Q .Explain the principle of LASER. What is
population inversion?

Ans- LASER stands for Light Amplification by Stimulated Emission of Radiation. The principle behind a laser involves the emission of light through a process of stimulated emission.

1. Stimulation: At the core of a laser is a medium, often a crystal or gas, that can be stimulated to release photons. This stimulation can be achieved through various means like electrical discharge or another light source.
2. Population Inversion: Normally, in a collection of atoms or molecules, more particles reside in lower energy states than higher ones. In laser operation, a population inversion is created, where more particles are in higher energy states. This inversion is crucial for laser action.
3. Stimulated Emission: When a photon passes close to an atom or molecule in an excited state, it can trigger the emission of another photon with the same frequency, phase, and direction. This is called stimulated emission and is the key to laser amplification.
4. Amplification: The emitted photons stimulate neighboring atoms or molecules to undergo the same process, leading to a cascade of stimulated emissions. This results in a coherent beam of light with all photons having the same frequency, phase, and direction.
5. Mirrors: To amplify the light further, the laser medium is placed between two mirrors, one fully reflective and one partially reflective. The partially reflective mirror allows some light to escape, forming the laser beam.
6. Coherence and Monochromaticity:
Because of the way photons are emitted and amplified, laser light is coherent (waves are in phase) and monochromatic (single wavelength), which is why lasers produce intense, focused, and uniform beams of light useful in various applications from surgery to communication.

Q. What are the types of laser based on laser medium used?
Ans-

1. Gas Lasers:
2. Solid-State Lasers:
3. Semiconductor Lasers:
4. Dye Lasers:
5. Fiber Lasers:

Q.what is laser ? Differences between spontaneous emission and stimulated emission ?
Ans- A laser is a device that produces a narrow, intense beam of coherent light through a process called stimulated emission of radiation. Here's the difference between spontaneous emission and stimulated emission:

1. Spontaneous Emission:
   - Occurs when an atom or molecule transitions from an excited state to a lower energy state spontaneously, without any external stimulation.
   - The emitted photons have random phases, directions, and frequencies, leading to incoherent light.
   - Examples include everyday light sources like incandescent bulbs and fluorescent lights.
2. Stimulated Emission:
   - Occurs when an incoming photon interacts with an already excited atom or molecule in a way that induces it to emit another photon that is in phase with the incoming photon.
   - This process leads to coherent light where the emitted photons have the same frequency, phase, and direction, resulting in a laser beam.
   - Stimulated emission is the principle behind laser operation and is key to generating a concentrated, powerful beam of light.

Q. write short note on Photo-electric cell?
Ans- A photoelectric cell, also known as a photocell or light-dependent resistor (LDR), is a device that converts light energy into electrical energy. It operates based on the principle of the photoelectric effect, where photons of light striking a material cause the emission of electrons, generating an electric current. Photoelectric cells find applications in light sensors, solar panels, and various light-sensitive devices.

Q. Write short note on Binding energy and mass defect ?
Ans-Binding energy refers to the energy required to disassemble a nucleus into its individual nucleons (protons and neutrons) completely. It's essentially the energy that holds the nucleus together. Mass defect, on the other hand, is the difference in mass between the individual nucleons and the nucleus they form. This mass difference is due to the conversion of mass into energy as nucleons come together to form a nucleus, according to Einstein's mass-energy equivalence principle ($E=mc^2$).

Q.What do you understand by the term 'internal resistance' of a cell ?
Ans- Internal Resistance: The resistance offered by the electrolyte inside the cell to the flow of electric current through it is called the internal resistance of the cell.

Q. What is thermion ? Explain how a diode can be used as a rectifier?
Ans-

Thermion refers to a hot cathode emitter, often used in vacuum tubes or cathode ray tubes. When heated, it emits electrons due to thermionic emission. These electrons can then be manipulated using electric and magnetic fields.

A diode can be used as a rectifier due to its property of allowing current to flow in one direction only. In an alternating current (AC) circuit, a diode allows current to flow during one half of the

AC cycle (when the diode is forward biased) and blocks current flow during the other half (when it's reverse biased). This results in converting AC to pulsating DC (direct current). To get smoother DC, capacitors can be used to filter out the ripples, creating a more continuous flow of current.

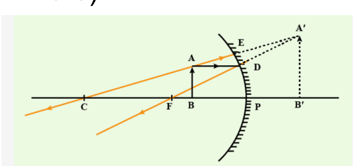
Q.Distinguish between real and virtual image. With a neat ray diagram show the formation of a virtual image by a concave mirror.
Ans- Differences Between Real and Virtual Images:

1.Formation:
- Real Image: Formed when rays of light actually converge at a point after reflection or refraction.
- Virtual Image: Formed when rays of light appear to diverge from a point behind the mirror or lens.

2. Visibility:
- Real Image: Can be projected on a screen.
- Virtual Image: Cannot be projected on a screen; can only be seen by looking into the mirror or lens.

