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Set B

1) When torque acting upon a system is Zero, which of the following will be constant?

a) Force
b) linear Momentum
c) Angular Momentum
d) Impulse

2) A hole is bored in the earth along its diameter, when a ball is dropped from its one end,

a) It remains stationary
b) It moves and stops at its center
c) It exhibits SHM
d) It comes out from the other end

3) In the surface tension of a soap solution T, What is the workdone in blooming a soap bubble of radius r?

a) $\pi r^2 T$
b) $2\pi r^2 T$
c) $4\pi r^2 T$
d) $8\pi r^2 T$.

4) A carnot's cycle obtains

a) Two isothermal processes only
b) Two adiabatic process only.
c) Two isothermal process & two adiabatic process
d) Two isothermal process and two isobaric process.

5) First law of thermodynamics is the law of conservation of.

a) Mass
b) energy
c) momentum
d) heat.

6) Light waves are transverse because they.

a) get reflected
b) get refracted
c) get polarized
d) composition & surface area.

7) Speed of sound depends on

a) Temperature & pressure
b) surface area & volume
c) Temperature & composition
d) Composition and surface area

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8) Three charge particles H^+, He^+ and O^+ moving with same energy enter normally in a uniform magnetic field. Then,

a) H^+ deflects most
b) H^+ & He^+ deflects equally
c) He^+ deflects least
d) all deflects equally

9) The cold junction of a thermocouple is maintained at 10°C. No thermas is developed when the junction is maintained at 530°C then the neutral temperature is.

a) 520°c
b) 540°C
c) 270°C
d) 265°C

10) Current in the LCR circuit becomes extremely large when

a) frequency of AC supplies is increased.
b) frequency of AC supplies is decreased.
c) Inductive reactance becomes equal to capacitive reactance.
d) Inductance becomes equal to capacitance

11) Momentum of a photon of wavelength λ is.

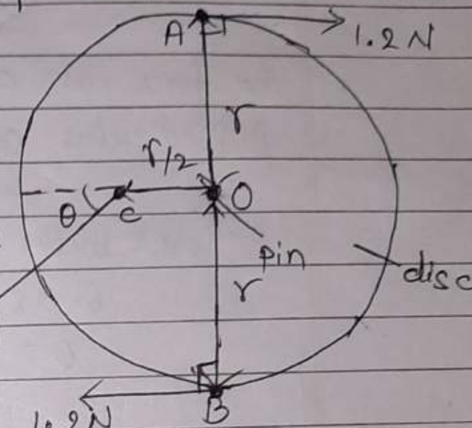
a) $h\lambda$
b) h/λ
c) λ/h
d) $h/c\lambda$

Group B.

1 a) Define the torque of a couple.

Ans. Torque of a couple is defined as two equal and opposite parallel force having different line of action such that their line of action do not coincide.

b) A thin disc of radius r is supported at its center O by a pin. The disc is supported so that it is vertical. Three force act in the plane of disc, as shown in the fig.



Two horizontal and opposite forces, each of magnitude 1.2 N act at points A and B on the edge of disc. A force of 6.0 N, at an angle θ below the horizontal, acts on the midpoint C of a radial line of the disc, as shown in fig. The disc has negligible weight and is in equilibrium.

1) state an Expression, in the terms of r, for the torque of the couple due to the forces at A and B acting on the disc.

11) Friction between the disc and the pin is negligible. Determine the angle θ.

111) State the magnitude of the force of the pin on the disc.

Soln

a) The moment of a force is defined as the product of force and perpendicular of line of action of the force to a point.

b)

1) Torque = force × Perpendicular distance betn 2 forces.

