04

KAMMAVARI SANGHAM (R) - 1952

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#14, Raghuvanahalli, Kanakapura Road, Bengaluru - 560109

BLUE BOOK

Name of the student: Adithya.M (Roll No 4)

Sem / Section: I 'A' Branch: CSE

USN: 1 K S 2 2 C S 0 0 4

SUBJECT: Physics SUBJECT CODE : 22PHYS12

MAXIMUM MARKS

Test	I	II	III	Average Marks Obtained
Date	18/01/2023	01/03/2023	27/03/2023	(a) Test (60) 50
Marks Obtained	18	20	12	(b) Assignment (20) 20
Signature of Student				c ~~Activity~~ lab (20) 19
Initials of Faculty		Madhavi		Total (60+20) 70 | (30) 27
		Final Assessment		27+19 = 46

NAME OF FACULTY : Dr. Madhavi. S

SIGNATURE OF FACULTY Madhavi

SIGNATURE OF H.O.D.

K.S. INSTITUTE OF TECHNOLOGY

First Internal Test

Q.No	Marks		Q.No	Marks	CO	CO	Total
1 (a)	04	OR	2 (a)	—	CO1	CO1	[illegible]
1 (b)	04		2 (b)	—	CO1		
1 (c)	03		2 (c)	—	CO1	CO2	07
3 (a)	03		4 (a)	—	CO2		
3 (b)	04	OR	4 (b)	—	CO2		
						Grand Total	15

Second Internal Test

Q.No	Marks		Q.No	Marks	CO	CO	Total
1 (a)	04	OR	2 (a)	—	CO3	~~12~~ CO3	12
1 (b)	04		2 (b)	—	CO3		
1 (c)	04		2 (c)	—	CO3	~~08~~ CO2 CO4	08
3 (a)	04		4 (a)	—	CO2		
3 (b)	04	OR	4 (b)	—	CO4		
						Grand Total	20

Third Internal Test

Q.No	Marks		Q.No	Marks	CO	CO	Total
1 (a)	03	OR	2 (a)	—		CO5	04
1 (b)	01		2 (b)	—			
1 (c)	00		2 (c)	—		CO4	08
3 (a)	04		4 (a)	—			
3 (b)	04	OR	4 (b)	—			
						Grand Total	12

Assignment	A1 (10)		A2 (10)	Total
	10		10	10
~~Activity~~ lab	15	05	20	Total
	15	04	19	19

Madhavi

SIGNATURE OF FACULTY.

First Internals

Part - A

1a) LASER stands for Light Amplification by Stimulated emission of radiation. It's basic principle is interaction with matter.
It has 3 principles.

- Induced absorption: It is the absorption of energy by the lower energy atom levels to the excited state.

- ~~Stimul~~ Spontaneous emission: It is the spontaneous release of energy by the higher excited state to the ~~lower~~ ground state

- Stimulated emission: It is the release of energy when an excited atom is supplied with energy to yield 2 photons releasing the atom back to the ground state.

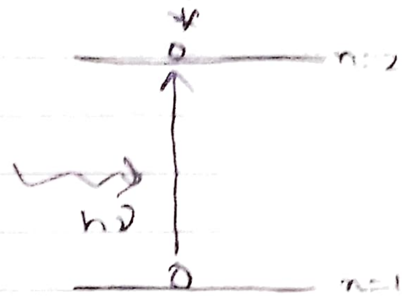
Case of Induced absorption

Atom + Photon $\longrightarrow$ Atom*

~~Rat~~

Rate of Induced absorption $\propto N_1 U_\nu$

$= B_{12} N_1 U_\nu \rightarrow (1)$

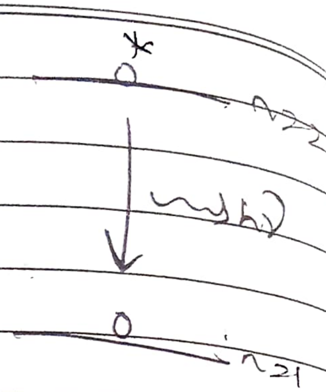


$N_1 \rightarrow$ no. of atoms in lower energy state

$U_\nu \rightarrow$ Energy density

$B_{12} \rightarrow$ Constant (transition from n=1 to n=2)

Case of Spontaneous emission:



$Atom^* \longrightarrow Atom + Photon$

Rate of Spontaneous emission $\propto N_2$

$$= A_{21} N_2 \rightarrow (2)$$

$N_2 \rightarrow$ No. of atoms in the higher energy state

$A_{21} \rightarrow$ constant (Transition from n=2 to n=1)

Case of Stimulated Emission:

