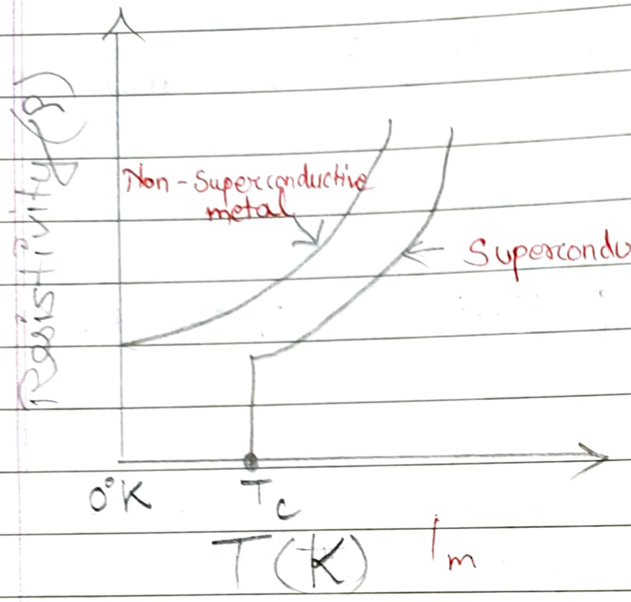
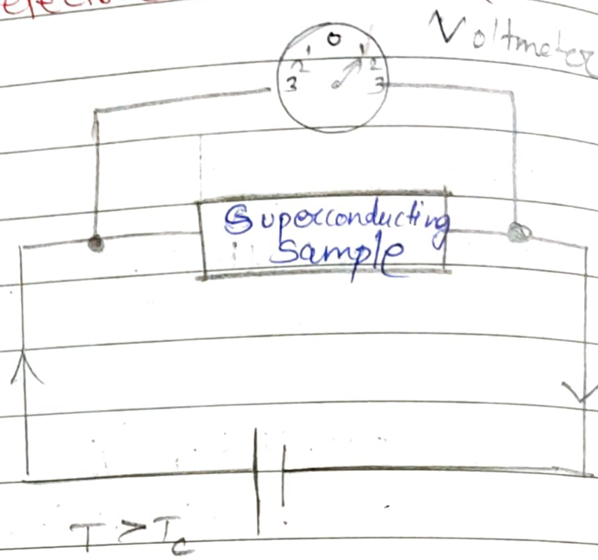
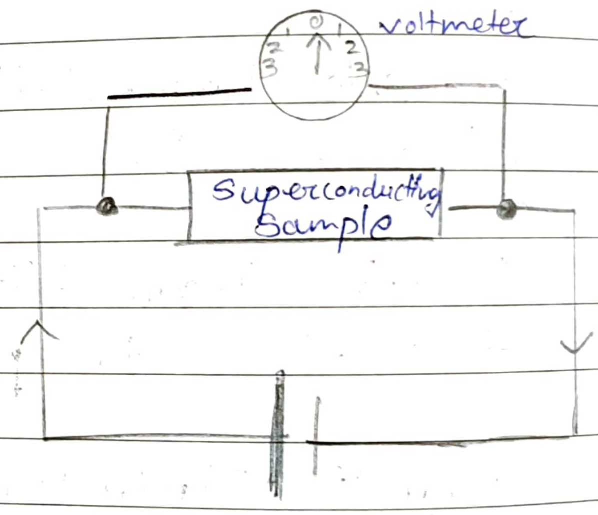
Define Superconductivity with R vs T graph + Example. Explain zero electrical Resistance



Im





$T < T_c$ $\frac{V}{I} \to 0$

Im

Phenomenon in which

1. When we cool substance at a particular temperature resistance becomes zero
2. Conductivity becomes ∞ ← Im
3. T at which conductivity becomes ∞ is called critical temperature (T_c)
4. Electrical ρ of pure mercury dropped to zero ← Im @ 4.2 K.

2m

S.C is characterized by zero ρ.

5. When material is in normal state, V drop is obs^d
6. When material is in S.C state V drops to zero suddendly

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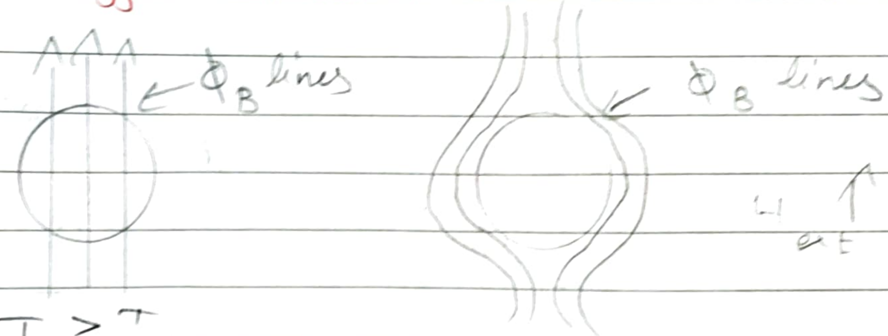
प्रश्न२ (6m)

Meissner effect + cause + show S.C exhibit diamag



1m ① When specimen placed in weak magnetic field & cooled below T_c, the magnetic flux (Φ) originally pr in specimen is ejected / excluded / expelled from specimen

② This property is independent of path by which the S.C^{g} state is reached.

