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paper:Applied physics

5B

a) $1.2\,cm \times 1.2\,cm = 1.44 \times 10^{-4}\,m^2$.

$R = \rho \frac{L}{A} = (9.68 \times 10^{-8}\,\Omega \cdot m)\frac{0.15\,m}{1.44 \times 10^{-4}\,m^2} = 100\,\mu\Omega$

b) $A = 1.2\,cm \times 1.5\,cm = 1.8 \times 10^{-4}\,m^2$

$R = \rho \frac{L}{A} = (9.68 \times 10^{-8}\,\Omega \cdot m)\frac{0.012\,m}{1.8 \times 10^{-3}\,m^2} = 0.65\,\mu\Omega$

Q5 PART A

| S.no | difference | Resistance | Resistivity |
| --- | --- | --- | --- |
| (1) | Definition | Resistance is the Physical property of a substance because of which it opposes the flow of current ie. electrons | Resistivity is the Physical property of a particular substance which is having particular dimensions |
| (2) | Proportionality | Resistance is directly proportional to the length and temperature while it is inversely proportional to the cross sectional area of the material | Resistivity is only proportional to the nature and temperature of the particular material |
| (3) | Symbol | R | ρ |
| (4) | Formula | R = V/I or R = ρ(l/A) V = voltage, I = current ρ = resistivity | ρ = RA/l R = Resistance, l = length, A = cross sectional area |
| (5) | SI unit | the SI units of resistance is ohm | the SI unit of resistivity is ohm meter |
| (6) | application | The property of resistance is used in several places like heater fuse sensors etc | Electrical resistivity measurement is used as a quality control test for calcareous soil. |

Q4B

Current $i = 28\,A$

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 magnetic force

$$mg = ilB$$

$$B = mg/il$$

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

$$B = 0.0466 \times 9.8/28$$

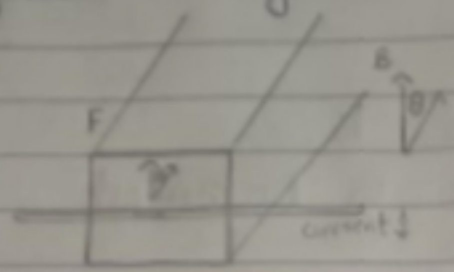
$$B = 0.01631\ T$$

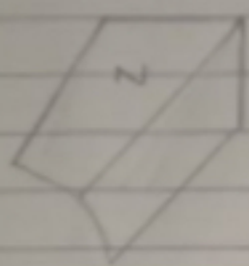
thus,
the magnetic field is 0.01631 T

Q4 (A)

# MAGNETIC FORCE ON A CURRENT-CARRYING WIRE

Positive charge moving through stationary wire in magnetic field




$F = ILB \sin\theta$

or $F = ILB$ if $\theta = 90$

This relationship arises from the basic magnetic force:

$$F = qvB \sin\theta$$

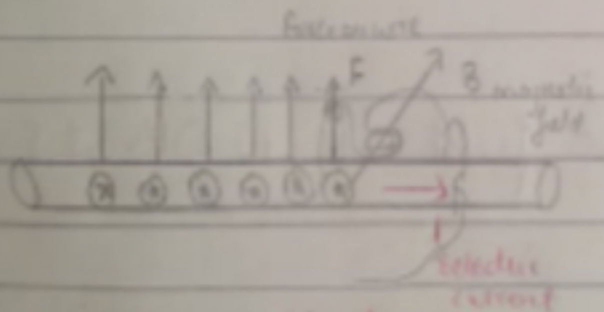
which for a charge q travelling length L in a wire can be written

$$F = q \frac{L}{t} B \sin\theta$$

$$F = \frac{q}{t} LB \sin\theta$$

$$F = ILB \sin\theta$$

The magnetic force on a current-carrying wire is perpendicular to both the wire and the magnetic field with direction given by the right hand rule




This depicts conventional current

Curl fingers as if rotating vector I into vector B. The thumb is then in the direction of the force F

$$\vec{F} = \vec{I} L \times \vec{B}$$

force on straight wire of length L

If the current is perpendicular to the magnetic field then the force is given by the simple product.

Q3 ~~Part~~ (A)

Ans, Solution

The initial flux through solenoid C is

$\Phi_{Bi} = B A_C = \mu_0 i n_s \pi r_C^2 = \pi \mu_0 i n_s r_C^2$

Now we can write

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

$$= \frac{0 - \pi \mu_0 i n_s r_C^2}{\Delta t} = -\frac{\pi \mu_0 i n_s r_C^2}{\Delta t}$$

Substituting gives

$$\frac{d\Phi_B}{dt} = -\frac{\pi (4\pi \times 10^{-7}\, T \cdot \frac{m}{A})(1.5 A)}{25 ms}$$