$Atom^* + Photon \longrightarrow Atom +$ Incident photon + Stimulated photon

Rate of Stimulated emission $\propto N_2 U_\nu$

$$= B_{21} N_2 U_\nu \rightarrow (3)$$

$U_\nu \rightarrow$ energy density

$N_2 \rightarrow$ no. of atoms in the higher excited state

$B_{21} \rightarrow$ constant (Transition from n=2 to n=1)

ok

At Thermal equilibrium,

Rate of induced absorption = Rate of Spontaneous emission + Rate of Stimulated emission

From (1), (2), (3)

$$B_{12} N_1 U_\nu = A_{21} N_2 + B_{21} N_2 U_\nu$$

$$B_{12} N_1 U_\nu - B_{21} N_2 U_\nu = A_{21} N_2$$

$$U_\nu (B_{12} N_1 - B_{21} N_2) = A_{21} N_2$$

$$U_\nu = \frac{A_{21} N_2}{(B_{12} N_1 - B_{21} N_2)}$$

$$U_\nu = \frac{A_{21} \cancel{N_2}}{B_{21} \cancel{N_2} \left(\frac{B_{12} N_1}{B_{21} N_2} - 1 \right)} \rightarrow (4)$$

From Boltzmann's law, we have

$$\frac{N_2}{N_1} = e^{-h\nu/kt} \qquad \frac{N_1}{N_2} = e^{h\nu/kt} \rightarrow (5)$$

So, (5) in (4),

$$U_\nu = \frac{A_{21}}{B_{21} \left(\frac{B_{12}}{B_{21}} e^{h\nu/kt} - 1 \right)} \rightarrow (6)$$

From Planck's law, we have

$$U_\nu = \frac{8\pi h \nu^3}{c^3} \left[\frac{1}{e^{h\nu/kt} - 1} \right] \rightarrow (7)$$

Comparing (7) & (4), $\frac{A_{21}}{B_{21}} = \frac{8\pi h \nu^3}{c^3}$

Comparing (4) & (6), $\frac{A_{12}}{B_{21}} = 1$ $B_{12} = B_{21}$

$B = B$

(No need of subscripts)

$A_{21} = A$

Rewriting (4),

$$U_\nu = \frac{A}{B\left(\frac{\cancel{B}}{\cancel{B}} e^{h\nu/kt} - 1\right)}$$

$$U_\nu = \frac{A}{B\left(e^{h\nu/kt} - 1\right)}$$ → This is the required equation

A, B → Einstein's Coefficients
U_ν → Energy density
h → planck's constant
ν → frequency
k → Boltzmann constant $= 1.38 \times 10^{-23}$
t → Temperature

1 b) $T = 300K$ | $\lambda = 1 \times 10^{-6}\ m$ | $h = 6.63 \times 10^{-34}\ Js^{-1}$, $c = 3 \times 10^{8}\ ms^{-1}$ | $k = 1.38 \times 10^{-23}$

↑ given data

$$\frac{N_2}{N_1} = e^{-h\nu/kt}$$ (BOLTZMANN LAW)

$$\frac{N_2}{N_1} = e^{-hc/\lambda kt}$$

$$\frac{N_2}{N_1} = e^{\left[\frac{-6.6\times10^{-34}\times3\times10^{8}}{1\times10^{-6}\times1.38\times10^{-23}\times300}\right]}$$

to the power of

$$\frac{N_2}{N_1} = e^{\left(\frac{-19.89\times10^{-26}}{414\times10^{-29}}\right)}$$