③ Wen SC is placed in M.F it induces I which circulated on surface in a manner that it creates M.F everywhere equal & opposite to applied M.F

④ Thus, material is S.C^{g} state does not permit any Φ to exist within material.

⑤ At $T > T_c$, $B = \mu_0 (H + M)$
magnetic induction, M.F, Magnetisation

1m For $T < T_c$ $B = 0$

$\mu_0 (H + M) = 0 \Rightarrow H = -M \Rightarrow \chi = \frac{M}{H} = -1$

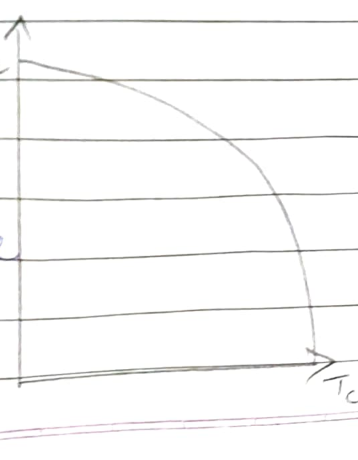
⑥ Magnetic Susceptibility $\chi = -1$ indicates that S.C are perfectly diamagnetic substance.

Q What is Critical Magnetic Field? (H_c) :

① Min M.F necessary 2 destroy S.C & restore normal resistivity is called H_c

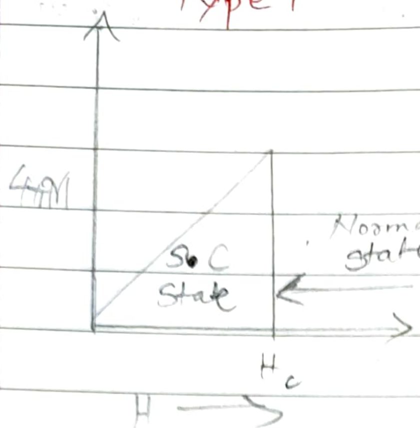
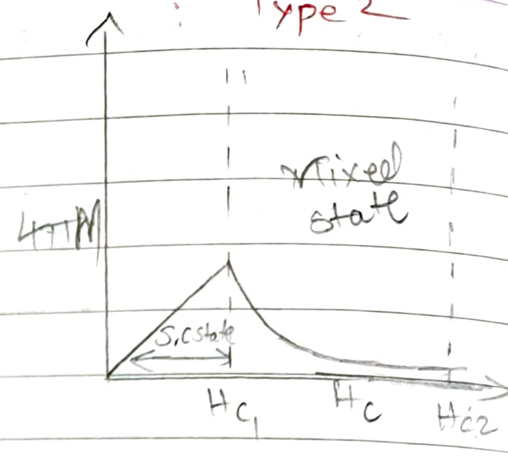
② C.M.F / H_c is funⁿ of Temperature