3. Orientation:
- Real Image: Inverted (upside down).
- Virtual Image: Erect (right side up).

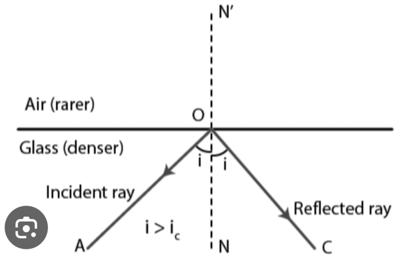
4. Location:
- Real Image: Formed on the same side as the object (for lenses) or the opposite side (for mirrors).
- Virtual Image: Formed on the opposite side as the object (for lenses) or the same side (for mirrors).



Q.What is total internal reflection? Explain it with a diagram.
Ans- Total internal reflection occurs when a light ray traveling through a medium with a higher refractive index strikes the boundary with a medium of lower refractive index (such as air) at an angle greater than the critical angle. At this angle, all of the light is reflected back into the original medium rather than refracting into the second medium.

Explanation:
1. Incident Ray: A ray of light traveling in the denser medium.
2. Angle of Incidence: The angle between the incident ray and the normal.
3. Critical Angle: The minimum angle of incidence at which total internal reflection occurs. It is specific to the pair of media involved.
4. Refracted Ray: The ray that would have passed into the second medium if the angle of incidence were less than the critical angle.

5. Reflected Ray: The ray that is reflected back into the original medium when the angle of incidence is greater than the critical angle.



Q.State inverse square law of magnetism and hence define unit pole.
Ans- The inverse square law of magnetism states that the force between two magnetic poles is directly proportional to the product of their pole strengths and inversely proportional to the square of the distance between them. Mathematically, it is expressed as:

$$F = \frac{\mu \cdot p_1 \cdot p_2}{4\pi d^2}$$

where:
- (F) is the force between the poles,
- (mu) is the permeability of the medium,
- (p1) and (p2) are the strengths of the magnetic poles,
- (d) is the distance between the poles.

A unit pole is defined as a magnetic pole that, when placed in a vacuum 1 meter away from an identical pole, experiences a force of newtons. This definition establishes the strength of the magnetic pole in terms of the force it generates at a specified distance in a standard medium.

Q.What are the defects of a simple voltaic cell? State the method of their remedy.
Ans- A simple voltaic cell, also known as a galvanic cell, converts chemical energy into electrical energy. However, it has several defects:

1. Polarization: During the operation of the cell, hydrogen gas bubbles form on the copper electrode, causing an increase in internal resistance and a decrease in the cell's efficiency and voltage.
   Remedy: Polarization can be minimized by using a depolarizer like manganese dioxide (MnO_2) or potassium dichromate ($K_2Cr_2O_7$) which reacts with the hydrogen gas to form water.
2. Local Action: This occurs due to impurities in the zinc electrode, which creates small local cells that cause the zinc to corrode even when the cell is not in use.
   Remedy: Local action can be reduced by using pure zinc or by amalgamating the zinc electrode with mercury, which covers the impurities and prevents the formation of local cells.
3. Voltage Variation: The voltage of the simple voltaic cell can fluctuate due to the accumulation of hydrogen bubbles on the copper electrode and the degradation of the zinc electrode.

Remedy: Ensuring proper maintenance and regular replacement of the electrodes can help maintain a stable voltage. Additionally, using an electrolyte with consistent concentration can prevent significant voltage variations.
4. Short Cell Life: The simple voltaic cell tends to have a short operational life due to the rapid consumption and degradation of its components.
Remedy: Employing more durable materials for electrodes and electrolytes, as well as improving the cell design, can extend the cell's operational life.

Q.Define resistance. Give its unit. What is the effect of temperature on resistance of a conductor?
Ans- Resistance is a measure of the opposition to the flow of electric current through a conductor. The unit of resistance is the ohm (Ω).

The effect of temperature on the resistance of a conductor is as follows:

- For most conductors, resistance increases with an increase in temperature. This is because, as temperature rises, the atoms in the conductor vibrate more, which increases the likelihood of collisions between electrons and atoms, thereby increasing resistance.
- For some materials, such as semiconductors, resistance decreases with an increase in temperature due to the increase in the number of charge carriers.

Overall, the relationship between temperature and resistance can often be approximated using the formula:
[$R_t = R_0 1+\alpha(T-T_0)$]
where:
- (R_t) is the resistance at temperature (T),
- (R_0) is the resistance at a reference temperature (T_0),
- (α) is the temperature coefficient of resistance.

Q.State Joule's law of heating. What is a thermo couple?
Ans- Joule's law of heating states that the heat produced in a conductor due to the flow of electric current is proportional to the square of the current (I), the resistance (R) of the conductor, and the time (t) for which the current flows. Mathematically, it is expressed as:
$H=I^2 Rt$

A thermocouple is a type of temperature sensor that consists of two different conductors that are joined at one end. When there is a temperature difference between the joined end and the other ends , a voltage is generated that can be measured and used to calculate the temperature. Thermocouples are widely used for their wide temperature range and durability.

