FIRST PRE-BOARD EXAMINATION || SET-05

CLASS-12

Subject-Physics (Theory)

Maximum Marks: 70 Marks Time Allowed: 3 hours

**Section-A**

| Q | Question | |
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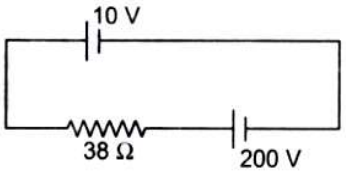
| 1 | Two point charges having equal charges separated by 1m distance experience a force of 8N. What will be the force experienced by them, if they are held in water, at the same distance? (Given : $K_{water} = 80$ )<br>(a) 1N (b) 10 N (c) 0.1N (d) 0.01N<br>**ANSWER**<br>Given: $K_W = \frac{F_{air}}{F_{water}} = 80 \quad (F_{air} = 8N)$<br>$F_{water} = \frac{F_{air}}{K_W} = \frac{8}{80} = \frac{1}{10} N$ | 1 |
| 2 | Name the physical quantity whose S.I. unit is $JC^{-1}$<br>(a) Electric field intensity (b)Electric Potential<br>(c) Electric flux (d) Electric dipole<br>**ANSWER - (b)** | 1 |
| 3 | A 10 V battery of negligible internal resistance is connected across a 200 V battery and a<br>  | 1 |

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| | resistance of 38 Ω as shown. The value of the current in the circuit is .(a) 5A (b) 5.52 A (c) 5.26 (d) 3.8A<br>**ANSWER-**<br>The net potential difference applied across the resistor=200V - 10V = 190 V<br>The resistance of the resistor=38 Ω<br>Hence current through the resistor = 190 /38 = 5 A | |
| 4 | Which of the following statement is not correct?<br>(a) Equipotential surfaces are closer in regions of strong field and farther in regions of weak field.<br>(b) Work is done in moving a test charge from one point to another over an equipotential surface.<br>(c) Electric field is always normal to the equipotential surface at every point.<br>(d) No two equipotential surfaces can intersect each other<br>**ANSWER- (c).** | 1 |
| 5 | Which of the following statement is not correct?<br>(a) Bi and Cu both are diamagnetic substances and Al is a paramagnetic substance.<br>(b) Intensity of magnetization increases with increase in temperature.<br>(c) The permeability of a diamagnetic magnetic material | 1 |

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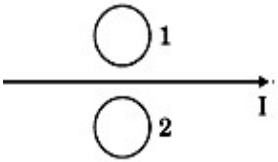
| | is less than one.<br>(d)Magnetic field lines forms a closed loop. | |
| 6 | The pole strength of a magnet is 40 Am. Calculate the magnetic intensity at a distance of 20cm.<br>(a)99.54Am$^2$ (b)49.54Am$^2$ (c)79.54Am$^2$ (d)89.54Am$^2$<br>Here, $d = 20cm = 1/5m, m = 40Am,$<br>$H = ?, B = ?$<br>$H = \frac{1}{4\pi}\frac{m}{d^2} = \frac{1 \times 7}{4 \times 22} \times \frac{40}{(1/5)^2} = 79 \cdot 54Am^{-1}$<br>$B = \mu_0 H = 4\pi \times 10^{-7} \times 79 \cdot 54 = 10^{-4}Wbm^{-2}$ | 1 |
| 7 | What is the direction of induced currents in metal rings 1 and 2 when current I in the wire is increasing steadily?<br>  <br><br>(a) Anticlockwise in loop 1, Clockwise in loop 2<br>(b) Clockwise in loop 1, Clockwise in loop 2<br>(c) Anticlockwise in loop 1, anticlockwise in loop 2<br>(d) Clockwise in loop 1, anticlockwise in loop 2<br>ANSWER- | 1 |