$$\frac{N_2}{N_1} = e^{\left(10^{3}\times\frac{-19.89}{414}\right)}$$

$29-26$
$=\underline{3}$

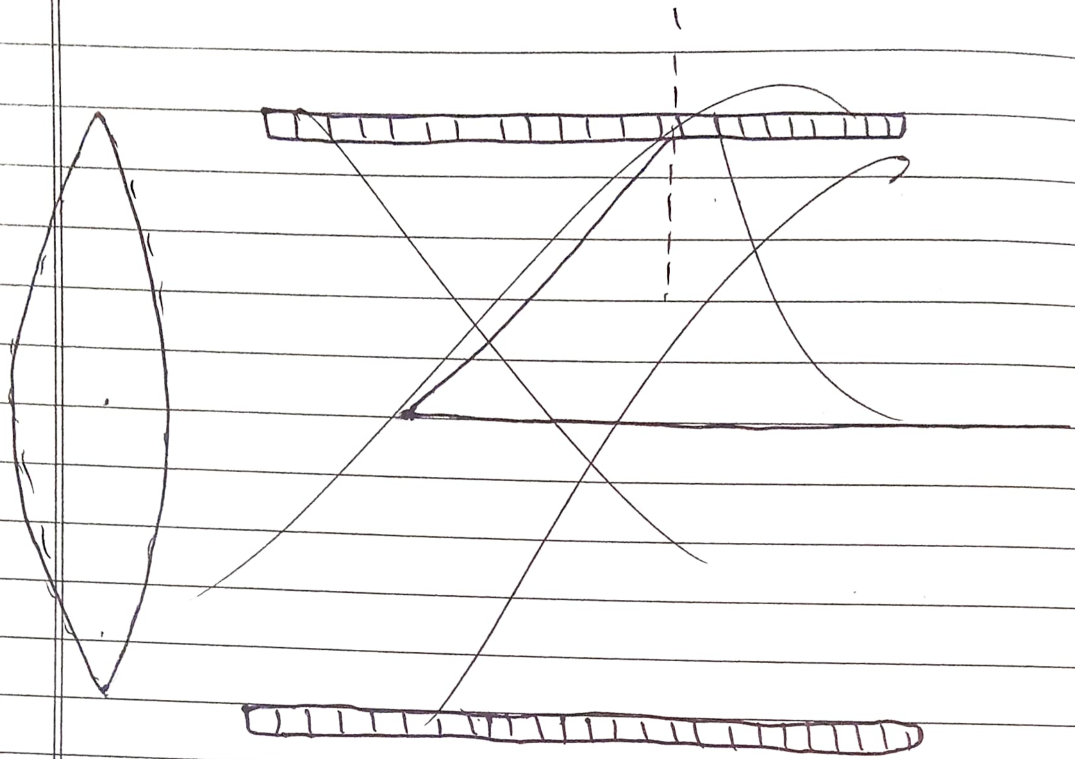
04

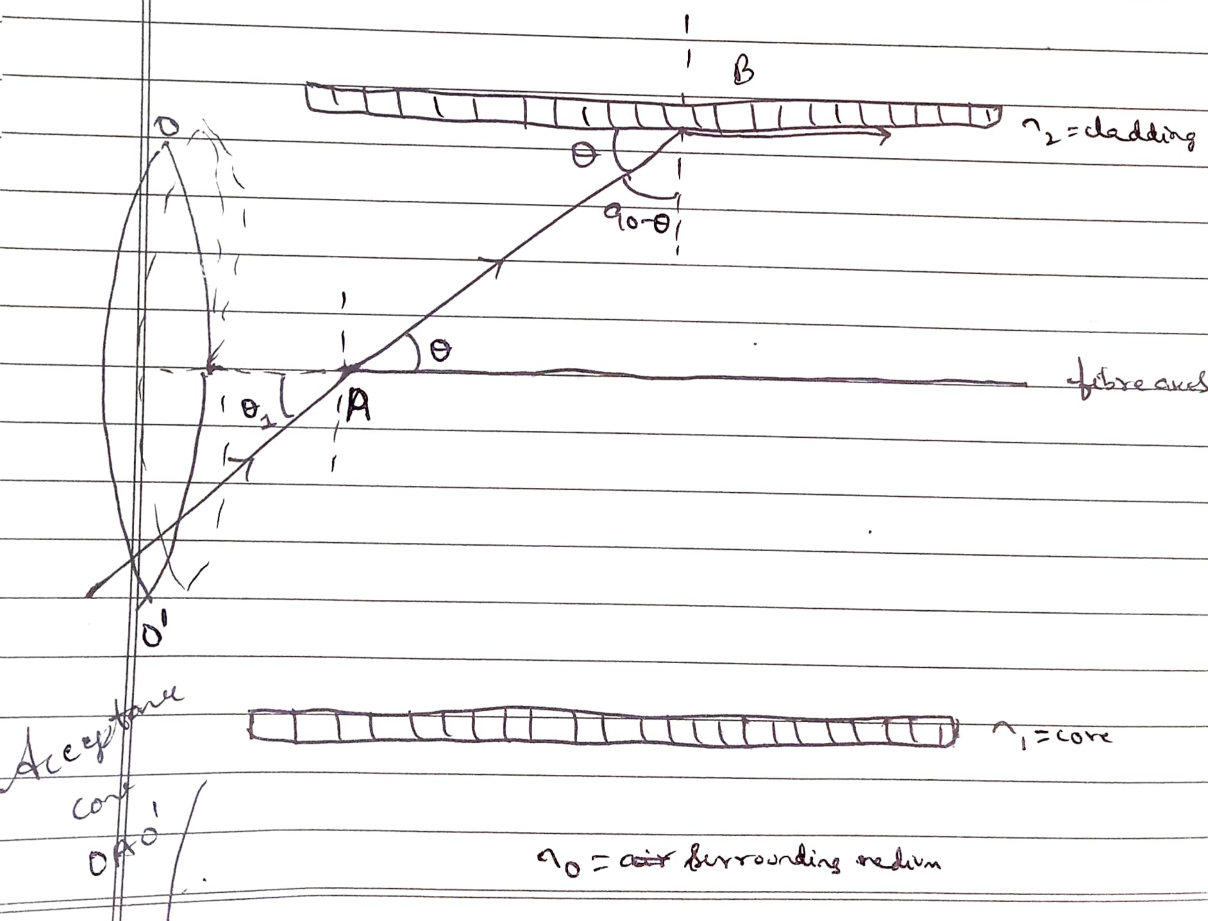
$$\frac{N_2}{N_1} = e^{\left(-0.048044\times10^{3}\right)}$$

