungi and bacterium.
Has only one lens for magnifying objects.	Has two sets of lenses for magnifying objects: eyepiece lens and objective lenses
Can only be used in simple ways such as enlarging small letters while reading.	Has a wide range of use such as in studying the structure of different objects, e.g. details of cells in living organisms.

Q 22. Draw ray diagram for the image formation by a concave mirror. Also state their characteristics

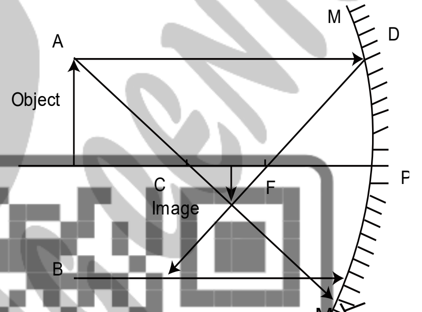
1. CHARACTERISTICS

Position of object	At infinity
Position of image	At the focus F
Size of image	Highly diminished point sized
Nature	Real and inverted



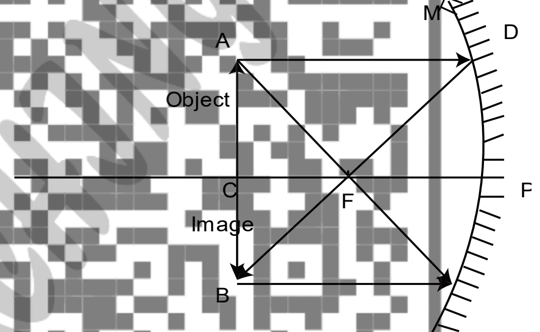
2. CHARACTERISTICS

Position of object	Beyond C
Position of image	Between F and C
Size of image	Diminished
Nature	Real and inverted



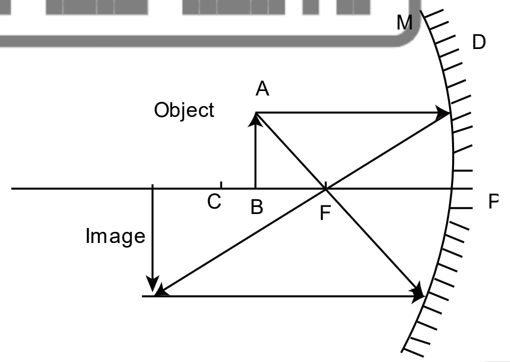
3. CHARACTERISTICS

Position of object	At C
Position of image	At C
Size of image	same size
Nature	Real and inverted



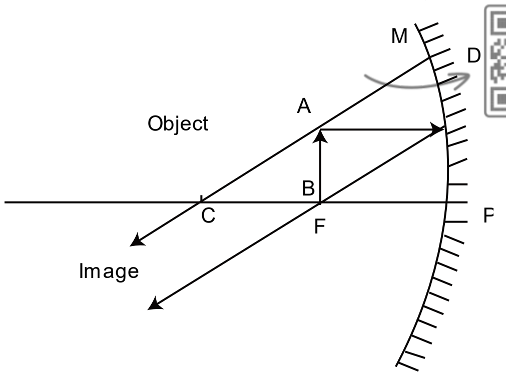
4. CHARACTERISTICS

Position of object	Between C and F
Position of image	Beyond C
Size of image	Enlarged
Nature	Real and inverted



5. CHARACTERISTICS

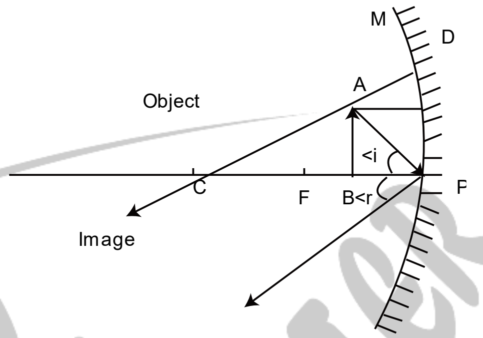
Position of object	At F
Position of image	At infinity
Size of image	Highly enlarged
Nature	Real and inverted



6. CHARACTERISTICS

Position of object	Between P and F
Position of image	behind the mirror
Size of image	Enlarged

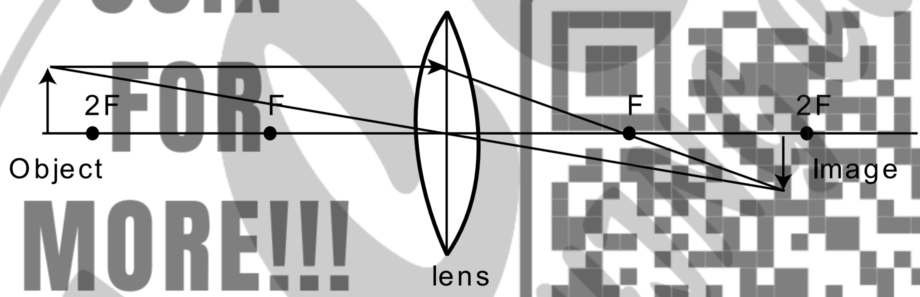
Nature virtual and erect



Q 23. Draw ray diagram when image form by convex lens also give its characteristics.

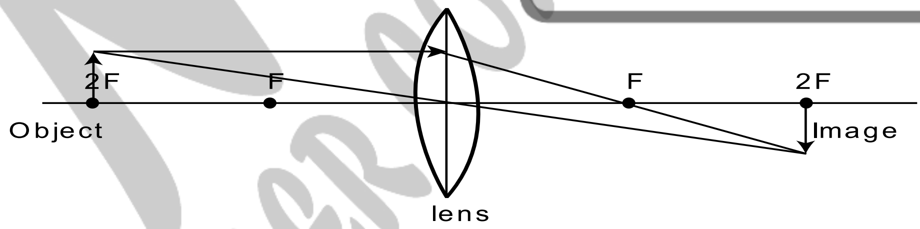
CHARACTERISTICS

Position of object	beyond 2F
Position of image	between F and 2F
Size of image	small
Nature	Real and inverted



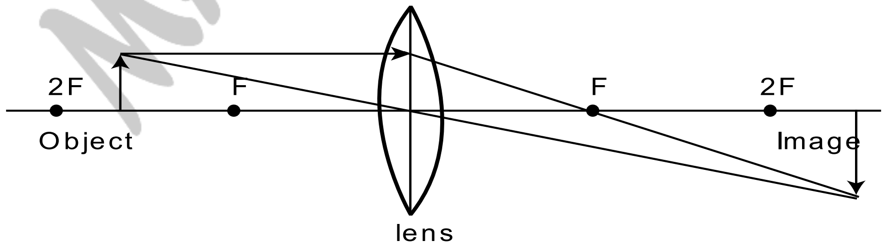
CHARACTERISTICS

Position of object	At 2F
Position of image	At 2F
Size of image	same as that of size of the object
Nature	Real and inverted



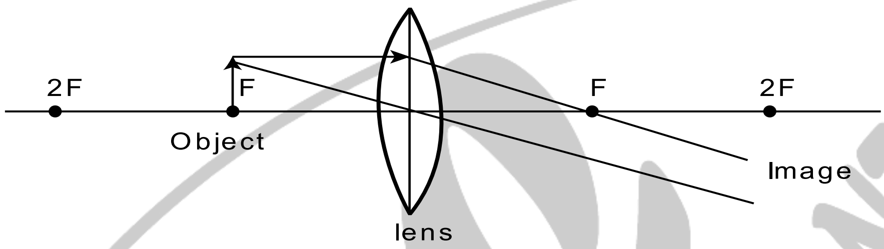
CHARACTERISTICS

Position of object	between 2F an F
Position of image	beyond 2F
Size of image	enlarged
Nature	Real and inverted



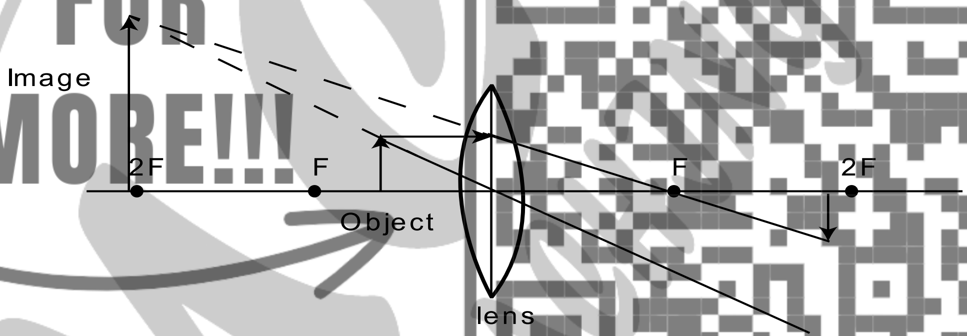
CHARACTERISTICS

Position of object	At F
Position of image	At infinity
Size of image	Highly enlarged
Nature	Real and inverted



CHARACTERISTICS

Position of object	between F anf 2F
Position of image	same side of the lens
Size of image	enlarged
Nature	virtual and erected



Worked Example 1

A concave mirror forms a real image at 25.0 cm from the mirror surface along the principal axis. If the corresponding object is at a 10.0 cm distance, what is the focal length of the mirror?

Worked Example 2

The refractive index of the diamond is 2.42. What is the speed of light in a diamond?

Worked Example 3

Calculate the value of critical angle for water refracted angle at The retractive index of water is 1.33.

Worked Example 4

A boy is standing 2.500 m in front of a camera. The camera uses a convex lens whose focal Length is 0.050 m. Find the image distance (the distance between the lens and the film and determine whether the image is real or virtual. Also, find the power of the lens.

Book Numerical

1. A thumb pin is positioned at a distance of 15 cm from a convex mirror of a focal length of 20 cm. Determine the position and nature of the image. (8.57cm)
2. An image of a specimen appears to be 11.5 cm behind a concave mirror with a focal length of 13.5 cm. Find the specimen's distance from the mirror. (6.21cm)

3. A convex mirror used for rear-view on an automobile has a radius of curvature of 4.00 m. If a bus is located at 5.00 m from this mirror, find the image's position, nature, and size. (1.428m)

4. An object is placed 15 cm away from a converging lens of a focal length of 10 cm. Determine the position, size, and nature of the image formed. (2cm)

5. A concave lens of focal length 20 cm forms an image 15 cm from the lens. Determine the power of a lens. Also, how far is the object positioned from the lens? (0.05cm)

6. The angle of incidence for a ray of light from air to water interface is 40. If the ray travels through the water with a refractive index of 1.33, calculate the angle of refraction. (28.8°)

CHAPTER # 14

ELECTROSTATICS

Q1. Define Electrostatics and Electric charge.

Electrostatics or Static Electricity: The study of charges while they are not moving is referred to as electrostatics or static electricity.

Electric charge

Electric charge is a basic characteristic of matter that causes electrical processes.

Nature: Electric charge is a scalar quantity.

Unit: Its SI unit is coulomb.

Charge of one electron: the electron has a negative charge of 1.6×10^{-19} coulomb.

Repulsion: Like charges repel each other.

Attraction: Opposite charges attract each other.

Q2. Name the Types of charges .

Types of charges: There are two types of charges.

1. Positive charge
2. Negative charge

Q3. Describe the methods of charge formation.

Methods of charge formation

There are three methods of formation of charges on a body.

1. Induction
2. Conduction
3. Friction

Induction

It is a charging method in which a neutral object is charged without actually touching another charged object.

Conduction: It is charging by contact where charge is transferred to the object.

Friction: The imbalance of electrons and protons can be easily created by friction when two objects rubbing over one another. This process of charging is called charging by friction.

Q4. What do you know about Electrostatic charging by induction?

Electrostatic charging by induction

Consider two metal spheres A and B which are touching in the illustration. Take a rubber balloon that is negatively charged.

When we put the charged balloon close to the spheres, the repulsion between the balloon's electrons and spheres' electrons causes electrons in the two-sphere system to move away from the balloon. Following that, electrons from sphere A are transported to sphere B. As electrons migrate, sphere A becomes positively charged, whereas sphere B becomes negatively charged. As a result, the entire two-sphere system is electrically neutral. As depicted in the diagram, the spheres are then separated using an insulated covering such as gloves or a stand. When the balloon is removed, the charge is redistributed throughout the spheres.

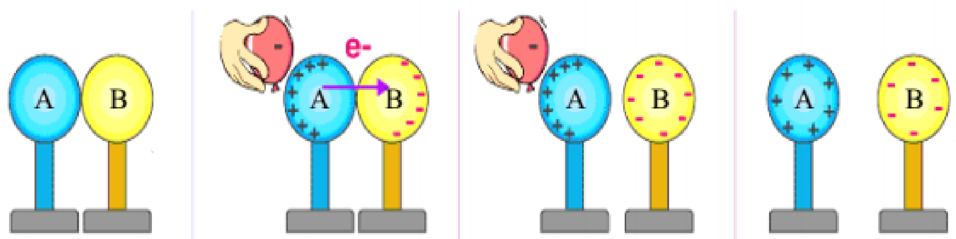
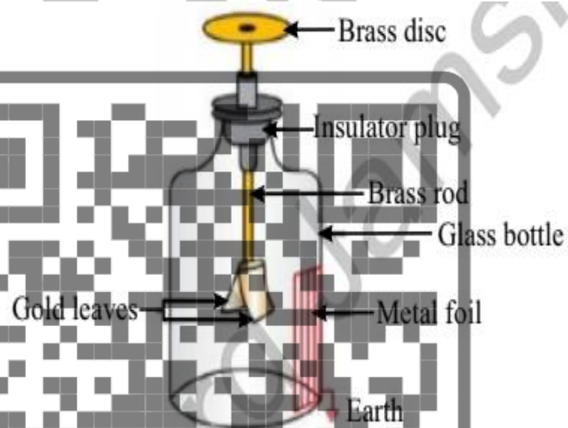


Fig: 14.5 Electric Charge

Q5.what is Electroscope? Describe its cunstruction.

Electroscope



Introduction: In 1600, British physician William Gilbert constructed the first electroscope with a pivoting needle, called verborum.

Definition: An electroscope is a scientific instrument for detecting the presence of an electric charge on a body.

Principle: The operation of an electroscope is based on the atomic structure of elements; charge induction, the internal structure of metal elements, and the concept that similar charges repel each other while unlike charges attract each other. These four concepts form the basis of the electroscope's working principle.

Construction: An electroscope has a metal detector knob on top and metal leaves on the connecting rod. When there is no charge present, the metals' leaves are allowed to hang

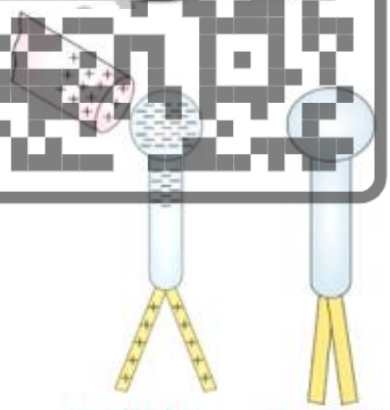
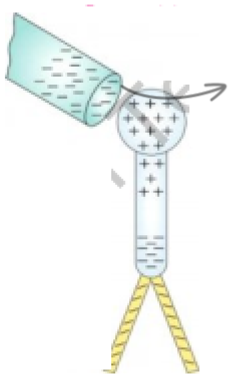


Fig: 14.9 (a) Fig: 14.9 (b)

Working: When an item with a charge is brought near an electroscope, one oF two things may happen Positive charges attract electrons in the electroscope's metal, which migrate upward out of the leaves. This causes the leaves to have a transient positive charge, and since similar charges repel, the leaves split as illustrated in figure (a). When the charge is released, the electrons return to their normal places and the leaves relax, figure (b).



(c)

When the charge is negative, the electrons in the electroscope metal reject and migrate toward the leaves. When the leaves are temporarily negatively charged, they split once again because opposite charges repel one another figure (c). If the charge is removed, the electrons return to their original location and the leaves relax.

An electroscope reacts to a charge by moving electrons into or out from the leaves. In both circumstances, the leaves separate. The electroscope cannot tell whether a charge item is positive or negative; it just detects an electrical charge

Q6.State and explain Coulomb's law. Also derive its formula and give value of its constant.

Coulomb's law

STATEMENT:

Coulomb's law states that:

The magnitude of the electrostatic force of attraction or repulsion between two points charges is directly proportional to the product of the magnitudes of charges and inversely proportional to the square of the distance between them.

MATHEMATICALLY:

Magnitude of the electrostatic force is

Directly proportional to the product of the magnitudes of charges

$$F \propto q_1 q_2$$

Inversely proportional to the square of the distance between them

$$F \propto \frac{1}{r^2}$$

Combining eq 1 and 2

$$F \propto \frac{q_1 q_2}{r^2}$$

$$F = k\frac{q_1 q_2}{r^2}$$

Where "k" is constant and its value is 9×10^9 Nm^2/C^2

Where is the constant of proportionality

For value of ε:

$$K = \frac{1}{4\pi\varepsilon}$$

Where K is the constant of proportionality

$$F = \frac{1}{4\pi\varepsilon}\frac{q_1 q_2}{r^2}$$

For value of ε

K – 9×10^9 Nm^2/C^2

$\varepsilon = 8.85 \times 10^{-12}$ C^2/Nm^2

Q7.Define Electric field. Give its formula and unit.

Electric field

A region around the charged particle or object within which a force would be exerted on other charged particles or objects.

Mathematically: The formula of electric field is given as

$$E = \frac{F}{Q}$$

Whereas,
E = electric field.
F = force.
Q = charge

Unit: The SI unit of electric field is N/C

Q8. Define Electric field lines

Electric field lines

The electric field that surrounds a charge may be imagined as the existence of a line of force all the way around it. Electric or electrostatic lines of force refer to a system of imaginary lines around a charged object and indicating the stress on that object.

Q9. What is Point charge and test charge?

Point charge is an electric charge. When the linear sizes of charge bodies are much smaller than the distance between them, their sizes may be ignored and considered as a point charge.

Test charge: Test charge is a charge with a magnitude so small that placing it at a point has a negligible effect on the field around the point.

Quantization of electric charge: The fact that all observable charges are always some integral multiple of elementary charge $e = 1.6\times10^{-19}$ C is known as quantization of electric charge.

Mathematically:

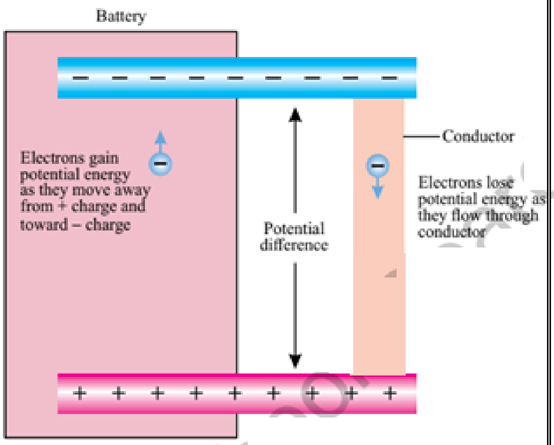
$$q=ne$$

Where,
n=1,2,3,4....
$e = 1.6\times10^{-19}$ C

Q10. Define Electrostatic potential. Also give its unit.

Definition: The amount of work that is done in order to transport a unit charge from a reference point to a given location within the field without causing an acceleration.