$= 1.2 \times 2r$

$\tau = 2.4r$

ii) Since the disc is in equilibrium, ~~anticlockwis~~
anticlockwise moment = clockwise moment
Clockwise moment (due to forces at A & B) $= (1.2 \times r) + (1.2 \times r)$
$= 2.4r$

The force at C acts at a distance $r/2$ from pin.
perpendicular component of force $= 6.0 \sin\theta$

Anticlockwise moment = clockwise moment
$6.0 \times r/2 \times \sin\theta = 2.4r$
$\theta = 53°$

iii) for equilibrium,
Resultant torque/moment $= 0$ (rotational equilibrium)
Resultant force $= 0$ (translational equilibrium)

The 1.2 N force cancel each other. So, we need another 6.0N force for equilibrium.
Force = 6.0N

Q 2a)

	Viscous force	Solid friction
i)	Viscocity is proportional to surface area.	i) Solid area is independent of area of solid surfaces in contact
ii)	Viscous force on the body depends ~~upo~~ upon its velocity in viscous media	ii) Surface ~~to~~ friction doesnot depend on the velocity of body

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Q.No 3

a) ⇒ We don't obtain 100% efficiency in carnot's engine. The ideal heat engine called carnot engine which works betn two temperature limits T_1 & T_2, where T_1 is tempr of source & T_2 is tempr of sink. The efficiency of engine is given by

$$\eta = \left(1 - \frac{Q_2}{Q_1}\right) \times 100\%$$

for carnot engine, $\frac{Q_2}{T_2} = \frac{Q_1}{T_1} \Rightarrow \frac{Q_2}{Q_1} = \frac{T_2}{T_1}$

$$\eta = \left(1 - \frac{T_2}{T_1}\right) \times 100\%$$

for effiency, to be 100%, the low tempr reservoir (sink) should be at absolute zero tempr but it is impossible to ~~have~~ have cold reservoir at absolute ~~temp~~ zero. Hence efficiency of engine is always less than 100%.

b) ⇒ Soln

Initial efficiency (η) = 50% = 0.5

Tempr of sink (T_2) = 9°C = 9 + 273 = 282 K.

final efficiency (η') = 70% = 0.7.

Tempr of source to be increased (ΔT) = ?

Now we have,

$$\eta = 1 - \frac{T_2}{T_1}$$

$$0.5 = 1 - \frac{282}{T_1}$$

$$\cancel{T_1 = 282}$$

$$\frac{282}{T_1} = 1 - 0.5$$

$$T_1 = \frac{282}{1-0.5} = 564\ K$$

Again

$$\eta' = 1 - T_2/T_1'$$

$$0.7 = 1 - 282/T_1'$$

$$\frac{282}{T_1'} = 1 - 0.7$$

$$T_1' = \frac{282}{1-0.7} = 940\ K$$

Tempr of source to be increased.

$$\Delta T = T_1' - T_1$$

$$= 940 - 564 = 376\ K$$

103°C

OR

a ⇒ Isothermal process is the process in which pressure & volume of a system change without any change in temperature.

Here T = constant

$\therefore\ PV = nRT$ = constant

PV = constant

$P \propto \frac{1}{V}$

$P_1V_1 = P_2V_2$.

Applying 1st law of thermodynamics.

$dQ = dU + dW$.

Here ~~dQ =~~ $dU = 0$

So, $dQ = dW$

All the supplied heat goes to external work.

⇒ Workdone in Isothermal process

$dW = PdV$ —— (1)

for n mole of ideal gas.

$PV = nRT$

$P = \frac{nRT}{V}$

$dW = \frac{nRT}{V} dV$ ∵ from (1)