$$\frac{N_2}{N_1} = \frac{1\cancel{.3692826}\times10^{-21}}{1.42516403} \%$$

$$\frac{N_2}{N_1} = 1.425\times10^{-21} \%$$

1) c)




B
n_2 = cladding
θ
$90-\theta$
O
θ
θ_1
A
fibre axis
O'
Acceptance cone OAO'
n_1 = core
n_0 = ~~air~~ surrounding medium

n_1 = refractive index of core
n_2 = refractive index of cladding
n_0 = refractive index of surrounding medium

($n_1 > n_2$ → always)

Apply Snell's Law at A,

$n_0 \sin\theta_1 = n_1 \sin\theta$ → (1)

Apply Snell's Law at B,

$n_1 \sin(90-\theta) = n_2 \sin 90$

$n_1 \sin(90-\theta) = n_2 (1)$ → (2)

$\cos\theta = \sqrt{1-\sin^2\theta}$

$\sin^2\theta + \cos^2\theta = 1$

$n_1 \cos\theta = n_2$

$\cos\theta = \frac{n_2}{n_1}$

03

If surrounding medium is air ($n_0 = 1$)

From (1),

$\cos\theta = \frac{n_2}{n_1}$

~~$\sin\theta = \sqrt{n_1^2 - n_2^2}$~~

Condition for ~~wave~~ propogation,

$\theta < \sin^{-1}\sqrt{n_1^2 - n_2^2}$ //.

$\cos\theta = \frac{n_2}{\frac{\sin\theta_1}{\sin\theta}}$

$\sqrt{1-\sin^2\theta} = \frac{n_2}{\frac{\sin\theta_1}{\sin\theta_0}}$

$\sqrt{1 - \frac{n_0^2 \cdot \sin\theta_1^2}{\sin\theta}} = \frac{n_2 \times \sin}{\sin\theta_1}$

On substitution,

~~$\cos\theta$~~ = 1

$\sin\theta = \sqrt{n_1^2 - n_2^2}$ or $\theta = \sin^{-1}\sqrt{n_1^2 - n_2^2}$ //.

Part B

3a) ~~De~~ Broglie ~~p~~stated that light shows dual nature

$\lambda = \frac{h}{mc}$ The wavelength of matter waves is inversely proportional to the momentum of the particle

$E = h\nu$ (planck's law) $E \to$ Energy

$h \to$ planck's const $= 6.6 \times 10^{-34}\ JS^{-1}$

$\nu \to$ frequency

$E = mc^2$ (Einstein's Energy-mass equation)

$E \to$ Energy | $m \to$ mass | $c \to$ Speed of light $= 3 \times 10^8$ velocity

~~mc^2~~

$E = h\nu \mid E = mc^2$

$h\nu = mc^2$

$h \cdot \frac{c}{\lambda} = mc^2$

$\frac{h}{\lambda} = mc$ $\quad \lambda = \frac{h}{mc}$ ~~for~~

02

We can change ~~c~~ to v for normal particles.

$\lambda = \frac{h}{mv}$ $\quad \lambda = \frac{h}{p} \Rightarrow \lambda = \frac{h}{\sqrt{2mE_k}}$ $\quad p = mv$ (linear momentum)

$m \to$ mass of particle

$E_k \to$ kinetic energy

$\lambda = \frac{h}{\sqrt{2mqV}}$

$q \to$ charge of particle

$V \to$ Voltage

$m \to$ mass of the particle

$p = mv$

$p^2 = m^2v^2$

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

$\frac{p^2}{2m} = KE$ But $(KE = eV)$

$\frac{p^2}{2m} = eV$ $p^2 = 2meV$ $p = \sqrt{2meV}$

for accelerated electron

$e = 1.6\times10^{-19}\,C$

$m = 9.1\times10^{-31}\,kg$

3 b) $m = 9.1\times10^{-31}\,kg$ $c = 3\times10^8\,ms^{-1}$ $KE = 100\,eV$ $m = \frac{0.5\,MeV}{c^2}$

$h = 6.6\times10^{-34}\,Js^{-1}$

$\lambda = \frac{h}{mc}$

$m = \frac{0.5\times10^6\times1.6\times10^{-19}}{3\times10^8\times3\times10^8}\,kg$