Unit: The SI unit of electrostatic potential is volt



Electrostatic potential

Mathematically

$$V = \frac{W}{q}$$

Where,

W = electric potential energy

q = charge

V = potential difference

Q11. **What are Factors on which electrostatic?**

potential depends: The magnitude of electrostatic potential depends on the amount of work done in moving the object from one point to another against the electric field

Q12. Define Electric potential energy or electrical energy

Electric potential energy or electrical energy

When an object is moved against the electric field it gains some amount of energy which is defined as the electric potential energy or electrical energy.

Factors on which electric potential energy depends:

A charge with higher potential will have more electric potential energy and the charge with lesser potential will have less electric potential energy

Q13. List down the Applications of electrostatics

Applications of electrostatics

There are many applications of electrostatics which are given below:

- The Van de Graaff Generator
- Xerography
- Laser Printers
- Ink Jet Printers and Electrostatic Painting
- Smoke Precipitators and Electrostatic Air Cleaning

Q14. Write short note on Spray painting and Electrostatic Air Cleaning.

Spray painting

The friction that occurs when the spray exits the nozzle gives it an electrical charge. The droplets all have the same charge, which means that they will repel each other since similar charges repel; as a result, the droplets disperse themselves equally throughout the surface.

Electrostatic Air Cleaning

Electrostatic precipitators is another name for these types of devices. It is possible to ionize the dust and smoke particles in the air by passing them through an electric cell. By bringing a charge collecting plate into touch with the charged dust and smoke particles, an attraction is created between the two. Thus, these particles are collected on the plate

Q15. Define Capacitor. Describe the construction and working of a capacitor

Capacitor

The capacitor is a simple electronic device or component that is used to store charge.

Construction

Two conductors of any shape (plates) carrying equal and opposite charges, separated from each other by an insulating material medium called Dielectric form a capacitor.

Working

First, we can note that a metal typically has an equal amount of positively and negatively charged particles, which means it's electrically neutral If we connect a power source or a battery to the metal plates of the capacitor, a current will try to flow, or the electrons from the plate connected to the positive lead of the battery will start moving to the plate connected to the negative lead of the battery. However, because of the dielectric between the plates, the electrons won't be able to pass through the capacitor, so they will start accumulating on the plate.

After a certain number of electrons accumulated on the plate, the battery will have insufficient energy to push any new electrons to enter the plate because of the repulsion of those electrons which are already there. At this point, the capacitor is actually fully charged. The first plate has developed a net negative charge, and the second plate has developed an equal net positive charge, creating an electric field with an attractive force between them which holds the charge of the capacitor.

Q16. **What is Capacitance? Write its formula and unit.**

Capacitance

The ability of storing charges in a capacitor is known as capacitance.

Mathematically

$$Q \propto V$$

$$Q = CV$$

The constant C is called capacitance of the capacitor and the equation Q = CV is called equation of capacitor.

So,

$$C = Q/V$$

Unit: The unit of capacitance is Farad(1Coul/Volt).

Q17. What are the Factors on which capacitance depends

Factors on which capacitance depend

Capacitance depends on these factors.

1. Area of the plate. Capacitance increases if area of the plate increases. Hence $C \propto A$
   Distance between the plates.
2. Capacitance increases if the separation distance between the plates decreases. Hence $C \propto 1/d$
3. Dielectric constant εr capacitance increases if insulating medium of high dielectric constant is used.
   Hence $C \propto \varepsilon r$

Q18. Five a formula for Energy of capacitor.

Energy of capacitor

The energy of capacitor can be calculated by

$$E = \frac{1}{2}CV^2$$

Q19. Name the different Combination of capacitors

Combination of capacitors

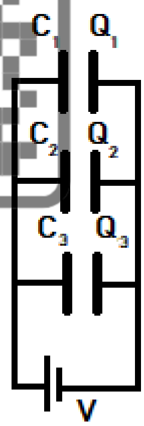
Combinations of capacitors are as follows.

1. Parallel combination
2. Series combination

Q20. what is Parallel combination of capacitors. Derive the formula for equivalent capacitance of capacitor.

Parallel combination of capacitors

A combination of capacitors in which the positive terminal of each capacitor is connected with the positive terminal of the other capacitor and the negative terminal of each capacitor is connected with the negative terminal of the other capacitor, is said to be a parallel combination.



Derivation

If three capacitors C_1, C_2 and C_3 are connected in parallel and further connected with a battery of V volts as shown in figure

then: C_1 draws charge Q_1, C_2 draws charge Q_2, and C_3 draws charge Q_3.

Since the capacitor connected in parallel total charge is equal to the sum of individual charge through capacitors

$$Q = Q_1 + Q_2 + Q_3$$

As we know that

$$Q = CV,\ Q_1 = C_1V,\ Q_2 = C_2V,\ Q_3 = C_3V$$

Putting in above

$$CV = C_1V + C_2V + C_3V$$

$$CV = V(C_1 + C_2 + C_3)$$

$$C = C_1 + C_2 + C_3$$

Q21. What is Parallel combination of capacitors. Derive the formula for equivalent capacitance of capacitor

Series combination of capacitors

A combination in which the positive terminal of one capacitor connected with the negative terminal of the other capacitor and the negative terminal of first capacitor is connected with the positive terminal of the other capacitor, is said to be a series combination.

Derivation

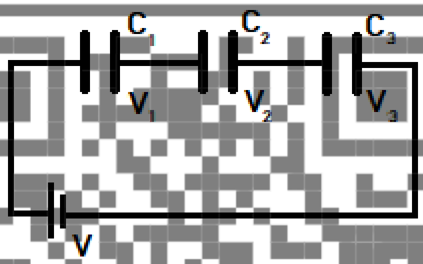
If three capacitors C_1, C_2 and C_3 are connected in series and further connected with a battery of V volts, as shown in figure

Since the capacitor connected in series the total potential difference is equal to the sum of individual potential difference through capacitors

$$V = V_1 + V_2 + V_3$$

$$Q = CV \text{ , OR } V = \frac{Q}{C}$$

$$V_1 = \frac{Q_1}{C}. V_2 = \frac{Q_2}{C}, V_3 = \frac{Q_3}{C}$$



Putting in above

$$\frac{Q}{C} = \frac{Q}{C_1} + \frac{Q}{C_2} + \frac{Q}{C_2}$$

$$\frac{Q}{C} = Q\left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_2}\right)$$

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_2}$$

Q22. Give some Uses of capacitors

Uses of capacitors

1. They are utilized in the process of tuning transmitters, receivers, and transistor radios.
2. They are utilized to run table fans, ceiling fans, exhaust fans, air conditioner, motors and many other appliances to keep them running at a high efficiency.
3. It is also common to find capacitors in the electronics circuitry of computers and other products like smartphones.
4. It is possible to utilize capacitors to distinguish between high and low frequency signals, which makes them valuable in electronics circuits.

Multiple Choice Questions (MCQs)

1. Branch of physics which deals with the charges at rest is called
(a) Electricity (b) Electrostatic (c) Quantum (d) Magnetism

2. The magnitude of force between two unit positive charges when the distance between them is 1 m would be
(a) 0 N (b) 1 N (c) 2 N (d) Coulomb's Constant

3. Coulomb's law most closely resembles with
(a) Law of Conservation of Energy (b) Newton's Law of Gravitation
(c) Newton's 2nd Law of Motion (d) Faraday's law

4. If the electrostatic force between two electrons is F Newton, then the electrostatic force between two protons at the same distance is
(a) 0 N (b) 2F (c) $\frac{2}{3}$ F (d) F

5. The direction of electric force and electric field intensity is
(a) Parallel to each other (b) Perpendicular to each other
(c) Opposite to each other (d) In any direction

6. The word done on a unit charge against electric field intensity is called
(a) Electric field (b) Electric current (c) Electric potential (d) Electric field

7. Capacitance of capacitors increases when they connected in
(a) Parallel (b) Series (c) both (d) none of them

8. Two capacitors of 8 μF are connected in series then the equivalent capacitance is
(a) 4 μF (b) 2 μF (c) 3 μF (d) 6 μF

9. The presence of a dielectric between the plates of capacitors, the capacitance of capacitor
(a) increases (b) decreases (c) remains constant (d) remains uncharged

10. If the area of the parallel plate capacitor is doubled then the capacitance will be
(a) remains uncharged (b) half (c) double (d) increased two times Ans:

1.Electrostatic	2.Coulomb's Constant	3.Newton's Law of Gravitation	4.F	5.Parallel to each other
6.Electric potential	7.Parallel	8. 4 μF	9.increases	10.double

Numerical

1. What is the electric force of repulsion between two electrons at a distance of 1m? (2.3×10^{-28} N)

2. Two-point charges $q_1 = 5\mu C$ and $q_2 = 3\ \mu C$ are placed at a distance of 5 cm. What will be the coulomb's force between them? (54 N)

3. If $2\mu C$ charge is placed in the field of 3.42×10^{11}N/C, what will be the force on it? (684×10^3 N)

4. What is the charge on the capacitor, if a 40 μF capacitor has a potential difference of 6 V across it? (2.4×10^{-4})

5. The potential difference between two points is 100 V. If an unknown charge is moved between thee points, the amount of work done is 500J. Find the amount of charge. (5 C)

6. Find the equivalent capacitance when a $4\mu F$, 3 μF and 2 μF capacitor are connected in series. (0.92 μF)

Worked Example 1 Calculate the force of attraction between two point charge of +2mC and-3mC, if they apart of 1cm.

Worked Example 2 Calculate the electric field intensity if 9uN force acting on 3 μC charge.

Worked Example 3 Calculate the p.d of 300mJ of work done on a 150 mC charge?

Worked Example 4 Calculate the coulombs force between two protons 10cm apart from each other? Charge on proton is 1.69×10^{-19} C and K $= 9.0 \times 10^9$ N-m^2/C^2

Unit-15

Current Electricity

Q1. What is a Current

Current

A current is motion of any charge moving from one point to another point.

Representation:

Current is represented by I.

Unit

The SI unit of current is ampere.

Nature

Current is a tensor quantity.

Mathematically

Current can be calculated by

$$I = \frac{q}{t}$$

Q2. Define Electronic current and Conventional current

Electronic current

When current flows from the negative terminal to the positive terminal of battery.

Conventional current

When current flows from the positive terminal to the negative terminal of battery.

Q3. Name and discus the Types of current

Types of current

There are two types of electric current.

1. Direct current (DC)
2. Alternating current (AC)

Direct current (DC)

A current that always flows in one direction only is called direct current.

Example The current we get from a battery is a direct current.

Alternating current (AC)

A current that reverses its direction periodically is called alternating current.

Example Most power stations in our country produce alternating current.

Q4. Differentiate between A.C and D.C.

Alternating Current	**Direct Current**

Safe to transfer over longer city distances and can provide more power.	Voltage of DC cannot travel very far until it begins to lose energy.
Rotating magnet along the wire.	Steady magnetism along the wire.
The frequency of alternating current is 50Hz or 60Hz depending upon the country.	The frequency of direct current is zero
It reverses its direction while flowing in a circuit.	It flows in one direction in the circuit.
Electrons keep switching directions - forward and backward.	Electrons move steadily in one direction or 'forward'.
A.C Generator and mains.	Cell or Battery

Q5. What are Advantage of AC over DC.

Advantage of AC over DC

One advantage of AC over DC is that it can be transmitted over long distances without much loss of energy.

Q6. DEFINE Potential difference. Give its formula and unit.

Potential difference The potential difference is the difference in the amount of energy that charge carriers have between two points in a field.

Mathematically

Equation of electric potential difference is

$$\Delta V = \frac{w}{q}$$

$$\Delta V = V_B - V_A$$

$$V_B - V_A = \frac{W}{q}$$

Unit

The unit of potential differences volt(V).

Define Electromotive force. Also write its formula and unit.

Electromotive force

The amount of energy required to move the charge from lower potential to higher potential of the battery is called electromotive force (EMF).

Mathematically:

$$\boldsymbol{EMF(\varepsilon) = \frac{Energysupplies(w)}{Unitcharge(q)}}$$

SI unit of EMF

The SI unit of EMF is volt(V).

CGS unit of EMF

The CGS unit of EMF: Stat volt or one erg per electrostatic unit of charge.

Q7.State Ohm's law. Also derive V = IR.

Ohm's law

Statement

The current flowing through the conductor is directly proportional to the potential difference across the two ends of a conductor, provided the physical state (Dimension, Temperature, etc) of the conductor remains same.

Mathematically:

According to ohm's law

$$I \propto V$$

$$I = KV$$

Where K is constant of proportionality called conductance or physical state of conductor. Conductance is opposite to resistance. Thus, K = 1/R

$$I = V/R$$

$$V = I R$$

Where R is the constant called resistance.

Q8.What are the limitation of Ohm's law

Ohm's law limitations

There are some limitations to ohm's law. They are as follows:

- Ohm's law is an empirical law which is found true for maximum experiments but not for all.
- Some materials are non-ohmic under a weak electric field.
- Ohm's law holds true only for a conductor at a constant temperature because resistivity changes with temperature.
- As long as the current flows, greater will be the temperature of the conductor.
- Heat produced in a conductor can be calculated by Joule's heat law $H= I^2Rt$ where I is current, R is resistance and t is time.
- Ohm's law is not applicable to in-network circuits.
- Ohm's law does not apply directly to capacitor circuits and inductor circuits.
- The V-I graph of ohmic conductors is not really a straight graph. It does show some variation.
- The V-I characteristics of diodes are much different from ohmic conductors V-I graph.

Q9.What do you know about Non-ohmic device? Also give example of it.

Non-ohmic device

The device that does not follow ohm's law is known as a non-ohmic device.

Example

The examples of non-ohmic devices are thermistors, crystal rectifiers, vacuum tube and diode etc.

Q10. What is resistance?

Resistance

The electrical resistance measures how much the flow of this electric charge is restricted within the circuit.

Mathematically:

$$R = \frac{V}{I}$$

Unit

The SI unit of electrical resistance is ohm(Ω).

Q11. What are the Factors affecting the resistance?

Factor affecting the resistance

- Electrical resistance is directly proportional to the length (L) of the conductor and inversely proportional to the cross-sectional area (A). It is given by the following relation.

$$R = \frac{\rho L}{A}$$

Where ρ is the resistivity of the material measured in Ω-m.

- Electrical resistance is inversely proportional to the temperature of metallic conductors.

Q12. Define Resistivity. State its uses.

Resistivity

Resistivity is a qualitative measurement of a material's ability to resist flowing electric current.

Uses of resistance

Resistance is also useful in things like transistor radios and TV sets.

The volume knob is actually part of an electronic component called a variable resistor. If you turn the volume down, you are actually turning up the resistance in an electrical circuit that drives the TV's loudspeaker. When you turn up the resistance, the electric current flowing through the circuit is reduced. With less current, there is less energy to power the loudspeaker - so it sounds much quieter.

Q13. What is a Circuit? Name the types of Circuit.

Circuit

The method of connecting the electric components is called circuit.

Types of circuits:

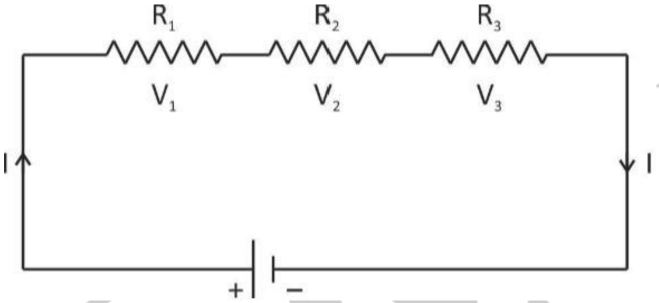
There are two types of circuits

1. Series combination circuit
2. Parallel combination circuit

Q14. Derive an expression of equivalent resistance the resistance connected in series

Series combination circuit

When resistors are connected end to end such that there is only one path for the current to flow then the combination is called series combination.



Derivation for Equivalent resistance

Let suppose three resistors R_1, R_2 and R_3 are connected in series, when this combination is connected to a battery of V volts, it draws current I from the battery. R_e is called equivalent resistor and its resistance is called equivalent resistance.

Then, for series combination

$$V = V_1 + V_2 + V_3 \quad \text{........(i)}$$

By applying Ohm's Law to each resistor. We have:

$$V_1 = IR_1,\ V_2 = IR_2,\ V_3 = IR_3$$

Using them in equation (i) we get:

$$IR = IR_1 + IR_2 + IR_3$$

$$IR = I\,(R_1 + R_2 + R_3)$$

$$R = R_1 + R_2 + R_3$$

Thus, equivalent resistance is equal to the sum of individual resistance.

Q15. List some Advantages and disadvantages of series resistance.

Advantages

1. It's employed when a large number of bulbs or lights need to be used at the same time.
2. Because the circuit receives less current, it is safer.
3. Because all the bulbs, lights and appliances are connected together, it's easier to turn them on or off.

Disadvantages:

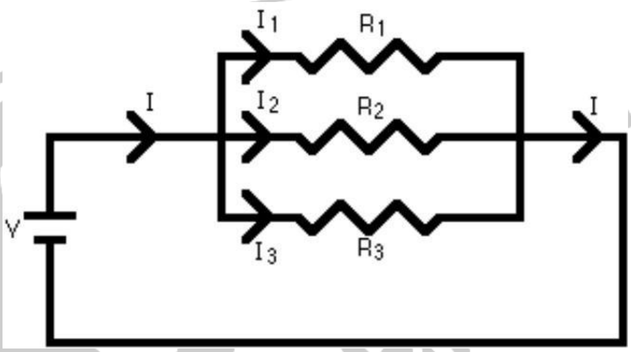
1. Because all electrical appliances have only one switch, no single appliance may be turned off separately.
2. The second component of the circuit will not function if one component is used or quits operating.
3. Because the voltage is distributed in series or combination, not all of the components receive the same voltage.

Q16. Derive an expression of equivalent resistance the resistance connected in series

Parallel combination circuits

When there are multiple paths for current flow in a circuit, the combination of resistance is referred to as parallel combination.

Derivation for Equivalent resistance



Let suppose three resistors R_1,R_2 and R_3 are connected in parallel. When the combination is connected to a battery of V volts, it draws a current I from the battery. R_e is called equivalent resistor and its resistance is called equivalent resistance.

Then, for parallel combinations

$$I = I_1 + I_2 + I_3$$

By applying Ohm's law to each register. We have:

$$V = IR \quad \text{or } I = \frac{V}{R}$$

$$I = \frac{V}{R_1}, I = \frac{V}{R_2}, I = \frac{V}{R_3}$$

Using them in equation (i). We get:

$$\frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\frac{V}{R} = V\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)$$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Thus the reciprocal of equivalent resistance is equal to the sum of reciprocals of individual resistances.

Q17. List some Advantages and disadvantages of parellel resistance.

Advantages:

1. Each appliance can be turned on or off independently.
2. The voltage of each electrical appliance is the same as the power supply line.
3. If one electrical appliance stops working due to a problem, the other appliances will continue to function.

Disadvantages:

1. Because the circuit can carry higher current, it is less safe.
2. If hundreds of appliances or lamps need to be turned on or off at the same time, this method is difficult to apply.

Q18. Define Electric power.

Electric power

The rate at which the work is being done in an electrical circuit is called an electric power.

Q19. What is Power dissipation

Power dissipation

The rate at which the heat is dissipated is called power dissipation.

Representation

It is represented by P.

Unit

The SI unit of power dissipation is Watts(W).

