Unit 4 - Specific heat of an electron gas and the behaviour of thermal conductivity of a solid and relationship with electrical conductivity

Register for Certification exam

Course outline

Assignment 3

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

Due on 2019-02-20, 23:59 IST.

1) *1 point*

The electronic contribution to specific heat within the Sommerfeld's Model is due to

- Increased electron – electron collision with increasing T.
- Due to electron within k_BT of ε_F, exciting to unoccupied energy levels above ε_F .
- Collision of electrons with ions while exciting to higher energy states.
- Flip of spin of electrons in the metal.

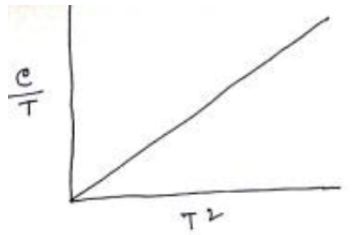
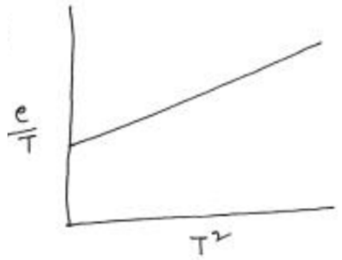
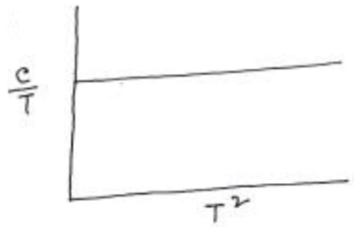
No, the answer is incorrect.
Score: 0

Accepted Answers:

Due to electron within k_BT of ε_F, exciting to unoccupied energy levels above ε_F .

2) *1 point*

The temperature dependence of the specific heat of a perfect insulator would be

- 
- 
- 

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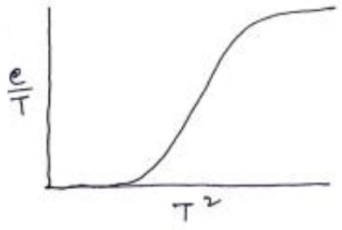
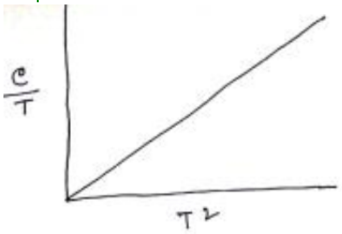
Solutions of Assignments



No, the answer is incorrect.
Score: 0

Accepted Answers:



3) The ratio of $\varepsilon_F / k_B T$ at room temperature (ε_F =1eV) is of the order of

1 point

- 100
- 1
- 10000
- 10

No, the answer is incorrect.
Score: 0

Accepted Answers:
10

4)

1 point

Given that the electron density of copper (n) is 8.47×10^{22} electrons/cc and fermi energy ε_F is 7eV. Using the expression of density of states, the ratio of the number of states contributing to specific heat of the solid at 4K to the total density of electrons in the solid is(n) is of the order of -

- 0.001%
- 0.1%
- 0.01%
- 1%

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.01%

5)

1 point

The general expression for the internal energy per electron at finite temperature in terms of energy of electrons ε,density of states $g(\varepsilon)$, Fermi Dirac distribution $f_D(\varepsilon)$ is

- $\dfrac{\int_0^\infty \varepsilon^2 g(\varepsilon) f_D(\varepsilon) d\varepsilon}{\int_0^\infty g(\varepsilon) f_D \, d\varepsilon}$
- $\dfrac{\int_{\varepsilon_F}^\infty \varepsilon g(\varepsilon) f_D(\varepsilon) d\varepsilon}{\int_{\varepsilon_F}^\infty g(\varepsilon) f_D \, d\varepsilon}$
- $\dfrac{\int_0^{\varepsilon_F} \varepsilon g(\varepsilon) f_D(\varepsilon) d\varepsilon}{\int_0^{\varepsilon_F} g(\varepsilon) f_D \, d\varepsilon}$
- $\dfrac{\int_0^\infty \varepsilon g(\varepsilon) f_D(\varepsilon) d\varepsilon}{\int_0^\infty g(\varepsilon) f_D \, d\varepsilon}$

No, the answer is incorrect.
Score: 0
Accepted Answers:

$$\frac{\int_0^\infty \varepsilon g(\varepsilon) f_D(\varepsilon) d\varepsilon}{\int_0^\infty g(\varepsilon) f_D \, d\varepsilon}$$

6) *1 point*

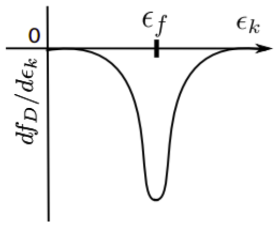
For Cu the theoretically calculated γ_{th} is 0.505 mJ/mole – K^2 while experimentally calculated
0.95 mJ/mole – K^2. Ratio of theoretical value of mass of the electron in the solid to the actual ı

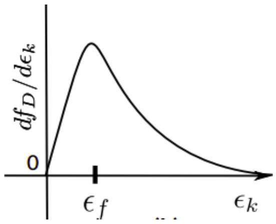
- 0.53
- 1.88
- 1
- 0.27

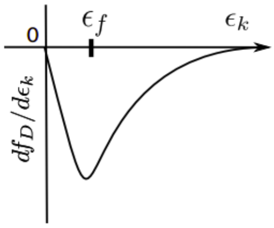
No, the answer is incorrect.
Score: 0
Accepted Answers:
0.53

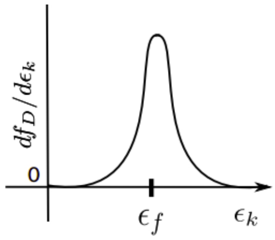
7) *1 point*

In a number of calculations in solid state physics, one encounters $df_D/d\epsilon_k$ which is the derivative
FD distribution at temperature T. Out of the shapes given below which shape best represents d

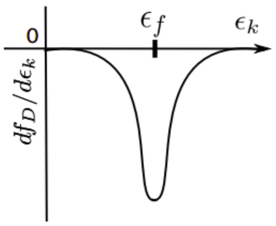








No, the answer is incorrect.
Score: 0
Accepted Answers:



8) **1 point**

For a two dimensional piece of metal expression for thermal conductivity (κ) on the Drude's/Somm picture is

- $\kappa = \frac{1}{2}v^2\tau c_v$
- $\kappa = v^2\tau c_v$
- $\kappa = \frac{1}{3}v^2\tau c_v$
- $\kappa = \frac{1}{4}v^2\tau c_v$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\kappa = \frac{1}{2}v^2\tau c_v$

9) **1 point**

In Cu if $\tau = 2 \times 10^{-9}s$ at 4K, $\epsilon_f = 7$eV and $n = 8.5 \times 10^{22}$electrons/cc, then the mean free path electrons is

- 0.3 cm
- 0.03 cm
- 0.8 cm
- 0.08 cm

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.3 cm

10) Using the Wiedemann-Franz law, estimate the electrical conductivity of Cu at 4K **1 point**

- $\sigma = 6.43 \times 10^{10}\ \Omega^{-1}\text{cm}^{-1}$
- $\sigma = 6.43 \times 10^{12}\ \Omega^{-1}\text{cm}^{-1}$
- $\sigma = 6.43 \times 10^{9}\ \Omega^{-1}\text{cm}^{-1}$
- $\sigma = 6.43 \times 10^{6}\ \Omega^{-1}\text{cm}^{-1}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\sigma = 6.43 \times 10^{10}\ \Omega^{-1}\text{cm}^{-1}$

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