Q.State Faraday's laws of electromagnetic induction.
Ans- Faraday's laws of electromagnetic induction consist of two laws:

1. First Law: Whenever the magnetic flux through a circuit changes, an electromotive force (EMF) is induced in the circuit. If the circuit is closed, a current will flow.
2. Second Law: The magnitude of the induced EMF is directly proportional to the rate of change of magnetic flux through the circuit. Mathematically, it is expressed as:

$EMF = -\, d\Phi/dt$

where Φ is the magnetic flux and $d\Phi/dt$ is the rate of change of magnetic flux. The negative sign indicates the direction of the induced EMF is such that it opposes the change in magnetic flux (Lenz's Law).

Q.What is a transformer? What are the types of a transformer? Write one use of each type of transformers.
Ans-A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction.

Types of Transformers and Their Uses:

1. Power Transformer: Used in transmission networks for high voltage application.
2. Distribution Transformer: Used in distribution networks to provide the final voltage transformation.
3. Isolation Transformer: Used to transfer power while isolating the powered device from the power source.
4. Instrument Transformer: Used in conjunction with measuring instruments.
5. Autotransformer: Used for adjusting the voltage within a power system.
6. Current Transformer: Used to measure high currents.
7. Potential Transformer: Used to measure high voltages.

Q.Establish Einstein's Photo-electric equation. Define threshold frequency.
Ans- Einstein's Photoelectric Equation

Einstein's photoelectric equation explains the photoelectric effect, where light incident on a material ejects electrons. The equation is:
$E=hv$

Where:
- E is the energy of the incident photon.
-(h) is Planck's constant(6.626×10^{-34}js).
- (v) is the frequency of the incident light.

When light strikes a material, the energy of the photon is absorbed by an electron. If the energy is sufficient to overcome the work function (ϕ) of the material, the electron is ejected with kinetic energy (KE):

$h\nu = \phi + KE$

Rearranging, the equation becomes:

$KE = h\nu - \phi$

Where:
- (KE) is the kinetic energy of the ejected electron.
- (ϕ) is the work function of the material (the minimum energy required to eject an electron).

Threshold Frequency
The threshold frequency ($\nu 0$) is the minimum frequency of light required to eject electrons from a material. If the frequency of the incident light is below the threshold frequency, no electrons are ejected regardless of the light's intensity.
$v0 = \phi/h$

Where:
-(v0) is the threshold frequency.
- (ϕ) is the work function of the material.
- (h) is Planck's constant.

Q.How a diode can be used as a half wave rectifier?
Ans- A diode can be used as a half-wave rectifier by allowing current to pass through only during the positive half-cycles of an AC input signal. When the AC voltage is positive, the diode becomes forward-biased and conducts, allowing current to flow and creating a voltage across the load resistor. During the negative half-cycle, the diode is reverse-biased and blocks the current, resulting in zero voltage across the load. This process converts the AC input into a pulsating DC output, effectively "rectifying" the signal to only include positive voltage pulses.

Q.Explain the formation of a p- type semiconductor.
Ans- A p-type semiconductor is formed by doping an intrinsic (pure) semiconductor, typically silicon (Si) or germanium (Ge), with a trivalent impurity. Here’s how the process works:
1. Intrinsic Semiconductor: Begin with a pure semiconductor, which has an equal number of electrons and holes.
2. Dopant Addition: Introduce a small amount of trivalent impurity atoms, such as boron (B), aluminum (Al), gallium (Ga), or indium (In). These elements have three valence electrons.
3. Creation of Holes: Each trivalent atom forms covalent bonds with three of the four neighboring silicon atoms. However, because they have only three valence electrons, they leave one bond incomplete, creating a "hole".
4. Majority Carriers: The holes act as positive charge carriers. In a p-type semiconductor, holes are the majority carriers, while electrons are the minority carriers.
5. Electrical Neutrality: Despite the presence of holes, the semiconductor remains electrically neutral overall because the number of protons in the dopant atoms balances the number of electrons in the system.

Q.What is Photo Electric effect? Derive Einstein's equation of photo electric effect.
Ans- The photoelectric effect is the phenomenon where electrons are ejected from a material's surface when it is exposed to light of sufficient frequency.

Einstein's Photoelectric Equation Derivation:

1. Photon Energy:
   - Each photon has energy (E) given by:
   $E=hv$
   where (h) is Planck's constant and (v) is the frequency of light.
2. Energy Transfer:
   - When a photon hits an electron in the material, its energy (hv) is transferred to the electron.
3. Work Function (ϕ):
   - A part of the photon's energy is used to overcome the work function(ϕ), the minimum energy needed to eject the electron from the material.
4. Kinetic Energy:
   - The remaining energy becomes the kinetic energy (KE) of the ejected electron:
   $KE=hv-\phi$

Einstein's Photoelectric Equation
Combining the above points, Einstein's photoelectric equation is:
$KE=hv-\phi$

This equation shows that the kinetic energy of the ejected electron depends on the frequency of the incident light and the material's work function.