③ $H_c = H_0 \left[1 + \left(\frac{T}{T_c}\right)^2 \right]$



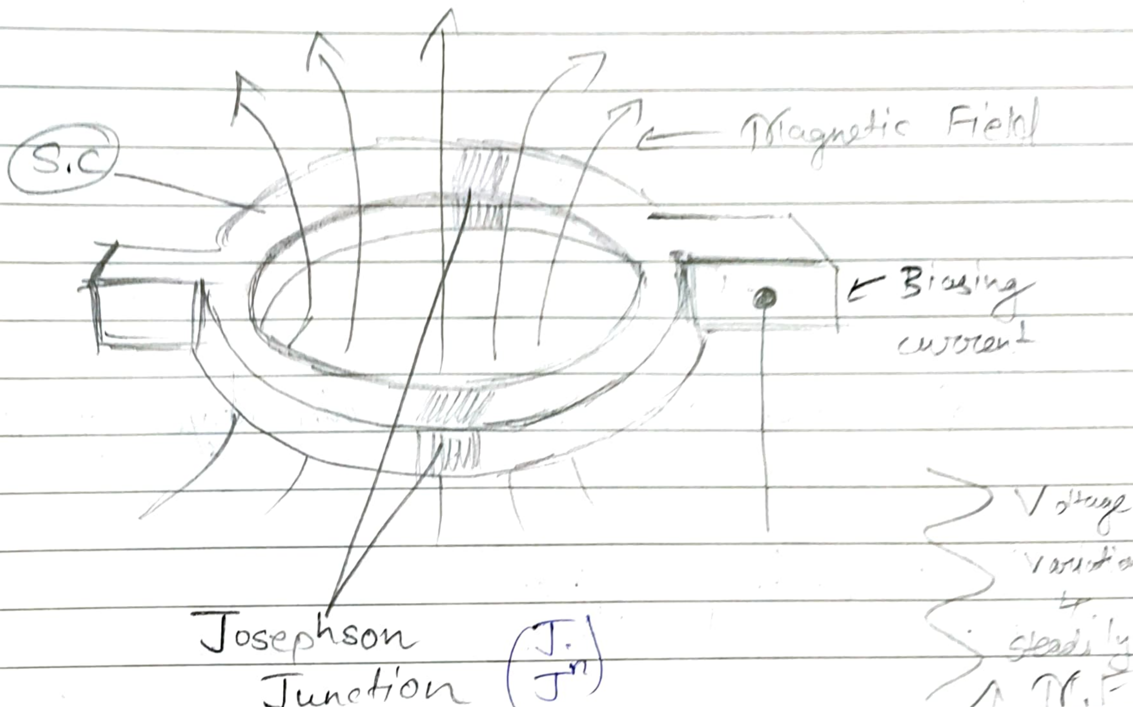
(4m)

Q Distinguish Bet^n Type I & Type II S.C

Type I	Type 2
	
① Change from S.C state to normal is sudden	① " " " " is gradual.
② Knowns as soft S.C	② Knowns as hard S.C
③ In Type 1 SC the ϕ is completely expelled below H_c.	③ In Type II S.C ϕ is not completely excluded below H_c
④ Behaves completely diamagnetic (c.d)	④ It does not behave c.d.
⑤ Less industrial Application	⑤ More industrial Applications.
⑥ Pure Al, Zn, Mo, Sn	⑥ Alloy Nb, Ba_3Bi_3, $CoSi_2$, HTS
There is only one critical field	There are two

Q What are SQUID + Principle + Construction + Working (6m)

Name : ____ Date : / /



1m ① SQUIDS is Superconducting Quantum Interfering Devices that are sensitive magnetometer.

② Current is moving in two opposite directions, the electrons have the ability to perform qbits that means theorotically could be used to enable quantum computing.

Principle 1m

③ SQUID consist of tiny loop of S.C

④ The loop is interrupted by 1/more J.J.

construction 2m

⑤ If constant biasing I is maintained in SQUID the measured V oscillates with changes in phase @ J^n

⑥ Change in phase depends on change in ϕ

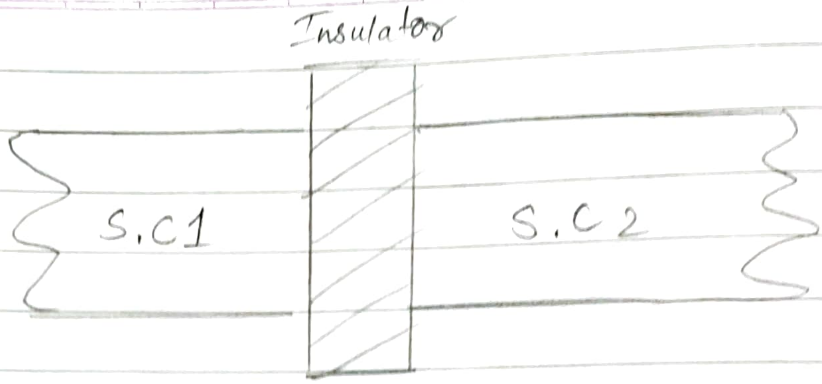
⑦ Counting the oscillations allows u 2 evaluate ϕ change which has occured.

2m

⑧ Used 2 detect Earthquake time due 2 Δ M.F in Earth core

⑨ Brain operates electrically, one can by sensing M.F created by neurological I. monitor activity of Brain.

(4m) Explain DC & AC Josephson Effect



J.J^{n} : 2 SC seperated by thin layer of Insulator

DC Josephson effect

1. Wen cooper pairs tunnel from one side of J^{n} to other there introduces a phase diff bet^{n} 2
2. Bcaz of this phase diff, a DC supercurrent appears across jun^{n} even though the applied voltage is zero.

AC Josephson effect

1. When DC Vol is applied across J.J^{n} it introduces an additional phase on cooper pairs during tunniling.
2. As a result, when DC voltage is applied across a JJ^{n}, AC current is produced by Junction