X

Unit 1 - How to access the portal

Register for Certification exam

Course outline

How to access the portal

- How to access the home page?
- How to access the course page?
- How to access the MCQ, MSQ and Programming assignments?
- How to access the subjective assignments?
- Quiz : Assignment 0

Introduction to Drude's free electron theory of metals, electrical conductivity Ohm's law and Hall effect

Introduction to Sommerfeld's model

Assignment 0

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

Due on 2019-02-04, 23:59 IST.

1) *1 point*

- $\vec{F} = -e\vec{E}-\gamma\vec{v}$
- $\vec{F} = e(\vec{v}\times\vec{B})-\gamma\vec{v}$
- $\vec{F} = -e\vec{E}-e(\vec{v}\times\vec{B})-\gamma\vec{v}$
- $\vec{F} = e\vec{E}+e(\vec{v}\times\vec{B})+\gamma\vec{v}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\vec{F} = -e\vec{E}-e(\vec{v}\times\vec{B})-\gamma\vec{v}$

2) *1 point*

20 non-interacting electrons are filled in a 1-D box. Taking into account of Pauli exclusion principle the maximum number of filled level N (at $T = 0$ K) for the ground state is

- N=2
- N = 20
- N = 1
- N= 10

No, the answer is incorrect.
Score: 0

Accepted Answers:
N= 10

3) *1 point*

If the length of the box in Q.2. is 2 Å then the energy of the system (in eV) is given by

electrical conductivity

Introduction to crystal structure and their classifications

Direct Imaging of Atomic Structure, Diffraction of Waves by Crystals, Reciprocal lattice, Brillouin Zones

Vibrations of Crystals with Monatomic Basis, Acoustic modes

Two Atoms per Primitive Basis, Quantization of Elastic Waves, Phonon Momentum

Bloch's theorem for wavefunction of a particle in a periodic potential, nearly free electron model, origin of energy band gaps, discussion of Bloch wavefunction

Band theory of metals, insulators and semiconductors, Kronig-Penney model, tight binding method of calculating bands, and semi-classical dynamics of a particle in a band

Introductory Semiconductor Physics

Magnetism in materials

Superconductivity

Solutions of

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No, the answer is incorrect.
Score: 0

Accepted Answers:
7200

4) **1 point**

Electricalconductivity (σ) and specific heat (C_v)are defined as (where symbols have their usual meanings):

- $\sigma = {}^{l}/_{RA}, Cv = {}^{dQ}/_{dT}$
- $\sigma = {}^{RA}/_{l}, Cv = {}^{dQ}/_{dT}$
- $\sigma = {}^{RA}/_{l}, Cv = -{}^{dQ}/_{dT}$
- $\sigma = {}^{RA}/_{l}, Cv = {}^{dQ}/_{dt}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\sigma = {}^{l}/_{RA}, Cv = {}^{dQ}/_{dT}$

5) **1 point**

Specific heat of a non-interacting monoatomic gas at constant volume is given by (where R = gas constant):

- $5R/2$
- $3R/2$
- $R/2$
- $3R$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$3R/2$

6) What is the Fourier expansion of the square wave given as **1 point**

$$f(x) = \begin{cases} -1 \; for \; -\pi < x < 0 \\ 1 \; for \; 0 < x < \pi \end{cases}$$

where $f(x + 2\pi) = f(x)$

- 0
- $[\sin x + \frac{1}{3}\sin 3x + \frac{1}{5}\sin 5x + \frac{1}{7}\sin 7x + \dots\dots\dots]$
- $\frac{4}{\pi}[\sin x + \frac{1}{3}\sin 3x + \frac{1}{5}\sin 5x + \frac{1}{7}\sin 7x + \dots\dots\dots]$
- $\frac{1}{\pi}[\cos x + \frac{1}{3}\cos 3x + \frac{1}{5}\cos 5x + \frac{1}{7}\cos 7x + \dots\dots\dots]$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{4}{\pi}[\sin x + \frac{1}{3}\sin 3x + \frac{1}{5}\sin 5x + \frac{1}{7}\sin 7x + \dots\dots\dots]$

Assignments

7) Typical wavelength (in Å) range of X-rays is *1 point*

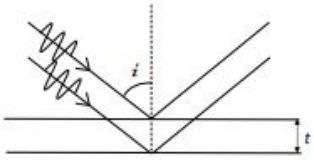
- 1 - 10
- 100 - 1000
- 0.1 - 100
- 1 - 10