Q.Discuss the use of diode as a half wave rectifier.
Ans- A diode used as a half-wave rectifier allows only one half of an AC waveform to pass through to the load, effectively converting AC to DC.

Basic Operation:

1. Positive Half-Cycle: During the positive half-cycle of the AC input, the diode is forward-biased and conducts current. The output voltage across the load resistor matches the positive half-cycle of the input voltage.
2. Negative Half-Cycle: During the negative half-cycle of the AC input, the diode is reverse-biased and does not conduct current. The output voltage across the load resistor is zero during this period.

Components Needed:
- Diode: A semiconductor device that allows current to flow in one direction.
- Load Resistor: A resistor connected across the output to consume the rectified power.

Circuit Diagram:

```
AC Input
    |
    |--------|>|--------|
    |       Diode       |
   ( )                [R]
    |                 Load
    |                  |
    ---------------------
```

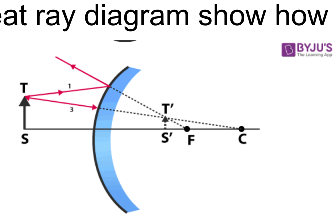
Characteristics:
- Output Voltage: The output is a pulsating DC that corresponds to the positive half-cycles of the AC input.
- Efficiency: Not very efficient compared to full-wave rectifiers, as only half of the input signal is utilized.
- Ripple Factor: High ripple factor due to the absence of negative half-cycles, resulting in a less smooth DC output.
- Peak Inverse Voltage : The maximum voltage a diode can withstand in the reverse-biased condition. For a half-wave rectifier, the PIV is equal to the peak value of the input AC voltage.

Applications:
- Signal Demodulation: In AM radio receivers to extract the audio signal from the carrier wave.
- Simple Power Supplies: For low-power applications where the high ripple is tolerable or can be filtered out with capacitors.

Advantages and Disadvantages:
Advantages:
- Simple design and easy to construct.
- Requires only one diode.

Disadvantages:
- Inefficient use of the AC signal.
- High ripple in the output.
- Lower average output voltage compared to full-wave rectifiers.

Q. draw a neat ray diagram show how a real image is formed by a convex mirror.



Ans-

Q.Write the conditions of total internal reflection.

Ans- Total internal reflection occurs when a light ray traveling in a denser medium strikes the boundary with a less dense medium at an angle greater than the critical angle. Here are the conditions for total internal reflection:

1. Light Must Travel from a Denser to a Less Dense Medium:
   - The light ray must be traveling from a medium with a higher refractive index to a medium with a lower refractive index.

2. Angle of Incidence Greater than the Critical Angle:
   - The angle of incidence must be greater than the critical angle for the two media.
   - The critical angle ($\theta c$is given by the equation:

$\sin(\theta ç)=n2/n1$

where n1 is the refractive index of the denser medium and (n2) is the refractive index of the less dense medium. Total internal reflection occurs when the angle of incidence θi satisfies:

$\theta i > \theta c$

Summary of Conditions:
1. The light must be moving from a medium with a higher refractive index to one with a lower refractive index.
2. The angle of incidence must be greater than the critical angle for the specific pair of media.

Q.What do you mean by terrestrial magnetism? Name its elements.
Ans-Terrestrial magnetism, also known as geomagnetism, refers to the magnetic field generated by the Earth. This magnetic field extends from the Earth's interior out into space, where it interacts with solar wind, a stream of charged particles emanating from the Sun.

Elements of Terrestrial Magnetism:
1. Magnetic Declination (D):
2. Magnetic Inclination (I):
3. Horizontal Component (H):
4. Vertical Component (Z):
5. Total Magnetic Field (F):

Q.Define electric potential. Deduce an expression for electrostatic potential at a point due to a point charge.
Ans- Electric Potential
Electric potential (V) at a point is the work done to bring a unit positive charge from infinity to that point. It's measured in volts (V).

Electrostatic Potential Due to a Point Charge:
For a point charge Q, the electric potential
V at a distance r is:
$V= Q/4\pi\epsilon 0\ r$

where ϵ0 is the permittivity of free space.
Steps to derive:

1. **Electric Field (E):**

$$E = \frac{1}{4\pi\epsilon_0}\frac{Q}{r^2}$$

2. **Relation:**

$$E = -\frac{dV}{dr}$$

3. **Integration:**

$$V = -\int_{\infty}^{r} E\,dr$$

4. **Substitute E:**

$$V = -\int_{\infty}^{r}\left(\frac{1}{4\pi\epsilon_0}\frac{Q}{r^2}\right)dr$$

5. **Evaluate:**

$$= \frac{Q}{4\pi\epsilon_0 r}$$

Q.What is a secondary cell. Give an example. How are the defects of a cell is rectified in dry cell?
Ans- A secondary cell, also known as a rechargeable battery, is a type of electrochemical cell that can be charged, discharged, and recharged multiple times. Unlike primary cells, which are single-use and disposable, secondary cells can be restored to their original charged state by applying an external electrical energy source.

