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NPTEL

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Courses » Introduction to Solid State Physics

Announcements Course Ask a Question Progress FAQ

Unit 13 - Superconductivity

Register for Certification exam

Course outline

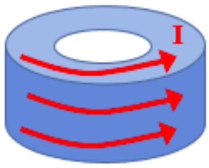
Assignment 12

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2019-04-24, 11:59 IST.

1) *1 point*

For a ring shown below, made of a metal of very low resistance R and the ring has an inductance is L. A current I_0 is setup in the ring at time $t = 0$ and subsequently no voltage is applied to the ring after $t = 0$. Then, which of the following statements is true for the current circulating in the ring,



- The current will decay down to zero
- The current will remain constant as Lenz law will prevent the current to die down
- The current will oscillate
- The current will decay down to a constant value.

No, the answer is incorrect.
Score: 0

Accepted Answers:
The current will decay down to zero

2) For the previous question the differential equation governing the decay of current in the low resistance ring is *1 point*

- $L\frac{dI}{dt} + RI = 0$

ce De

$\mathrm{R}\frac{dI}{dt} + \mathrm{LI} = \text{constant} \neq 0$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\mathrm{L}\frac{dI}{dt} + \mathrm{RI} = 0$

3) For the question 1, the time dependence of the current in the ring is *1 point*

- $I = I_0 \exp(-\frac{R}{L}\mathrm{t})$
- $I = I_0 (1 - \exp(-\frac{R}{L}\mathrm{t}))$
- $I = I_0 \exp(i\frac{R}{L}\mathrm{t})$ where $i = \sqrt{-1}$
- $I(t) = I_0 \frac{Rt}{L}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$I = I_0 \exp(-\frac{R}{L}\mathrm{t})$

4) If the material in question 1 becomes superconducting, then the correct equations describing the situation *1 point*

- Total current circulating in the ring $I(t)$ is slightly greater than I_0 because of Meissner effect
- Total current circulating in the ring $I(t)$ is slightly less than I_0 because of Meissner effect
- Total current circulating in the ring $I(t)$ is equal to I_0
- Total current circulating in the ring $I(t)$ will be zero

No, the answer is incorrect.
Score: 0

Accepted Answers:
Total current circulating in the ring $I(t)$ is slightly less than I_0 because of Meissner effect

5) A true test of superconductivity developing in a material is *1 point*

- Only when resistance R ® 0
- Magnetic susceptibility c= -1
- Magnetic susceptibility c= 1
- Only when conductivity becomes very high

No, the answer is incorrect.
Score: 0

Accepted Answers:
Magnetic susceptibility c= -1

6) In the Kammeling Onnes experiment on superconductivity, the Hg on which he conducted his experiments had an atomic mass of 198 a.m.u. The superconducting transition temperature T_c was measured to be 4.18 K. If the same experiment was performed with using an isotope of Hg with *1 point*

atomic mass of 203 a.m.u then what is the T_c you would expect to measure

- 4.23K
- 4.18K
- 4.13K
- 4.08K

No, the answer is incorrect.
Score: 0

Accepted Answers:
4.13K

7) For Hg with a superconducting transition temperature of 4.18 K, a rough estimate of the superconducting energy gap associated with Cooper pairing of electrons in the solid is *1 point*

- 3.6 Joules
- 4.18 meV
- 0.36 MeV
- 0.36 meV

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.36 meV

8) For Hg with a superconducting transition temperature of 4.18 K, an order of magnitude estimate of the Debye frequency of Hg (atomic mass 198) is *1 point*

- 10^{14} Hz
- 10^{13} Hz
- 10^{12} Hz
- 10^{11} Hz

No, the answer is incorrect.
Score: 0

Accepted Answers:
10^{14} Hz

9) In question 8, if we used Hg with increasing atomic mass, then the Debye frequency of the material would *1 point*

- Increase in proportion to the square of the atomic mass
- Decrease in proportion to the square of the atomic mass
- Decrease in proportion to the square root of the atomic mass
- Increase linearly with the atomic mass

No, the answer is incorrect.
Score: 0

Accepted Answers:
Decrease in proportion to the square root of the atomic mass

10) At the superconducting transition T_C, which of the following statement is correct **1 point**

- It becomes relatively difficult to heat the electrons in the system with a very small amount of heat supplied to the material and the superconducting transition is a second order transition in zero applied magnetic field
- It becomes very easy to heat up the electrons system by supplying a very small amount of heat and the superconducting transition is a second order transition in zero applied magnetic field
- It becomes very easy to heat the system and the superconducting transition is a first order transition in zero applied magnetic field
- It becomes relatively difficult to heat the electrons in the system with a very small amount of heat supplied to the material and the superconducting transition is a first order transition in zero applied magnetic field

No, the answer is incorrect.
Score: 0

Accepted Answers:
It becomes relatively difficult to heat the electrons in the system with a very small amount of heat supplied to the material and the superconducting transition is a second order transition in zero applied magnetic field

11) Consider two identical superconductors of Niobium (Nb) are connected to each other with the help of a superconducting wire also of Nb having a cross-sectional area x^2, where x is the superconducting coherence length of Nb. The entire circuit is maintained at a temperature below the superconducting transition temperature of Nb. If a small finite voltage V is applied across the two superconductors then which of the following statements is true **1 point**

- The phase difference across the superconducting wire connecting the two superconductors will change as a function of time and a dissipationless time dependent current will flow across the junction
- The phase different across the superconductors will remain constant and no current will flow across the junction
- The junction will become normal and a dissipative current will flow across the superconductor
- The phase difference across the junction will begin changing chaotically as a result the current across the junction will be very noisy

No, the answer is incorrect.
Score: 0

Accepted Answers:
The phase difference across the superconducting wire connecting the two superconductors will change as a function of time and a dissipationless time dependent current will flow across the junction

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