$$\times \left(2200 \frac{turns}{m}\right)(0.0105 m)^2$$

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

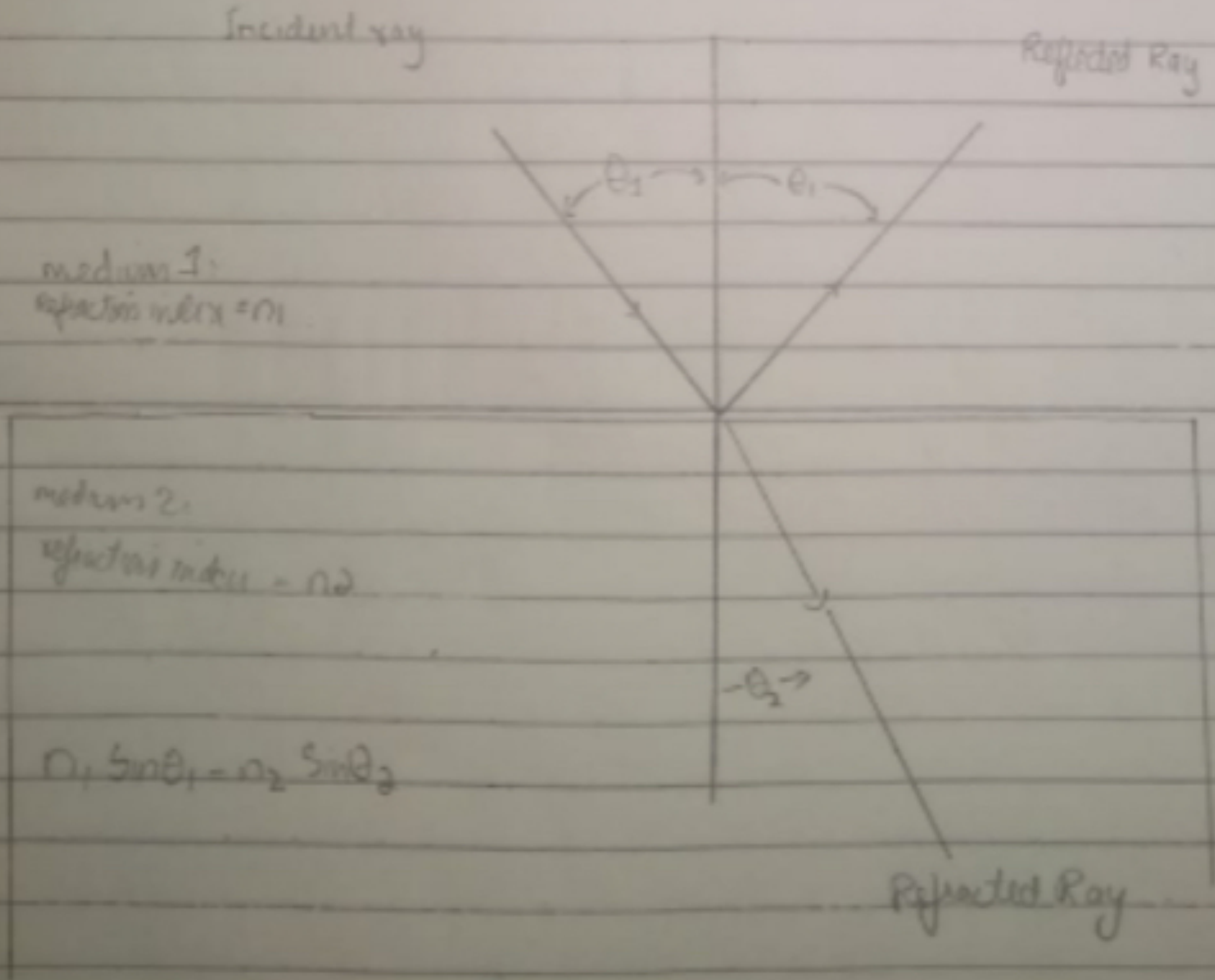
The magnitude of the induced emf is then

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

$$= 75 mV$$

Q2B

At the point incidence when the ray strikes the mirror, a line can be drawn perpendicular to the surface of the mirror. The angle between the incident ray and normal is known the ~~incident~~ angle of incidence. The angle between the reflected ray and the normal is known as the angle of reflection.
Also the relationship between the Angle of incidence and angle of refraction is explained by Snell's law. which states that ratio of the sin of angle of refraction and sin of the angle of incidence is always constant and equivalent to the ratio of phase velocities of two mediums.
So law of reflection is equal to angle of incidence through this law.



Q2 PART A

Solution

Ans (a)

Reflection

This phenomena usually occurs in mirrors

Reflection can simply be defined as the reflection of light when it strikes the medium on a plane

The light entering the medium returns back in same direction

considering the light waves, they bounce from the plane and change direction

The angle of incidence of the light is equal to the angle of reflection.

Refraction

This ~~refraction~~ phenomena usually occurs in lenses

Refraction can be defined as the process of shift of light when it passes through a medium leading of the bending of light

The light entering the medium travels from one medium to another.

Q1

(b) PART B

Solution:

Ans(b)

This maximum is about half way between the first and second minima produced with wavelenght λ we can find it without to much error by putting mλ for m = 1,2,3...7 obtaining

$a \sin\theta = 1.5\lambda$

Solving for λ and substituting known data give

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

$= (2511\,nm)(\sin 15^{\circ}) / 1.5$

$= 430\,nm$

From the above observation, we conclude that, the wavelenght λ of the light whose first side diffraction maximum for light of wavelenght 430nm will always concide with the first minimum for light of wavelenght 650 nm no matter what the slit is realitive narrow the angle θ at which this overlap occurs will be realtively large and conversely.

Q1 (Part A)

Solution

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

$= (1)(650\text{nm})/(\sin 15°)$

$= 2511\text{nm}$

$= 2.5\,\mu\text{m}$

Therefore The value of a the first minum 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 wavelenght note that a fine human hair may be about 100 $\mu m$ in diameter