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NPTEL

reviewer4@nptel.iitm.ac.in ▾

Courses » Introduction to Solid State Physics

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Unit 3 - Introduction to Sommerfeld's model

Register for Certification exam

Assignment 2

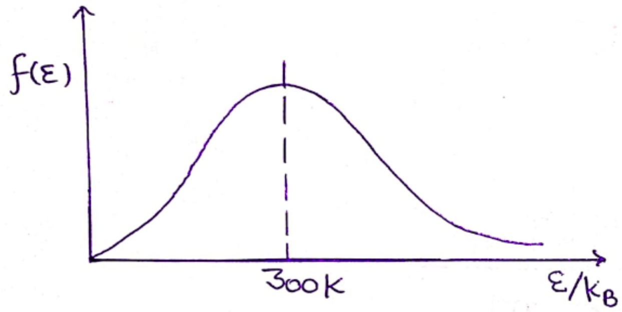
The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

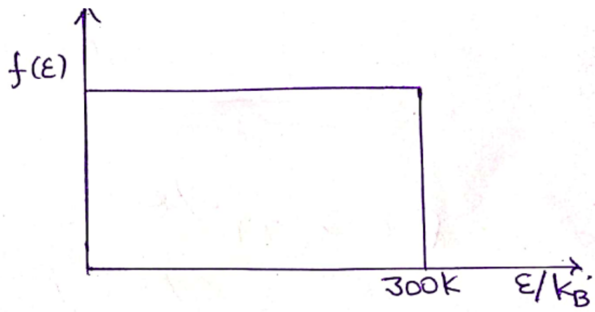
Due on 2019-02-13, 23:59 IST

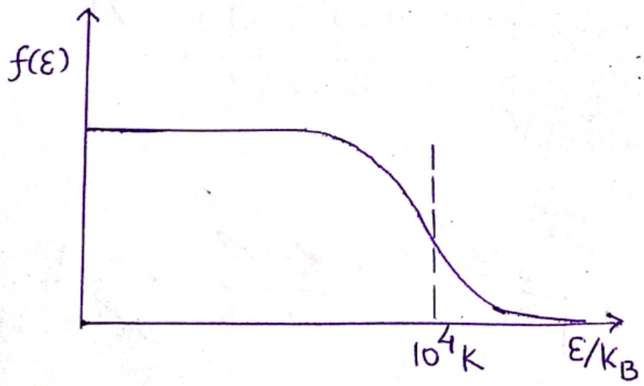
1) *1 point*

(Note: All across the paper the Boltzmann constant is k_B)

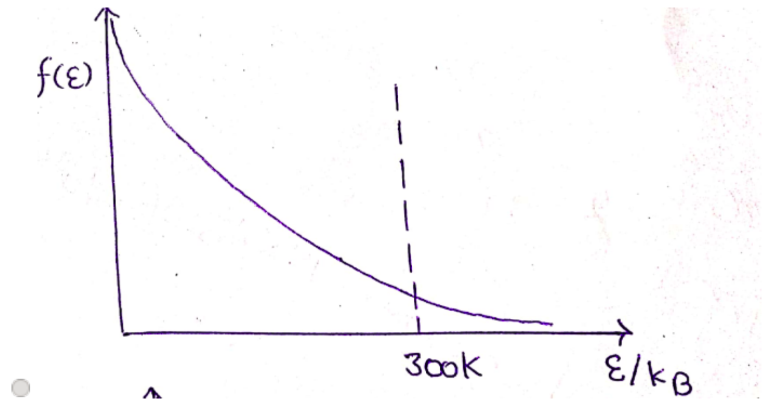
1. The probability distribution of electrons in a metal amongst the available energy stat
K is best described by the following graphs (graphs are schematic and not to scale):





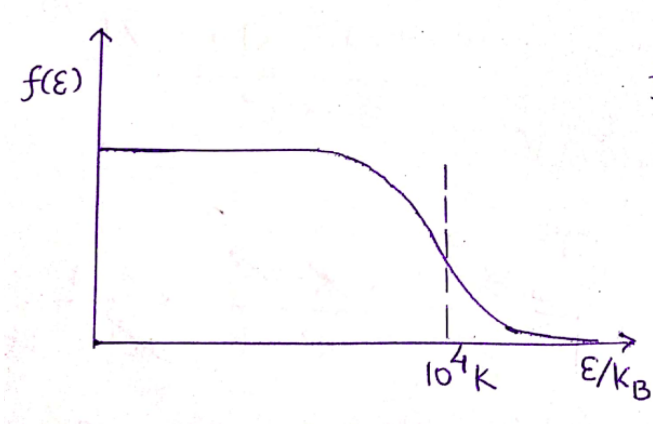


of a particle in a band
Introductory Semiconductor Physics
Magnetism in materials
Superconductivity
Solutions of Assignments



No, the answer is incorrect.
Score: 0

Accepted Answers:



2) *1 point*

The probability of electrons at 300 K having energy ε_F+1000 k_B is:

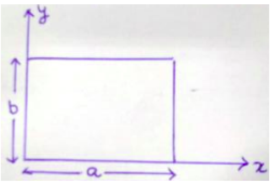
- 0
- 0.034
- 0.037
- ∞

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.034

3) *1 point*

Using periodic boundary condition over a rectangle a × b (a≠b) shown below, the Sommerf wave function is



where n_x and n_y are integers.

