APPLIED PHYSICS

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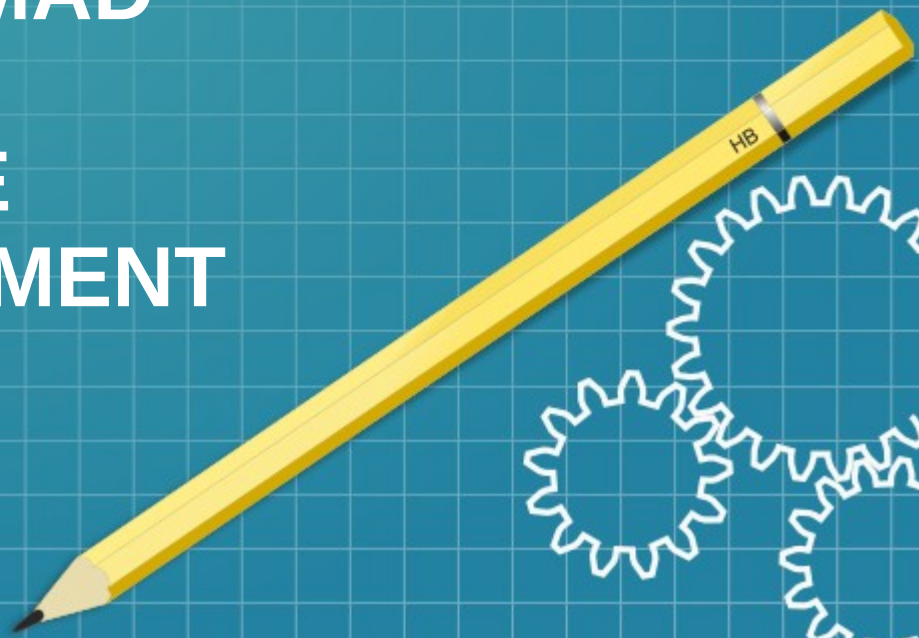
FINAL TERM ASSIGNMENT



Q1). A slit of width a is illuminated by white light.

A). For what value of a will the first minimum for red light of wave length $\lambda = 650$ nm appear at $\theta = 15°$?

Ans). At the first minimum, $m = 1$ in equation [$a \sin\theta = m\lambda$, for $m = 1, 2, 3....$] Solving for a, we then find

$a = m\lambda / \sin\theta$

$= (1)(650\text{nm}) / (\sin 15°)$

$= 2511$ nm.

$= 2.5\,\mu$m.

Therefore, the value of a the first minimum for red light of $\lambda = 650$ nm be at $\theta = 15°$ would be $2.5\,\mu$m. For the incident light to flare out that much ($\pm 15°$) the slit has to be very fine indeed, amounting to about four times the wave length. Note that a fine human hair may be about 100 μm in diameter.

B). What is the wave length λ' of the light whose first side diffraction maximum is at 15°, thus coinciding with the first minimum for the red light?

Ans). This maximum is about halfway between the first and second minima produced with wavelength λ'. We can find it without too much error by putting $m = 1.5$ in equation [$a \sin\theta = m\lambda$, for $m = 1, 2, 3, \ldots$] obtaining

$$a \sin\theta = 1.5\lambda'$$

Solving for λ' and Substituting known data given

$$\lambda' = a \sin\theta / 1.5$$
$$= (2511\text{nm})(\sin 15^\circ)/1.5$$
$$= 430\text{nm}$$

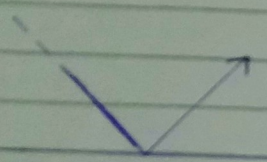
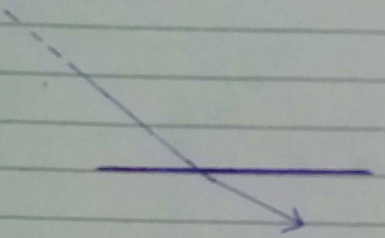
From the above observation we conclude that, the wavelength λ' of the whose first Side diffraction maximum is at 15° would be 430nm. light of this wavelength is violet. The first Side maximum for light of wavelength 430 nm will always Coincide with the first minimum for light of wavelength 650nm, no matter what the slit width. If the slit is relatively narrow, the angle θ at which this overlap occurs will be relatively large, and Conversly.

Q2).

a). What is the difference between reflection and refraction?

Ans). There is usually a misunderstanding that occurs when anybody heats the term Reflection and Refraction During Refraction, the incident ray enters the medium and the refracted ray is the ray that leaves out of the medium. Usually there is a particular angle at which the light enters the medium through which it needs to disperse and refract off of. Thus, this is the key difference between Reflection and Refraction.