Example:
- Lithium-ion Battery: Commonly used in mobile phones, laptops, and electric vehicles.

Rectifying Defects in Dry Cells:
Dry cells, like the common zinc-carbon battery, can experience defects over time due to various factors such as leakage, internal short circuits, and reduced efficiency. Here are some methods to rectify or mitigate these defects:

1. Improving Seal Integrity:
   - Problem: Leakage of electrolyte.
   - Solution: Enhancing the sealing materials and methods to prevent leakage.
2. Better Electrolyte Composition:
   - Problem: Degradation of electrolyte.
   - Solution: Using more stable and less corrosive electrolytes to extend battery life.
3. Enhanced Separator Materials:
   - Problem: Internal short circuits due to separator breakdown.
   - Solution: Utilizing robust separator materials to prevent direct contact between the anode and cathode.

4. Corrosion-resistant Materials:
   - Problem: Corrosion of zinc anode.
   - Solution: Using corrosion inhibitors or protective coatings to prolong the anode's lifespan.
5. Improved Cathode Materials:
   - Problem: Inefficient cathode reaction.
   - Solution: Using high-performance cathode materials to enhance the electrochemical reactions.

Q.State Ohm's law and hence define resistance.
Ans- Ohm's Law states that the current (I) flowing through a conductor between two points is directly proportional to the voltage (V) across the two points, given a constant temperature. Mathematically, Ohm's Law is expressed as:

[V = IR]

where:
- (V) is the voltage across the conductor,
- (I) is the current flowing through the conductor,
- (R) is the resistance of the conductor.

From Ohm's Law, we can define resistance (R) as the ratio of voltage (V) to current (I):

R=v/r

Resistance is a measure of how much a material or device opposes the flow of electric current. It is typically measured in ohms (Ω).

Q.What is Seeback effect? Describe a thermo- couple.
Ans- The Seebeck effect is the phenomenon where a voltage, known as the thermoelectric voltage, is generated in a circuit composed of two different conductors or semiconductors when their junctions are maintained at different temperatures. This effect is named after Thomas Johann Seebeck, who discovered it in 1821.

Thermocouple:
A thermocouple is a device that exploits the Seebeck effect to measure temperature. It consists of two different types of metals or semiconductors joined together at one end, called the junction. The other ends of the metals are connected to a voltmeter or another measuring device. Here's how it works:

1. Hot Junction: The junction where the two metals are joined is exposed to the temperature to be measured.
2. Cold Junction: The other ends of the metals are kept at a known reference temperature.

Applications of Thermocouples:

Thermocouples are widely used in various applications due to their wide temperature range, durability, and relatively low cost. Some common applications include:

- Industrial temperature measurement
- Household appliances like ovens and stoves
- Scientific research
- Automotive and aerospace industries for engine monitoring.

Q.Define Lenz's law and explain it. State the unit of self induction.
Ans- Lenz's Law states that the direction of an induced electromotive force (emf) and the resulting current in a closed circuit will be such that it opposes the change in magnetic flux that produced it. Essentially, this law is a consequence of the conservation of energy and can be summarized by the phrase "nature abhors a change in magnetic flux."

Explanation:
When a change in magnetic flux through a coil or circuit occurs, it induces an emf in the circuit according to Faraday's Law of Electromagnetic Induction. Lenz's Law provides the direction of this induced emf. If the magnetic flux through a coil increases, the induced current will flow in a direction that creates a magnetic field opposing the increase. Conversely, if the magnetic flux decreases, the induced current will flow in a direction that creates a magnetic field supporting the original magnetic flux.

Unit of Self Induction:
The unit of self-induction is the henry (H). One henry is defined as the amount of inductance in a circuit when a change in current of one ampere per second induces an emf of one volt.