Total workdone in expanding from V_1 to V_2 is,

$$W = nRT \int_{V_1}^{V_2} \frac{dV}{V}$$

$$= nRT \left[\log_e V\right]_{V_1}^{V_2}$$

$$nRT\left[\log_e V_2 - \log_e V_1\right]$$

$$nRT \log_e\left(\frac{V_2}{V_1}\right)$$

from $P_1V_1 = P_2V_2$

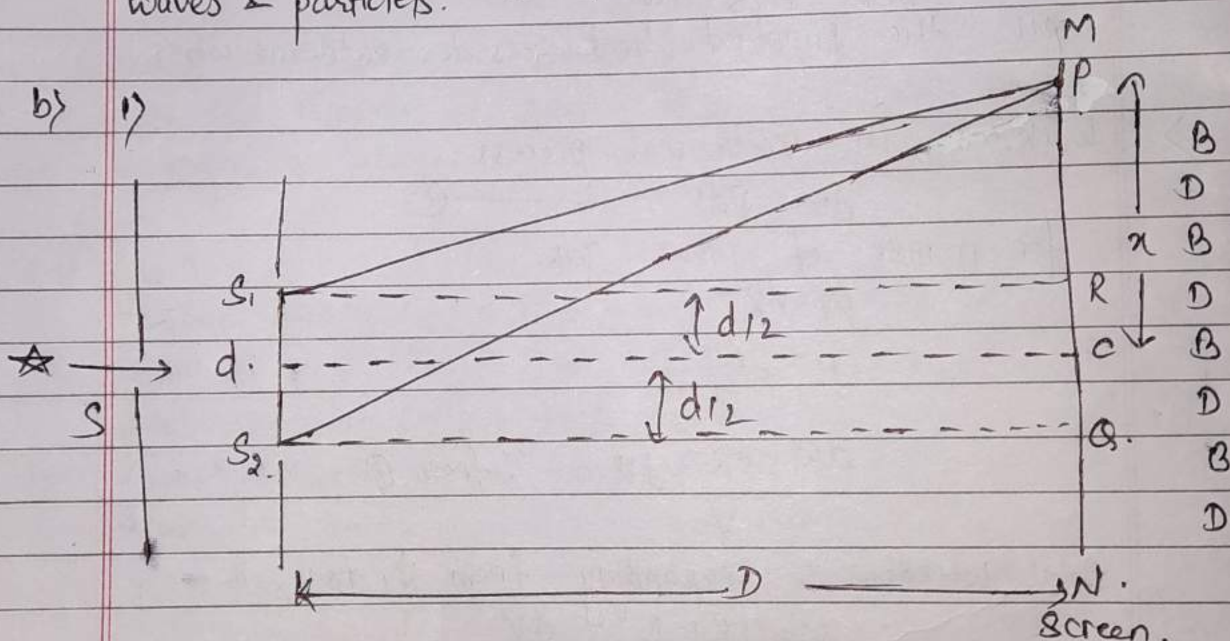
$\frac{V_2}{V_1} = \frac{P_1}{P_2}$

$W = nRT \log_e\left(\frac{P_1}{P_2}\right)$ is required expression.

~~Q No 4 a) Young's Double slit experiment gave~~ is ~~a definitive proof of the wave character of light.~~

Q No 4 a) Young's Double slit experiment is a demonstration that light & matter can display characterists of both classically defined waves & particles.

b) i)



Let us consider S be the monochromatic light. S_1 & S_2 are two slits which act as the coherent sources, d be the distance between them. Let D be the distance ~~between~~ of the screen from double slits, C be the central point on the screen, which is equidistance from S_1 & S_2. A bright fringe of maximum intensity is observed at C because path difference of wave reaching at C from S_1 & S_2 is zero. From central bright fringes, alternative dark fringes of equal ~~which~~ width are formed on either side of it.

Let us consider a point P on the screen at a distance x from C. If y be the path difference between the light waves reaching the point P from the sources S_1 & S_2, then

$$\text{path difference} = y = S_2P - S_1P \quad \text{——— (i)}.$$

From geometry, In ΔS_2PQ

$$(S_2P)^2 = (S_2Q)^2 + (PQ)^2$$

$$\cancel{D^2} = = D^2 + (x + d/2)^2.$$

Again In ΔS_1PR.

$$(S_1P)^2 = (S_1R)^2 + (PR)^2.$$

$$= D^2 + (x - d/2)^2.$$

Now.

$$(S_2P)^2 - (S_1P)^2 = \cancel{D^2} + (x + d/2)^2 - \cancel{D^2} - (x - d/2)^2$$

$$= \cancel{x^2} + xd + \cancel{\frac{d^2}{4}} - \cancel{x^2} + xd - \cancel{\frac{d^2}{4}}$$

$$= 2xd.$$

$$\therefore (S_2P)^2 - (S_1P)^2 = 2xd.$$

$$(S_2P + S_1P)(S_2P - S_1P) = 2xd.$$

$$S_2P - S_1P = \frac{2xd}{S_2P + S_1P}$$

$$y = \frac{2xd}{S_2P + S_1P}. \qquad (\because \text{from (i)})$$

In Practice, point P is very close to C & d is very small, therefore

$$S_2P \approx S_1P \approx D.$$

Thus path difference $(y) = \dfrac{2xd}{2D} = \dfrac{xd}{D}$ ——— (ii).