Mathematically:

$$P = IV$$

Or

$$P = I^2R$$

Or

$$P = \frac{V^2}{R}$$

Q20. Define the term Energy in resistors

Energy in resistors or components or circuits

Energy is dissipated when a particular amount of power is dissipated over a period of time.

Unit

The SI unit of energy dissipated is Joules (J).

Mathematically

The energy dissipated by a component or circuit can be estimated by including time(t) in the power formulas.

Energy dissipated = Pt Or

Energy dissipated = IVt Or

Energy dissipated = I^2Rt Or

Energy dissipated = $\frac{V_2 t}{R}$

Q21. What is Kilowatt hour

Kilowatt hour(kWh): The commercial unit of energy is kilowatt hour.

To calculate the kWh for a specific appliance, multiply the power rating (watts) of the appliance by the amount of time (hrs) you use the appliance and divide by 1000.

$$\text{Khw} = \frac{\text{watt} \times \text{time}}{1000}$$

Q22. State and explain Joule's law

Statement

When an electric current passes through a conductor, heat H is produced, which is directly proportional to the resistance R of the conductor, the time t for which the current flows, and to the square of the magnitude of current I.

Mathematically:

$$H \propto I^2Rt$$
$$H = I^2Rt$$

- The amount of generated heat is proportional to the wire's electrical resistance when the current in the circuit and time of flow are not changed.
- The amount of generated heat in a conductor carrying current is proportional to the square of the current flow through the circuit when the electrical resistance and time of flow are constant.
- The amount of heat produced because of the current flow is proportional to the time of flow when the resistance and current flow is kept constant.

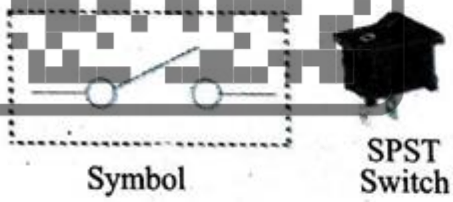
Q23. Discus some Electrical components or circuit components and their uses.

Electrical components or circuit components and their uses

The devices that make up an electric circuit are known as electrical components. Different components are used for different purposes.

Switches or key:

It is one of the most fundamental electrical components.
it is used to turn electric circuits ON and OFF. This simply implies that when you press or flick a switch, current is allowed to pass through to the rest of the circuit.

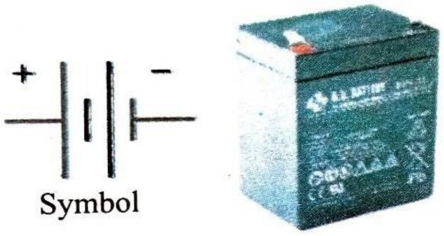


Switch or key

Resistor

It is a two-terminal electrical component that implements electrical resistance as a circuit element.

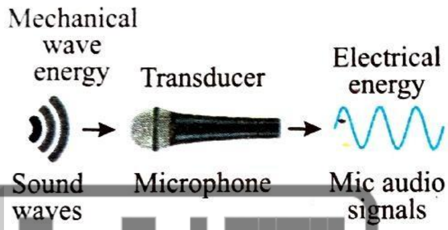
Resistor



Battery

Battery
It is electrical source that store the chemical energy and converts the chemical energy into electrical energy.

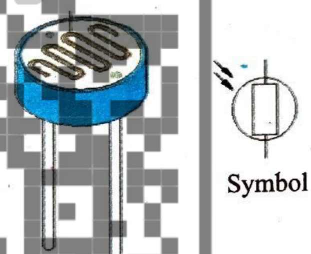
Transducer
It is an electrical component that converts one form of energy into another form of energy like microphone converts sound energy into electrical energy/signal.



Transducer

LDRs (Light Dependent Resistors)
A photoresistor or light dependent resistor is an electronic component that is sensitive to light. It is used in automatic security lights.

- In low light levels, the resistance of an LDR is high and little current can flow through it.
- In bright light, the resistance of an LDR is low and more current can flow through it.



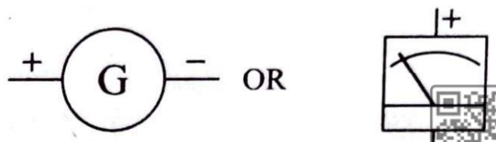
Light dependent resistor (LDR)

Thermistors
It is thermally sensitive resistors whose resistance is strongly dependent on temperature. It is used to measure the temperature very accurately.

Relay
It switches which aim at OFF and ON the circuits electronically as well as electromechanically.

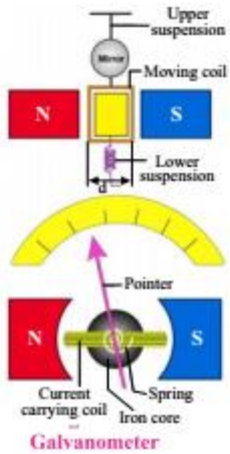
Q24. **what is Moving coil galvanometer?**

Moving coil galvanometer
It is an electromechanical instrument used to detect and measure small amount of current which is in the range between milliamperes or microamperes.



Working principle

This is a current detecting meter based on magnetic dipole torque.



Q25. What is an ammeter? How galvanometer is converted in ammeter?

Ammeter

An ammeter is an electromechanical instrument used to measure electric current.

Conversion of galvanometer into ammeter

A galvanometer can be converted into an ammeter by connecting a low shunt resistance in parallel to the galvanometer.

Conversion in to Ammeter

Connection

An ammeter is used in a circuit always in 'series'.

Circuit diagram of ammeter

Symbol

Its symbol is (A).

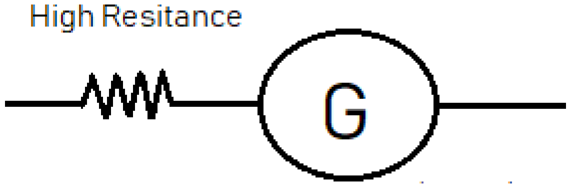
Q26. What is an voltmeter? How galvanometer is converted in voltmeter?

Voltmeter

Voltmeter is an electromechanical instrument used to measure potential difference.

Conversion of galvanometer into voltmeter

A galvanometer can be converted into a voltmeter if a high resistance is connected in series with galvanometer.



Conversion in to Voltmeter

Connection

A voltmeter is used in a circuit always in parallel.

Symbol

Its symbol is (V).

Q27. What is Shunt resistor

Shunt resistor

A resistor having a very low value of resistance, such type of resistor is called shunt resistor.

Q28. Write short note on Electrical Power transmission to a house

Electrical Power transmission to a house

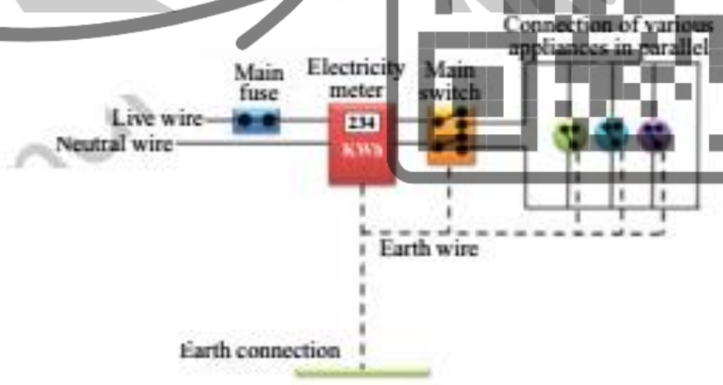
There are three cables that provide electricity into the building. One is referred to as a **ground wire** or **earth wire(E)**. There is no current through this. The house's earth wire is connected to a buried metal plate.

The other cable, known as **neutral wire**, is grounded to the earth within the power plant itself to keep its voltage constant (N). The current flows back through this wire. The third wire, which has a high potential and is called the **livewire**, is connected to the battery (L). Difference in voltage between the live and neutral wires is 220 V.

The human body is a good conductor of electricity. If a person holds livewire, current will flow to the ground through his body, which could be dangerous. The live and neutral wires are used to connect all of the equipment in a home. All have the same potential difference; thus they are joined in parallel to the power source.

A connection has been made between the cables coming from the mains and the electricity meter that has been installed in the residence is shown in the figure. The electric meter's output goes to the main distribution board and subsequently the home electric circuit.

The main box has uses with ratings of about 30 A. Each appliance has its own connection made directly to the live wire. A fuse and a switch are used to connect the appliance terminal to the live wire. In the event that the fuse of one appliance blows, it will not have any impact on the functioning of the other appliances.



Illustrate the distribution of electrical power from main to the home appliances

Q29. What are the Hazards of electricity?

Hazards of electricity

Electrical shock, fire, and arc flashes are the primary hazards that are present in working with electricity. When the human body comes into contact with either or both of the wires in an electrical circuit or with one wire of an energized circuit and the ground, or with a metallic part that has become energized by contact with an electrical conductor, the result is an electric shock.

Electrical shock depends on the pathway through the body, the amount of current, the length of exposure, and whether the skin is wet or dry. Wet skin and wet conditions are good conductors of electricity.

Damaged Insulation

Insulation refers to the sheath made of plastic that is wrapped around wires in a circuit. If the insulation on a cable is damaged, the metal conductors inside will be exposed.

It is possible for a person to receive an electric shock if he comes into contact with the exposed wires, which could result in his death. Before replacing any damaged insulation, attempt to cover any damaged insulation with electrical tape, make sure that all power sources have been turned off and then replace that damaged insulation.

Overheating of cables

When a very high current is passed through a cable, there is a possibility that the wire will overheat as a result of the excessive amount of energy.

Because of the overheating, there is a risk of electrical fires.

Damp conditions

People who are in close proximity to an electrical appliance that is being used in a damp environment, such as a bathroom, have an increased risk of being electrocuted by the electricity that is being conducted through the water because water is a conductor. If a person touches a socket while their skin is wet in any way, they run the risk of being electrocuted.

Q30. Discus some of devices use for Safety measures in household electricity.

Safety measures in household electricity

To avoid any unwanted incident few measures must be taken which are given below:

Fuses: Fuses prevent damage to electronic components caused by overheating. When there is a significant amount of current running through the circuit, the wires that are contained within the circuit will begin to overheat. A metal wire fuse with a low melting point will become molten, breaking the circuit.

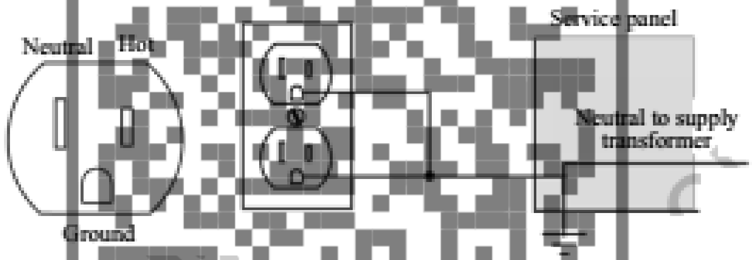
Different type of fuse used in electronic components

The Circuit-Breaker

Breakers prevent damage to electronic components caused by overheating. In the majority of applications found in the home, circuit breakers are used to restrict the amount of current flowing through a single circuit. Although the circuit breakers are available in a wide range of sizes, the maximum current that can flow through a single circuit is typically 20 amps. 20 amps of current will heat the bimetallic strip, bending it download and releasing the trip-lever. In the case of a high-current spike, the bimetallic strip will be rapidly retracted by a small electromagnet made from wire loops wrapped around a piece of iron.

The ground wires

The word 'ground' means that something is connected to the Earth, which stores charge. A ground wire gives an electrical appliance a path to the earth that is separate from the normal path that current takes. As a practical matter, it is connected to the electrical neutral at the service panel so that if there is an electrical fault, there is a path with low enough resistance to trip the circuit breaker as illustrated in figure.



Attached to an appliance's case, it keeps the case's voltage at ground potential (usually taken as the zero of voltage). In this way, electric shock is prevented.

Standard electric circuits

Standard electric circuits have a ground wire and either a fuse or a circuit breaker for safety.

Q31. List some Effects of electric shock on human body

Effects of electric shock on human body

- Electric current of 0.001 A can be felt.
- Electric current of 0.005 A can be painful for human body.
- If electric current is of 0.01 A, resulting in the contraction of muscles in an uncontrollable manner (spasms).
- Electric shock of 0.015 A can lead to a lack of control over the muscles.

- The electric current of 0.070 A passes through the heart; creates a significant disturbance; and is almost certainly fatal if the current continues for more than one second.

Multiple Choice Questions (MCQs)

1. In an electric circuit when electrons move from low to high potential they will:
(a) Gain energy (b) Lose their identity
(c) Lose energy (d) Gain potential

2. In an electric circuit an ammeter is always connected in
(a) series (b) parallel (c) mixed (d) none of the above

3. Resistance of a conductor does not depend on
(a) Length of the conductor (b) area of cross section
(c) Density (d) Resistivity

4. Ohm's law states that:
(a) Resistance increases as current increases
(b) Resistance decreases as current increases
(c) Resistance increases as voltage increases
(d) Current increases as voltage increases

5. The condition when the resistance of a circuit is zero is known as
(a) Closed-circuit (b) Open circuit (c) Short circuit (d) Zero circuit

6. The condition for the validity of Ohm's law is that the
(a) Temperature should remain constant (b) Current should be proportional to voltage
(c) Resistance must be wire wound type (d) All of the above

7. Ohm's law is not applicable to
(a) Semiconductors (b) D.C. circuits (c) Small resistors (d) High currents

8. Two resistances of 6Ω and 12 Ω are connected in parallel their net resistance is —--.
(a) 7Ω (b) 6Ω (c) 4Ω (d) 5Ω

9. The property of a body to oppose the flow of electric resistance through it is called electric —--.
(a) Capacitance (b) potential (c) resistance (d) conductance

10. Which of the following is the purpose of connecting a battery in an electric circuit?
(a) To maintain resistance across the conductor.
(b) To vary resistance across the conductors.
(c) To maintain constant potential difference across the conductor.
(d) To maintain varying potential difference across the conductor.

Ans:

1.Lose energy	2.series	3.Density	4.Current increases as voltage increases	5.Short circuit
6.All of the above	7.Semiconduct or s	8. 4Ω	9.resistance	10.To maintain constant potential difference across the conductor.

Numerical

1. When the current in a pocket calculator is 0.0002 A, how much charge flows every minute? (12mC)

2. Calculate the amount of current that an electric heater uses to heat a room in 5 minutes if the charge is 2100 C. (7 A)

3. A potential difference of 90 V exists between two points. The amount of work done when an unknown charge is moved between the points is 450J. Determine the charge amount (5 C)

4. Calculate the potential difference between two points A and B if it takes 9×10^4J of external work to move a charge of +9 HC from A to B. (100 V)

5. The potential difference applied to a portable radio terminal is 6.0 Volts. Determine the resistance of the radio when a current of 20 mA flows through it. (300 Ω)

6. Resistances of 4 Ω, 6 Ω, and 12 Ω are connected in parallel and then connected to a 6V emf source. Determine the value of
   1. The circuit's equivalent resistance. (2 2)
   2. The total current flowing through the circuit. (3 A)
   3. The current that flows through each resistance. (1.5 A, 1 A, 0.5 A)

7. A 220 V circuit is used to power two 120 watt and 80 watt light bulbs. Which bulb has the greater resistance and which one has the higher current? (80 W bulb, 120 W bulb)

Worked Example 1 How much voltage will be dropped across a 50 kΩ resistance whose current is 300 μA?

Worked Example 2 Find the current passing through circuit and the voltage across each of the resistors. 100Ω, 400Ω and 200Ω Resistors in series.

Worked Example 3 100J of heat is produced each second in a 4 Ω resistance, Find the potential difference across the resistor.

UNIT-16
ELECTROMAGNETISM

Q1.Define Electromagnetism, Electromagnetic force.

Electromagnetism

Electromagnetism is a branch of Physics that deals with the electromagnetic force that occurs between electrically charged particles.

Electromagnetic force

The electromagnetic force is a type of physical interaction that occurs between electrically charged particles.

Q2.Discus the Magnetic field of a study current

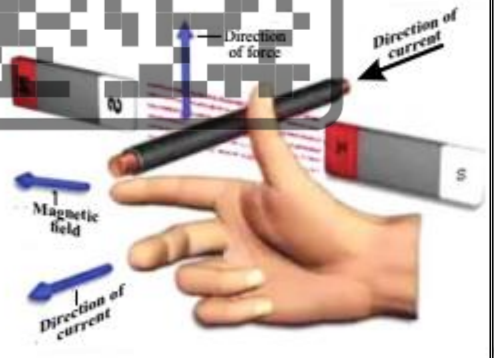
Magnetic field of a study current

Pass a current-carrying conductor through a cardboard sheet. Small compasses should be placed near the conductor. Then, the compasses will point in the direction of the magnetic lines of force.

Rule

The magnetic field direction around a current carrying conductor can be determined by following this rule.

"The magnetic field made by a current in a straight wire curl around the wire in a ring. You can find it by pointing your right thumb in the direction of the current in the wire and curling your fingers. Your fingers will be curled in the same direction as the magnetic field around the wire".



Demonstration of the right-hand rule for conductors.

Q3.What is Fleming's right hand rule

Fleming's right hand rule Fleming's right-hand rule gives which direction the current flows.

The right hand is held with the thumb, first finger and second finger mutually perpendicular to each other (at right angles), as shown in the diagram.

- The thumb is pointed in the direction of force.
- The first finger is pointed in the direction of the magnetic field. By convention, it is directed from the North to South magnetic pole.
- Then the second finger represents the direction of the induced or generated current within the conductor.

Q4. Derive a formula for Force acting on a charge moving through a magnetic field

Force acting on a charge moving through a magnetic field

Now suppose a particle carrying charge **q** is projected with speed **V** into a magnetic field of induction **B** such that the angle between **B** and **V** is **θ**. The magnetic field of the charged particle interacts with the magnetic field of the magnet in which it is sent, due to which a force is produced which acts upon the particle. It is found that:

- The force F acting on the particle is directly proportional to the charge q.
- The force F acting on the particle is directly proportional to the velocity V.
- The force F is directed perpendicular to the plane containing V and B. Combining the above three observations, we found that

F = q (V x B)

So the magnitude of B is given by:

$$B = \frac{F}{qvSin\theta}$$

Define Magnetic field and Magnetic field lines

Magnetic field

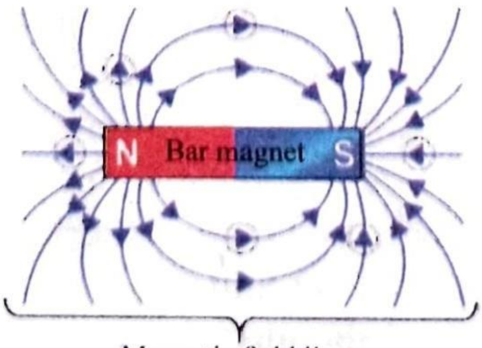
Magnetic Field is the region around a magnetic material or a moving electric charge within which the force of magnetism acts.

Example

Earth has magnetic field around it, because of flowing of liquid metal in the outer core cause to generate electric current.

Magnetic field lines

Magnetic field lines are imaginary lines coming outward from the north pole and going inward in a south pole and inside a bar magnet, magnetic field will be zero. The magnetic field is strongest at the end of the pole because magnetic field lines are very close at the end of poles, while it is weakest at the centre.



Magnetic field lines

Q5. Define Magnetic flux density. Also give is unit.