Q.Write two properties each of a, ß and y radiations.
Ans-

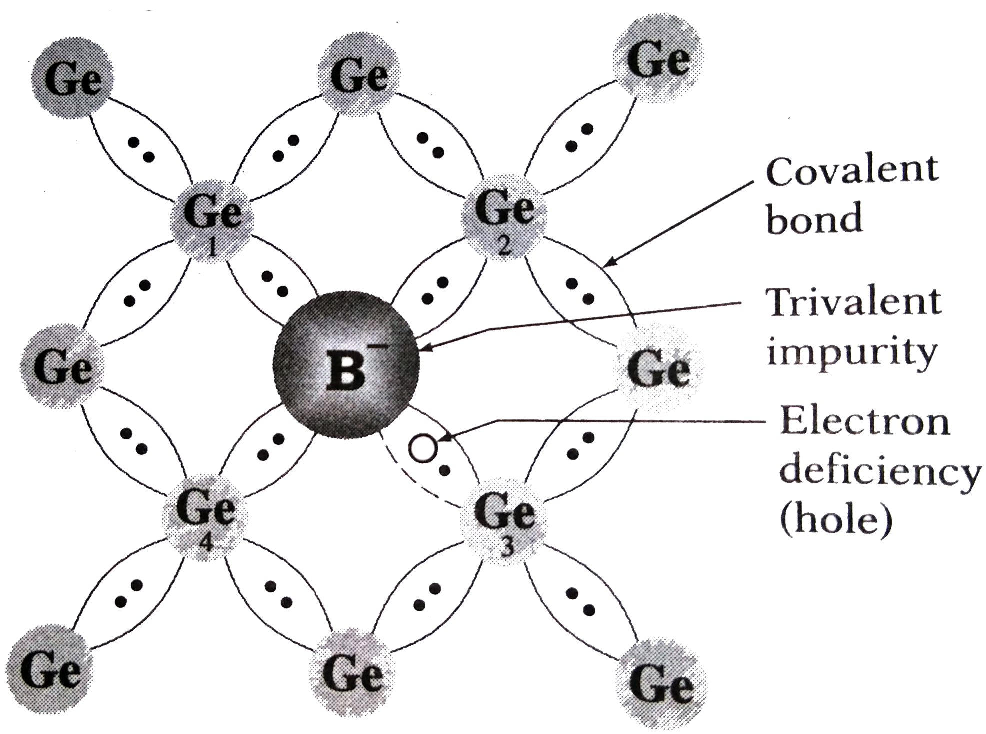
Alpha Radiation (α):
1. Charge: Alpha particles are positively charged.
2. Mass: They have a relatively high mass compared to beta and gamma radiation.

Beta Radiation (β):
1. Charge: Beta particles can be either positively or negatively charged.
2. Penetration: They can penetrate deeper into materials compared to alpha particles but are stopped by materials like aluminum.

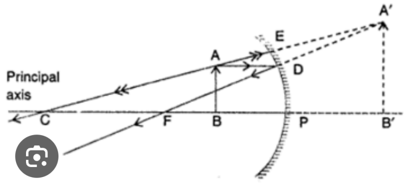
Gamma Radiation (γ):
1. Charge: Gamma rays are neutral; they have no electric charge.
2. Penetration: They have high penetration ability and can pass through most materials, requiring dense materials like lead or concrete to shield effectively.

Q.With a neat diagram show how a P type semiconductor is formed.

Ans-
(1) A trivalent element such as boron, gallium or aluminiom has three valence electrons. Silicon and germanium are tetravalent elements.
A p-type semiconductor is formed when crystal of tetravalent sillicon or germanium is doped with a trivalent impurity.
(2)All the three valence electrons of an impurity atom form covali bonds with three of the four nearest-neighbour ost anoms. One bonds remains incomplete and needs an additional electron.
(3) A valence electron of a meighbouring atom may become free and electrons to the condaction band. Such mpurity holes greatly inrease the small concentration of holes that are already present in the material due thermal energy. The total hole concentration in the valence band
(nh)greatly exceeds that of thermal electrons in the conduction band
(ne) : (nh>>ne)
. Conduction in such an extrinsic semiconductor is largely due to holes.
(4) Such an extrinsic semiconductor is, therefore, termed positive charge carrier types, or p-type, semiconductor.



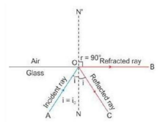
Q.Draw the virtual image that can be found for concave mirror.



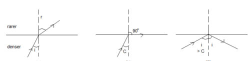
Ans-

Q.What is an optical image.
Ans- An optical image is a reproduction of an object formed by light rays. It can be captured on a screen, viewed directly with the eyes, or recorded with devices such as cameras. Optical images are created through the interaction of light with lenses, mirrors, or other optical elements.

Q.Explain with a neat diagram the 'critical angle" and "total internal reflection.
Ans- Critical angle: The angle of incidence in the denser medium corresponding to which the angle of refraction in the rarer medium is 90◦ is called the critical angle.



Total internal reflection:When a light ray travels from a denser to a rarer medium, it bends away from the normal. The angle of refraction is greater than the angle of incidence.



As the angle of incidence increases, the angle of refraction also increases. For a particular angle of incidence, the angle of refraction becomes 90◦ and the refracted ray grazes the surface separating the two media. This angle of incidence is called the ‘critical angle’ and is defined for a pair of media. If the angle of incidence is increased beyond this critical angle, the ray is not refracted but gets reflected as shown in diagram (c). Then, the entire incident light is reflected back into the denser medium. This phenomenon is called the total internal reflection.

Q.How local action and polarisation are avoided in a Lechlanche cell?
Ans- In a Leclanché cell, local action and polarization are common issues that can affect its efficiency and performance. Here’s how these issues are addressed:

Local Action
Local action refers to the self-discharge of the cell due to impurities in the zinc anode, which react with the electrolyte even when the cell is not in use.