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.1 - 100

8) *1 point*

The condition for the constructive interference from a soap water thin film in air of thickness t and reflective index $\mu$and light incident at an angle$i$ on the film(as shown in figure below) is



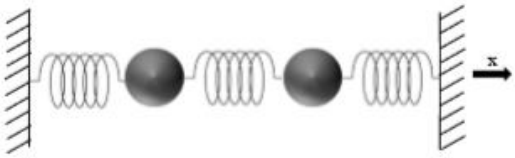
- $2\mu t \cos i = (2n-1)\ \lambda/2$
- $2\mu t \cos i = (2n)\ \lambda/2$
- $2\mu t \cos i = (n^2)\ \lambda/2$
- $2\mu t \cos i = (n+1)\ \lambda/2$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$2\mu t \cos i = (2n-1)\ \lambda/2$

9) *1 point*

Two particles each of mass m are attached through a spring having spring constant k (as shown in figure below). The particles are confined to move only in x direction



Then the natural mode(s) of vibration is(are)

- $\sqrt{\frac{2k}{m}}, \sqrt{\frac{3k}{m}}$
- $\sqrt{\frac{k}{m}}$
- $\sqrt{\frac{3k}{m}}$
- $\sqrt{\frac{k}{m}}, \sqrt{\frac{3k}{m}}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\sqrt{\frac{k}{m}}, \sqrt{\frac{3k}{m}}$

10) **1 point**

Hamiltonian of a simple harmonic oscillator in terms of creation ($a^\dagger$) and annihilation operator (a) is given as

- $H = \hbar\omega\,(aa^\dagger + {}^1/_2)$
- $H = \hbar\omega\,(a^\dagger a + {}^1/_2)$
- $H = \hbar\omega\,(a^\dagger a - {}^1/_2)$
- $H = \hbar\omega\,(aa^\dagger - 1)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$H = \hbar\omega\,(a^\dagger a + {}^1/_2)$

11) **1 point**

Average energy of a classical 3-dimensional harmonic oscillator at temperature T is

-
- $1/2kT$
- $3/2kT$
- 0

No, the answer is incorrect.
Score: 0

Accepted Answers:

12) **1 point**

Wave function of a free electron moving in the x-direction given by the function

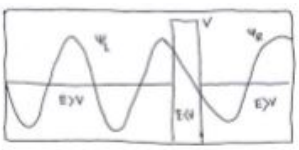
- $\sin^2 x$
- e^{ikx}
- e^{kx}
- 1

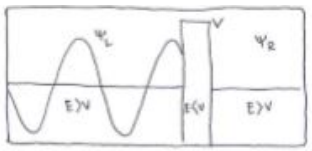
No, the answer is incorrect.
Score: 0

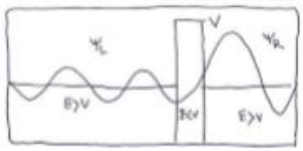
Accepted Answers:
e^{ikx}

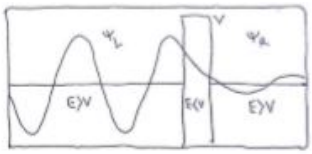
13) **1 point**

A particle with energy E (<V) is moving in the +ve x-direction. Which of the following best describes the wave function ψ(x) in different regions



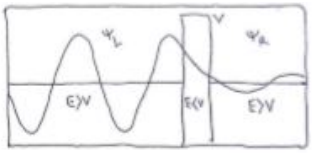






No, the answer is incorrect.
Score: 0

Accepted Answers:



14) *1 point*

In terms of a band gap (E_g) the conductor, insulator and semi-conductor are typically described respectively by

a) $E_g<0, E_g=0, E_g>0$
b) $E_g=0, E_g>0, E_g>>0$
c) $E_g=0, E_g>>0, E_g>0$
d) $E_g>0, E_g=0, E_g>>0$

No, the answer is incorrect.
Score: 0

Accepted Answers:
c) $E_g=0, E_g>>0, E_g>0$

15) *1 point*

Behaviour of the resistance(R) of a pure metal as a function of temperature(T) is described by

a) $R \propto 1/T$
b) $R \propto T$
c) R is independent of T
d) None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
b) $R \propto T$

16) *1 point*

Susceptibility of a diamagnetic (χ_d) and paramagnetic (χ_p) material are given respectively as

a) $\chi_d<0, \chi_p>0$

b) $\chi_d=0, \chi_p>0$

c) $\chi_d<0, \chi_p=0$

d) $\chi_d>0, \chi_p<0$

No, the answer is incorrect.
Score: 0

Accepted Answers:
a) $\chi_d<0, \chi_p>0$

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