Magnetic flux density or magnetic induction

Definition: A vector quantity measuring the strength and direction of the magnetic field around a magnet or an electric current.

Representation: It is represented by B.

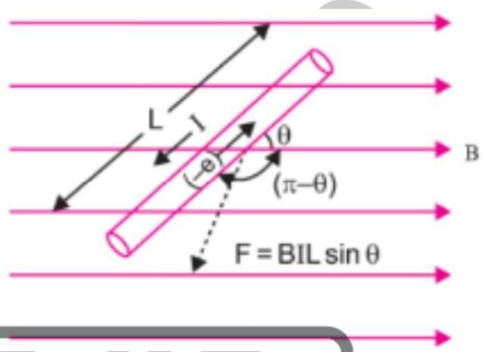
Unit: Its unit is tesla (N/(A x m)).

Q6. Derive an expression for Force on current carrying conductor in a magnetic field

Force on current carrying conductor in a magnetic field

When current passes through a conductor placed in a magnetic field experiences a force.

When a conductor of length **L** carrying current **I** and placed in a magnetic field **B** at an angle **θ** as shown in figure, it experiences a force **F**:



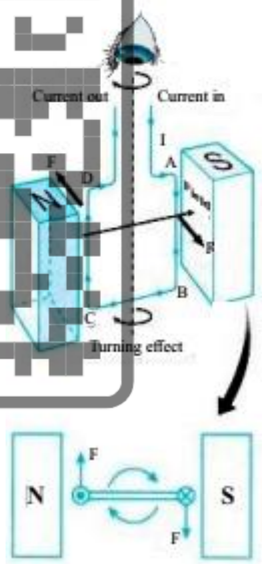
$$F = I\,(l \times B)$$
$$F = BIL\,sin\theta$$
$$B = \frac{F}{Ilsin\theta}$$

The direction of the force acting on the conductor will be perpendicular to the direction of the magnetic field and the electric current if they are perpendicular to each other.

Q7. Derive an expression for Turning effect on a current carrying coil in a magnetic field.

Turning effect on a current carrying coil in a magnetic field

When a current passes through the coil, equal and opposite parallel forces act respectively on the sides of the coil beside the poles of the permanent magnet. This pair of forces produces a turning effect to rotate the coil until it is supported by the control springs.



Consider a rectangular coil placed in the magnetic field of strength **B** and the plane of the coil is parallel to the field and is free to rotate about an axis.
When current **I** passes through the coil, a force is experienced on the perpendicularly placed conductor. The magnitude of the force is **F = BIL**. Hence a pair of two equal but opposite forces (couple) acts on the coil. That causes the coil to rotate. So,

$$\text{Torque} = \tau = BIA$$

If the plane of the coil makes an angle **α** with the field **B** then the perpendicular distance **Cosα** can be added:

$$\tau = BIA\,Cos\alpha$$

If the coil has N turns, then:

τ = BIAN Cosα

Q8. What is D.C motor. Describe the construction and working of D.C motor. Also draw its figure

D.C motor

D.C motor is an electromechanical device that converts electrical energy into mechanical energy.

Construction

A D.C motor consists of following main parts.

Magnetic Field System

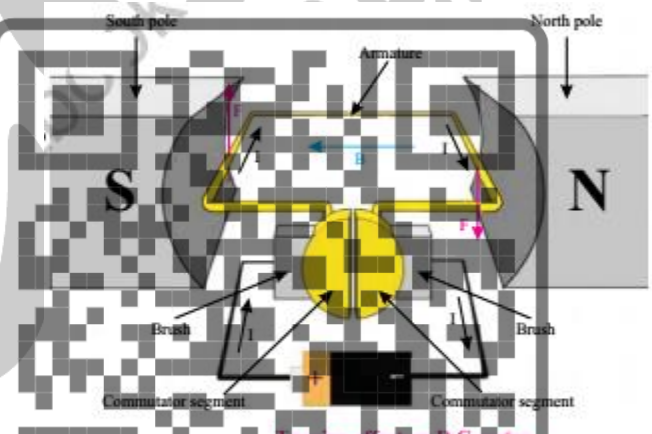
The magnetic field system of a D.C motor is the stationary part of the machine. It produces magnetic field in the motor.

Armature

The armature of D.C motor is connected with the shaft and rotates between the field poles after passing current through it.

Commutator

A commutator is a mechanical rectifier which converts the direct current input to the motor from the DC source into alternating current in the armature.



Turning effect on D.C motor

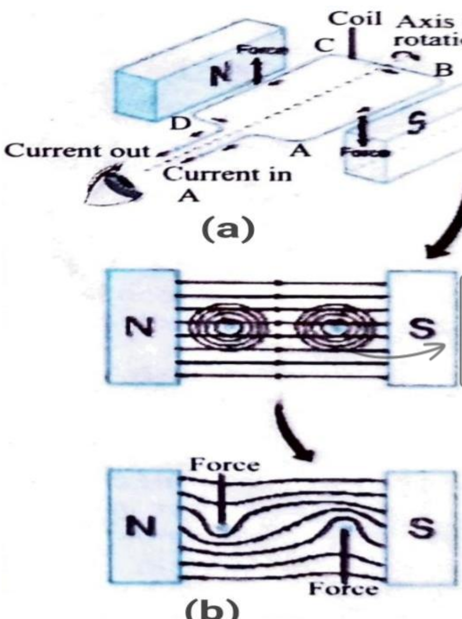
Brushes

The brushes are mounted on the commutator and are used to inject the current from the DC source into the armature.

Working

A current carrying coil in a magnetic field experiences a turning effect. In figure (a) below, a rectangular coil ABCD carries a current in the magnetic field between two magnets.

a. The sides BC and DA carry currents with directions parallel to the magnetic field. No force is exerted on these two sides.
b. The side AB next to the South pole experiences a force. The direction of the force can be determined using Fleming's left-hand rule or the right-hand slap rule.
c. The side CD experiences a force that acts in the opposite direction.



Torque on D.C motor

The two forces acting in opposite directions on the two sides of the coil form a couple and produce a turning effect on the coil. The forces are produced when the magnetic field due to the current in the coil combines with the external magnetic field to produce two resultant catapult fields around the coil.

Q9. Define Electromagnetic.

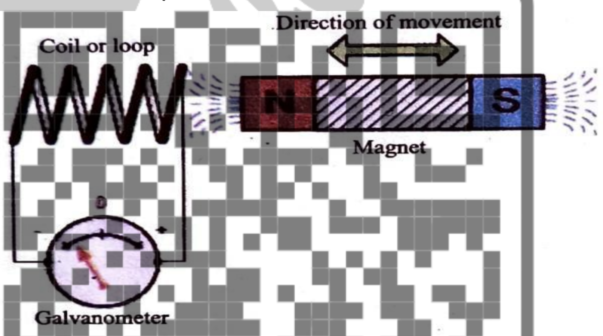
Electromagnetic or magnetic induction

Electromagnetic or magnetic induction is the production of an electromotive force across an electrical conductor in a changing magnetic field.

Q10. How magnetic field can induce e.m.f in a circuit

Changing magnetic field can induce e.m.f in a circuit Electromagnetic Induction by a Moving Magnet

Faraday demonstrates that magnetic fields can create currents as illustrated in figure below. When the magnet shown below is moved "towards" the coil, the Galvanometer's pointer or needle will deflect away from its centre position in one direction only.



changing magnetic produced induced e.m.f

When the magnet stops moving and is held stationary with respect to the coil, the needle of the galvanometer returns to zero as there is no physical movement of the magnetic field.

Similarly, when the magnet is moved "away" from the coil, the galvanometer needle deflects in the opposite direction, indicating a change in polarity. By moving the magnet back and forth towards the coil, the needle of the galvanometer will deflect left or right, positive or negative, relative to the magnet's motion.

Electromagnetic Induction by a Moving Coil

For Faraday's law to be valid, either the coil or the magnetic field (or both) must be in "relative motion" with one another for the induced emf or voltage.

If you keep the magnet stationary and move only the coil toward or away from the magnet, the needle on the galvanometer will also move in either direction. A voltage is induced in a coil when the coil is moved through a magnetic field, and the magnitude of this voltage is proportional to the speed at which the coil is moved.

Q11. What do you know about Faraday's Law of Induction?

Faraday's Law of Induction

Statement: A voltage is induced in a circuit whenever relative motion exists between a conductor and a magnetic field and that the magnitude of this voltage is proportional to the rate of change of the flux".

Mathematically: According to Faraday's law

$$\varepsilon \ \alpha \frac{d\emptyset}{dt}$$

$$\varepsilon = N\frac{d\emptyset}{dt}$$

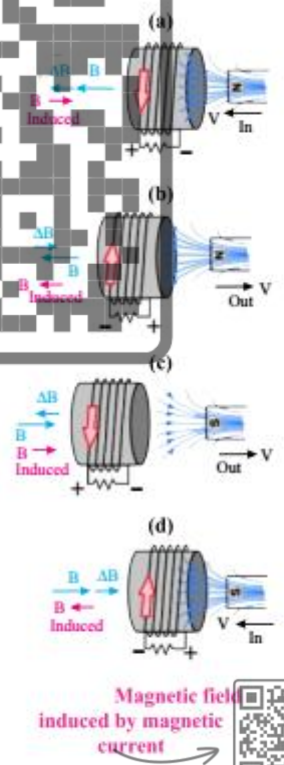
Where:
ε = Induced emf
$d\emptyset$ = change in magnetic flux N = No of turns in coil

Q12. Discus the Factors affecting the magnitude of an induced e.m.f

Factors affecting the magnitude of an induced e.m.f:

The factors involved in the induced emf of a coil are:

- The induced e.m.f. is directly proportional to N, the total number of turns in the coil.
- The induced e.m.f. is directly proportional to A, the area of cross-section of the coil.
- The induced e.m.f. is directly proportional to B, the strength of the magnetic field in which the coil is rotating.
- The induced e.m.f. is directly proportional to '', the angular velocity of the coil.
- The induced e.m.f. also varies with time and depends on instant 't'.
- The induced e.m.f. is maximum when the plane of the coil is parallel to magnetic field B and e.m.f. is zero when the plane of the coil is perpendicular to magnetic field B.



Q13. State and explain Lenz's law

Lenz's law of electromagnetic induction

Statement: Lenz's law of electromagnetic induction states that the magnetic field produced by the induced current opposes the original magnetic field that produced the current.

Explanation: Below illustration showing that, if magnetic field "B" is increasing, the induced magnetic field will oppose it in
As illustrated in figure (b), the induced magnetic field will once again oppose the magnetic field "B" when "B" is decreasing. This time, "in opposition" suggests it's acting to increase the field by opposing the decreasing rate of change.

Lenz's law derives from Faraday's law of induction.

When a magnetic field changes, an induced current will flow in the opposite direction, as described by Lenz's law. That's why the minus sign ('-') appears in the formula for Faraday's law to emphasize this point.

According to Faraday's law that the magnitude of the EMF induced in the circuit is proportional to the rate of change of flux.

$$\varepsilon \;\alpha\; \frac{d\emptyset_B}{dt}$$

$$\varepsilon = N\frac{d\emptyset_B}{dt}$$

Where:
ε = Induced emf
$d\emptyset_B$ = change in magnetic flux N = No of turns in coil

Q14. Describe the comparison between Lenz's Law and Conservation of Energy

Lenz's Law and Conservation of Energy

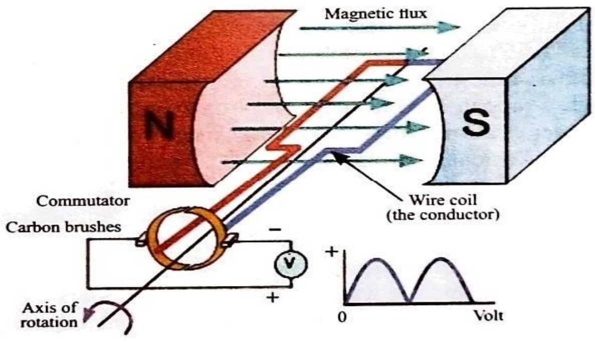
To obey the law of energy conservation, the direction of the current induced by Lenz's law must create a magnetic field that is opposite to the magnetic field that created it. In fact, Lenz's law is a result of the law of conservation of energy. If the magnetic field created by the induced current is in the same direction as the field that produced it, then the two magnetic fields would combine to make a larger magnetic field. By combining their magnetic fields, they may create a field that is twice as strong as the original one, inducing a current twice as large in the conductor. As a result, a new magnetic field would be produced, which in turn would induce a new current. And so on.
Because of this, it is easy to understand that the conservation of energy would be violated if Lenz's law did not state that the induced current must produce a magnetic field that opposes the field that originated it.

Q15. Describe the comparison between Lenz's law and Newton's third law of motion

Lenz's law and Newton's third law of motion

Lenz's law states that in electromagnetic induction, the direction of induced current is such that it opposes cause of its creation. Remember the experiment of moving magnet towards and away from a coiled wire. The galvanometer needle deflects towards right on moving magnet towards left the coil.

Here, the third law of motion is followed because direction of induced current is opposite to the force which we apply. Hence action i.e. motion of magnet and reaction i.e. induction of current are equal and opposite.



A.C generator

what is A.C generator

A.C generator An AC generator is an electric generator that converts mechanical energy into electrical energy in the form of alternative emf or alternating current. An AC generator works on the principle of "Electromagnetic Induction".

Q16. Define Mutual induction. Also derive its formula.

When an electric current passing through a primary coil changes with time, an emf is induced in the secondary coil. This phenomenon is known as mutual induction and the emf is called mutually induced emf.

Derivation

The secondary coil's e.m.f. is proportional to the primary coil's rate of change of current. Thus:

$$\varepsilon_s \alpha \frac{\Delta I_p}{\Delta t}$$

$$\varepsilon_s = -M\frac{\Delta I_p}{\Delta t}$$

–ve sign is due to Lenz's law.
Where M is a constant, called Mutual Inductance of the two coins.
Hence:

$$M = \frac{\varepsilon_s}{\frac{\Delta I_p}{\Delta t}}$$

Q17. What is Transformer? Describe its construction and working

Transformer

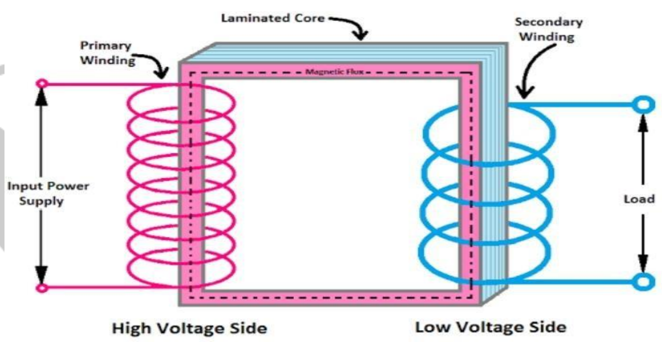
Transformer is a static machine used for transforming power from one circuit to another without changing the frequency. It operates on an AC supply.

Working principle

Transformers operate based on the principle of mutual induction.

Construction

It consists of two coils which are magnetically linked to each other but electrically isolated from one another although wrapped around the same iron core, make up a transformer. The primary coil is the first of two coils in the system which is connected to A.C input power. The secondary coil is the other coil which delivers the power to the output circuit.



Main Parts of Transformer

Working

When current passing through the primary coil generates magnetic field, which is transmitted to the secondary coil through the core. The change in the field causes an alternating e.m.f. to be generated in the secondary coil.

Factors on which secondary voltage depends:

The secondary voltage (V_s) is proportional to the primary voltage (V_p). The ratio of the number of turns on the secondary coil (N_s) to the number of turns on the primary coil (N_p) also affects the secondary voltage, as illustrated by the following expression.

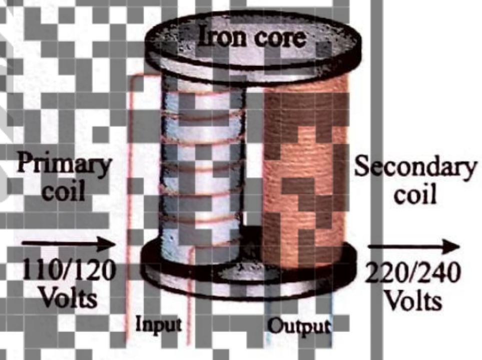
$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

Q18. List and discus the Types of transformers

Types of transformers

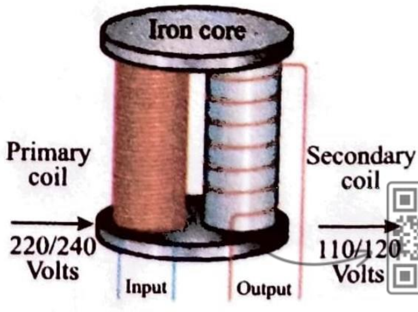
The types of transformers are following.

1. Step up transformer.
2. Step down transformer



(a)
Step up transformer

1. **Step up transformer:** The transformer is referred to as a step-up transformer if the secondary voltage exceeds the primary voltage.
2. **Step down transformer:** A step-down transformer is one in which the secondary voltage is lower than the primary voltage.



(b)
Step down transformer

Ideal transformer

Definition

An ideal transformer dissipates no power.

Mathematically

We may write the following mathematical expression for such a transformer

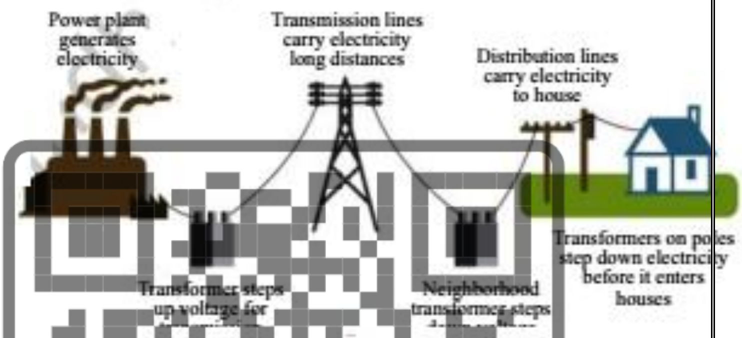
$P_p = P_s$

$$V_p I_p = V_s I_s$$

Q19. Describe the Role of Transformer in Power Transmission

Role of Transformer in Power Transmission Generation of electrical power in low voltage level is very much cost effective. Theoretically, this low voltage level power can be transmitted to the receiving end. This low voltage power if transmitted results in greater line current which indeed causes more line losses.

But if the voltage level of a power is increased, the current of the power is reduced which causes reduction in ohmic or $P=I^2R$ losses in the system, reduction in cross-sectional area of the conductor i.e. reduction in capital cost of the system and it also improves the voltage regulation of the system. Because of these, low level power must be stepped up for efficient electrical power transmission. This is done by step up transformer at the sending side of the power system network. As this high voltage power may not be distributed to the consumers directly, this must be stepped down to the desired level at the receiving end with the help of step down transformer. Electrical power transformer thus plays a vital role in power transmission.



Power transmission from power house to residential area

Q20. What are the Daily life applications of transformers?

Daily life applications of transformers

There are several ways a transformer can be used in our daily life.

In stabilizer:

A stabilizer is made up of transformers that help to give out a voltage or manage voltage in such a way that it is ok with the voltage circuits. It helps to step down and step up the level of current in a building.