$= \frac{0.8\times10^{-13}}{9\times10^{16}}$

$= 0.088\times10^{-29}\,kg$

$\lambda = \frac{h}{\sqrt{2mE_k}}$

$$\lambda^2 = \frac{(6.63\times10^{-34})^2}{\cancel{2\times9.1\times10^{-31}}\ 2\times 0.088\times10^{-29}\times100\times1.6\times10^{-19}}$$

$$\lambda^2 = \frac{43.9569\times10^{-68}}{28.16\times10^{-48}}$$

$$\lambda^2 = 10^{-68+48}\times1.560$$

02

$$\lambda^2 = 10^{-20}\times1.560$$

$$\lambda^2 = (10^{-10})^2\times(1.2489)^2$$

$$\lambda^2 = (10^{-10}\times1.2489)^2$$

$$\lambda = 1.2489\times10^{-10}\ m$$

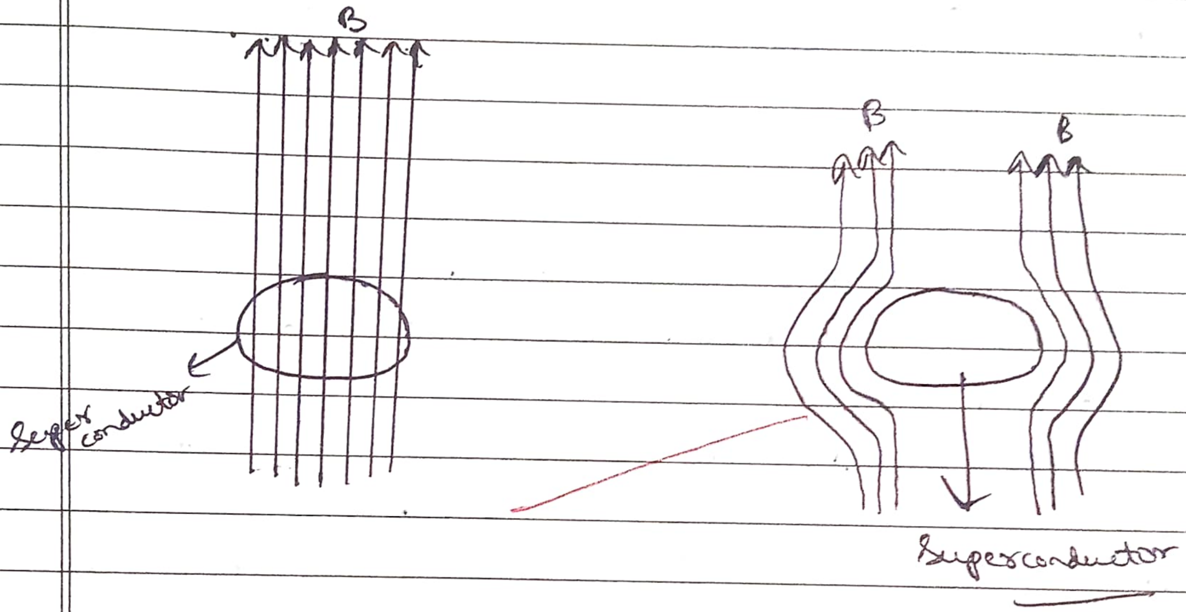
$$\lambda = 1.2489\ \mathring{A}$$

02

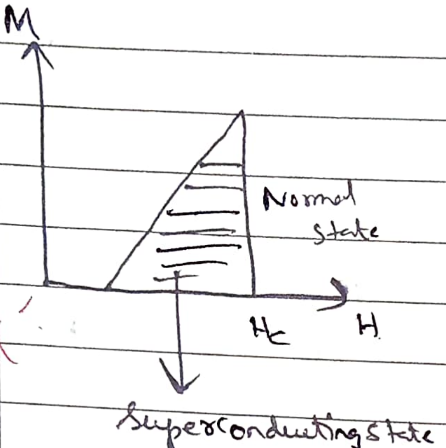
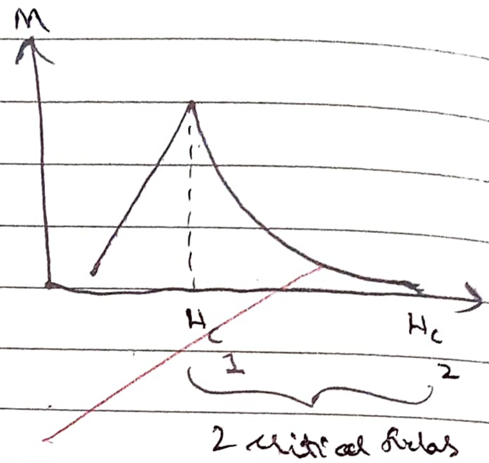
2nd Internals

Part A

1A- When a Superconductor is placed in a magnetic field at normal temperature (greater than critical temperature), the magnetic field lines pass through it.
But when a Superconductor is placed in the magnetic field when cooled below its critical temperature, the magnetic field lines get expelled out of it. This is called Meissner's effect.