We have path difference $(\phi) = \dfrac{2\pi}{\lambda} \times$ path diff.

$$= \frac{2\pi}{\lambda} \cdot \frac{xd}{D} \quad \text{——— (iii)}.$$

Case 1: Position of bright fringes (constructive interference)

For bright fringe at P, path difference must be an integral multiple of wavelength (λ)

$\therefore$ path diff $(y) = n\lambda$ for $n = 0, 1, 2, 3 \ldots$

$$\frac{xd}{D} = n\lambda$$

$$x_n = \frac{n\lambda D}{d} \quad \text{for } n = 0, 1, 2, 3 \ldots$$

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(B) distance of various bright fringes from c can be calculated as

for $n = 0$: $x_0 = 0$ central bright fringe.

for $n = 1$ $x_1 = \frac{\lambda D}{d}$ first bright fringe

for $n = 2$ $x_2 = \frac{2\lambda D}{d}$ second bright fringe.

Similarly for $n = n$ $x_n = \frac{n\lambda D}{d}$; n^{th} bright fringe.

distance betn two consecutive bright fringe $(\beta) = \frac{2\lambda D}{d} - \frac{\lambda D}{d}$

$$= \frac{2\lambda D - \lambda D}{d}$$

$$\beta = \frac{\lambda D}{d}$$

Case II Position of dark fringes.

For dark fringes at P, path difference must be odd integral multiple of half wavelength (λ)

path diff $(y) = \frac{(2n+1)\lambda}{2}$ for $n = 0, 1, 2, \ldots$

$$\frac{xd}{D} = \frac{(2n+1)\lambda}{2}$$

$$x_n = \frac{(2n+1)\lambda D}{2d} \quad \text{for } n = 0, 1, 2, 3 \ldots$$

distance betn various dark fringes can be calculated as.

for $n = 1$, $x_1 = \frac{3\lambda D}{2d}$ second dark fringe

for $n = 2$ $x_2 = \frac{5\lambda D}{2d}$, third dark fringe.

for $n = n$ $x_n = \frac{(2n+1)\lambda D}{d}$ for n^{th} dark fringe.

distance betn two consecutive dark fringes $(\beta) = \frac{\lambda D}{d}$.

Hence bright & Dark fringes are equally spaced

11) If the Young's double slit ~~is~~ experiment is performed in water the effect on fringe width will be narrower. The wavelength of light is less in water than in air

Hence the fringe width will ~~increase~~ decrease. The interference pattern will be observed, but the fringes will be narrower.

Q5 No 5

a) Wattless current is the current through pure L or pure C which consumes no power.

b) Soln

$$I_{peak} = 14\,A$$

$$I_{rms} = \frac{I_{peak}}{\sqrt{2}}$$

$$= \frac{14}{\sqrt{2}} = 9.899\,A$$

c) Soln

Alternating current $I = I_0 \sin \omega t$

Where $\omega = 2\pi f = 2\pi \times 50 = 100\pi$.

for

$$I = I_{rms} = \frac{I_0}{\sqrt{2}}$$

We get $\frac{I_0}{\sqrt{2}} = I_0 \sin \omega t$

$$\text{or, } \sin \omega t = \frac{1}{\sqrt{2}}.$$

$$\omega t = \frac{\pi}{4}.$$

$$100\cancel{\pi} \times t = \frac{\cancel{\pi}}{4}.$$

$$t = \frac{1}{400} \text{ secs}.$$

7 a) ⇒ Ratio of charge of an electron to its mass is called specific charge of an electron
Yes its value is a universal constant for an electron.

b) ⇒ Cathode rays are the stream of electrons. The mass and charge of electrons are ~~different~~ constant. & hence the specific charge (e/m) of cathode rays is constant. But positive rays are the stream of positive ions. Masses of positive ions are different for different substance. Hence the value of e/m is not constant for +ve ions.