Reflection	Refraction
1) This phenomenon usually occurs in mirrors.	This phenomenom usually occurs in lenses.
2). Reflection can simply be defined as the reflection of light when it strike the medium on a plane.	Refraction can be defined as the process of shift of light when it passes through a medium leading to the bending of light.
3). The light entering the medium returns backs in the same direction.	The light entering the medium travels from one medium to another.
4) Considering the light waves, they bounce from the plane and change direction	The light waves pass through the surface while simultaneously change from medium to medium.

Reflection	Refraction
5). The angle of incidence of the light is equal to the angle of Reflection.	The angle of incidence is not equal to the angle of reflection.
6). Figure 	Figure: 

Q2)

b). Explain the difference among angle of incident, angle of reflection ~~with~~ and angle of refraction with the help of formula and a single diagram?

Ans). Angle of incidence is the angle between the normal at the interface and incident ray.

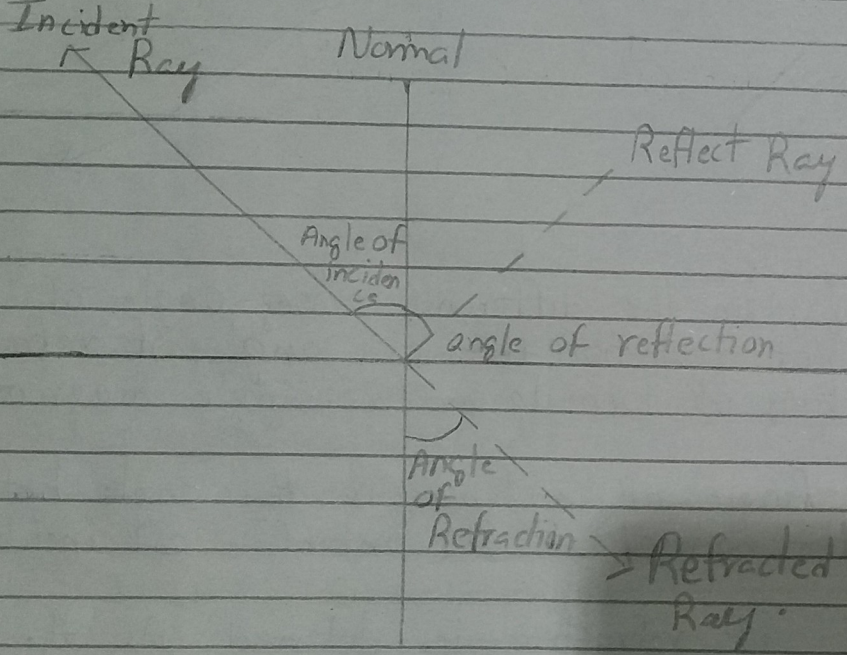
Angle of refraction is defined As the angle between the normal at the interface and refracted Ray.

Angle of Reflection is the reflected ray with a perpendicular to the reflecting surface.

The relationship between these angles are explained by Snell's law :-

$$n_i \sin(\theta_i) = n_r \sin(\theta_r)$$

where θ_i = angle of incidence.
θ_r = angle of refraction.



Q3). The long solenoid S shown (in cross section) in the following diagram has 220 turns/cm and carries a current $i = 1.5$ A; its diameter D is 3.2cm. At its center we place a 130 turn closely packed coil C of diameter $d = 2.1$ cm. The current in the solenoid is reduced to zero at a steady rate in 25ms. What is the magnitude of the emf that is induced in coil C while the current in the Solenoid is Charging?

Ans). The initial flux through Solenoid C is,

$$\Phi_{Bi} = BA_c = \mu_0 i n s A_c = \pi \mu_0 i n s r_c^2$$

Now we can write

$$\frac{d\Phi_B}{dt} = \frac{\Delta\Phi_B}{\Delta t} = \frac{\Phi_{Bf} - \Phi_{Bi}}{\Delta t}$$

$$= \frac{0 - \pi \mu_0 i n s r_c^2}{\Delta t} = -\frac{\pi \mu_0 i n s r_c^2}{\Delta t}$$

Subsituting gives

$$d\Phi_B = -\frac{\pi \left(4\pi \times 10^{-7}\ T \cdot \frac{m}{A}\right)(1.5\ A)}{25\ ms} \times \left(2200\ \frac{turn}{m}\right)(0.0105\ m)^2$$

$$= -5.76 \times 10^{-4}\ V.$$

The magnitude of the induced emf is then

$$\mathcal{E} = N\left|\frac{d\Phi_B}{dt}\right| = (130)(5.76 \times 10^{-4}\,V)$$

$$= 75\,mV.$$

Q4)

a). How to calculate the magnetic force on current carrying wire?

Calculate the force on the wire shown in figure A given B = 1.50 T, L = 5.00 cm and I = 20.0 A.

Strategy

The force can be found with the given information by using $F = IlB \sin\theta$ and nothing that the angle θ between I and B is 90°, so that $\sin\theta = 1$.