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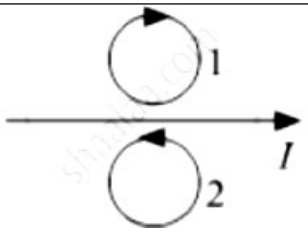
| |  <br>Using Lenz's Law we can predict the direction of induced current in both the loops. Induced current opposes the cause of increasing of magnefic flux. So, induced current will be clockwise in loop I and anticlockwise in loop 2. | |
| 8 | The power factor of an a.c. circuit is 0.5. What is the phase difference between the voltage and current in the circuit?<br>(a) $30^0$ (b) $60^0$ (c) $90^0$ (d) $45^0$<br>**ANSWER**- Power factor = $\cos\phi=0.5 \Rightarrow \phi=60^o$ Hence, the phase difference between voltage and current in the circuit is $\pi/3$ | 1 |
| 9 | A plane electromagnetic wave of frequency 25 MHz travels in free space along the x-direction. At a particular point in space and time, $\overrightarrow{E}$ = 6.3 $\hat{j}$ V/m. What is $\overrightarrow{B}$ at this point?<br>(a) 1.57 X $10^{-8}$ $\hat{k}$ Tesla (b) 2.1 X $10^{-8}$ $\hat{k}$ Tesla<br>(c) 1.59 X $10^{8}$ $\hat{k}$ Tesla (d) 2.1 X $10^{8}$ $\hat{k}$ Tesla<br>Answer- | 1 |

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| | The magnitude of B is given by<br>$B = \frac{E}{c} = \frac{6.3V/m}{3 \times 10^8 m/s} = 2.1 \times 10^{-8} T$<br>E is along Y-direction and the wave propagates along X-axis. Therefore, B should be in a direction perpendicular to both X and Y-axis. Using vector algebra. E $\times$ B should be along Z-direction. Since, $\left(+\hat{j}\right) \times \left(+\hat{k}\right) = \hat{i}$, B is along the Z-direction.<br>Thus, $B = 2.1 \times 10^{-8} \hat{k} T$ | |
| 10 | Which among the following is correct for magnification produced by a mirror?<br>(a) $\frac{f}{u+f}$ (b) $\frac{u-f}{u+f}$ (c) $\frac{f}{u-f}$ (d) $\frac{u}{u+f}$<br>We know magnification of spherical mirror $m = -\frac{v}{u}$<br>From mirror formula $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{u}{f} = \frac{u}{v} + \frac{u}{u} \Rightarrow \frac{u}{v} = \left(\frac{u}{f} - 1\right)$<br>$\Rightarrow \frac{u}{v} = \frac{u}{f} - 1 = \frac{u-f}{f} \Rightarrow \frac{v}{u} = \frac{f}{u-f} \Rightarrow m = -\frac{v}{u} = \left(\frac{f}{f-u}\right)$ | 1 |
| 11 | Find the false statement for the phenomenon of total internal reflection<br>(a) Light ray must travel from denser to a rarer medium.<br>(b) Angle of incidence must be greater than critical angle.<br>(c) The working principle of optical fibre is based on | 1 |

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| | total internal reflection.<br>(d) Critical angle for a material of refractive index $\sqrt{2}$ is $30^0$.<br>**Answer- (d)** | |
| 12 | Find the true statement.<br>(a) Displacement current and conduction current are never equal.<br>(b) The current that flows through connection wires is called conduction current.<br>(c) During charging of the capacitor, in the connection wires,conduction current is discontinuous and displacement current is continuous.<br>(d) During charging of the capacitor, in the gap between the capacitor plates, conduction current is continuous and displacement current is discontinuous.<br>**Answer- (b)** | 1 |
| 13 | When an electron orbiting in hydrogen atom in its ground state moves to third excited state, how the de-Broglie wavelength associated with it would be affected?<br>(a) will become four times (b) will become two times<br>(c) will become half (d) Will remain same | 1 |

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| | Answer-<br>The velocity of a electron in a hydrogen atom is given by the relation<br>$v_n = \frac{e^2}{2n\varepsilon_0 n}$ so $v_n \propto \frac{1}{n}$ ...(i)<br>and the de Broglie wavelength associated with it is $\lambda = \frac{h}{p} = \frac{h}{mv}$<br>So $\lambda \propto \frac{1}{v_n}$ ...(ii)<br>using equation (i) and (ii) $\lambda \propto n$<br>So when electron jump from n = to n = 4 level<br>$\frac{\lambda_1}{\lambda_2} = \frac{n_1}{n_2} = \frac{1}{4}$<br>$\lambda_2 = 4\lambda_1$ So the wavelength increases four times. | |
| 14 | Find the false statement<br>(a) The minimum frequency of incident radiation, below which photoelectric emission is not possible, is called cut off frequency or threshold frequency.<br>(b) Number of photons incident per unit area per second normal to the surface, is defined as the intensity of radiation.<br>(c) The minimum positive potential of anode at which photoelectric current becomes zero is called stopping potential.<br>(d) The minimum energy required to by an electron to just eject out from the metallic surface is called work function of that surface. | 1 |