In Battery Charger

Batteries can also be charged with the help of transformers. The voltage needs to be controlled properly so that it doesn't damage the parts inside the battery. This can only be done with the help of a step down transformer.

In circuit breaker

Circuit breakers with integrated transformers can prevent damage from high voltage current by allowing users to manually switch on and off power.

In air conditioner (AC)

This is another modern use of a transformer in our homes. Because of its high inductance and low resistance levels, it aids in the proper functioning of the AC. Without this, there would be no long-lasting AC (Air condition) in our home.

Multiple Choice Questions (MCQs)

1. Which statement is true about the magnetic poles?
(a) unlike poles repel (b) like poles attract
(c) magnetic poles do not affect each other (d) a single magnetic pole does not exist

2. What is the direction of the magnetic field inside a bar magnet?
(a) from north pole to south pole (b) from south pole to north pole
(c) from side-to-side lines (d) there are no magnetic field lines

3. The presence of a magnetic field can be detected by a
(a) small mass (b) stationary positive charge
(c) stationary negative charge (d) magnetic compass

4. If the current in a wire which is placed perpendicular to a magnetic field increases, the force on the wire
(a) Increases (b) decreases
(c) remains the same (d) will be zero

5. AD.C motor converts
(a) mechanical energy into electrical energy (b) mechanical energy into chemical energy
(c) electrical energy into mechanical energy (d) electrical energy into chemical energy

6. Which part of a D.C motor reverses the direction of current through the coil every half-cycle?
(a) the armature (b) the commutator
(c) the brushes (d) the slip rings

7. The direction of induced e.m.f. in a circuit is in accordance with conservation of
(a) Mass (b) charge (c) momentum (d) energy

8. The step-up transformer
(a) increases the input current (b) increases the input voltage
(c) has more turns in the primary (d) has less turns in the secondary coil

9. The turn ratio of a transformer is 10. It means
(a) $I_s = 10 I_p$ (b) $N_p = 10 N_s$ (c) $N_s = 10 N_p$ $V_s = 10 V_p$ Ans:

1.a single magnetic pole does not exist	2.there are no magnetic field lines	3.magnetic compass
4.Increases	5.electrical energy into mechanical energy	6.the commutator
7.energy	8.increases the input voltage	9.$V_s = 10 V_p$

Numerical

1. A wire carrying 4A current and has length of 15 cm between the poles of a magnet is kept at an angle of 30P to the uniform field of 0.8 T. Find the force acting on the wire? (0.24N)

2. A square loop of wire of side 2.0 cm carries 2.0 A of current. A uniform magnetic field of magnitude 0.7 T makes an angle of 30° with the plane of the loop. What is the magnitude of torque on the loop? (4.8×10^{-4} Nm)

3. A transformer is needed to convert a mains 220 V supply into a 12 V supply. If there are 2200 turns on the primary coil, then find the number of turns on the secondary coil. (120)

4. A coil surrounding a long solenoid, the current in the solenoid is changing at a rate of 150A/s and the mutual induction of the two coils is 5.5×10^{-5}H. Determine the emf induced in the surrounding coil? – 8.25×10^{-3}V).

UNIT-17

INTRODUCTORY ELECTRONICS

Q1. Define Electronics. Also name its field.

Electronics is the branch of physics and electrical engineering that deals with the emission, behaviors, and effects of electrons and with electronic devices.

Fields of Electronics: Electronics may have two fields:

(1) Analogue
(2) Digital

Q2. What are the Advantages of digital information over analogue information

Advantages of digital information over analogue information

Digital information has several advantages over analogue information. Some of these advantages are:

(i) Easy storage.
(ii) Easy transmission.
(iii) Large amplification.
(iv) Less noisy signal (clear signal).
(v) Negligible power or line losses.

Q3. What are the Advantages of digital electronic devices over analogue electronic devices

Advantages of digital electronic devices over analogue electronic devices

Digital electronics devices have many advantages over analogue electronic devices. Some of these advantages are:

(i) They have greater speed.
(ii) They are very sensitive.
(iii) Their displays are easily readable.
(iv) They are very accurate.
(v) They have better resolution.
(vi) They can monitor remote signals.
(vii) Their sizes are small.

Q4. Give Example of advantages of digital electronic devices over analogue electronic devices

Example

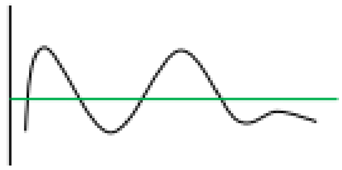
A digital voltmeter (DVM) has following advantages over electrical voltmeter.

(i) Higher accuracy.
(ii) Higher resolution.

(iii) Greater speed.
(iv) No parallax errors.
(v) Reduced human error.
(vi) Compatibility with other digital equipment.

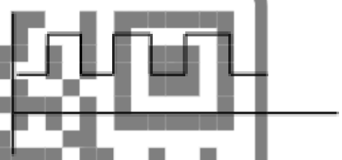
Q5. Define Analogue electronics and Digital electronics

Analogue electronics
Analogue electronics deals with circuits which have continuously varying signals.


Analog signal

Example
radio, television, oscillator etc.

Digital electronics
Digital electronics deals with circuits which have discrete signals.


Digital signal

Example
Computers, calculators, MP3 players etc.

Q6. Difference between analogue and digital electronics:

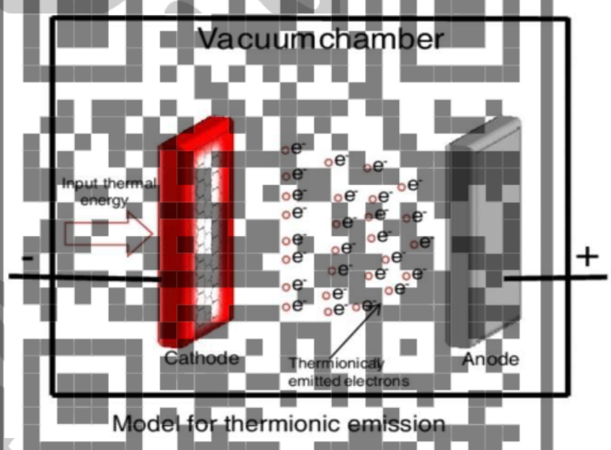
S.No.	Analogue Electronics	Digital Electronics
1.	Measures continuously varying quantities.	Measures discrete as well as continuously varying quantities.
2.	Analogue signals are in the form of a wave.	Digital signals are in the form of 0's and 1's. These two levels can be joined to form a square wave.
3.	Data cannot be stored closely (compactly).	Data can be stored more closely (compactly) like in CD's.
4.	Analogue signals are very much affected by noise (the unwanted voltage fluctuations).	Digital signals are almost not affected by noise (the unwanted voltage fluctuations).
5.	Analogue data can be transmitted less efficiently and reliably.	Digital data can be transmitted more efficiently and reliably.
6.	Amplified analogue signal does have noise.	Amplified digital signal almost does not have noise.

7.	Analogue devices have high precession.	Digital devices have very high precession.
8.	Examples of analogue devices include ordinary air thermometer, the barometer, speedometer, vehicles, the mechanical watches etc.	Examples of digital devices include computers, calculators, watches, MP3 players, DVD's, laptops, sensors, biometric machines, chip in ID cards etc.

Q7. What is Thermionic emission? Also describe it with an example.

Thermionic emission

Thermionic emission is the emission of electrons from a hot metal surface.



Demonstration of thermionic emission

Apparatus: The vacuum tube shown in below figure is called a thermionic diode. This vacuum tube consists of two electrodes called the anode and the cathode.

Experiment

The anode is positively charged so attracts negative charges (electrons). The cathode is negatively charged so repels negative charges (electrons).

The cathode shown is made up of tungsten filament.

Normally the gap between cathode and anode cannot be crossed by the electrons when the filament is switched OFF. As the filament is switched ON, the electrons escape from the hot tungsten surface. These electrons are attracted across to the anode. Hence thermionic emission occurs. Note that if air is in the tube instead of having vacuum in it, thermionic emission still occurs.

What are Cathode rays? Also list its properties.

Cathode rays

The beam of fast-moving electrons is called cathode rays.

Properties or characteristics of cathode rays

- They transfer negative charge (electrons).
- They transfer energy.
- They transfer mass.
- They transfer momentum.
- Their charge to mass ratio (e/m) is much larger than Hydrogen ion.

- Their properties are independent of the choice of gas in the tube and also the metal used as cathode.

Q8.Define an electron gun. Also describe its construction and working.

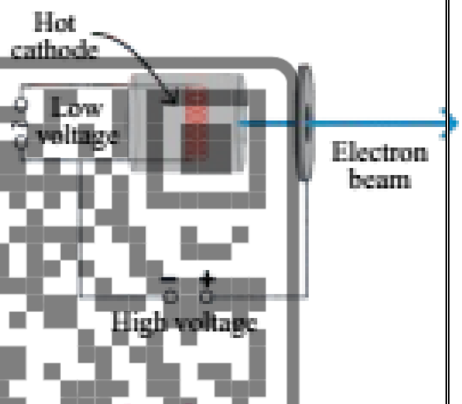
Electron gun

An electron gun makes the electrons to travel in straight lines like a beam called "Cathode rays".

An electron gun as a source of electron beam

Construction: It consists of cathode which is connected to negative terminal, anode which is connected to positive terminal, filament and sealed glass tube.

Working

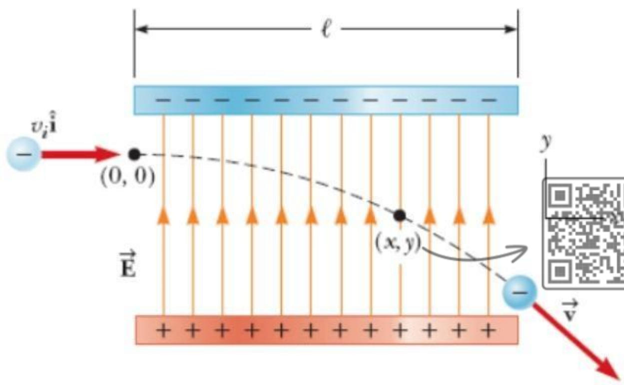


An electron gun

The above figure shows that an electron gun is used to produce a continuous flow of electrons. The electrons are emitted from the hot filament. The cathode is a metal plate warmed by the filament. The cathode is held at a negative potential compared with the anode. The anode is held at high positive potential. The difference of potential between cathode and anode is about thousands of volts. The electrons emitted from the hot filament are then accelerated by this large potential difference between cathode and anode. This produces fast moving electrons. As the electrons are negatively charged therefore they are repelled by cathode and attracted towards anode. So the electrons are not slowed down by colliding with air molecules. Hence a beam of fast moving electrons is produced. The electron gun is placed inside a sealed glass tube called vacuum tube because most of the air is removed from the tube.

Q9.Explain Deflection of an electron by electric field

Demonstration



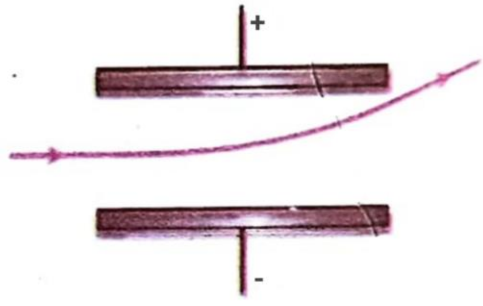
The diagram given below shows the deflection of an electron passing through a uniform electric field at 90° to the direction of motion of electron.

This field is generated by parallel charged plates. The two plates are oppositely charged. Force acting on electron is constant and towards the positive plate as a result electron follows a curved path towards the positive plate. Deflection of an electron passing through uniform electric field

Q10. Describe the Effect of electric field on an electron beam

Effect of electric field on an electron beam

The deflection pattern of an electron beam is same to that of a single electron.



Deflection of electron beam

The effects of electric field on an electron beam are:

(i) The beam bends and changes direction.
(ii) The beam follows a parabolic (curved) path in the electric field.
(iii) The beam of electron changes direction millions of times each second.
(iv) The energy and speed of electron beam increases. (v) The beam continues to move in a straight line after passing through the electric field.

Q11. Explain the Deflection of an electron by magnetic field

Demonstration

The diagram given below shows the deflection of an electron passing through a uniform magnetic field acting at 90° to the direction of motion of electron.

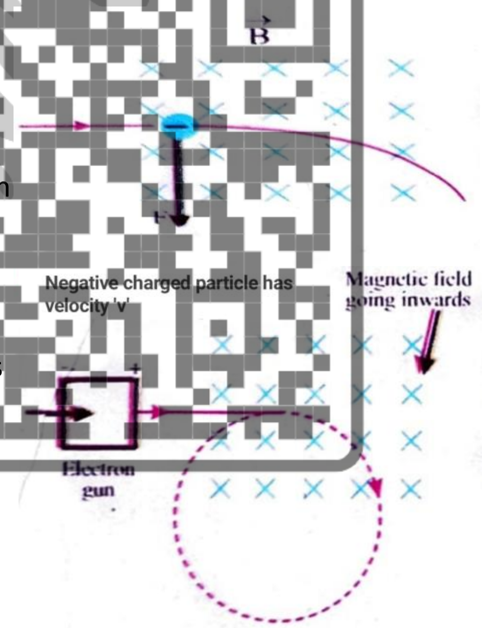


Fig: 17.17.
Effect of magnetic field

This field is generated by passing a current through a pair of plates (coils). In the above figure the field is sing shown by "x" sign. This means that the field lines are perpendicular to the page and are directed into the page. This produces a force that acts at right angles downwards to the direction of motion of electron. If the field direction is reversed, the force direction also reversed. The direction of the force can be found by Fleming's left-hand rule (Note that conventional current direction is opposite to that of electron flow). The electron changes direction and bends. Because the force acts at right angles to the direction of motion of electron, the electron will move in a circular path.

Q12. What are the Effect of magnetic field on an electron beam:

Effect of magnetic field on an electron beam

(i) The beam bends and changes direction.
(ii) The beam follows a circular path in the magnetic field.
(iii) The energy of electron beam does not change in the magnetic field.
(iv) The speed of electron beam does not change in magnetic field.

Q13. What is Cathode-ray Oscilloscope? give its construction and working.

Cathode-ray Oscilloscope (CRO): A Cathode-ray oscilloscope (CRO) is generally referred to as oscilloscope or scope.

Construction: A cathode ray oscilloscope consists of different components. The main component of a cathode-ray oscilloscope (CRO) is a cathode-ray tube. A cathode-ray tube is shown in figure below.

Working:

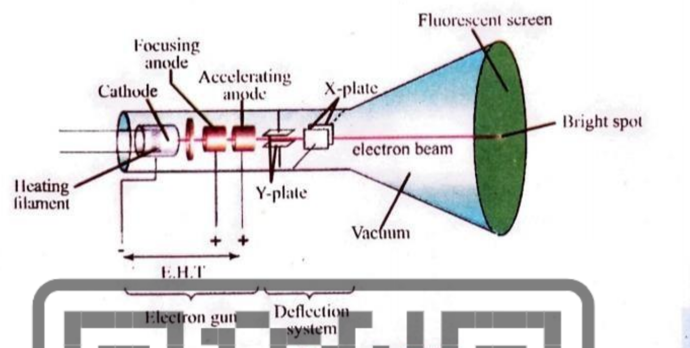


Diagram of CRO

- The electron gun emits a beam of electrons (ie. cathode-ray) which is produced by the cathode.
- When this electron beam strikes the fluorescent screen, a bright spot is created on the screen.
- The electron gun consists of a grid which is connected to (-ve) potential. It repels the electrons and therefore controls the number of electrons reaching to anode and screen. Thus it controls the brightness of the spot on the screen.
- The anode at (+ve) potential and is used to accelerate the electrons and to focus them into a fine beam.
- The deflecting system consists of X- plates and Y plates to move the spot on the screen.
- Y-plates cause deflection in vertical direction (up and down) when voltage is applied across them. The vertical deflection of the electron beam can be changed by varying the voltage across the Y- plates.
- X-plates cause deflection in horizontal direction (left and right) when voltage is applied across them. The horizontal deflection of the electron beam can be changed by varying the voltage across the X- plates.

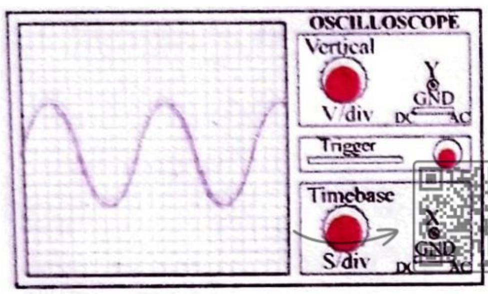
Q14. What are the Important controls oscilloscope?

Important controls oscilloscope

The figure below shows the front panel of a CRO with the understanding of the important terminals to be used.

The following are the four important controls on an oscilloscope.

1. X-shift
2. Y-shift
3. Time base
4. Y-gain



Front panel of CRO

- X-shift control moves the trace from the left or right of the screen to the centre of the screen.

- Y-shift control moves the trace from the top or bottom of the screen to the centre of the screen. The vertical deflection of the electron beam can be changed by varying the voltage across the Y- plates.
- Vertical deflection (Y-gain) of the electron beam can be amplified by using this control. This is done by varying the voltage applied across the Y-plates of the cathode-ray tube. An amplifier circuit amplifies the voltage across the Y-plates in the cathode-ray oscilloscope.
- Time base: Horizontal (X) speed of the electron beam on the screen can be adjusted by using this control. This is done by varying the voltage applied across the X-plates of the cathode-ray tube. The frequency of the time base is varied by an internal circuit in the cathode-ray oscilloscope which applies an alternating voltage across the X-plates. The time-base actually applies a saw tooth voltage to the X-plates.

Q15. Give the Uses of the CRO

Uses of the CRO

Some of the important
uses of cathode-ray oscilloscope are given below:

1. Measuring voltage
2. Displaying voltage waveforms
3. Measuring short intervals of time

The voltage to be measured is connected to the Y input of the oscilloscope. Two things to be remember.

1. Y-axis is used to measure the voltage.
2. X-axis is used to measure the time.

So, the display on a cathode-ray oscilloscope screen is a graph of voltage against time.

Q16. What do you know about the Basic operations of digital electronics?

Basic operations of digital electronics

Digital electronics-based devices use discrete signals. A digital signal represents two opposite states. These signals either represents a (ON, OFF, HIGH, LOW. OPEN, CLOSE, UPPER, LOWER, PLUS, MINUS, TRUE, FALSE, MAX, MIN) states of a system. There is no intermediate state is possible (allowed).

Example: A block diagram of a security alarm which operates through two switches is shown in figure below.

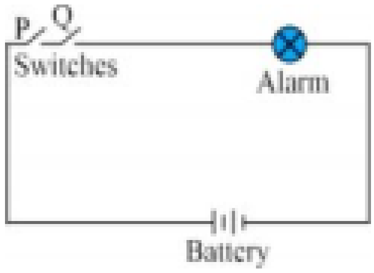


Diagram of security alarm

It can be seen clearly from the above diagram that:

- If either switch "p" or "Q" is OFF, the alarm will remain OFF (quite).
- If both switches "P" and "Q" are ON, the alarm will be ON (ringing). This example could be demonstrated by the following table:

Switch "p"	Switch "q"	Alarm status
OFF	OFF	Quite
ON	OFF	Quite
OFF	ON	Quite
ON	ON	Ringing

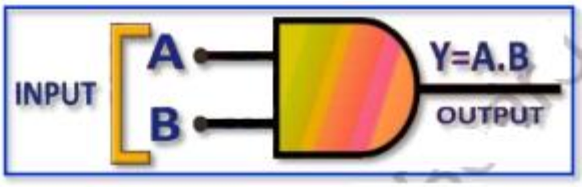
The above table represents the logic behind the working of the alarm. In digital electronics, this logic is implemented by "LOGIC GATES".