- Use of Pure Zinc: To minimize local action, the zinc anode is made as pure as possible to reduce unwanted reactions.
- Amalgamation of Zinc: The zinc anode is often amalgamated (coated) with mercury, which helps to reduce the impurities' reactivity and thus decreases local action.

Polarization
Polarization occurs when hydrogen gas bubbles form on the carbon rod (cathode), increasing internal resistance and reducing the cell’s efficiency.

- Manganese Dioxide Depolarizer: The Leclanché cell uses manganese dioxide (MnO_2) as a depolarizer. Manganese dioxide reacts with the hydrogen gas formed during the electrochemical reaction, preventing the buildup of hydrogen gas on the cathode.
- Carbon Rod: The carbon rod serves as the cathode and is surrounded by a mixture of manganese dioxide and carbon powder. This mixture facilitates the reduction of hydrogen gas.

By employing these methods, the Leclanché cell effectively minimizes local action and polarization, thereby maintaining its performance and longevity.

Q.Describe Molecular theory of magnetism
Ans- The molecular theory of magnetism explains that:

1. Atomic Magnetic Moments: Atoms have magnetic moments from electron spins and orbits.
2. Magnetic Domains: In ferromagnetic materials, regions where atomic magnetic moments align.
3. Exchange Interaction: Quantum effect causing alignment of magnetic moments in ferromagnets.
4. Types of Magnetism:
   - Diamagnetism: Weakly opposes external magnetic fields.
   - Paramagnetism: Weakly aligns with external magnetic fields.
   - Ferromagnetism: Strong alignment of moments without an external field.
   - Antiferromagnetism: Opposing moments cancel out.
   - Ferrimagnetism: Unequal opposing moments result in net magnetism.
5. Curie Temperature: The point above which ferromagnets lose permanent magnetism and become paramagnetic.

Q.Define electric field intensity.
Ans- Electric field intensity, often referred to simply as electric field, is a vector quantity that describes the strength and direction of the electric force experienced by a unit positive charge placed in the electric field. Mathematically, it is defined as the force per unit charge exerted on a small positive test charge placed at a point in space:

$$E=F/q$$

where:
- E is the electric field intensity vector,
- F is the force experienced by the test charge,
- q is the magnitude of the test charge.

The SI unit of electric field intensity is volts per meter (V/m).

Q. State Coulomb's law in electrostatics.

Coulomb's law in electrostatics states that the electrostatic force F between two point charges is directly proportional to the product of the magnitudes of the charges q_1 and q_2 and inversely proportional to the square of the distance r between them. Mathematically, it is expressed as:

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

where k_e is Coulomb's constant, approximately equal to $8.9875 \times 10^9 \mathrm{~N~m}^2/\mathrm{C}^2$ in vacuum. The force is attractive if the charges are of opposite signs and repulsive if they are of the same sign.

Ans-

Q.Explain the principle of electrostatic capacitor.
Ans- An electrostatic capacitor stores electrical energy using two conductive plates separated by an insulating material (dielectric). When a voltage is applied, one plate gets a positive charge and the other a negative charge, creating an electric field between them. The capacitor's ability to store charge, called capacitance, depends on the plate area, the distance between them, and the dielectric material. The stored energy can be released when needed, allowing current to flow in a circuit.

Q.Differentiate between emf and potential difference.
Ans- EMF (Electromotive Force):
- Definition: Energy per unit charge from a source.
- Nature: Maximum potential difference with no current (open circuit).
- Source: Energy conversion within the source.
- Symbol: E
- Unit: Volts (V)

Potential Difference:
- Definition: Work done to move a unit charge between two points.
- Nature: Potential difference with current flowing.
- Source: Caused by emf or circuit resistance.
- Symbol: v
- Unit: Volts(v)

Key Differences:
- Emf is the source's energy capability, while potential difference is the energy observed between two points with current flow.
- Emf is measured without current; potential difference is measured with current.

Q.Describe the construction and theory of a Simple voltaic cell.
Ans- A simple voltaic cell converts chemical energy into electrical energy through a redox reaction. It consists of:

1. Electrodes:
   - Anode (negative): Made of a metal like zinc, which loses electrons (oxidation).
   - Cathode (positive): Made of a metal like copper, which gains electrons (reduction).
2. Electrolytes:
   - Solutions containing ions, such as zinc sulfate ($ZnSO_4$) for the anode and copper sulfate ($CuSO_4$) for the cathode.
3. Salt Bridge:
   - Maintains electrical neutrality by allowing ion flow between the electrolytes.
4. External Circuit:
   - Connects the electrodes, allowing electron flow and generating an electric current.

Theory:

- **Oxidation at the anode:** Zinc loses electrons: $\mathrm{Zn\ (s)} \rightarrow \mathrm{Zn^{2+}(aq)} + 2e^-$
- **Reduction at the cathode:** Copper ions gain electrons: $\mathrm{Cu^{2+}(aq)} + 2e^- \rightarrow \mathrm{Cu\ (s)}$
- **Electron flow:** From anode to cathode through the external circuit.
- **Ion flow:** Maintained by the salt bridge for charge balance.

