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NPTEL

Courses » Micro and nano scale energy transport

Announcements   **Course**   Forum   Progress   Mentor

Unit 9 - Week 8

Week 8 assignment 1

The due date for submitting this assignment has passed. **Due on 2017-09-25, 23:59 IST.**

Submitted assignment

Answer the following questions, More than one option can be correct.

1) In the derivation of the ohm's law from BTE (Boltzmann Transport Equation), consider the correct statements.   **1 point**

☐ A. The gradient of equilibrium distribution function with respect to Fermi energy level has to be accounted.

☐ B. The electric field due to the transport of electrons has to be included in the equation.

☐ C. For metals, we can assume the gradient of Fermi energy level with respect to position is significant

☐ D. All the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
A. The gradient of equilibrium distribution function with respect to Fermi energy level has to be accounted
B. The electric field due to the transport of electrons has to be included in the equation.

2) From BTE, the electrical conductivity of the metals is dependent on   **1 point**

☐ A. Velocity

☐ B. Density of states

☐ C. Relaxation time

☐ D. Heat capacity

No, the answer is incorrect.
Score: 0

Accepted Answers:
A. Velocity
B. Density of states
C. Relaxation time

3) The thermal conductivity expression of the system derived from BTE, is dependent on   **1 point**

☐ A. Phonon velocity

☐ B. Density of states

☐ C. Frequency

☐ D. Heat capacity

No, the answer is incorrect.
Score: 0

Accepted Answers:
A. Phonon velocity

Week 12

B. Density of states
C. Frequency
D. Heat capacity

4) Choose the correct statements   ***1 point***

☐ A. The variation of equilibrium distribution function with fermi energy level and temperature are important during thermo electric transport phenomena.

☐ B. The variation of equilibrium distribution with temperature is negligible during heat transport.

☐ C. The variation of equilibrium distribution with fermi energy is significant during electron transport.

☐ D. All the above.

No, the answer is incorrect.
Score: 0

Accepted Answers:
A. The variation of equilibrium distribution function with fermi energy level and temperature are important during thermo electric transport phenomena.
C. The variation of equilibrium distribution with fermi energy is significant during electron transport.

5) For flow transport phenomena where bulk velocity is significant, the following statements are ***1 point*** true.

☐ A. The displaced equilibrium distribution function is used

☐ B. The molecular velocity has to corrected by considering the bulk velocity in a direction

☐ C. Molecular velocity can be neglected

☐ D. Bulk velocity is neglected and molecular velocity is used.

No, the answer is incorrect.
Score: 0

Accepted Answers:
A. The displaced equilibrium distribution function is used
B. The molecular velocity has to corrected by considering the bulk velocity in a direction

6) Continuum approximation applicability depends on   ***1 point***

☐ A. Knudsen number

☐ B. Time scales

☐ C. Length scales

☐ D. All the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
D. All the above

7) Consider the wrong statements   ***1 point***

☐ A. Cattaneo equation is a corrected form of Fourier's equation

☐ B. Relaxation time factor is neglected in Cattaneo equation

☐ C. Temperature dependence on all time scales is accounted in this equation

☐ D. Hyperbolic heat conduction equation considers the finite speed of propagation of heat

No, the answer is incorrect.
Score: 0

Accepted Answers:
B. Relaxation time factor is neglected in Cattaneo equation

8) . In order to find the size effects on transport phenomena, the BTE is modified by considering ***1 point*** the following assumptions

☐ A. Transient terms of equilibrium distribution and change in the equilibrium distribution are neglected

☐ B. The variation of perturbation distribution function with respect to position and momentum space is negligible compared to equilibrium distribution function.

   ☐ C. Physical time scales are comparable with relaxation time scales.

   ☐ D. All the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
A. Transient terms of equilibrium distribution and change in the equilibrium distribution are neglected

9) Choose the correct answers for the case of transport phenomena in thin films   ***1 point***

   ☐ A. The gradients of equilibrium distribution function along the transport direction is significant

   ☐ B. The gradients of equilibrium distribution function along the transport direction is negligible

   ☐ C. The gradients of perturbation distribution function perpendicular to the transport direction is significant

   ☐ D. All the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
A. The gradients of equilibrium distribution function along the transport direction is significant
C. The gradients of perturbation distribution function perpendicular to the transport direction is significant

10) The distortion in equilibrium distribution function happening in perpendicular direction even   ***1 point***
though the transport is parallel to thin film, is due to,

   ○ A. Electron - electron scattering

   ○ B. Phonon-phonon scattering

   ○ C. Electron-phonon scattering

   ○ D. Electron- boundary scattering

No, the answer is incorrect.
Score: 0

Accepted Answers:
D. Electron- boundary scattering

11) During the transport phenomena parallel to thin film, consider the correct assumptions   ***1 point***

   ☐ A. The gradients of perturbation function is significant along the transport direction

   ☐ B. The gradients of perturbation function perpendicular to the confinement, contains the size effect information

   ☐ C. The gradients of equilibrium distribution function is significant along the transport direction

   ☐ D. The gradients of perturbation and equilibrium distribution functions, are negligible along the direction of transport.