c) soln

Kinetic energy gained by an electron = workdone on it

$$\frac{1}{2}mv^2 = eV$$

$$\frac{e}{m} = \frac{v^2}{2V} \quad \text{——— (1)}$$

For electron to be in a circular path,

$$Bev = \frac{mv^2}{r}$$

$$Be = \frac{mv}{r}$$

$$v = B \times \frac{e}{m} r$$

Substituting the value of v in eqn (1).

$$\frac{e}{m} = \frac{1}{2V} \cdot B^2 \left(\frac{e}{m}\right)^2 r^2$$

$$1 = \frac{1}{2V} B^2 \left(\frac{e}{m}\right) r^2$$

$$\frac{e}{m} = \frac{2V}{B^2 r^2} = \frac{2 \times 3600}{(2 \times 10^{-3})^2 \times (0.1)^2} = 1.8 \times 10^{11} \text{ C/kg}$$

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8 a ⇒ i) Potential barrier is the potential difference across the junction of a diode which stops the flow of electrons and holes across the junction.

ii)

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Group C

9 a)

b) Soln

Let us consider a sound wave travelling through the medium whose displacement is given by, $y = a\sin(\omega t - kx)$.

The velocity of particle is given by.

$$v = \frac{dy}{dx} = a\omega\cos(\omega t - kx)$$

The KE per unit volume is given by.

$$\frac{KE}{V} = \frac{1}{2V} m v^2$$

$$= \frac{1}{2V} m a^2 \omega^2 \cos(\omega t - kx)$$

$$= \frac{1}{2} \rho a^2 \omega^2 \cos^2(\omega t - kx)$$

when $\cos(\omega t - kx) = 1$

$$\frac{KE_{max}}{V} = \frac{1}{2} \rho a^2 \omega^2.$$

The maximum KE per unit volume is called energy density & is given by,

$$\text{Energy density } (U) = \frac{1}{2} \rho a^2 \omega^2$$

Energy $(E) = U \times V$

$= \frac{1}{2}\rho a^2 \omega^2 V$.

If A be the cross sectional area, dx be length & t be time then

$$\text{Power}(P) = \frac{E}{t}$$

$$= \frac{1}{2}\frac{\rho a^2\omega^2 A \cdot dx}{t}$$

$$= \frac{1}{2}\rho a^2\omega^2 A v$$

The intensity is defined as energy per unit area per unit time

$$I = \frac{P}{A}$$

$$I = \frac{1}{2}\rho a^2\omega^2 v \quad \text{——— (i)}$$

We know

$$\omega = 2\pi f$$

$$I = \frac{1}{\cancel{2}}\rho a^2 \cancel{4}^{2}\pi^2 f^2 v$$

$$I = 2\rho a^2\pi^2 f^2 v$$

$$I = 2\rho\pi^2 f^2 v \cdot a^2$$

Hence $I \propto a^2$.

$\therefore$ Intensity of sound is directly proportional to square of amplitude.

8 c) Soln

Here $r_1 = 30\,cm \quad r_2 = 1.5\,m$.

Now $B_1 = 10\log\left(\frac{I_1}{I_0}\right) \quad B_2 = 10\log\left(\frac{I_2}{I_0}\right)$

$$B_1 - B_2 = 10\log\left(\frac{I_1}{I_0}\right) - 10\log\left(\frac{I_2}{I_0}\right)$$