Soft (Type-I) Superconductor	Hard (Type-2) Superconductor
• Exhibit Meissner's effect completely	• Exhibit Meissner's effect partially
• has 1 critical field	• has 2 critical fields
• No vortex region	• Vortex region present
• Low critical temperature	• high critical temperature
• Low critical magnetic field	• high critical magnetic field
• Cant be used for field magnets	• can be used for field magnets.
• Eg: Zn, Al	• Eg: Alloys of Niobium (Nb)

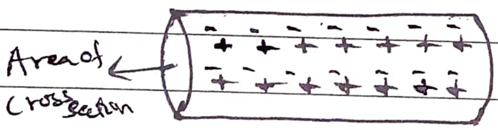
Type-1	Type-2
	

OK

1b) • It was proposed by Sommerfield in 1928.
• The energy levels of the electrons are quantized.
• The allowed energy levels of the electrons are realized in terms of quantum states.
• The order of energy levels is as per pauli's exclusion principle
• ~~An~~ The forces of attraction b/w the electrons of themselves and the force of ~~attr~~ repulsion b/w the scattered electron and the lattice points are ignored.

OK

• The ~~pt~~ electric potential inside the metal is assumed to be constant with the free electrons moving with elastic collisions continuously.



+ → phonon (lattice points)
− → electron (free electrons)

1c) $T_c = 7.26\,K$ $\qquad T = 6\,K$

$H_0 = 50 \times 10^3\ Am^{-1}$ $\qquad H_c = ?$

$$H_c = H_0\left[1-\left(\frac{T}{T_C}\right)^2\right]$$

$$H_c = 50\times10^3\left[1-\left(\frac{6}{7.26}\right)^2\right]$$

$$H_c = 50\times10^3\left[1-\left(\frac{36}{52.7076}\right)\right]$$

04 $$H_c = 50\times10^3\left[1-0.68301\right]$$

$$H_c = 50\times10^3\left[0.31699\right]$$

$$H_c = 15.8495\times10^3 \quad Am^{-1}$$

PART - B

3a) W.K.T

$\lambda = \frac{h}{P} \rightarrow (1)$ $\lambda \rightarrow$ wavelength

$h \rightarrow$ planck's constant $= 6.625\times10^{-34}\ JS^{-1}$

$p \rightarrow$ linear momentum mv

$\downarrow$

This is De-Broglie's expression for wavelength.

$$\Psi = Ae^{i(kx-\omega t)} \longrightarrow (2)$$

Exponential form of a Total wave function

Ψ = capital psi → displacement
A → Amplitude
e = log base
$i = \sqrt{-1}$
k → wave number $= \frac{2\pi}{\lambda}$
x → position coordinate
ω → angular frequency
t → time coordinate

$$\Psi = \underbrace{Ae^{ikx}} \times e^{-i\omega t}$$

$$\Psi = \psi \times e^{-i\omega t} \longrightarrow (3)$$

↑ Space wave function
Only position coordinate
no time coordinate

Differentiating (3) w.r.t x twice, we get,

$$\frac{d\Psi}{dx} = e^{-i\omega t} \times \frac{d\psi}{dx}$$

$$\frac{d^2\Psi}{dx^2} = e^{-i\omega t} \times \frac{d^2\psi}{dx^2} \longrightarrow (4)$$

Differentiating (3) w.r.t t twice, we get,

$$\frac{d\Psi}{dt} = \psi \cdot e^{-i\omega t} \cdot (-i\omega)$$

$$\frac{d^2\Psi}{dt^2} = \psi \cdot e^{-i\omega t} (-i\omega)(-i\omega)$$

$$= i^2\omega^2 \psi e^{-i\omega t}$$

$$= -\omega^2 \psi e^{-i\omega t} \longrightarrow (5)$$

$i = \sqrt{-1}$
$i^2 = -1$

For any travelling wave, with displacement Ψ, the wave equation is given by,

$$\frac{d^2\Psi}{dx^2} = \frac{1}{v^2}\left(\frac{d^2\Psi}{dt^2}\right) \longrightarrow (6)$$

