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Unit 3 - Week 2 : Excursion in Solid State Physics

Assignment 2

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment. **Due on 2018-08-15, 23:59 IST.**

1) Number of lattice points per unit cell in a body-centered cubic lattice is ***1 point***

- 1
- 2
- 3
- 4

No, the answer is incorrect.
Score: 0

Accepted Answers:
2

2) Gallium Arsenide (GaAs) has a zinc-blend crystal structure (which is equivalent to face-centered cubic lattice with two atoms per lattice point). Assume a lattice spacing of $a = 5.65$ angstrom. How many numbers of atoms per cc are there in GaAs? ***1 point***

- 4.44×10^{22}
- 2.22×10^{22}
- 1.42×10^{8}
- 2.51×10^{15}

No, the answer is incorrect.
Score: 0

Accepted Answers:

- 164.1
- 2.88

No, the answer is incorrect.
Score: 0

Accepted Answers:
2.88

4) Consider a semiconductor whose energy dispersion relation for the conduction band is defined by ***1 point***

$E = A + B(k - C)^2$

where, A, B and C are constants. Assume the mobility of the electron is μ_0. Find the mean free time of electrons in the conduction band.

- $\frac{\mu_0}{2Bq\hbar^2}$
- $\frac{Bq\hbar^2}{\mu_0}$
- $\frac{\mu_0\hbar^2}{2Bq}$
- None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{\mu_0\hbar^2}{2Bq}$

5) Assume that the electrons in an n-doped crystalline silicon suffer scattering only due to i) the lattice vibration and ii) the interaction with impurity ions. At an extremely low temperature region, mobility _____ with increase in temperature. (Fill in the gap) ***1 point***

- increases
- decreases
- remains constant
- becomes zero

No, the answer is incorrect.
Score: 0

Accepted Answers:
increases

6) Consider a 1D crystal with lattice constant '**a**' and crystal length '**L**'. Where do you observe the energy band gaps on the energy dispersion graph (E-k diagram)? ***1 point***

- At $k = n\frac{\pi}{a}$, where n is an integer
- At $k = n\frac{\pi}{L}$, where n is an integer
- At $k = n\frac{\pi}{a}$, where n is any real number
- At $k = n\frac{\pi}{L}$, where n is any real number

No, the answer is incorrect.
Score: 0

Accepted Answers:
At $k = n\,\frac{\pi}{a}$, where n is an integer

7) What is a Brillouin zone? ***1 point***

- A region of position-space where the electrons can reside within.
- A region of energy-space that contains all the allowed energy levels.
- Another name for the unit cell of the crystal.
- A region of k-space that contains all the unique solutions of the wave-equation.

No, the answer is incorrect.
Score: 0

Accepted Answers:
A region of k-space that contains all the unique solutions of the wave-equation.

8) Consider the following 1D band structure: ***1 point***
$E(k_x) = \hbar v_F |k_x|$
where, v_F is a velocity. What is the effective mass?

- $m^* = \hbar v_F$
- $m^* = \infty$
- $m^* = 0$
- Not defined

No, the answer is incorrect.
Score: 0

Accepted Answers:
Not defined

9) Bloch's theorem for a periodic potential is given by, $\psi(x+a) = \psi(x)e^{ika}$, where '$a$' is the lattice constant. Assume that $u(x)$ is the periodic lattice potential given by $u(x+a) = u(x)$. Which of the following represents an equivalent mathematical form of Bloch's theorem? ***1 point***

- $\psi(x+a) = u(x)e^{ikx}$
- $\psi(x+a) = u(x+a)e^{ika}$
- $\psi(x) = u(x)e^{ikx}$
- $\psi(x) = u(x)e^{ik(x+a)}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\psi(x) = u(x)e^{ikx}$

10) Molybdenum (Mo) crystallizes in a body-centered cubic structure with a lattice constant of $a = 3.147$ angstrom. If the radius of a Mo atom is one-half of the center-to-center spacing of the nearest neighbours, compute the percent of the cubic volume, a^3, that is occupied by Mo atoms. ***1 point***

- 50 %
- 68 %
- 32 %
- 78 %

No, the answer is incorrect.
Score: 0

Accepted Answers:
68 %

Previous Page End