Q17. Discus with example different gate.

Logic Gates: The logic gate is the basic unit of digital logic circuits.

Examples: There are mainly three basic gates AND, OR, and NOT and these logical gates perform AND, OR, and NOT operations in the digital system.

AND Gate: An AND gate is a digital circuit that has two or more inputs and a single output.



AND Gate using two input variables

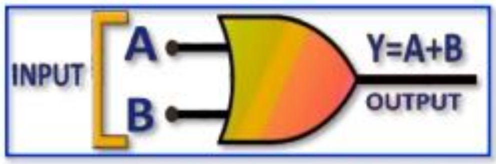
Operation: AND gate operates on logical multiplication rules.

Representation: AND operation using variables A and B is represented "A.B". here (.) dot is a logical multiplication sign.

Boolean Expression: Y=A.B

OR Gate

An OR gate is a digital circuit that has two or more inputs and produces a single output, which is the logical OR of all those inputs.



OR Gate using two input variables

Operation: An OR gate operates on logical Addition rules.

Representation: The logical OR is represented with symbol "+"

Boolean Expression: Y = A + B

NOT Gate

A NOT gate is a digital circuit that has a single input and a single output. It is also known as INVERTER.

NOT Gate

Operation: The NOT operates complement or invert of any input.

Representation

It is symbolized by the complement sign (') on the right side of the top of the input variable or bar (-) sign on top of the variable.

Boolean Expression: Y = A' or Y = $\bar{A}$

NAND Gate: A NAND Gate could be constructed by connecting a NOT Gate at the output terminal of the AND Gate.

NAND Gate

Boolean Expression

$$Y = (A.B)' \text{ or } Y = \overline{AB}$$

NOR Gate: A NOR Gate could be constructed by connecting a NOT Gate at the output terminal of the OR Gate.

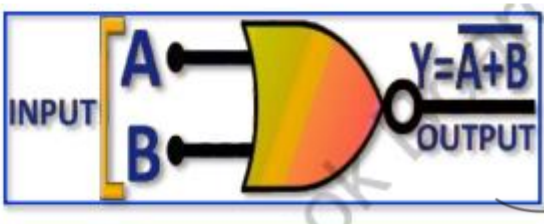


Fig: 17.29 NOR Gate

Boolean Expression

$$Y = (A + b)' \text{ or } Y = \overline{A+B}$$

Q18. Describe the Truth table of AND operation using two input variables:

Truth Table of AND gate using two input variables A, B and output is Y. If any input is 0, then output Y becomes 0.

If all inputs are 1 then output Y becomes 1.

Boolean expression of AND gate is Y=A.B

Truth table of AND operation using two input variables		
A	**B**	**Y = A . B**
0	0	0
0	1	0
1	0	0
1	1	1

Q19. Describe the Truth table of AND operation using three input variables

Truth Table of AND gate using three input variables A, B, C, and output is Y. If any input is 0, then output Y becomes 0. If all inputs are 1 then output Y becomes 1.

AND Gate using three input variables

Boolean expression of AND gate is Y=A.B.C

Truth table of AND operation using three input variables			
A	B	C	Y = A . B . C
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

Q20. **Describe the Truth table of OR gate operation using two input variables:** Truth Table of OR gate using two input variables A, B and output is Y, If any input is 1 then output Y becomes 1 and if all inputs are 0 then output Y becomes 0.

Boolean expression of OR gate is Y = A + B

Truth table of OR operation using two input variables		
A	**B**	**Y = A + B**
0	0	0
0	1	1
1	0	1
1	1	1

Q21. **Describe the Truth table of OR operation using three input variables**

Truth Table of OR gate using three input variables A, B, C and output is Y, If any input is 1 then output Y becomes 1 and if all inputs are 0 then output Y becomes 0.

Boolean expression of OR gate is Y = A + B + C

Truth table of OR operation using three input variables			
A	B	C	Y = A + B + C
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Q22. **Describe the Truth table of NOT gate operation using two input variables**

Truth table of NOT gate is A as input and Y = $\bar{A}$ as output.

Truth table of NOT gate operation using two input variable	
A	Y = $\bar{A}$
0	1
1	0

Q23. **Describe the Truth table of NAND operation using two input variables**

The Truth table of the NAND gate shows A, B are the inputs and Y is the output. When both inputs are "1" the output, Y is "0". If any one of the inputs is "0", then the output Y is "1".

Truth table of NAND operation using two input variables		
A	**B**	**Y =** $\overline{AB}$
0	0	1
0	1	1
1	0	1
1	1	0

Q24. **Describe the Truth table of NOR operation using two input variables**

The Truth table of the NOR gate shows A, B are the inputs and Y is the output. If both inputs are "0", then the output, Y is "1". If any one of the inputs is "1", then the output Y is "0".

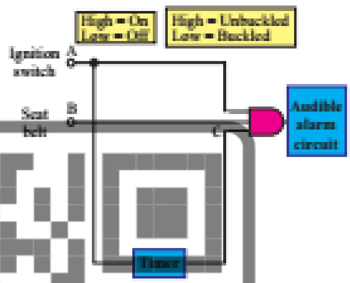
Truth table of NOR operation using two input variables

A	B	Y = $\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

Q25. What are the uses of Use of Logic Gates

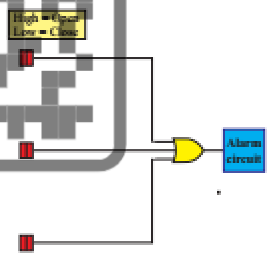
Use of Logic Gates

A seat belt alarm system: In Figure below, an AND gate is used in a simple automobile seat belt alarm system to detect when the ignition switch is on and the seat belt is unbuckled. If the ignition switch is on, a HIGH is produced on input A of the AND gate. If the seat belt is not properly buckled, a HIGH is produced on input B of the AND gate. Also, when the ignition switch is turned on, a timer is started that produces a HIGH on input C for 30 s. If all three conditions exist that is, if the ignition is on and the seat belt is unbuckled and the timer is running-the output of the AND gate is HIGH and an audible alarm is energized to remind the driver.



A simple seat belt alarm circuit using an AND gate.

Intrusion detection and alarm system: A simplified portion of an intrusion detection and alarm system is shown in Figure 17.31. This system could be used for one room in a home a room with two windows and a door. The sensors are magnetic switches that produce a HIGH output when open and a LOW output when closed. As long as the windows and the door are secured, the switches are closed and all three of the OR gate inputs are LOW. When one of the windows or the door is opened, a HIGH is produced on that input to the OR gate and the gate output goes HIGH. It then activates and latches an alarm circuit to warn of the intrusion.



A simplified intrusion detection system using an OR gate.

Multiple Choice Questions (MCQs)

1. Metals are good conductors of electricity because they have free:
(a) Electrons (b) Protons (c) Neutrons (d) Photons

2. The continuous flow of electrons is made possible by a device called:
(a) Cathode (b) Electron gun (c) Anode (d) Filament

3. The electric field can be detect:
(a)Photon (b) Neutron (c) Proton (d) Electron

4. If the direction of magnetic field is reversed, the direction of force is:
(a) Reversed (b) Not reversed
(c) May or may not reversed (d) None of these

5. The process of emission of electrons from the hot metal surfaces is called
(a) Plastic emission (b) Thermionic emission
(c) Static emission (d) Current emission

6. If input of a NOT gate is "1" then its output is:
(a) 1 (b) 0 (c) may be 1 or may be 0 (d) None of these

7. The Boolean expression of an AND gate is:
(a) A.B (b) A+B (c) AxB (d) None of these.

8. Electronics comprises the:
(a) Physics (b) Engineering (c) Technology (d) All of these

9. The Boolean expression of an OR gate is:
(a) A.B (b) A+B (c) AxB (d) None of these.

10. The cathode ray carry
(a) positive charge (b) neutral
(c) negative charge (d) positrons Ans:

1.Electrons	2.Electron gun	3.Electron	4.Reversed	5.Thermionic emission
6. 0	7.A.B	8.All of these	9.A+B	10. negative charge

Unit-18

Information and Communication Technology

Q1.Define Information technology, Telecommunication

Information technology
Information technology is the scientific approach for storing information, organizing it for optimal use, and communicating it to others.

Telecommunication
The process of transmitting information over long distances is known as telecommunication.

Q2.What do know about Information and Communication Technology (ICT)?

Information and Communication Technology
ICT refers to the scientific techniques and tools to process, and transport large volumes of information in a matter of seconds using electronic devices.

Q3.what are Components of Computer Based Information System (CBIS)

Five components must come together to create a CBIS as shown in figure below.

1. **Hardware is machinery**

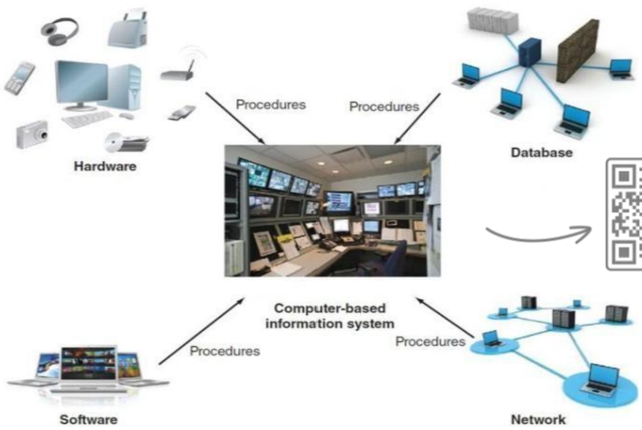
This comprises the CPU and its supporting hardware. Input/output, storage, and communication devices are examples of essential equipment.

2. **Software**

Software includes computer applications. They tell the CBIS's hardware how to process data and turn it into meaningful information. Programs are usually saved on chips or tapes.

3. **Data**

Programs utilize data to provide helpful information. It might be a phrase, picture, or figure that has special significance. Data, like programmers, are usually saved on chips or tapes until needed by the computer.



4. **Procedures**

The guidelines for creating and using information systems. These are in user manuals and papers. From time to time, these rules or techniques may be revised. In order to accommodate these adjustments, the information system must be adaptable.

5. **People**

A CBIS is useless without individuals who can impact the success or failure of information systems. People develop and maintain the software, enter data, and construct the hardware that makes a CBIS work. People write the processes and ultimately decide the CBIS's effectiveness.

Q4. What are input and output hardware

Input hardware

The devices that are used to command the data to the computer are known as input hardware devices.

Example

Mouse, joystick and keyboard.

Output hardware

The devices that are used to display processed data are known as output hardware.

Example

Loudspeaker, screen, printer.

Q5. What do you know about System software and Application software.

System software

System software is a type of computer program that is designed to run a computer's hardware and application programs.

Application software

Application software is a type of computer program that performs a specific personal, educational, and business function.

Q6. Define the Flow of Information with example.

Electronic and optical equipment can be used to transfer information from one place to another place, which is called flow of information.

Example 1: When you use a phone, electrical impulses are used to transmit data via cables.

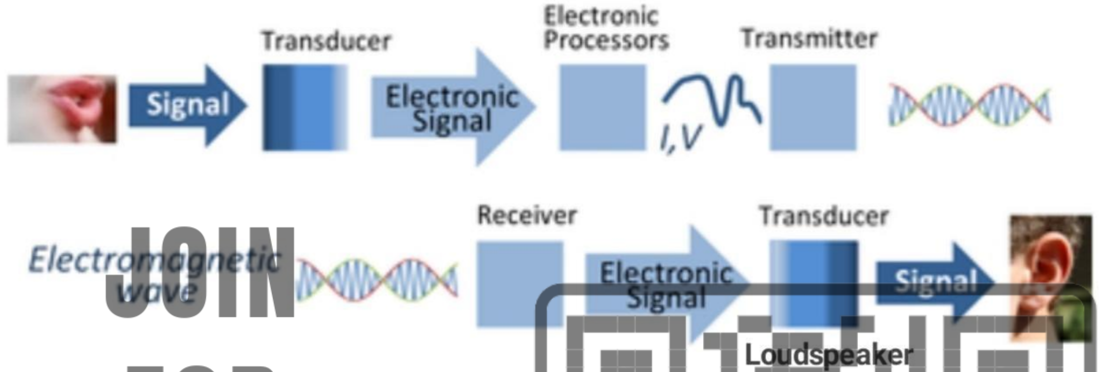
Example 2: Radio, television, and mobile phones provide information by electromagnetic waves or light via optical fibers.

Q7. What are the Communication system?

Communication system

Figure below shows a communication system. The transmitter, transmission channel, and receiver are three of the most important parts of any communication system.

The input signal is processed by the transmitter. The transmission channel is the medium used to transmit the signal. Wires or coaxial cables may be used in the same way as radio-wave and optical fiber cables. The transducer receives the output signal from the receiver after it has been processed. To compensate for transmission loss, the receiver may amplify the input signal.



Q8.What is Transducer? Explain the various of it.

Transducer

Transducer is a device that converts one form of energy into other form of energy.

Transmission Of Electrical Signal Through Wires

The mouthpiece and the earpiece are two elements of the telephone system as shown in figure below. A thin metal diaphragm and carbon granules are found in the mouthpiece and receiver, respectively. The diaphragm vibrates as we speak through the mouthpiece. An electrical current may travel through the wire because the diaphragm vibrates slightly, compressing the carbon.

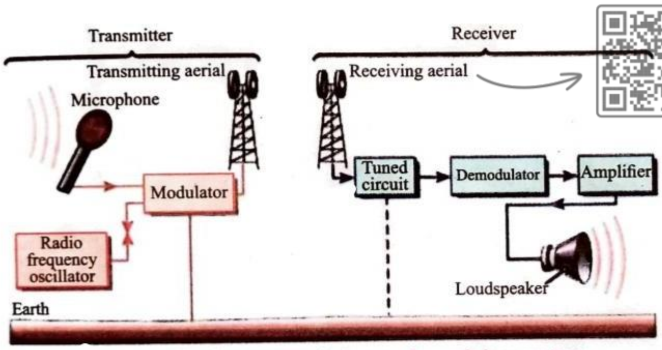
At the opposite end of the line, the receiver reverse this procedure. An electromagnet in the receiver generates a changing magnetic field as a result of the electrical current. As a result of the receiver's thin metal diaphragm vibrating due to the magnetic field, sound is produced.

Telephone

Transmissions Of Radio Waves Through Space

The microphone converts the radio station's sound waves into electrical impulses. The transmission aerial consists of an antenna, and these signals are subsequently fed into the antenna.

Electromagnetic radio waves are produced when the charges on the transmission antenna vibrate in response to electrical signals.



Radio transmission and receiving system

The modulated signal is selected and amplified by the receiver at the other end. In order to get at the information signal, we need to use the demodulator, which extracts it. In Figure below, we see a radio broadcast and reception system
in action.

Fax machine

A fax machine is a need for many enterprises across the globe.

There are two essential functions in the use of fax machines: scanning the page and transmitting the resulting electronic signals over telephone line. An internal printer on the receiving system is used to print out a copy of the transmitted message once it has been converted by the software.

Cell phone

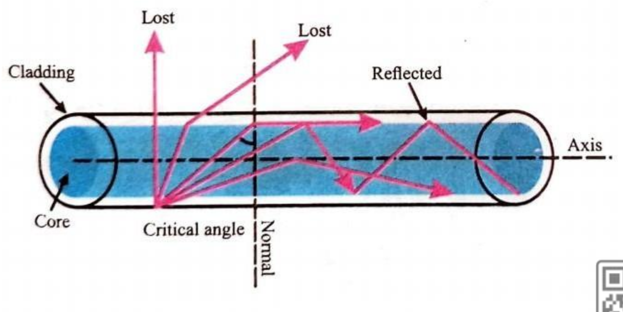
In mobile phones, radio technology is used and it is a sort of radio that allows for two-way communication between users.
There are radio transmitters and receivers built inside the mobile phone's internal components. To communicate, it uses radio waves to transmit and receive. When a mobile phone user makes a phone call, the sound waves of the caller are transformed into radio waves. As soon as this signal is received, it is routed to the caller's local base station and given a unique radio frequency. The receiver's base station receives this signal through mobile switching center (MSC), which transmits it to the transmitter. Afterwards, the caller's mobile phone is connected to the call. The radio waves are converted into sound once again by the mobile receiver as shown in figure below.

Photo phone

A photo phone is a phone by which we can transmit and receive sound as well as video.

Transmission Of Light Through Optical Fibers

Visible light waves are substantially higher in frequency than radio waves. This implies that light beams can convey information faster than radio waves or microwaves. An optical fiber was employed as a transmission path.



Light entering a glass rod at greater than the critical angle is trapped inside the glass

Light entering the core of an optical fiber travels straight and meets the inner wall (cladding). If the cladding incidence angle is below the critical angle, some light escapes the fiber optics and is lost as shown in figure below. It then proceeds in a straight path until it meets the inner wall again, and so on.

The benefit of optical fiber is that it can be used to transmit very large amounts of data across great distances with little loss of quality. This characteristic of fiber optics separates it from wire-based systems. Whenever electrical signals are transferred across wires, the signal loss rises in direct proportion to the increase in data rate delivered. As a result, the signal's range is reduced.

Q9.what do you know about the term Computer? Also give its uses.

Computer

A computer processes, stores, and displays data. Hardware and software are two components that are fundamental to the operation of a computer. "Hardware" is a physical component of computer. CPU, monitor, keyboard, and mouse are a few examples

Parts of a computer

Uses

Today, computers are employed in almost every field, including medicine, engineering, weather forecasting, transportation, and shopping malls.

Information Storage Devices

These are devices that can be used to store information in a computer.

Q10. What are Primary Memory and Primary Memory?

Primary Memory

Primary memory is made up of integrated circuits (ICs) that a processor or computer can access immediately.

Random Access Memory (RAM) is a region in the memory where running programmers and services may be accessed by the CPU. Whenever you turn off your computer, you lose all of your RAM's data.

The second part of memory is called read-only memory (ROM), which is a type of storage medium that stores data on personal computers (PCs) and other electronic devices in a way that doesn't change it. Among its many functions, it handles the majority of a computer's input and output and stores any program or software instructions that are loaded during bootup.

Secondary storage devices

It is used to keep the data in the computer for a long time. When we open a software, data is transferred from secondary to main storage.

Example

Audio-video cassettes, hard discs, USBS, memory cards are the few examples of secondary storage devices.

Q11. What do you know about Audio And Video Cassettes?

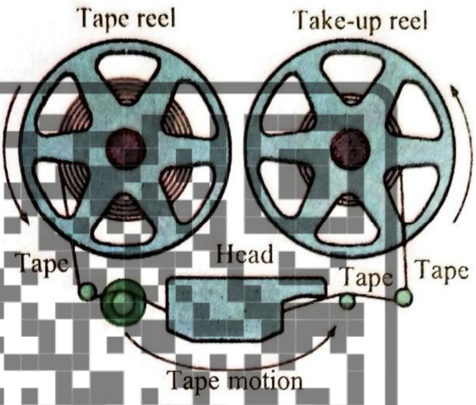
Audio And Video Cassettes

Audio cassette

These devices are based on magnetism. Audio cassettes consist of a tape of magnetic material on which sound is recorded in a particular pattern of a magnetic field

Recording of sound

For recording of sound, microphone changes sound waves into electric pulses, which are amplified by an amplifier. Magnetic tape is moved across the head of audio cassette recorder which is in fact an electromagnet.