This the differential equation of the wave $y = A\sin(kx - \omega t)$

(4) & (5) in (6), we get,

$$e^{-i\omega t}\frac{d^2\psi}{dx^2} = \frac{1}{v^2}\left[-\omega^2\psi\, e^{-i\omega t}\right]$$

$$\therefore \frac{d^2\psi}{dx^2} = \frac{1}{v^2}(-\omega^2\psi)$$

W.K.T $v = f\lambda$ $\omega = 2\pi f$

velocity, frequency, wavelength; angular velocity, frequency

$$\therefore \frac{d^2\psi}{dx^2} = \frac{1}{f^2\lambda^2}(-4\pi^2 f^2\psi)$$

$$\frac{d^2\psi}{dx^2} = \frac{1}{\lambda^2}(-4\pi^2\psi)$$

$$\frac{1}{-4\pi^2\psi}\frac{d^2\psi}{dx^2} = \frac{1}{\lambda^2} \longrightarrow (7)$$

W.K.T $KE = \frac{p^2}{2m}$ $\quad \left[p = \sqrt{2mKE} \quad p^2 = 2mKE \right]$

But we also know that, $p = \frac{h}{\lambda}$ (eqⁿ ①)

$$KE = \frac{h^2}{\lambda^2 2m}$$

$$\cancel{2m \cdot K} \quad KE = \frac{h^2}{2m}\left(\frac{1}{\lambda^2}\right)$$

$$KE = \frac{h^2}{2m}\left(\frac{-1}{4\pi^2\psi}\frac{d^2\psi}{dx^2}\right)$$

$$KE = \frac{-h^2}{8\pi^2 m\psi}\frac{d^2\psi}{dx^2} \longrightarrow ③$$

But Total Energy = Kinetic Energy + Potential Energy

$$E = KE + V$$

$$\therefore KE = E - V$$

$$E - V = \frac{-h^2}{8\pi^2 m\psi}\frac{d^2\psi}{dx^2}$$

$$(E - V)\psi = \frac{-h^2}{8\pi^2 m\psi}\frac{d^2\psi}{dx^2}$$

$$\frac{-8\pi^2 m\psi}{h^2}(E - V)\psi = \frac{d^2\psi}{dx^2}$$

or $$\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m}{h^2}(E - V)\psi = 0$$

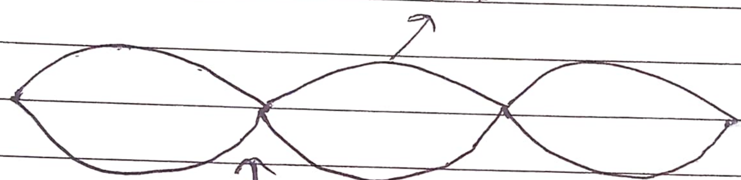
04

Time independent Schrondinger Wave equation

$$y(x,t) = A \cdot \sin\left(\frac{2\pi x}{\lambda}\right) \cdot \cos(2\pi f t)$$

A standing wave can be expressed in this form. This proves that electron is actually a standing wave around the nucleus

Antinodes



Node

STANDING WAVE SEGMENT

3b)

CLASSICAL COMPUTERS	QUANTUM COMPUTERS
• Data is stored in transistors in the form of bits in transistors	• Data is stored as qubits (quantum bits). obeying all laws of quantum mechanics.
• Logic gates process data	• quantum logic gates process data.
• Power increases in the ratio of 1:1 with the increase in no. of transistors	• Power exponentially increases with the increase in no. of qubits.
• Can be used at room temperature	• can be used only at ultracold temperature
• Less errors	• more errors.
• Wide range of ~~utilit~~ utility	• used for data analysis, quantum

04

CLASSICAL COMPUTERS	QUANTUM COMPUTERS
to process calculations, data storage, critical problem solving etc.	computing and optimization problems

I have answered

1a) 3a)

1b) 3b)

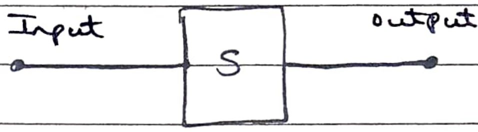
1c)

End

Part – B

3a) Phase gate (S–gate)

- Block diagram:



- It is a single input gate
- $S = \begin{bmatrix} 1 & 0 \\ 0 & i \end{bmatrix}$
- Can be formed by connecting 2 T–gates in series.
- Calculation:-

$$S|0\rangle = \begin{bmatrix} 1 & 0 \\ 0 & i \end{bmatrix} \times \begin{bmatrix} 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix} = |0\rangle$$

04

$$S|1\rangle = \begin{bmatrix} 1 & 0 \\ 0 & i \end{bmatrix} \times \begin{bmatrix} 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 0 \\ i \end{bmatrix} = i \begin{bmatrix} 0 \\ 1 \end{bmatrix} = i|1\rangle$$

$$S(\alpha|0\rangle + \beta|1\rangle) = \begin{bmatrix} 1 & 0 \\ 0 & i \end{bmatrix} \begin{bmatrix} \alpha \\ \beta \end{bmatrix} = \begin{bmatrix} \alpha \\ i\beta \end{bmatrix} = \alpha|0\rangle + i\beta|1\rangle$$