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| | **Answer - (c)** | |
| 15 | An electron is accelerated through a potential difference of 100 Volts. To which part of the electromagnetic spectrum does this value of the de-Broglie wavelength associated corresponds?<br>(a) X-rays (b) Radio wave (c) Infrared (d) Microwave<br>$\lambda = \frac{h}{\sqrt{2meV}} = \frac{6{\cdot}63\times10^{-34}}{\sqrt{2\times9{\cdot}1\times10^{-31}\times1{\cdot}6\times10^{-19}\times100}}$ m<br>$= 1.227 \times 10^{-10}$m = 1.227Å<br>This wavelength corresponds to X-ray region of em spectrum. | 1 |

Q.No. 16 To 18

Two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes

(a), (b), (c) and (d) as given below.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true and R is NOT the correct explanation of A.

(c) A is true but R is false.

(d) A is false and R is also false.

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| 16 | Assertion (A) :The electron mobility decreases if temperature is increased. | 1 |

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| | Reason (R) : on increasing temperature relaxation time $\tau$ decreases.<br>**Answer- (a)** | |
| 17 | Assertion (A) : When monochromatic light travels from one medium to another, its wavelength changes but its frequency remains same.<br>Reason (R) :frequency is a characteristic of the source of waves .But wavelength is characteristic of medium.<br>**Answer - (a)** | 1 |
| 18 | Assertion (A) :Concave mirror is used in headlights of vehicles.<br>Reason(R) :When object Placed against concave mirror between optical centre and focus is virtual, erect and enlarge image is formed.<br>**Answer - (a)** | 1 |

**Section-B**

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| 19 | How will the (i) energy stored and (ii) the electric field inside the air capacitor be affected when it is completely filled with a dielectric material of dielectric constant K? | 2 |

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| | **Answer-**<br>The electric field between two charged plates of a capacitor is given by the relation $E = Q/A\varepsilon_o$.<br>i) The energy stored in a capacitor is $U = Q^2/2C$.<br>After the introduction of dielectric capacitance becomes $\mathbf{C'} = KC$.<br>So, the energy stored becomes $U' = Q^2/2\mathbf{C'} = Q^2/2KC$.<br>So, the energy decreases and becomes I/K times the original.<br>ii) With the introduction of a dielectric, the field now becomes $E = Q/A(K\varepsilon_o)$.<br>Hence, the field decreases and becomes K times by the introduction of a dielectric. | |
| 20 | An electric bulb is rated at 200V−100W. What is its resistance? Five such bulbs burn for four hours. What is the electrical energy consumed? Calculate the cost if the rate is 50 paisa per unit.<br>Answer-<br>We know that for an electric appliance $P = V^2/R$<br>Here P = 100 W V = 200 volts<br>Resistance will be given by $R = V^2/P = 200^2 / 100$<br>$R = 40000/100 = 400\ \Omega$ | 2 |

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| | Now, electric energy consumed will be E = P x t<br>Here t = 4hrs = 4 x 60 x60sec = 14400s<br>Energy = 100 x 14400J = 1440000J = $1.44 \times 10^6$J<br>Electrical energy consumed by each bulb in Unit<br>$1.44 \times 10^6$ J /$3.6 \times 10^6$J = 0.4 kWh (1kWh=$3.6 \times 10^6$J)<br>Electrical energy consumed by 5 bulbs = 5 x 0.4 = 2 kWh The total cost of electricity = 0.5 x 2 = Rs.1 | |
| 21 | Electromagnetic waves with wavelengths-<br>(i) $\lambda_1$ are used to treat muscular strain.<br>(ii) $\lambda_2$ are used by a F.M. radio station for broadcasting.<br>(iii) $\lambda_3$ are used to detect fractures in bones OR used as a diagnostic tool in medicine.<br>(iv) $\lambda_4$ are absorbed by ozone layer of the atmosphere.<br>Identify the name and part of electromagnetic spectrum to which these radiations belong.<br>Arrange these wavelengths in increasing order of magnitude.<br>Answer-<br>1. **Identify the wavelength for muscular strain ($\lambda_1$)**:<br>- **Use**: Muscular strain treatment.<br>- **Part of the Spectrum**: Infrared radiation.<br>- **Reasoning**: Infrared waves are commonly used in | 2 |

physiotherapy to treat muscular strains due to their ability to penetrate the skin and provide heat.