A magnetic tape storage mechanism

Producing sound again

To produce the sound again, the tape is moved past the play back head. Changes in magnetic field on the tape induce alternating current signals in the coil wound on the head. These signals are amplified and sent to the loudspeakers which reproduce the recorded sound.

In video tape/cassettes pictures are recorded along with sound.

Fig: 18.15
Video cassette

Q12. What is Magnetic Disks?

Magnetic Disks

There are different types of magnetic disks coated with a layer of some magnetic material. The read/write head of disks are similar to the record and replay head on a tape recorder. It magnetizes parts of the surface to record information. The difference is that a disk is a digital medium-binary numbers are written and read.

Q13. what is a Floppy disk?

Floppy disk

A floppy disc Figure below is a small magnetically sensitive, flexible plastic wafer housed in a plastic case. It is coated with a magnetic oxide similar to the material used to coat cassettes and video tapes. Most personal computers include at least one disk drive that allows the computer to write it and read from floppy disk.

Q14. What is a Hard Disk?

Hard Disk

Most users rely on hard disks as their primary storage devices. A hard disk is a rigid, magnetically sensitive disk that spins rapidly and continuously inside the computer chassis or in a separate box connected to the computer housing; This type of hard disk is never removed by the user. A typical hard disk consists of several platters, each accessed via a read/write head on a moveable arm.

Hard disk

Compact Disc (CDs)

It's a molded plastic disc with tiny "pits" and "lands" that store digital data. Pits are CD's spiral tracks and lands lie between them. A laser beam scans the disc to read data. CD pits and lands reflect laser light differently. This pattern of pit and land light reflection is transformed to binary data. The lands represent '1' and the bits represent '0'. CDs can contain 680 MB of data.

Q15. What do you know about the Flash Drive?

Flash Drive

It is an electronics device and has Integrated circuits (ICs) that store data. A flash drive may transfer data between computers. This device can hold a year's load of schoolwork. We may connect it to our key chain, or book bag.
Because of flash derive; we don't need to bring a hard drive or laptop with us when we move around the world.

Flash drive

Q16. What is Word Processing?

Word Processing

Word processing is such a use of computer through which we can write a letter, article, book or prepare a report. Word processing is a computer program.

Q17. What is Data Management? Give its uses.

Data Management

To collect all information regarding a subject for any purpose and to store them in the computer in more than one inter linked files which may help when needed, is called 'data managing'.

Uses:

- The educational institutions, libraries, hospitals and industries store the concerned information by data management.
- In big departmental stores and supermarkets, optical scanners are used to read, with the help of a Laser Beam, the barcodes of a product which indicate the number at which this product is recorded in the register; Figu.re below. In this way, the detail about its price is obtained.
- NADRA, biggest data managing authority of Pakistan that manage the data of citizens through the internet by issuing computerized identity card and Form B.

Q18. What is Internet? How Internet uses communication system?

Internet is a network of networks, which spreads all across the globe.

Internet uses communication system

Recall that telephone communication system is well defined, time proven system. Internet makes use of this system and many other systems to connect all the computers. Thus like a telephone connection, any computer of any city can establish a connection with any other computer of any other city and exchange data or messages with it.

Q19. What is HTTP? Name the Internet Services.

HTTP HTTP, in full Hyper Text Transfer Protocol, standard application-level protocol used for exchanging files on the World Wide Web.

Internet Services

The main services used on the internet include:

- Web browsing - this function allows users to view webpages.
- E-mail - Allows people to send and receive text messages.

Q20. What is a Browsers?

Browsers

A browser is an application which provides a window to the Web. All browsers are designed to display the pages of information located at Web sites around the world.

Most popular browsers

The most popular browsers on the market today include Internet Explorer, The World, Opera, Safari, Mozilla Firefox, Chrome, etc.

Google Chrome Internet explorer Mozilla Firefox

Icons of different web browsers

What is an Electronic Mail? list down the Advantages of e-mail.

Electronic Mail

One of the most widely used application of internet is electronic mail (or e-mail), which provides very fast delivery of messages to any enabled site on the Internet.

Advantages of e-mail

Some advantages of e-mail are as follows:

1) **Fast Communication** We can send messages anywhere in the world instantly.
2) **Cost Free Service** If we have an internet access, then we can avail the e-mail service free of cost.
3) **Simple to Use** After initial set up of e-mail account, it is easy to use.
4) **More Efficient** We can send our message to many friends or people only in one action.
5) **Sending of pictures or other files** Pictures or other files can also be sent through e-mail.

Q21. List the Uses of internet?

Uses of internet

Here is the list of use of internet.

1. Faster Communication
2. Big Source of Information
3. Source of Entertainment
4. Access to social media
5. Access to Online Services
6. E-commerce
7. E-Learning

Multiple Choice Questions (MCQs)

1. Another name for a supercomputer is a:

a) High-performance computer b) Maxi computer
c) Mainframe computer d) None

2. Input, processing, output, and storage are collectively referred to as:

a) Information processing cycle b) Software life cycle
c) Hardware life cycle d) Information technology

3. is the output from a computer that ranks from processing input data

a) Data b) Information c) Computer d) Mouse

4. Which one of the following is not considered as a system software?

a) Assembler b) Interpreter c) Compiler d) Tally

5. Which of the following is suitable for connecting different computers in an organized manner within an office building?

a) MAN b) WAN c) ANN d) LAN

6. A computer program that translates one program instruction at a time into machine language is called?

a) Interpreter b) CPU c) Compiler d) Simulator

7. The name given to a sequence of instructions in a computer language, to get the desired result is?

a) Program b) Decision table c) Pseudo code d) Algorithm

8. USB stands for

a) Ultra Serial Bus b) Unlimited Structured Bit
c) Universal Serial Bus d) Unified Status Bus

9. Which is the extension not suitable to an ms-word file

a) .doc b) .docx c) .rtf d) .jpeg

10. ICT stands for

a) Information and Communications Technology b) Integrated Circular Technology
c) Intensive Computer Techniques d) Interfacing Computer Theories Ans:

1.High-performance computer	2. Information processing cycle	3. Information	4. Tally	5. LAN
6. Interpreter	7. Program	8.Universal Serial Bus	9. .docx	10. Information and Communication Technology

Unit-19

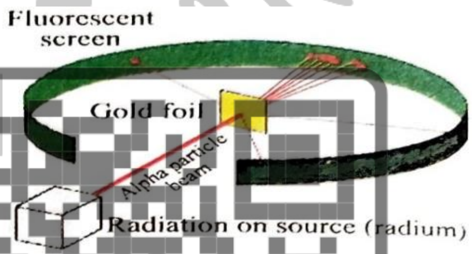
Atomic Structure

Q1.What is an Atom? Also describe the structure of atom

Atom is the smallest unit into which matter can be divided without releasing electrically charged particles.

The structure of an atom in terms of a nucleus and electrons

- The central hard-core of an atom is the nucleus which is the small, dense region consisting of closely packed protons and neutrons.
- Around the nucleus, electrons revolve at high speed. The number of particles (electrons and protons) depends on the type of atom.
- Most of the atom is empty space.
- Electrons are bound by a positively charged nucleus with the electrostatic force.



Experimental arrangement of Geiger and Marsden α- scattering

Q2.Explain the Geiger and Marsden α-scattering Experiment

Geiger and Marsden α-scattering Experiment

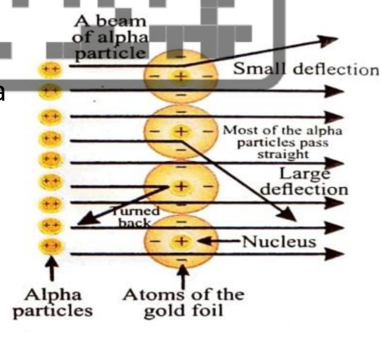
Introduction:

This experiment was conducted by Geiger and Marsden, two scientists.

Experiment: Geiger and Marsden used a beam of positively charged α-particles to bombard a thin gold foil placed in a vacuum surrounded by a ring-shaped fluorescent screen. After bombarding the foil, the scattered α-particles were detected using a rotating detector. When α-particles hit the screen of light was observed through the detector;

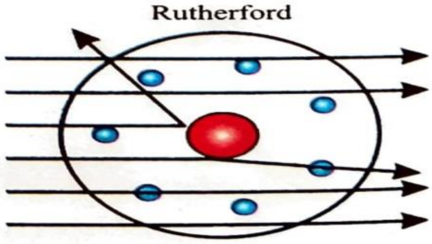
Observations:

- The most of the α- particles were not deflected or only a few deflected through small angles.
- A small number of the α-particles were deflected through considerable large angles of more than 90°.



Scattering of α-particles by a nucleus

- A few of the α-particles were even deflected back through nearly 180°.



Close up view of scattering of α-particles by a nucleus

Q3. What are the Rutherford's postulates?

Rutherford's postulates based on this experiment:

- The nucleus carries all the positive charge of atom and nearly all its mass.
- As a large number of α-particles passing through the foil undeflected suggest that there exit large empty spaces in an atom.
- Those positively charged α-particles that deflected through large angles had come very close to the positively charged nucleus. However, a few were repelled so strongly that they bounced back.

Q4. Define Nuclear physics.

Nuclear physics The branch of Physics concerned with the study and understanding of the atomic nucleus, including its composition and the forces which bind it together, is called nuclear physics.

Q5. Describe the the composition of the atom

The composition of the atom Atoms consist of three elemental particles:

✓ Electrons
✓ Protons
✓ Neutrons.

- The outermost region of the nucleus is called electron shell.
- It contains electrons.
- Electrons have a negative (-) charge.
- The nucleus contains the neutrons and the protons bound tightly together by the nuclear forces (gluons) .
- Neutrons carry no charge.
- The mass of a neutron is slightly larger than that of a proton.
- Proton has an equal positive (+) charge that of an electron in magnitude.
- An atom usually has an equal number of protons as electrons, so its net charge is zero.

Q6. Define Atomic number, Nucleons, Nucleon Number.

Atomic number

The number of protons in the nucleus of an atom element is called atomic number.

Representation

Atomic number is represented by Z.

Atomic number tells number of electrons

It is the atomic number which tells about the number of electrons.

Nucleons

The protons and neutrons are collectively called nucleons.

Nucleon Number or Atomic Mass:

The number of protons and neutrons is known as nucleon number or atomic mass.

Representation

It is represented by atomic number A.

Mathematically:

Where;
Z: Atomic number
N: Number of neutrons

A = Z + N

Representation of nucleus

A nucleus is represented symbolically by $_Z\mathbf{X}^A$

Where **X** represents the nuclide of a chemical element, **A** is the nucleon number, and **Z** is the atomic number.

Example

$_6C^{12}$epresents the carbon nucleus with six protons and twelve nucleons. Thus, the total orbiting electrons are also six, and the neutron number is

$$A=Z+N$$
$$N=A-Z$$
$$N=12-6$$
$$N=6$$

Q7. What is an Isotopes. List the isotopes of hydrogen.

Isotopes Two or more species of atoms of an element with the same atomic number(Z) but have different atomic mass(A) are called Isotopes.

The hydrogen atom (atomic number 1) has three isotopes with atomic masses 1, 2, and 3.

Name of isotope	Symbol	Proton number Z	Neutron number N	Atomic mass
Protium	1	0	1	$_1H^1$
Deuterium	1	1	2	$_1H^2$

Tritium	1	2	3	$_1H^3$

Multiple Choice Questions (MCQs)

Choose the correct answer from the following choices:

1. ${}_1H^2$, ${}_1H^3$ are:
a) Isotopes b) Isobars c) Isotones d) Isochores

2. The neutral atoms of all of the isotopes of the same element have
a) different numbers of protons. b) exact numbers of neutrons.
c) An exact number of protons. d) An exact number of nucleons.

3. Consider the species ${}_{17}Cl^{35}$ and ${}_{17}Cl^{35}$ These species have:
a) the exact number of nucleons b) the exact number of protons
c) the exact number of neutrons. d) the exact mass number.

4. Atomic mass of an element is equal to
a) Mass of protons and neutrons b) Mass of protons and electrons.
c) Mass of electrons and neutrons d) Mass of protons only

5. The maximum mass of an atom is concentrated in:
a) nucleus b) neutrons c) protons d) electrons

6. Consider isotope ${}_{92}U^{237}$ of uranium. The number of neutrons in it is:
a) 92 b) 237 c) 145 d) 329

7. The symbol denotes the proton number is:
a) P b) A c) N d) Z

8. The number of neutron(s) in Protium is:
a) no b) one c) two d) three

9. In an atom, the nucleus when compared to the extra-nuclear part, is
a) More significant in volume and heavier in mass
b) smaller in volume but heavier in mass
c) More significant in volume but lighter in mass
d) Smaller in volume and lighter in mass

10. If an element B has five protons and six neutrons what will be the symbol of element B
a) ${}_6B^{11}$ a) ${}_{11}B^6$ b) ${}_{11}B^5$ c) ${}_5B^{11}$

Ans:

1. Isotopes	2. An exact number of protons.	3. the exact number of protons	4. Mass of protons and neutrons	5. nucleus
6.145	7. Z	8. no	9. smaller in volume but heavier in mass	10. ${}_5B^{11}$

Unit-20

Nuclear Structure

Q1. Define Binding energy, radioactive element, Radioactivity, ionization, penetrating power.

Binding energy

It is amount of energy required to separate a particle from a system of particles or to disperse all the particles of the system.

Radio-isotope or radioactive element

If an isotope undergoes radioactive decay is called radio-isotope or radioactive element.

Radioactivity

The emission of α, β and γ radiation with the release of energy is known as radioactivity.

IONIZATION

The phenomenon by which radiations split matter into positive and negative ions is called ionization.

PENETRATING POWER

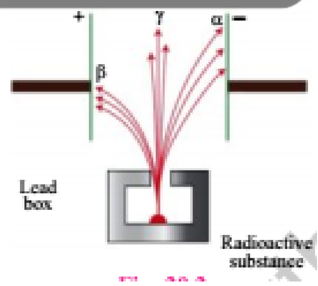
The strength of radiations to penetrate a certain material is called penetrating power.

Q2. Explain the radioactive emission

Nature of radioactive emission

Experiment

To describe the nature of three types of radiation α, β, and γ, the radioactive source is placed inside the electric field. The radiation emitted from the source breaks down into three components: α and β -radiations bend in the opposite direction in the electric field, while γ -radiation does not change its direction;

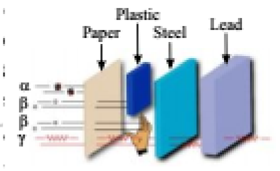


Conclusions:

- α deflected towards a negatively charged while the plate is positively charged.
- β deflected towards a positive plate that is negatively charged. It is deflected more in the field, thus, much lighter than a particle.
- γ rays are not deflected by the field and carry no electric charge.

Q3. what are the Relative penetrating abilities of α, β and γ?

Relative penetrating abilities of radioactive emission:



Relative penetrating abilities of three kinds of radiations.

An alpha particle has the shortest penetrating ability because of its strong interacting or ionizing power. Alpha particle has a penetrating range of only a few centimeters in the air; they can be stopped by a thick sheet of paper or by the skin.

The beta radiation interacts with the matter due to its charge and has a high penetrating range compared to alpha particles. Beta particles have a range of several meters in the air. They can penetrate through thick paper but are stopped by a few millimeters of aluminum.

Gamma rays range several hundreds of meters in the air. The gamma rays are very penetrating, never completely stopped through lead, and thick concrete will reduce their intensity. It is due to their high speed and neutral nature. F

Q4. Define Parent nucleus, Daughter nucleus.

Parent nucleus

The original nucleus before decay is called the parent nucleus.

Daughter nucleus

The nucleus formed after decay is called the daughter nucleus.

Radioactive disintegration

Radioactive disintegration causes nuclear transmutation and converts one chemical element or isotope into another chemical element or isotope.

Q5. What is Alpha (α)-decay, give its general equation and example

Alpha (α)-decay

In alpha decay, the proton number or atomic number (Z) of the parent nucleus reduces by 2, while its atomic mass or nucleon number (A), decreases by 4.

General equation:

$${}_{Z}X^{A} \rightarrow {}_{Z-2}Y^{A-4} + \alpha + \text{energy}$$

Parent nuclide — **daughter nuclide** — **alpha particle**

Example 1

When radium $_{88}Ra^{226}$ decays by alpha emission. The alpha decay leaves the nucleus with 2 protons and two neutrons less than before. So the atomic number drops to 86 and the atomic mass to 222. Radon has the atomic number of 86, so radon is the new element formed. Its decay process can be written as,

$$_{88}Ra^{226} \rightarrow {}_{86}Rn^{222} + \alpha + \text{energy}$$

Example 2

When radium $_{92}U^{238}$ decays by alpha emission. The alpha decay leaves the nucleus with 2 protons and two neutrons less than before. So the atomic number drops to 90 and the atomic mass to 234. Thorium has the atomic number of 90, so thorium is the new element formed. Its decay process can be written as,

$$_{92}U^{238} \rightarrow {}_{90}Th^{234} + \alpha + \text{Energy}$$

What is beta (β)-decay, give its general equation and example

Beta (β)-decay

In beta decay, the atomic number (Z) of the parent nuclide increases by one, and its atomic mass or nucleon number remains unchanged.

General equation:

$_ZX^A$	**→**	**$_{Z+1}Y^A$**	**+**	**$_{-1}e^0$**	**+**	**energy**
Parent nuclide		**daughter nuclide**		**beta particle**		

Example

When carbon $_6C^{14}$ decays by beta emission. The beta decay leaves the nucleus with one more proton and one neutron less than before. So the atomic number increases to 7, and the mass number remains unchanged. Nitrogen has the atomic number of 7, so nitrogen is the
new element formed. Its decay process can be written as,

$$_6C^{14} \rightarrow {}_7N^{14} + {}_{-1}e^0 + \text{energy}$$

Q6. What do you know about β+ decay

Positron emission or positive beta decay (β+ decay) or Beta (β)+ decay

A proton in the parent nucleus decays into a neutron that remains in the daughter nucleus and the nucleus emits a neutrino and a positron, which is a positive particle like an ordinary electron in mass but of opposite charge.

General equation:

$_ZX^A$	**→**	**$_{Z+1}Y^A$**	**+**	**e^+**	**+**	**energy**
Parent nuclide		**daughter nuclide**		**beta particle**		

Example

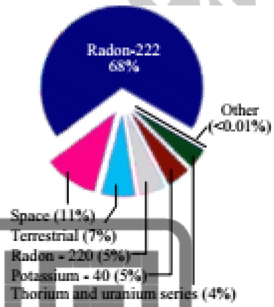
When carbon $_6C^{10}$ decays by beta emission. The beta decay leaves the proton with one more neutron and one proton less than before. So the atomic number decreases to 5, and the mass number remains unchanged. Boron has the atomic number of 5, so boron is the new element formed. Its decay process can be written as,

$$_6C^{10} \longrightarrow {}_5B^{10} + e^{+} + \text{energy}$$

Q7. What is Background radiations. Describe it in detail.