No, the answer is incorrect.
Score: 0

Accepted Answers:
B. The gradients of perturbation function perpendicular to the confinement, contains the size effect information
C. The gradients of equilibrium distribution function is significant along the transport direction

12) The solution for perturbation distribution function, for transport process in thin films   ***1 point***

   ☐ A. Depends upon the direction of scattering

   ☐ B. Type of scattering

   ☐ C. Dependence of equilibrium function on fermi energy for electron transport

   ☐ D. Dependence of equilibrium function on temperature for heat transport

No, the answer is incorrect.
Score: 0

Accepted Answers:
A. Depends upon the direction of scattering
B. Type of scattering
C. Dependence of equilibrium function on fermi energy for electron transport

D. Dependence of equilibrium function on temperature for heat transport

13)Whenever a phonon distribution function encounters a diffusive interface   *1 point*

   ☐ A. The distribution function will change only with physical coordinate

   ☐ B. The distribution function will change with direction of scattering

   ☐ C. The distribution function will be uniform and will not change with direction

   ☐ D. The distribution function equals equilibrium distribution which is independent of directional space

No, the answer is incorrect.
Score: 0

Accepted Answers:
A. The distribution function will change only with physical coordinate
C. The distribution function will be uniform and will not change with direction
D. The distribution function equals equilibrium distribution which is independent of directional space

14)For specular scattering boundary condition, consider the true statements   *1 point*

   ☐ A. The distribution function will equal to equilibrium distribution function

   ☐ B. The perturbation function value is non-zero

   ☐ C. The perturbation function becomes zero

   ☐ D. None of these

No, the answer is incorrect.
Score: 0

Accepted Answers:
B. The perturbation function value is non-zero

15)Choose the correct statements   *1 point*

   ☐ A. The ratio of thin film electrical conductivity to bulk electrical conductivity becomes one, when Knudsen number is small

   ☐ B. This ratio will be less than one, for large Knudsen numbers

   ☐ C. This ratio will be greater than one, for large Knudsen numbers

   ☐ D. This ratio will be less than one, for small values of Knudsen number

No, the answer is incorrect.
Score: 0

Accepted Answers:
A. The ratio of thin film electrical conductivity to bulk electrical conductivity becomes one, when Knudsen number is small
B. This ratio will be less than one, for large Knudsen numbers

16)For thin films, consider the wrong statements   *1 point*

   ☐ A. For specular boundary condition, transport parallel to thin film, there is effect of size on electrical and thermal conductivitivies

   ☐ B. For the transport in the direction of confinement, the effect of size on conductivities, is similar for both diffusive and specular interfaces

   ☐ C. For diffusive interfaces, size effects on conductivities are significant

   ☐ D. For diffusive interfaces, size effects on conductivities are negligible

No, the answer is incorrect.
Score: 0

Accepted Answers:
A. For specular boundary condition, transport parallel to thin film, there is effect of size on electrical and thermal conductivitivies
D. For diffusive interfaces, size effects on conductivities are negligible

17)Choose the correct pairs   *1 point*

   ☐ A. Specularity '0' - decrease in conductivities

   ☐ B. Specularity '1' - constant conductivities (parallel to thin film)

   ☐ C. Specularity '1' - constant conductivites (direction of confinement)

    ☐ D. Specularity '0' - increase in conductivities

No, the answer is incorrect.
Score: 0

Accepted Answers:
A. Specularity '0' - decrease in conductivities
B. Specularity '1' - constant conductivities (parallel to thin film)

18) While deriving the thin film conductivity, where transport is in the direction of confinement, the **1 point** following assumptions are accounted

    ☐ A. Distribution function is expressed in terms of intensities
    ☐ B. Intensities are used to evaluate the temperatures
    ☐ C. Non-dimensional representation of length scales in terms of mean free path, are used
    ☐ D. All the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
D. All the above

Previous Page   End