2. **Identify the wavelength for FM radio broadcasting ($\lambda_2$)**:
- **Use**: FM radio station broadcasting.
- **Part of the Spectrum**: Very High Frequency (VHF) radio waves.
- **Reasoning**: FM radio operates in the VHF range, which typically covers frequencies from 30 MHz to 300 MHz, corresponding to longer wavelengths.

3. **Identify the wavelength for detecting fractures in bones ($\lambda_3$)**:
- **Use**: Detecting fractures in bones.
- **Part of the Spectrum**: X-rays.
- **Reasoning**: X-rays are used in medical imaging to visualize the internal structure of bones and detect fractures.

4. **Identify the wavelength absorbed by the ozone layer ($\lambda_4$)**:
- **Use**: Absorbed by the ozone layer.
- **Part of the Spectrum**: Ultraviolet (UV) radiation.
- **Reasoning**: The ozone layer absorbs a significant portion of the Sun's harmful UV radiation, protecting living organisms on Earth.

5. **Arrange the wavelengths in decreasing order of magnitude**:
- The order of the parts of the electromagnetic spectrum from longest wavelength to shortest wavelength is:
- $\lambda_2$ (VHF radio waves) > $\lambda_1$ (Infrared radiation) > $\lambda_4$

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| | (Ultraviolet radiation) > $\lambda_3$ (X-rays).<br><br>**Final Arrangement:**<br>- $\lambda_2$ (VHF radio waves) > $\lambda_1$ (Infrared radiation) > $\lambda_4$ (Ultraviolet radiation) > $\lambda_3$ (X-rays) | |
| 22 | A series LCR circuit has L = 1mH, C = 0.1 μF and R = 10 Ω . It is connected across a source of alternating emf of 5V but of variable frequency. Find<br>(i) The frequency at which the impedance is minimum.<br>(ii) The current at resonance.<br>**Answer-**<br>$L\omega = \frac{1}{\omega C}; \omega^2 = \frac{1}{LC} = \frac{1}{10^{-3}\times 10^{-7}}$<br>$\omega = 10^5; f = \frac{10^5}{2\pi}$ Hz<br>$I = \frac{V}{R} = \frac{5}{10} = \frac{1}{2}$ A<br>OR<br>An emf of 2 V is induced in a coil when current in it is changed from 0 A to 10 A in 0.40 sec. Find the coefficient of self-inductance of the coil.<br>**Answer-**<br>Here, e = 2 V, dI = 10 – 0 = 10A, dt = 0.4s<br>we know, $e = L\frac{dI}{dt}$<br>$2 = L\frac{10}{0\cdot 4}$ or $L = \frac{2\times 0.4}{10} = 0\cdot 08$ henry | 2 |

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| 23 | A proton and an $\alpha$ – particle move perpendicular to a magnetic field. Find the ratio of radii of the circular paths described by them when both (i) have equal momenta, and (ii) were accelerated through the same potential difference.<br>**Answer-**<br>We know that $r = \frac{mv}{Bq}$<br>i. For equal momenta, $\frac{r_p}{r_\alpha} = \frac{q_\alpha}{q_p} = 2$<br>ii. Since $K.E. = \frac{p^2}{2m} = qV$ $\quad P = \sqrt{2mqV}$<br>$r = \frac{\sqrt{2qVm}}{Bq} = \sqrt{\frac{2mV}{qB^2}}$<br>$\frac{r_p}{r_\alpha} = \sqrt{\frac{m_p}{q_p}} \times \sqrt{\frac{q_\alpha}{m_\alpha}} = \sqrt{\frac{1}{4}} \times \sqrt{2} = \frac{1}{\sqrt{2}}$<br>OR<br>A solenoid 50cm long has 4 layers of windings of 350 turns each. The radius of the lowest layer is 1.4cm. If the current carried is 6 A estimate the magnitude of magnetic flux density<br>(i) near the centre of the solenoid on its axis. | 2 |