Background radiations

These natural radiations that come from the surroundings are called background radiations.



Sources of background radiations

Sources from which over half of background radiations come

In some areas, over half of these radiations come from radioactive radon $_{86}Rn^{222}$ gas, rocks seeping, and some types of granite.

Manufactured background radiation or man-made radiation

We all receive exposure to man-made radiation or background radiation.

Example

X-rays, radiation used to diagnose diseases and cancer therapy.

Sources

The fallout from nuclear explosives testing and also small amounts of radioactive materials released to the surroundings from coal and nuclear power plants are the sources of man-made radiation or background radiation.

Q8. What is Cosmic radiations?

Cosmic radiations

Our planet Earth is also exposed to radiation from outer space called cosmic radiations.

Composition

Cosmic radiations consist of electrons, protons, alpha particles, and larger nuclei.

Interaction with atmospheric atoms: The cosmic radiation interacts with atoms in the atmosphere to create a shower of radiation. Including X-rays, muons, protons, alpha particles, electrons, and neutrons.

Q9. What is Spontaneous decay?

Spontaneous decay

Spontaneous decay is a process in which environmental factors cannot influence.

Explanation: Radioactive decay takes place naturally (all by itself). The process is unaffected by pressure, temperature, chemical conditions, and other physical conditions.

Q10. What is Random decay?

A random decay is a process in which the exact time of decay of a nucleus cannot be predicted.

Q11. What do you know about Half-life?

Half-life

The half-life of a radioactive isotope is the time taken for half of the nuclei present in any given sample to decay.

Radioactive isotope	Half-life
Boron-12	0.02 second
Radon-220	52 second
Iodine-128	25 minutes
Radon-222	3.8 days
Iridium-192	74 days
Cobalt-60	5.27 year
Strontium-90	28 year
Radium-226	1602 year
Carbon-14	5730 year
Plutonium-239	24400 year
Uranium-235	7.1×10^8 year
Uranium-238	5×10^9 year

Q12. What is Radioactive dating? Give its example.

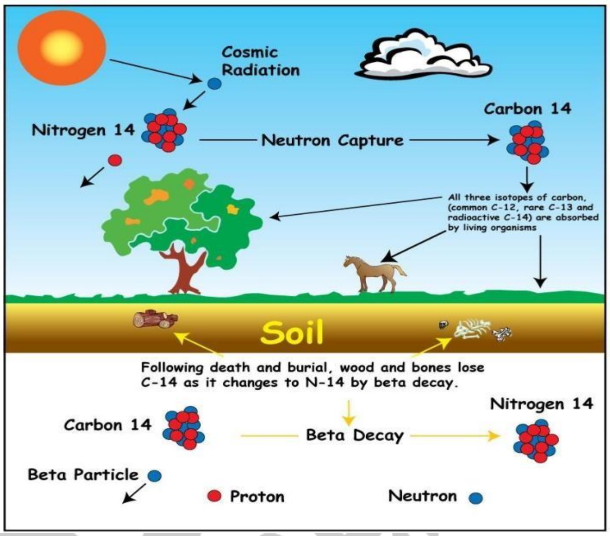
Radioactive dating

Radioactive dating is a process by which the approximate age of an object is determined by using certain radioactive nuclides.

Example 1

Radioisotope carbon-14 is used to measure the age of organic material. Living plants and animals use carbon dioxide and become slightly radioactive accordingly. While an organism is alive, the amount of carbon-14 remains constant because fresh carbon-14 enters whenever the organism consumes nutrients.

Cycle of Radio Carbon-14



When an organism dies, no more carbon is absorbed, and the radio carbon-14 presents inside the organism starts decaying to nitrogen-14. Since the half-life of carbon-14 is 5730 years, archaeologists can estimate the age of remains by computing the activity of carbon-14 in the live and dead organism.

Example 2

Radioisotope potassium-40 is used for dating rocks to estimate the age of the geological specimen. The unstable K-40 is trapped when molten material cools to form igneous rock. This K-40 decays to the stable argon nuclide Ar-40 with a half-life of x 10^8 years. The age of the rock sample can be estimated by computing the concentrations of K-40 and Ar-40.

Example 3

Uranium-containing materials that have been analyzed by radioactive dating have allowed scientists to determine that the Earth is over 4.5 billion years old.

Q13. What is Radio-isotopes?

Radio-isotopes

A radioisotope is a kind of the same element with different masses. It undergoes decay spontaneously and emits radiation to dissipate excess energy.

Example:

Naturally occurring radioisotopes

Hydrogen, the lightest element, has three isotopes H^1, H^2 and H^3. Only H^3 (tritium) is unstable. However, it is a radioactive isotope and undergoes nuclear decay.

Artificial radioisotopes

The stable and non-radioactive elements can also be transmuted into radioactive elements by exposing them to neutrons, or alpha particles. Here are some examples of the production of radioisotopes:

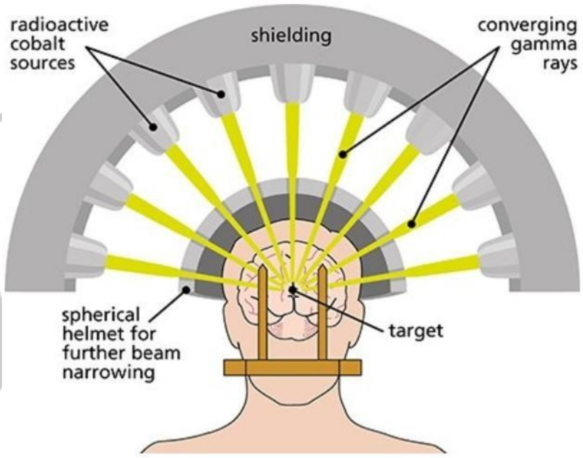
$_0n^1$	**+**	**$_{16}S^{32}$**	**→**	**$_{15}P^{32}$**	**+**	**$^1H_1$**
Neutron		**stable sulphur nuclide**		**unstable phosphorous Nuclide**		**Proton**
$_2He^4$	**+**	**$_{13}Al^{27}$**	**→**	**$_{15}P^{30}$**	**+**	**$_0n^1$**
Alpha particle		**stable aluminum nuclide**		**unstable phosphorous Nuclide**		**neutron**

In these examples, P^{32} and P^{30} produced are artificial radioisotopes.

Q14. What are the Applications of radioisotopes in different fields?

medicine, agriculture, and industrial fields

Radioisotopes are often used in medicine, industry, and agriculture for various beneficial purposes.



In medicine

Radiotracers: Radioisotopes are used as radiotracers in medicine.

For example, a patient drinks a liquid containing radio iodine-131, a gamma emitter, to check thyroid function. Over the next 24 hours, a detector measures the activity of the tracer to find out how quickly it becomes concentrated in the thyroid gland.

For the diagnosis of brain tumors, the phosphorous-32 isotope is used.

Curing various diseases

In nuclear medicines, radioisotopes are used for curing various diseases.

For example, cobalt-60 is a strong gamma emitter. These rays can penetrate in-depth into the body and kill the malignant tumor cells in the patient. Treatment like this is called radiosurgery.

Gamma knife radiosurgery

In Industry:

Radiotracers

Radioisotopes are used as radiotracers in industry. A small amount of short-lived radioactive substances is used in various processes and scanned the flow rates of various materials, including liquids, powders, and gases, to locate leakages. Radiotracers are also used in the oil and gas industry to detect and estimate the extent of oil fields.

Crack Testing

Gamma rays have high penetrating power, so they can photograph metals to check cracks. A cobalt-60 is a natural gamma rays source and does not need electrical power like an x-ray tube.

In agriculture:

Radiotracers

In agriculture, fertilizer uptake in the plant from root to leaves is traced by adding tracer phosphorus- 32 to the soil water.

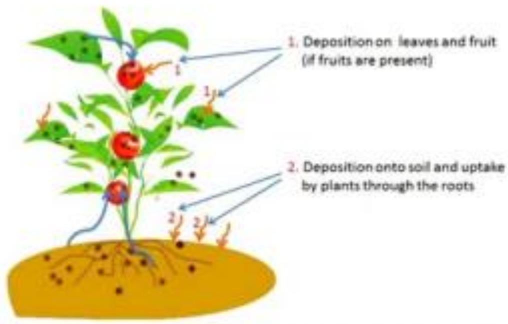


Illustration of radionuclide transfer to plants

Q15. What is Nuclear reactions?

Nuclear reactions

Nuclear reactions are processes in which one or more nuclides are produced from the collisions between two atomic nuclei.

Types: Types of nuclear reactions are given below:

1. Nuclear fission
2. Nuclear fusion

Q16. Describe Nuclear Fission with example.

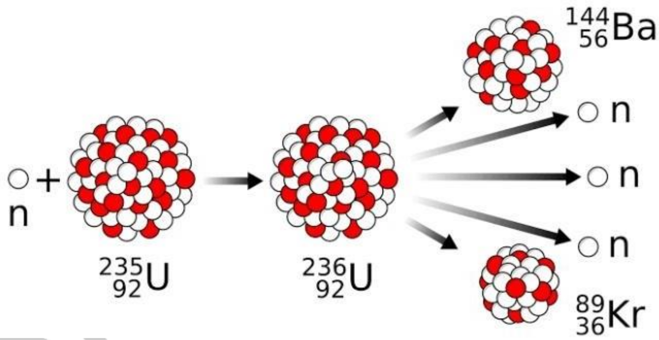
Nuclear fission occurs when a heavy nucleus absorbs a slow-moving neutron and splits or fissions into two smaller nuclei with the release of energy.

Example

When U-235 captures a neutron, an intermediate, highly unstable nucleus, U-236 is formed that disintegrates only for a fraction of a second into two smaller nuclei of nearly equal fragments, Kr-144 and Barium-89, called fission fragments accompanied by two or three neutrons.

$$^{0}n_{1} + {}_{92}U^{235} \rightarrow {}_{92}U^{236} \rightarrow {}_{56}Kr^{144} + {}_{36}Ba^{89} + 3\,{}_{0}n^{1}$$

Measurements showed that about 200 MeV of energy is released in each fission event. The following schematic illustration represents the fission of ${}_{92}U^{235}$.

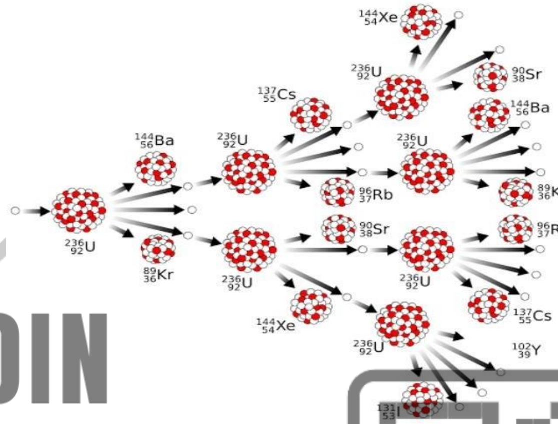


Schematic illustration of nuclear fission

In nuclear fission, the total mass of the products is less than the original mass of the heavy nucleus that is converted into energy.

Q17. What is Chain reaction? Illustrate it with diagram.

In each nuclear fission, a few neutrons are emitted. These neutrons can, in turn, trigger further nuclei to undergo fission with the possibility of a chain reaction. Computations show that if the chain reaction is not controlled, it will explode, releasing massive energy.



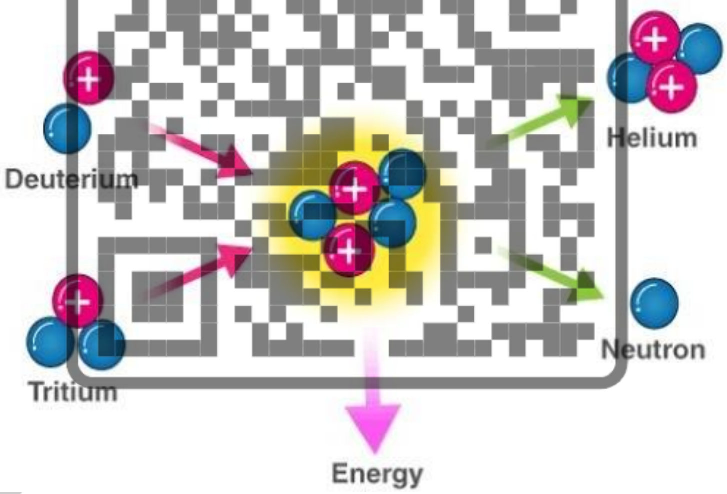
The fission chain reaction in U-235

This fission chain reaction is controlled in nuclear reactors.

Q18. What is Nuclear Fusion? Also explain with example

Nuclear Fusion

Nuclear fusion occurs when two light nuclei combine to form a heavier nucleus with the release of energy.



Example

When a nucleus of Deuterium ($_1H^2$) is fused with a nucleus of Tritium ($_1H^3$), then a Helium nucleus or alpha particle is formed as represented by the equation,

$$_1H^2 + {_1H^3} \rightarrow {_2He^4} + {_0n^1} + \text{energy}$$

The total mass of the final nuclei is always less than the mass of the original nuclei. This loss of mass produces nuclear energy.

Q19. What are Radiation Hazards? Also give Hazards of particles.

Radiation Hazards

The prolonged exposure to radioactive radiations (α,β,γ and rays) can produce deep-sited burns, damage to cells or tissues, and the mutations of the cells that can lead to genetic changes. Radioactive exposure can also cause cancerous growth in specific body tissues.

Hazards of α-particles

The danger from α particles because of their lower penetration power is minimal. If sources of α particles are lodged into the body, through the air, or we cat, it can damage our body tissues.

Hazards of β-particles

The β particles are more penetrating and can damage the body surface tissues. Sources of these particles that enter the body can be quite damaging.

Hazards of γ-particles

The γ rays are highly penetrating and the most dangerous of all other radioactive radiations.

Q20. What are the Safety Measures taken for radiations?

Safety Measures

While working in the radiology department in hospitals, nuclear reactors, and research laboratories, should take the following safety measures to avoid any risk of radiation hazards:

1. Keep all radioactive sources at a safe distance from the body.
2. Minimize the time spent near radioactive materials.
3. Wear personal protective equipment, including a laboratory coat, gloves, safety glasses, and close toed shoes.
4. Lapel the dosimeter badge always and monitor regularly.
5. Do not eat, drink, smoke or touch exposed areas of skin while working in a room where radioisotopes are handled.
6. Use tongs to handle radioactive sources.
7. After use, must return the source immediately to its lead boxes.
8. All radioactive sources should be kept in thick lead containers.
9. Dispose of all radioactive waste under permitted regulation or statutory control.

Q21. What is Radiation dosimeter

Radiation dosimeter

Radiation dosimeter is a scientific device that detects, measures and calculates dose uptake of external high energy ionizing beta, gamma, or X-ray radiation.

Section (A) Multiple Choice Questions (MCQs)

1. The α-radiation is

(a) A stream of fast-moving electrons. (b) A form of electromagnetic radiation.
(c) Highly ionizing than γ-radiation. (d) More penetrating than β-radiation.

2. A radioactive nuclide emits a β-particle. The atomic number (proton number) of the nucleus

(a) Stays the same. (b) Increases by 1. (c) Decreases by 2. (d) Decreases by 4.

3. A radioactive element emits a particle from the nucleus of one of its atoms. The particle comprises two protons and two neutrons. The name of this process is called

(a) α-emission (b) β-emission (c) γ-emission (d) Nuclear fission

4. A radioactive decay can be represented as shown ${}_{91}Pa^{233} \rightarrow {}_{92}U^{233}$ +...The emitted particle is a/an

(a) Gamma-ray. (b) Proton. (c) α-particle. (d) β-particle.

5. The type of radiation that travels in a straight line across an electric field is a/an

(a) Proton (b) Electron (c) Alpha particle (d) Gamma-ray

6. A powder contains 100mg of a radioactive material that emits α-particles. The half-life of the isotope is five days. The mass of isotope that remains after ten days will be

(a) 0mg (b) 25mg (c) 50mg (d) 75mg

7. The main source of energy in the stars is.

(a) Chemical reaction (b) Nuclear fission

(c) Nuclear fusion (d) Mechanical energy

8. The splitting of a heavy nucleus into smaller nuclei is called

(a) Fusion (b) Fission (c) Half-life (d) Gamma decay

9. A process in which two light nuclei combine to form a heavier nucleus is called

(a) Nuclear fusion (b) Nuclear fission (c) Beta-decay (d) Alpha-decay

10. Compared with α -particles and β-particles, γ-rays,

(a) Are a type of radiation to carry a charge.

(b) Have the most significant ionizing effect.

(c) Have the most significant penetrating effect.

(d) Have the most negligible mass.

11. The severe health hazards caused by radioactive emissions is/are.

(a) Cancer (b) Genetic change (c) Deep-sited burns (d) All of these

12. Radioactive materials should be handled carefully. Which safety measure does not reduce the risk of using radioactive material?

(a) Keeping the material a long distance (b) Keeping the material at a low temperature

(c) Using lead screening (d) Using the material for a short time

13. A scientist experiments using a sealed source that emits β-particles. The range of the β-particles in the air is about 30cm. The precaution that is the most effective to protect the scientist from the radiation is,

(a) Handling the source with long tongs (b) Keeping the temperature of the source low

(c) Opening all windows in the laboratory (d) Washing his hands before leaving the laboratory

14. The safest way to dispose of a large quantity of radioactive waste is,

(a) Burying it in a dry rock deep underground (b) Washing it in the drain

(c) Burning it on a fire (d) Draining it into the sea

Ans:

1. Highly ionizing than γ-radiation.	2. Increases by 1.	3. α-emission	4. β-particle.	5. Gamma-ray
6. 25mg	7. Nuclear fusion	8. Fission	9. Nuclear fusion	
10. Have the most significant penetrating effect.	11. All of these	12. Keeping the material at a low temperature	13. Handling the source with long tongs	14. Burying it in a dry rock deep underground

Numerical

1. A living plant contains approximately the same isotopic abundance of C-14 as does atmospheric carbon dioxide. The observed rate of decay of C-14 from a living plant is 15.3 disintegrations per minute per gram of carbon. How much disintegration per minute per gram of carbon will be measured from a 12900 year-old sample? (The half-life of C-14 is 5730 years.) (2.2513, 0.21, 3.2)

2. The smallest C-14 activity that can be measured is about 0.20%. If C-14 is used to date an object, the object must have died within how many years? (51374 yr)

3. How long will it take for 25% of the C-14 atoms in a sample of C-14 to decay? (2378 yr)

. The carbon-14 decay rate of a sample obtained from a young tree is 0.296 disintegration per second per gram of the sample. Another wood sample prepared from an object recovered at an archaeological excavation gives a decay rate of 0.109 disintegration per second per gram of the sample. What is the age of the object? (8258 yr)

Worked Example 1 If there are 96 grams of radioactive element Neptunium-240 present, how much Np-240 will remain after 6 hours? (Neptunium-240 has a half-life of 1 hour)

Worked Example 2 A sample of Ac-225 originally contained 8.0×10^{24} nuclei. After 960 hours, how much of the original sample remains un-decayed. The half-life of the isotope is ten days.

Worked Example3 How long will it take to decay for 36.0 mg of Ra-226 to leave 4.5 mg? The half-life of the isotope is 1600 years.