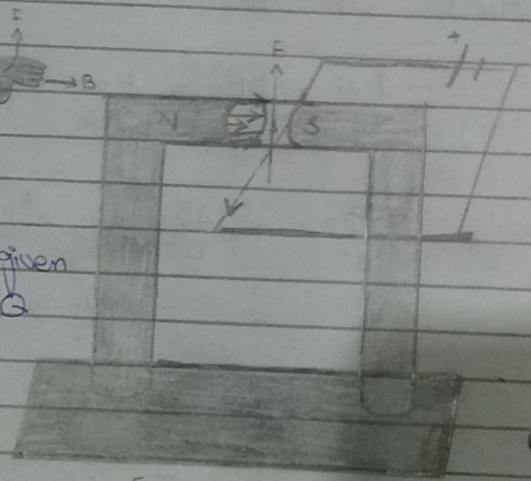


Figure A

Solution

Entering the given values into $F = IlB \sin\theta$ yields

$$F = IlB\sin\theta = (20.0\,A)(0.0500\,m)(1.50\,T)(1).$$

The units for tesla are $1\,T = \frac{N}{A \cdot m}$; thus,

$$F = 1.50\,N.$$

Discussion

The large magnetic field creates a significant force on a small length of wire.

Magnetic force on current-carrying conductors is used to convert electric energy to work. (Motors are a prime example — they employ loops of wire and are considered in the next section.) Magnetohydrodynamics (MHD) is the technical name given to a clever application where magnetic force pumps fluids without moving mechanical parts. (~~See figure 3.~~)

A strong magnetic field is applied across a tube and a current through the fluid at angles to the field, resulting in force on the parallel to the tube axis as shown. The absence of moving parts makes this attractive for moving a hot, chemically active substance such as the liquid sodium employed in some nuclear reactors. Experimental artificial hearts are testing with this technique for pumping blood, perhaps circumventing the adverse effects of mechanical pumps. (cell membranes, however, are affected by the large needed in MHD, delaying its practical application in humans.) MHD propulsion for nuclear submarines has been proposed, because it could be considerably quieter than conventional propeller drives.

Q4)

b). A straight, horizontal length of copper wire has a current $i = 28$ A through it. What are the magnitude and

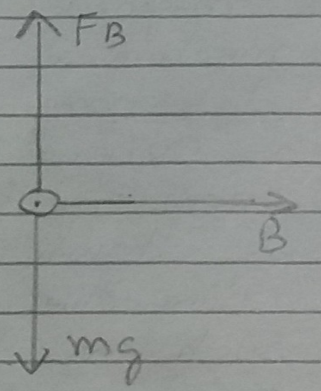
direction of the minimum magnetic field B needed to suspend the wire, that is, balance the gravitational force on it? The linear density (mass per unit length) of the wire is 46.6 g/m.

Ans). Current, $i = 28A$

mass per unit length, $m/l = 46.6\ g/m = 0.0466\ kg/m$

let the magnetic field is B.

the weight of the wire is balanced by the magnetic force.



$mg = ilB$

$B = mgl/il$

$B = (m/l) \times g/i$

$B = 0.0466 \times 9.8/28$

$B = 0.01631\ T$

Thus, the magnetic field is 0.01631T.

Q5)

a). What is the difference between Resistance and Resistivity?

A). Resistance	Resistivity
1). Resistance is the physical property of a substance because of which it opposes the flow of current i.e electrons.	Resistivity is the physical property of a particular substance which is having particular dimensions.

2). Resistance is directly proportional to the length and temperature while it is inverse proportional to the cross sectional area of the material

Resistivity is only proportional to the nature and temperature of the particular material.

3). Symbol of Resistance is 'R'.

Symbol of Resitivity is "ρ"

4). Formula, $R = V/I$ or, $R = \rho(L/A)$

Formula, $\rho = (R \times A)/L$

voltage = V, Current = I, Restivity = ρ

R = Resistance, L = length, A = Cross-Sectional area

5). The SI unit of resistance is Ohms.

The SI unit of resistivity is Ohms-meter.

Q5)

a).

Ans): Cross-Sectional area of rectangular block is square.

$S = 1.2 \times 1.2\ cm^3 = 1.44 \times 10^{-4}\ m^2$

Li, 5cm so $L = 0.15m$

So $R = 19.6 \times 10^{-8} \left(\frac{0.15}{1.44 \times 10^{-4}}\right)$

$R = 1 \times 10^{-4}\ \Omega$

B).

Ans. Cross - Sectional area for rectangular block is rectangular

$S = 1.2 \times 15 cm^2 = 1.8 \times 10^{-3} m^2$

$L = 1.2 cm = 0.012 m$

$R = (9.6 \times 10^{-8}) \left(\frac{0.012}{1.8 \times 10^{-3}}\right)$

$R = 6.4 \times 10^{-7} \Omega$.