$$= 10\log\frac{I_2}{I_1}$$

But

$$\frac{I_1}{I_2} = \frac{r_2^2}{r_1^2}$$

then,

$$B_1 - B_2 = 10 \log\left(\frac{r_2^2}{r_1^2}\right)$$

$$= 10 \log\left(\frac{r_2}{r_1}\right)^2$$

$$= 20 \log\left(\frac{1.5}{0.3}\right)$$

$$= \cancel{20 \log} = 13.97 \text{ dB}$$

OR,

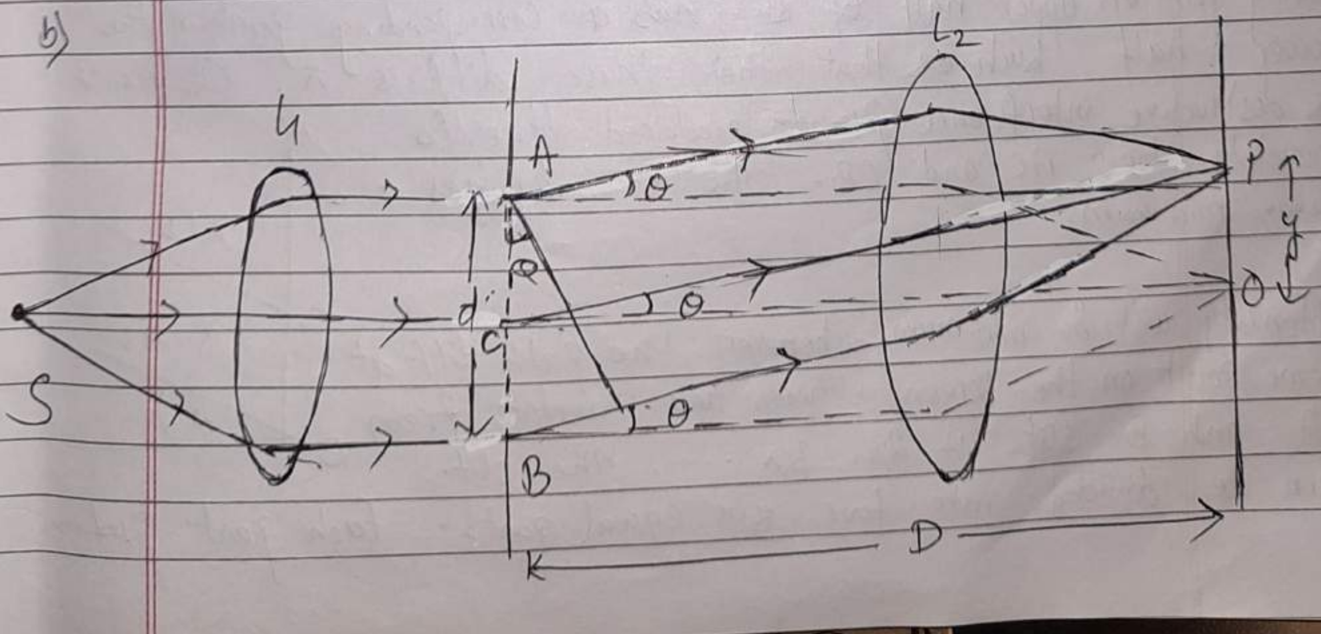
a) The phenomenon of spreading of light when it is passed through small openings or obstacles is known as diffraction of light.

Types of diffraction pattern are.

i) Frenel diffraction : When the source of light lies at finite distance from the aperture or obstacle, the wavefronts are spherical and pattern is quite complex. This type of diffraction is called the Frensel diffraction

ii) Fraunhofer diffraction : When both the source and screen are placed at a greater distance from the aperture or obstacles the incident light is plane waves and rays leaving the opening are parallel. This is called the Fraunhofer ~~di~~ diffraction

b)



Consider that a monochromatic source of light emitting light waves of wavelength λ is placed at principal focus of convex lens L_1. A parallel beam of light gets incident on a narrow slit AB of width d. The diffraction pattern is obtained on the screen lying at distance D from the slit at the focal plane of convex lens L_2. The diffraction pattern is found to have central maxima at center of the screen, which is followed on the sides by a ~~nob~~ number of dark & bright bands called secondary maxima & minima.

Central maximum: The wavelets which fall on the lens in a direction parallel to CO meet at point O in the same phase. Therefore, the wavelets reinforce each other and give rise to central maximum at O.

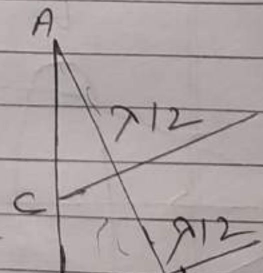
Position of widths of secondary maxima & minima.