Truth table:-

Input	Output
$\|0\rangle$	$\|0\rangle$
$\|1\rangle$	$i\|1\rangle$
$\alpha\|0\rangle + \beta\|1\rangle$	$\alpha\|0\rangle + i\beta\|1\rangle$

It can be formed by connecting 2 gates in series

$$T = \begin{bmatrix} 1 & 0 \\ 0 & e^{i\pi/4} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & \frac{i+1}{\sqrt{2}} \end{bmatrix}$$

$$S = \begin{bmatrix} 1 & 0 \\ 0 & i \end{bmatrix}$$

$$T \times T = \begin{bmatrix} 1 & 0 \\ 0 & \frac{i+1}{\sqrt{2}} \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & \frac{i+1}{\sqrt{2}} \end{bmatrix}$$

$$T^2 = \begin{bmatrix} (1\times1)+(0\times0) & (1\times0)+0\times\left(\frac{i+1}{\sqrt{2}}\right) \\ (0\times1)+\left(\frac{i+1}{\sqrt{2}}\times0\right) & (0\times0)+\left(\frac{i+1}{\sqrt{2}}\right)^2 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 \\ 0 & \frac{(i+1)^2}{2} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & \frac{i^2+1+2i}{2} \end{bmatrix}$$

$i = \sqrt{-1}$

$i^2 = -1$

$$= \begin{bmatrix} 1 & 0 \\ 0 & 2i/2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & i \end{bmatrix} = S$$

$\therefore S = T^2$

3b) $|\psi\rangle = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix}$ $\quad |\phi\rangle = \begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix}$

To prove : $\langle \psi | \phi \rangle = \langle \phi | \psi \rangle^*$

$$= \underbrace{\langle \psi |}_{\text{Bra vector}} x \underbrace{| \phi \rangle}_{\text{ket vector}} = (\langle \phi | x | \psi \rangle)^*$$

$\langle \psi | = [\alpha_1 \quad \alpha_2]$ $\quad \langle \phi | = [\beta_1 \quad \beta_2]$

$$\underset{1\times 2}{[\alpha_1 \ \alpha_2]} \underset{2\times 1}{\begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix}} = [\alpha_1\beta_1 + \alpha_2\beta_2] = \text{LHS}$$

04

$$[\beta_1 \ \beta_2] \times \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} = [\beta_1\alpha_1 + \beta_2\alpha_2] = \text{RHS}$$

$$= [\alpha_1\beta_1 + \alpha_2\beta_2] = \text{RHS}/.$$

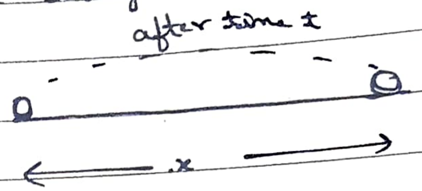
$x+iy \xrightarrow{\text{CONJUGATION}} x-iy \longrightarrow$ only for imaginary part.

There is no i part in RHS. So, Conjugate of that remains same. $[\beta_1\alpha_1 + \beta_2\alpha_2]$ only/.

LHS = RHS/.

Part – A

1a) Motion of a body along a straight line is called linear motion.



Uniform motion is the motion of a body where equal distances are covered in equal intervals of time.

Slow in implies acceleration [rate of change of increase in velocity w.r.t time]

Slow out implies deccelaration [rate of change of decrease in velocity w.r.t time]

03

Speed = $\frac{\text{distance}}{\text{time}}$ velocity = $\frac{\text{displacement}}{\text{time}}$

$s = \frac{d}{t}$ $v = \frac{x}{t}$ $v = \frac{\Delta x}{\Delta t}$ $v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$

acceleration $= \frac{\text{velocity}}{\text{time}} = \frac{v}{t} = \frac{\Delta v}{\Delta t} = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt}$

3 Kinematic equations:- $v = u + at$

$s = ut + \frac{1}{2} at^2$

$v^2 - u^2 = 2as$

1c) Total distance = (last frame no − 1) × base distance

$25m = (6-1) \times x$

$25 = 5 \times x$

$\therefore x = 5$ $\therefore$ Base distance = 5 m

1b) Push time is the time taken to push a body upto a certain distance. It involves acceleration.

Stop time is the time taken to stop or obstruct the motion of the body. It involves retardation.
The abrupt stop or halt of a body against ~~on~~ a surface results in collision. ~~etc~~.

$v_2 - v_1 = e(u_1 - u_2)$ Newton's Law of Collision.

final velocity

elasticity

3 Types of Collision:- Perfectly elastic
Inelastic
Perfectly inelastic

~~Conser~~ Conservation of linear momentum plays a vital role in collision.

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

End