Started on	Monday, 4 September 2023, 6:50 PM
State	Finished
Completed on	Monday, 4 September 2023, 7:04 PM
Time taken	14 mins 43 secs
Grade	**8.00** out of 10.00 (**80**%)

Question 1

Correct

Mark 1.00 out of 1.00

In Drude Model, only possible interaction of free electron with its environment is via

Select one:

- ○ a. Particle velocity
- ◉ b. Instantaneous collision ✔
- ○ c. Carrier diffusion process.
- ○ d. Particle acceleration

Your answer is correct.

The correct answer is: Instantaneous collision

Question 2

Correct

Mark 1.00 out of 1.00

Correct statement about the Drude-Sommerfeld model

Select one:

- ○ a. None of the other options
- ○ b. Interaction with nearest-electrons and ionized particles are ignored and instead, a global interaction value is considered.
- ◉ c. Throughout the solid, potential is considered to have a constant value. ✔
- ○ d. Potential is minimal/zero near the ionized core and maximum in-between, following the periodicity similar to the lattice.

Your answer is correct.

The correct answer is: Throughout the solid, potential is considered to have a constant value.

Question 3

Correct

Mark 1.00 out of 1.00

Identify the correct answer on Fermi temperature.

Select one:

○ a. Fermi temperature is an intrinsic property of the material this can have a very low value or upto room temperature depending on material's defect states, valency etc.

◉ b. Usually, Fermi temperature is much higher than room temperature. Reason is: electrons are fermions and obeys Pauli exclusion principle. As electrons cannot occupy the same state, they are forced to occupy higher energy states resulting in high Fermi energy and high Fermi temperature. ✓

○ c. Usually, Fermi temperature is very low compared to the room temperature. This is because, at Fermi temperature, phonon contribution to the electrical and thermal conductivity must be very low.

○ d. Fermi temperature is the temperature where phonon contribution plays an dominating role in materials' electrical and thermal conductivity. So this can be closer to room temperature.

Your answer is correct.

The correct answer is: Usually, Fermi temperature is much higher than room temperature. Reason is: electrons are fermions and obeys Pauli exclusion principle. As electrons cannot occupy the same state, they are forced to occupy higher energy states resulting in high Fermi energy and high Fermi temperature.

Question 4

Correct

Mark 0.50 out of 0.50

In Krönnig-Penney model, the forbidden gap has following relationship with energy (E):

Select one:

◉ a. Gap decreases with increasing E ✓

○ b. The gap is independent of E

○ c. There is no forbidden gap

○ d. The gap increases with increasing E
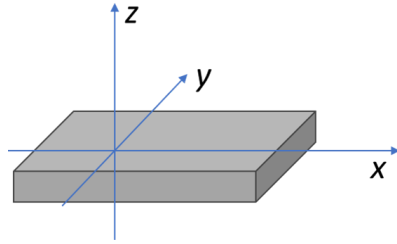
Your answer is correct.

The correct answer is: Gap decreases with increasing E

Question 5

Correct

Mark 1.00 out of 1.00

Consider that a device is fabricated in the following rectangular shape of a metallic compound.

Identify the correct statement in connection with the carrier effective mass of the charge carries.

Select one:

○ a. Conductivity of the electron carriers will have same along all directions, but holes will have different conductivity depending on heavy, light or split-off bands.

◉ b. Conductivity of the charge carriers can be different along different directions, depending on material's anisotropic band dispersion and crystal structure. ✓

○ c. Carrier conductivity in the device is same in all directions since it is made from a single material.

○ d. Carrier conductivity in the device is same along the x-y direction and can be different along z depending on crystal structure of the material.

Your answer is correct.

The correct answer is: Conductivity of the charge carriers can be different along different directions, depending on material's anisotropic band dispersion and crystal structure.

Question 6

Correct

Mark 1.00 out of 1.00

If h,k,l are the miller indices, then the symmetrically equivalent planes are represented as:

Select one:

○ a. <hkl>

○ b. $[hkl]$

◉ c. $\{hkl\}$

✓

○ d. (hkl)

Your answer is correct.

The correct answer is: $\{hkl\}$

Question 7

Correct

Mark 1.00 out of 1.00

Identify the correct statement on the Debye temperature.

Select one:

○ a. Debye temperature is defined as the reference temperature below which electrons behaves as Fermions and at higher temperature it follows the Maxwell–Boltzmann distribution.

◉ b. Debye temperature is the temperature above which the phononic contribution of resistivity dominates and it increases linearly with temperature. ✔

○ c. Debye temperature is the temperature above which only, the electronic correlation and scattering plays an dominating role and the carriers follows the Kronig penney model

○ d. Debye temperature is the temperature above which the Drude-Sommerfeld model is invalid for metals.

Your answer is correct.

The correct answer is: Debye temperature is the temperature above which the phononic contribution of resistivity dominates and it increases linearly with temperature.

Question 8

Incorrect

Mark 0.00 out of 1.00

Identify the correct statement regarding the Fermi energy (E_F):

Select one:

○ a. At a non zero temperature, all the states below E_F are completely filled for a metal.

○ b. E_F is a reference energy and depending on the respective temperature, appears at same value for different materials/metals

○ c. Generally E_F has different values for different materials/metals.

◉ d. At zero temperature, E_F defines the energy where Fermi-Dirac distribution function is 0.5 ✘

Your answer is incorrect.

The correct answer is: Generally E_F has different values for different materials/metals.

Identify correct statement related to the Wiedemann Franz Law:

Select one:

    ○   a. This is an empirical law with expression: $\frac{k}{\rho T}$ =constant

    ○   b. This is mathematically derived by the Drude model for any material with expression: $\frac{k}{\sigma T}$ =constant

    ○   c. This is mathematically derived by the Drude model with expression: $\frac{k}{\rho T}$ =constant

    ◉   d. This is an empirical law, valid for metals only with expression: $\frac{k}{\sigma T}$ =constant

        ✔

Your answer is correct.

The correct answer is: This is an empirical law, valid for metals only with expression: $\frac{k}{\sigma T}$ =constant

Correct statement about the Bloch electron in a solid:

Select one:

    ○   a. Both the Wavefunction and probability are periodic in nature with respect to the lattice parameter of the system.

    ◉   b. The wavefunction is not periodic in nature, but it's probability is periodic. ✔

    ○   c. Wavefunction is periodic in nature with respect to the lattice parameter of the system.

    ○   d. Neither the Wavefunction or the probability are periodic in nature. But the carrier potential is periodic.

Your answer is correct.

The correct answer is: The wavefunction is not periodic in nature, but it's probability is periodic.

Question 11

Incorrect

Mark 0.00 out of 1.00

Correct sentence regarding the relaxation time and atomic collision:

Select one:

○ a. Relaxation time ζ is system's intrinsic property and hence independent of temperature. ✗

○ b. With increased temperature relaxation time ζ increases.

○ c. With increased temperature relaxation time ζ decreases.

○ d. Atomic collision is controlled by system's kinetic energy and hence the relaxation time ζ exponentially increases at higher temperature.

Your answer is incorrect.

The correct answer is: With increased temperature relaxation time ζ decreases.

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