- $\psi(x,y) = A\, e^{i(\frac{2\pi n_x}{a}x)} e^{i(\frac{2\pi n_y}{a}y)}$
- $\psi(x,y) = A \sin(\frac{\pi n_x}{a}x) \sin(\frac{\pi n_y}{b}y)$
- $\psi(x,y) = A\, e^{i(\frac{2\pi n_x}{b}x)} e^{i(\frac{2\pi n_y}{b}y)}$
- $\psi(x,y) = A\, e^{i(\frac{2\pi n_x}{a}x)} e^{i(\frac{2\pi n_y}{b}y)}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\psi(x,y) = A\, e^{i(\frac{2\pi n_x}{a}x)} e^{i(\frac{2\pi n_y}{b}y)}$

4) *1 point*

The time dependent part of the wave function of the electron in the metal strip of previ question is

- $e^{-\frac{i}{\hbar}[\frac{\hbar^2}{2m}(\frac{n_x^2}{a^2}+\frac{n_y^2}{a^2})]t}$
- $e^{\frac{i}{\hbar}[\frac{\hbar^2}{2m}(\frac{n_x^2}{a^2}+\frac{n_y^2}{b^2})]t}$
- $e^{-\frac{i}{\hbar}[\frac{\hbar^2}{2m}(\frac{n_x^2}{a^2}+\frac{n_y^2}{b^2})]t}$
- $e^{-\frac{i}{\hbar}[\frac{\hbar^2}{2m}(\frac{n_x^2}{b^2}+\frac{n_y^2}{b^2})]t}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$e^{-\frac{i}{\hbar}[\frac{\hbar^2}{2m}(\frac{n_x^2}{a^2}+\frac{n_y^2}{b^2})]t}$

5) *1 point*

In a 1D metal wire ,taking periodic boundary condition over length L,the density of states g is

- L/2π
- $(L/2\pi)^2$
- (2π/L)
- (π/L)

No, the answer is incorrect.
Score: 0

Accepted Answers:

L/2π

6) The dependence of density of state $g(E)$ on energy in previous problem is *1 point*

- $\propto E^{3/2}$
- $\propto E^{1/2}$
- $\propto E^{0}$
- $\propto E^{-1/2}$

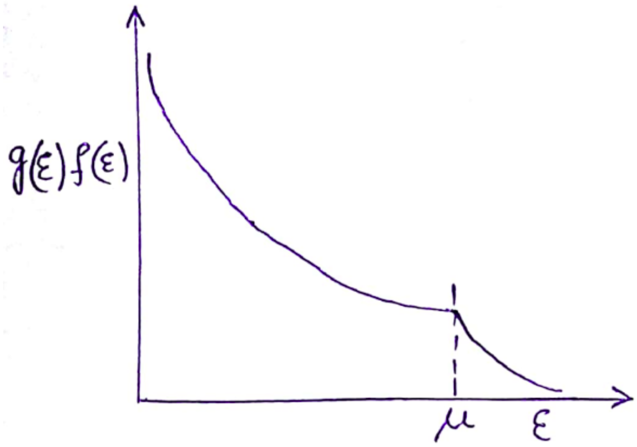
No, the answer is incorrect.
Score: 0

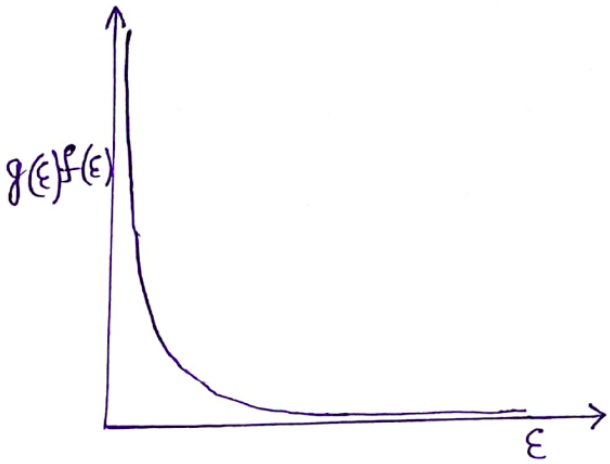
Accepted Answers:

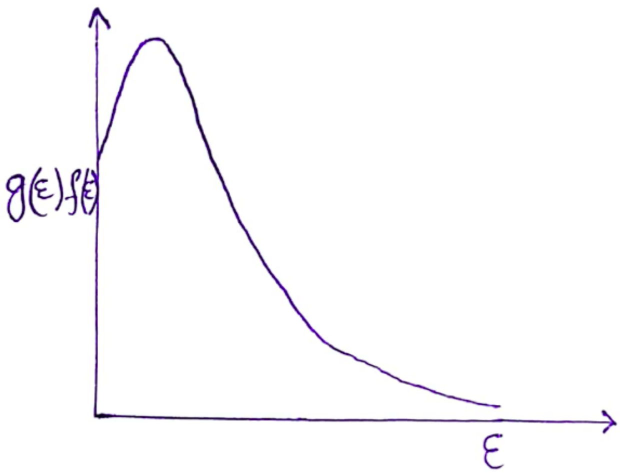
$\propto E^{-1/2}$

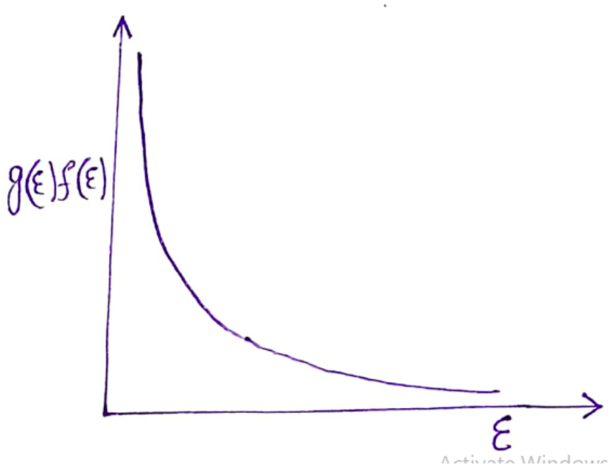
7) *1 point*

At finite T in a 1D metal (wire of length L) the sketch of the density of occupied states is


g(ε)f(ε)
μ
ε

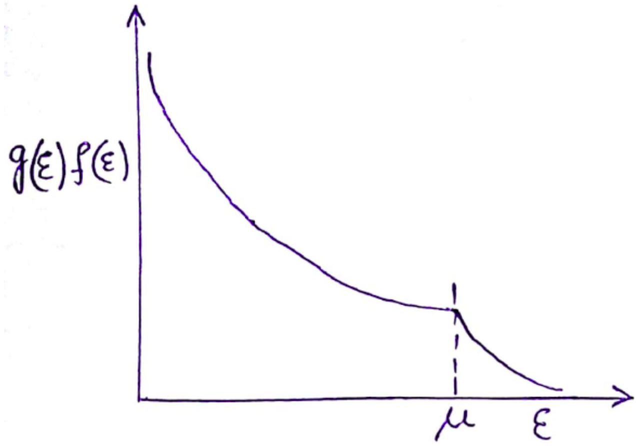

g(ε)f(ε)
ε


g(ε)f(ε)
ε



No, the answer is incorrect.
Score: 0

Accepted Answers:



8) 1 point

The fermi energy of the 1D metal wire of length L is (where N is the total number of electr

- $E_F = \frac{\hbar^2\pi^2}{8m}(\frac{N}{L})^2$
- $E_F = \frac{2\hbar^2\pi^2}{m}(\frac{N}{L})^2$
- $E_F = \frac{2\hbar^2\pi^2}{m}(\frac{N}{L})$
- $E_F = \frac{2\hbar^2\pi^2}{m}(\frac{L}{N})^2$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$E_F = \frac{\hbar^2\pi^2}{8m}(\frac{N}{L})^2$

9) In a pure piece of Aluminium (Al) with $n = 18.06\times10^{22}$ e/c.c. the E_F is 1 point

- 1165 eV
- 116.5 eV
- 1.17 eV
- 11.65 eV

No, the answer is incorrect.
Score: 0

Accepted Answers:

11.65 eV

10) 1 point

Using Drude like approximation for the Sommerfeld model as was done in the lecture w charge (-e) in a 1D metal are subjected to an electric field $\vec{E}$ in the $+x$ direction and τ is the me collision time then the ratio of the energy gained by electron in the metal in steady state in t electric field w.r.t. the fermi energy E_f is

- $(eEv_F\tau/E_f)$
- $(eE\tau/E_f)$
- (eE/E_f)
- $(eE/\tau E_f)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$(eEv_F\tau/E_f)$

Previous Page End