Consider a point P on the screen at which wavelets travelling in a direction making angle θ with CO are brought to focus by lens. The wavelets from points A & B will have path difference equal to BN. from Δ ANB

$$BN = AB \sin\theta$$

$$\text{path diff } (BN) = d \sin\theta \qquad (1)$$

Suppose the path difference between the wavelet from A and B i.e BN is an integral multiple of λ. To simplify the consideration slit is divided into equal parts AC & BC. The path diff betn wavelets arising from points betn A & C and symmetrical points betn C & B is $\lambda/2$. Every point on upper half of slit has a corresponding point on the lower half such ~~as~~ that their phase diff is π. The result is destructive interference ~~provide~~ produced due to wavelets betn AC and CB. The intensity has a ~~min~~ minimum.



Intensity will be minimum whenever the path diff at some point on the screen between two wavelets from A and B slit is 2λ, 3λ ..... The slit can be divided into four six equal parts. Each part ~~produce~~

Produces a path diff of $\lambda/2$ which has a counterpart p. that produces destructive interference.

Hence path difference both wavelets from two extreme ends of the slit giving integral multiple of λ & results in dark band due to destructive interference.

This condition can be written as

$$d \sin\theta_n = n\lambda.$$

θ_n gives direction of n^{th} minima & n is integer.

$$\sin\theta_n = \frac{n\lambda}{d} \quad \text{--- (ii).}$$

In Δ OPC

$$\sin\theta_n = \frac{OP}{OC} = \frac{y_n}{OC} \quad \text{--- (iii).} \quad (\because y_n \rightarrow n^{th} \text{ minima from } O)$$

Equating (ii) & (iii).

$$\frac{y_n}{OC} = \frac{n\lambda}{d}.$$

Secondary minima,

$$y_n = \frac{OC \cdot n\lambda}{d} = \frac{n\lambda D}{d}.$$

for 1st minima. $n = 1$.

$$y_1 = \frac{1\lambda D}{d} = \frac{\lambda D}{d}.$$

Width of central ~~minim~~ maximum is distance betn first secondary minimum on either side of O thus the width of central maxima is given by.

$$B = 2y_1 = \frac{2\lambda D}{d}.$$

10

a) ⇒ The current developed is induced current.

b) ⇒ We can find the direction of induced current by flemming's right hand rule.
According to this rule, if three fingers of right hand, The thumb, the middle & the fore finger are stretched mutually perpendicular to each other such that the thumb points the direction of motion of conductor, forefinger points direction of magnetic field then direction of induced emf is given by middle finger.

c) Soln

We have $\phi = 4t^3 + 5t^2 + 8t^{-3} + 5$ wb.

$$\frac{d\phi}{dt} = 12t^2 + 10t - 24t^{-4}$$

$$= 12t^2 + 10t - \frac{24}{t^4}$$

Induced emf $E = \left|\frac{-d\phi}{dt}\right|_t$.

$$= \left|12t^2 + 10t - \frac{24}{t^4}\right|$$

at $t = 2$ sec,

$$= \left|12\times4 + 10\times2 - \frac{24}{16}\right|$$

$$= 66.5\ V$$

Again

$$|\varepsilon| = IR$$

$$I = \frac{|\varepsilon|}{R} = \frac{66.5}{31} = 21.45A$$

Induced current $I = 21.45\ A$

d ⇒ transformer works on the principle of mutual induction i.e emf induced in a coil when current changes in a neighbouring coil.

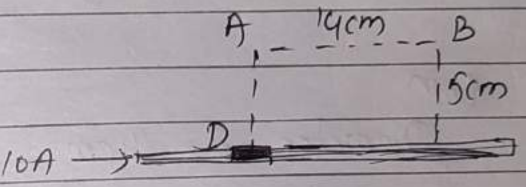
Two ideas to reduce loss of transformer are.

i)

ii)

OR,

a) Biot savarts law gives the magnetic field produced by a loop of any shape,
whereas Ampere's law is a simplified and convenient version for symmetrical wire & magnetic field configurations.



b) Soln

$I = 10A.$

$r = 5cm = 0.05\,m$

$dl = 1.1mm = 1.1\times10^{-3}\,m.$

Now.