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| | (ii) near the ends on its axis.<br>(iii) outside the solenoid near its centre.<br>**Answer-**<br>Here, $l = 50cm = 0.50m$,<br>$r = 1.4cm = 1.4 \times 10^{-2}m$,<br>$I = 6.0A$,<br>No. of turns per unit length, $n = \frac{4 \times 350}{0.50} = 2800m^{-1}$<br>(i) The magnitude of $\vec{B}$ near the centre of solenoid on the axis is<br>$B = \mu_0 nI = 4\pi \times 10^{-7} \times 2800 \times 6.0 = 2.11 \times 10^{-2}T$<br>(ii) The magnitude of $\vec{B}$ near the end of solenoid on the axis is<br>$B = \frac{\mu_0 nI}{2} = \frac{2.11 \times 10^{-2}}{2} = 1.05 \times 10^{-2}T$<br>(iii) Outside the solenoid, the magnetic field is negligibly small as compared to that inside the solenoid. | |
| 24 | Sketch the wave front that will emerge from<br>**(i)** A distance source of light<br>(ii) A point source of light<br>(iii)A linear source of light<br>(iv) Emerging from convex lens | 2 |
| 25 | The work function for the following metals is given :<br>Na : 2.75 eV and Mo : 4.175 eV<br>(i) Which of these will not give photoelectron emission from a radiation of wavelength 3300 $A^0$ from a laser beam ?<br>(ii)What happens if the source of laser beam is brought | 2 |

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| | closer?<br>Here, the wavelength of radiation is $\lambda = 3300A^0 = 3300 \times 10^{-10}$<br>Therefore, the energy of a photon of the incident light,<br>$E = \frac{hc}{\lambda} = \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{3300 \times 10^{-10}}$<br>$\Rightarrow E = 6.018 \times 10^{-19}\ J = \frac{6.018 \times 10^{-19}}{1.6 \times 10^{-19}} = 3.76eV$<br>Since the frequency is directly proportional to the energy of the radiation,<br>It is found that the given incident energy is greater than $V_0$ of Na<br>but less than of Mo<br>Therefore, Mo will not give photoelectric emission.<br>If the laser is brought closer, intensity of radiation increases, but this does not affect the result regarding Mo<br>However, photoelectric current from Na will increase in proportion to intensity. | |

**Section-C**

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| 26 | Using Gauss's law, obtain the expression for electric field intensity at a point due to an infinitely large, plane sheet of charge of charge density $\sigma$ C/m$^2$. How is the field directed if the sheet is (i) positively charged (ii) negatively charged? | 3 |
| 27 | On the basis of electron drift, derive an expression for resistivity of a conductor in terms of number density of free electrons and relaxation time. | 3 |
| 28 | Derive an expression for the force per unit length between the two infinitely long straight parallel current carrying conductors. Hence define S.I. unit of current. | 3 |

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| 29 | Draw a schematic diagram of a reflecting telescope. State the advantages of reflecting telescope over refracting telescope.<br>OR<br>A biconvex lens made of transparent material of refractive index 1.5 and the radii of curvature of the faces of the double convex lens are 20 cm each<br>(i) Calculate the focal length of the lens.<br>(ii) What will be its new focal length when placed in a medium of refractive index 1.2 and 1.65 ? Will the lens behave a converging or diverging lens ? Give reason.<br>**Answer- (i)**<br>From Lens maker's formula,<br>$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$<br>$r_1 = 20cm, R_2 = -R_1 = -20cm$<br>$\therefore \frac{1}{f} = (1.5 - 1)\left(\frac{1}{20} + \frac{1}{20}\right) = 0.5\left(\frac{1}{10}\right)$ or $f = 20cm$<br>**(ii)**<br>$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$<br>$\frac{1}{f} = \left(\frac{\mu_m}{\mu_w} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$<br>$\frac{\mu_m}{\mu_w} = \frac{1.25}{1.33} = 0.98$<br>The value of $(\mu - 1)$ is negative and 'f' will be negative. So it will behave like diverging lens. | 3 |

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| | $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$<br>$\frac{1}{f} = \left(\frac{\mu_m}{\mu_w} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$<br>$\frac{\mu_m}{\mu_w} = \frac{1.65}{1.33} = 1.24$<br>The value of $(\mu - 1)$ is positive and 'f' will be positive . So it will behave like converging lens. | |
| 30 | (i) Plot a graph showing the variation of photoelectric current with intensity of light.<br>(ii) Show the variation of photocurrent with collector plate potential for different intensity but same frequency of incident radiation.<br>(iii) Show the variation of photocurrent with collector plate potential for different frequency but same intensity of incident radiation. | 3 |