Overall Reaction:

$$\mathrm{Zn\ (s)} + \mathrm{CuSO_4(aq)} \rightarrow \mathrm{ZnSO_4(aq)} + \mathrm{Cu\ (s)}$$

Q.Derive the relation between electric current and drift velocity.
Ans-
The relationship between electric current (I) and drift velocity (vd) can be summarized as follows:

1. Electric Current (I): The rate of flow of electric charge through a conductor.
2. Electron Movement: Electrons in a conductor have an average drift velocity (vd).
3. Charge Density (n): Number of free electrons per unit volume.
4. Cross-Sectional Area (A): The area through which electrons flow.
5. Elementary Charge (e): Charge of a single electron.

The formula linking these quantities is:
$I = n \cdot A \cdot vd \cdot e$

This means that the electric current (I)is directly proportional to the drift velocity (vd) of the electrons, the cross-sectional area (A), the number density of electrons (n), and the charge of an electron (e).

Q.write short note
(i) Seebeck effect
(ii) Thomson effect
(iii) Peltier effect
Ans-

SEEBECK EFFECT:
The Seebeck effect refers to the phenomenon where a voltage is generated across the junction of two different metals or semiconductors when they are subjected to a temperature gradient. This effect is the basis for thermocouples, which are used to measure temperature.

THOMSON EFFECT:
The Thomson effect describes the change in temperature of a conductor when an electric current passes through it while a temperature gradient is applied. This effect leads to either heating or cooling of the conductor depending on the direction of the current relative to the temperature gradient. It was discovered by William Thomson (Lord Kelvin).

PELTIER EFFECT:
The Peltier effect occurs when a voltage is applied across the junction of two different conductors, causing a heat absorption or release at the junction. This effect is used in thermoelectric coolers and heaters, where heat is either absorbed or released depending on the direction of the current.

Q.Describe the working of a LASER.
Ans- Working of a LASER

A LASER (Light Amplification by Stimulated Emission of Radiation) works on the principle of stimulated emission. Here's a step-by-step description of its working:

1. Energy Absorption: Atoms or molecules in the laser medium (like a gas, crystal, or semiconductor) absorb energy from an external source (such as a flash lamp or electrical current) and move to a higher energy state (excitation).
2. Spontaneous Emission: Some of the excited atoms spontaneously return to a lower energy state, emitting photons (light particles) in the process.
3. Stimulated Emission: Photons emitted from spontaneous emission stimulate other excited atoms to emit additional photons of the same energy, phase, and direction. This process is known as stimulated emission.

4. Light Amplification: The stimulated emission process causes a chain reaction, amplifying the number of photons and generating a coherent and monochromatic beam of light.
5. Resonance Cavity: The laser medium is placed between two mirrors, one fully reflective and the other partially reflective. The photons bounce back and forth between the mirrors, amplifying the light with each pass. Eventually, the coherent light passes through the partially reflective mirror as a concentrated beam.

Q.What is a LED?
Ans- A LED (Light Emitting Diode) is a semiconductor device that emits light when an electric current passes through it. It works on the principle of electroluminescence, where the material emits light in response to an electric current or a strong electric field.

- Construction: A LED consists of a p-n junction diode made from semiconductor materials like gallium arsenide, gallium phosphide, or indium gallium nitride.

- Operation: When a forward voltage is applied to the p-n junction, electrons from the n-type material recombine with holes in the p-type material. This recombination releases energy in the form of photons (light).

- Applications: LEDs are used in various applications such as indicator lights, displays, lighting, and communication devices due to their efficiency, long life, and low energy consumption.

Q.Describe the operation of a bridge rectifier.
Ans- A bridge rectifier is a type of rectifier circuit that converts an AC (alternating current) input into a DC (direct current) output. It consists of four diodes arranged in a bridge configuration. Here's how it works:

1. AC Input: An AC voltage is applied to the input terminals of the bridge rectifier.
2. Positive Half Cycle:
   - During the positive half cycle of the AC input, the current flows through diode D1, passes through the load resistor (R), and returns through diode D2 to the AC source.
   - Diodes D3 and D4 are reverse-biased and do not conduct.
3. Negative Half Cycle:
   - During the negative half cycle of the AC input, the current flows through diode D3, passes through the load resistor (R), and returns through diode D4 to the AC source.
   - Diodes D1 and D2 are reverse-biased and do not conduct.
4. Output: The output voltage across the load resistor is always in the same direction, providing a pulsating DC voltage.
5. Smoothing: A capacitor is often connected across the output to smooth the pulsating DC voltage, resulting in a more stable DC output.

The bridge rectifier is widely used due to its efficiency in converting AC to DC and its ability to provide a full-wave rectification, which utilizes both halves of the AC cycle.

Q.