i) magnetic field at A $(dB) = \dfrac{\mu_0}{4\pi}\dfrac{Idl\sin\theta}{r^2}$

$= \dfrac{4\pi\times10^{-11}}{4\pi}\times\dfrac{10\times1.1\times10^{-3}\times1}{(0.05)^2}$

$= 4.4\times10^{-11}\,T$

ii)

iii)

c) The radial magnetic field is applied to a moving coil galvanometer to produce a constant torque on the coil. It is applied to measure the relation between the current and the angle which is not linear such that the current cannot be measured easily. With the help of radial magnetic field, the angle betn the plane of the coil and magnetic field is is maintained zero in all the orientation of the coil

d Soln

Diameter $d = 14\,cm = 0.14\,m$

radius $= 0.07\,m$.

No of turns, $N = 600$

Current passed $I = 0.65\,A$.

Magnetic field $B = ?$

Now

$$B = \frac{\mu_0 N I}{2\pi r}$$

$$= \frac{4\pi \times 10^{-7} \times 600 \times 0.65}{2\pi \times 0.07}$$

$$= 1.11 \times 10^{-3}\ T$$

11)

a ⇒ De-Broglie equation is an equation used to describe the wave properties of matter ~~or~~ specially wave nature of electrons.

$$\lambda = h/mv$$

where, λ is wavelength, h is planks constant, m is mass of particles moving with velocity v. de Broglie suggested that particles can exhibit properties of waves.

b 1) ⇒ let us consider a photon of mass m moving with velocity c. According to Einstein's mass energy relation

$$E = mc^2 \quad \text{—— (i)}$$

According to quantum theory of radiation

$$E = \frac{hc}{\lambda} \quad \text{—— (ii)}$$

from (i) & (ii)

$$mc^2 = \frac{hc}{\lambda}$$

Since matter posses dual characteristics, $\lambda = h/mc$. for particle moving with velocity v is ~~given~~ to.

$$\lambda = \frac{h}{mv} \quad \text{—— (iv)}$$

from work energy theorem $eV = E$ —— (v)

$$eV = \frac{1}{2}mv^2$$

$$v^2 = \frac{2eV}{m}$$

$$v = \sqrt{\frac{2eV}{m}}$$

Now

$$\lambda = \frac{h}{mv} = \frac{h}{m\sqrt{\frac{2eV}{m}}} = \frac{h}{\sqrt{\frac{2eVm^2}{m}}} = \frac{h}{\sqrt{meV}}$$

We know ~~E~~ $= eV$ from V $E = eV$.

then $\lambda = \frac{h}{\sqrt{2mE}}$

c) ⇒ Soln

$V = 2.0\,kV = 2\times10^{3}\,V$.

We have

$$\lambda = \frac{h}{\sqrt{m e V \cdot 2}}$$

$$= \frac{6.625\times10^{-34}}{\sqrt{9.1\times10^{-31}\times1.6\times10^{-19}\times2\times10^{3}}}$$

$$= \cancel{2.19\times10^{-34}}\ m.$$

$$= 2.74\times10^{-11}$$

d.

OR

a ⇒ i) A radioactive substance is one, where atoms have unstable nuclei. The nuclei of radioactive substance emit α, β & γ rays.

ii) Decay constant is defined as the reciprocal of time when 37% of the atom is remaining b). Soln

Let N_0 be initial No of atoms in a radioactive substance of decay constant λ after time $T_{1/2}$ the No of atoms left behind is $N_0/2$ so

$$t = T_{1/2} \ \& \ N = N_0/2.$$

from

$$N = N_0 e^{-\lambda t}, \text{ we get,}$$

$$\text{or, } \cancel{N=} \frac{N_0}{2} = N_0 e^{-\lambda t}$$

$$\frac{1}{2} = e^{-\lambda T_{1/2}}.$$

$$2 = e^{\lambda T_{1/2}}$$

$$\ln 2 = \lambda T_{1/2}$$

$$T_{1/2} = \frac{0.0693}{\lambda}.$$

This is the relation betn half life & decay constant

c)