**Section-D**

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| 31 | (i) Derive the expression for the potential energy of an electric dipole of dipole moment $\vec{p}$ placed in a uniform electric field $\vec{E}$.<br>(ii) Find out the orientation of the dipole when it is in<br>(a) Stable equilibrium (b) unstable equilibrium.<br>OR<br>State Kirchhoff's rules in electrostatics. Use Kirchhoff's rules to obtain conditions for the balanced condition in a | 5 |

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| | Wheatstone bridge. | |
| 32 | (a) State Biot-Savart law and express this law in vector form.<br>(b) Using Biot-Savart law, deduce the expression for the magnetic field at a point (x) on the axis of a circular current carrying loop of radius R. How is the direction of the magnetic field determined at this point ?<br>OR<br>With the help of a neat and labelled diagram, explain the principle and working of a moving coil galvanometer.<br>(i) What is the function of uniform radial field and how is it produced ?<br>(ii) Why is it necessary to introduce a cylindrical soft iron core inside the coil of a galvanometer ? | 5 |
| 33 | (a) Draw a ray diagram to show the refraction of light through a glass prism. Hence derive the relation<br>$$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin A/2}$$<br>(b) A ray of light passing from air through an equilateral glass prism undergoes minimum deviation when the angle of incidence is 3/4th of the angle of prism. Calculate the speed of light in the prism.<br>Answer - | 5 |

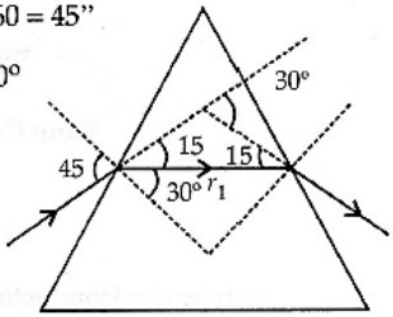
Angle of incident $i = \frac{3}{4}A = \frac{3}{4} \times 60 = 45°$

$r = 45 - 15 = 30°$

$\mu = \frac{\sin i}{\sin r} = \sqrt{2}$

$v = \frac{c}{\mu} = \frac{3 \times 10^8}{\sqrt{2}}$

$= 2.1 \times 10^8$ m/s




OR

(a)What are coherent sources of light? Why are coherent sources necessary to produce a sustained interference pattern?

(b) Explain Young's double slit experiment and write the conditions for constructive and destructive interference at a point on the screen.

(c) In the Young's double slit experiment, how does the fringe width get affected if the entire experimental apparatus is immersed in water ?

Answer-

On immersing the apparatus in a liquid(say water), the wavelength of light decreases.

That is :- $\lambda' = \frac{\lambda}{\mu}$ .....(1)

As fringe width is calculated by:- $\beta = \frac{\lambda D}{2d}$ .....(1)

Put value of $\lambda = \lambda'\mu$ in eq.(1):- Now:- $\beta' = \frac{\lambda}{\mu} \times \frac{D}{2d} = \beta/\mu$

That is fringe width decreases and hence becomes $\frac{1}{\mu}$ times of its value in air.

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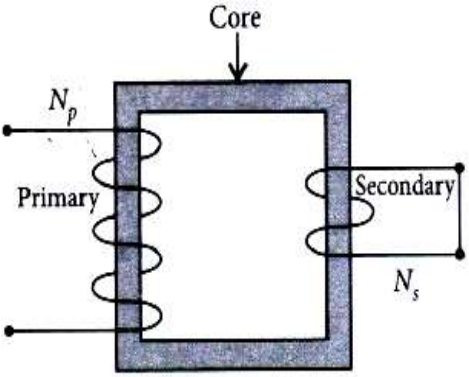
| 3 | **Case Study :Transformer** | 4 |
| 4 | **Read the following paragraph and answer the questions.**<br>A transformer is essentially an a.c. device. It cannot work on d.c. It changes alternating voltages or currents. It does not affect the frequency of a.c. It is based on the phenomenon of mutual induction.<br>  <br><br>A transformer essentially consists of two coils of insulated copper wire having different number of turns and wound on the same soft iron core. There are two types of transformer-Step up & Step down.<br>In step-up transformer $N_s > N_p$ and in Step-down transformer $N_s < N_p$.<br>Step-down transformers are used to decrease or step-down voltages. Step-up transformers are used to increase or step-up voltages.<br>For an ideal transformer, the resistances of the primary and secondary windings are negligible , efficiency is 100% and $E_s/E_p = I_p/I_s = N_s/N_p = k$(Transformation Ratio)<br>At electric power plant, step-up transformer is used which increase the voltage help us to supply the electric power for | |

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| | large distance without loss (or minimum loss) of energy.<br>At a small town the step-down transformer is used which lowered the voltage at suitable voltage for proper working of home appliances.<br>(i) Why transformer cannot work on DC Supply.<br>(ii) Calculate the value of transformation ratio for step-up transformer.<br>(iii) The number of turns in the primary and secondary coils of an ideal transformer are 2000 and 500 respectively. The primary coil is connected to a main supply of 120 V, Calculate the potential difference across each turn of the secondary coil .<br>**Answer-**<br>Given : $N_S = 4000$, $N_P = 2000$ and $V_P = 120$ volts<br>As we know that, $\frac{V_S}{V_P} = \frac{N_S}{N_P}$<br>$V_S = V_P \cdot \frac{N_S}{N_P} = \frac{4000}{2000} \times 120 = 240$ volts<br>$\therefore$ Potential difference across each turn $= \frac{240}{4000} = 0.06V$<br>OR (For option iii only)<br>(iii) At electric power plant, step-up transformer is used which increase the voltage help us to supply the electric power for large distance without loss of energy. Explain | |
| 3 | **Case Study :Diffraction of coherent laser light** | 4 |

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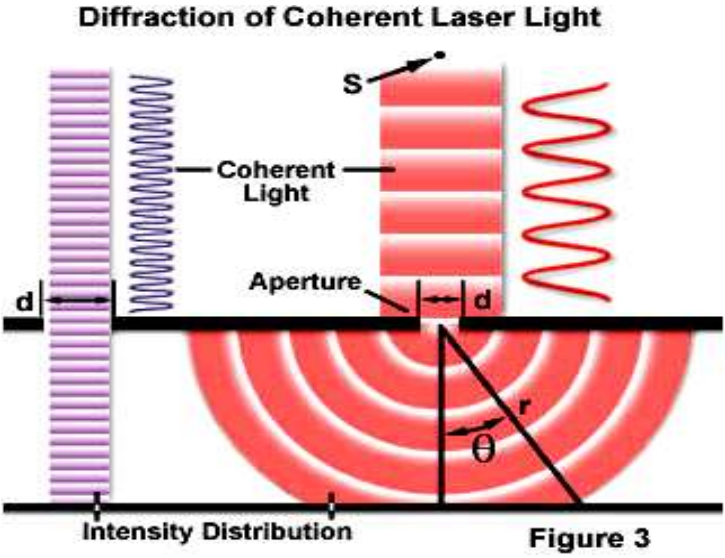
| 5 | **Read the following paragraph and answer the questions.**<br>When a light wave propagates through a slit(or aperture) the result depends upon the physical size of the aperture with respect to the wavelength of the incident beam. This is illustrated in Figure assuming a coherent, monochromatic wave emitted from point source S, similar to light that would be produced by a laser, passes through aperture d and is diffracted, with the primary incident light beam landing at point P & the first secondary maxima occurring at point Q.<br>  <br><br>Figure 3<br>As shown in the left side of the figure, when the wavelength (λ) is much smaller than the aperture width (d), the wave simply travels onward in a straight line, just as it would if it were a particle or no aperture were present. However, when the wavelength exceeds the size of the aperture, we experience diffraction of the light according to the equation: $\sin\theta = \lambda/d$<br>Where θ is the angle between the incident central propagation | |

direction and the first minimum of the diffraction pattern.

(i) State the essential condition for diffraction of light to occur.

(ii) Explain the cause of diffraction?

(iii) Single slit diffraction is completely immersed in water without changing any other parameter, is the width of the central maximum affected? Justify your answer.

Answer-

Wavelength of light in water $(\lambda' = \lambda/\mu)$ decreases,

so width of central maximum $(\beta_0 \propto \lambda)$ also decreases.

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OR (For option iii only)

(iii) How would the diffraction pattern due to a single slit be affected when the monochromatic source of light is replaced by white light.

**Answer-**

When white light is used instead of monochromatic light, then the central maximum remains white as all seven wavelengths meet there in the same phase. The first minimum and second maximum will be formed by violet color due to its shortest wavelength while the last is due to the red color as it has the longest wavelength.

Thus, a colored pattern is observed. However, after the first few colored bands, the clarity of the band is lost, due to overlapping.