PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Semiconductor Physics - CSIR NET Physics PYQs

Solid State Physics . All PYQs (2015-2025) with answer key

7 questions . Answer key included

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Q1. [June 2015] . 3.5 marks

Solid State Physics > Semiconductor Physics

CSIR NET	2015 June	3.5 M

The concentration of electrons, n, and holes, p, for an intrinsic semiconductor at a temperature T can be expressed as $n = p = AT^{3/2}\exp\left(-\frac{E_g}{2k_BT}\right)$, where E_g is the band gap and A is a constant. If the mobility of both types of carriers is proportional to $T^{-3/2}$, then the log of the conductivity is a linear function of T^{-1}. with slope

1. $E_g/(2k_B)$
2. E_g/k_B
3. $-E_g/(2k_B)$
4. $-E_g/k_B$

Q2. [June 2017] . 5.0 marks

Solid State Physics > Semiconductor Physics

CSIR NET	2017 June	5M

The energy gap and lattice constant of an indirect band gap semiconductor are1.875 eV and $0.52nm$, respectively. For simplicity take the dielectric constant of the material to be unity. When it is excited by broadband radiation, an electron initially in the valence band at $k = 0$ makes a transition to the conduction band. The wavevector of the electron in the conduction band, in terms of the wavevector k_{max} at the edge of the Brillouin zone, after the transition is closest to

1. $k_{\text{max}}/10$
2. $k_{\text{max}}/100$
3. $k_{\text{max}}/1000$
4. 0

Q3. [June 2017] . 5.0 marks

Solid State Physics > Semiconductor Physics

CSIR NET	2017 June	5M

The electrical conductivity of copper is approximately 95% of the electrical conductivity of silver, while the electron density in silver is approximately 70% of the electron density in copper. In Drude's model, the approximate ratio τ_{Cu}/τ_{Ag} of the mean collision time in copper (τ_{Cu}) to the mean collision time in silver (τ_{Ag}) is

1. 0.44
2. 1.50
3. 0.33
4. 0.66

Q4. [Dec 2018] . 5.0 marks

Solid State Physics > Semiconductor Physics

CSIR NET	2018 Dec	5M

A silicon crystal is doped with phosphorus atoms. (The binding energy of a H atom is $13.6eV$, the dielectric constant of silicon is 12 and the effective mass of electrons in the crystal is $0.4m_e$). The gap between the donor energy level and the bottom of the conduction band is nearest to

1. 0.01 eV
2. 0.08 eV
3. 0.02 eV
4. 0.04 eV

Q5. [June 2018] . 5.0 marks

Solid State Physics > Semiconductor Physics

CSIR NET	2018 June	5M

The dispersion relation for the electrons in the conduction band of a semiconductor is given by $E = E_0 + \alpha k^2$ where α and E_0 are constants. If ω_c is the cyclotron resonance frequency of the conduction band electrons in a magnetic field B, the value of α is

1. $\frac{\hbar\omega_c}{4eB}$
2. $\frac{2\hbar^2\omega_c}{eB}$
3. $\frac{\hbar^2\omega_c}{eB}$
4. $\frac{\hbar^2\omega_c}{2eB}$

Q6. [June 2019] . 5.0 marks

Solid State Physics > Semiconductor Physics

CSIR NET	2019 June	5M

A bound electron and hole pair interacting via Coulomb interaction in a semiconductor is called an exciton. The effective masses of an electron and a hole are about $0.1m_e$ and $0.5m_e$ respectively, where m_e is the rest mass of the electron. The dielectric constant of the semiconductor is 10 . Assuming that the energy levels of the excitons are hydrogen- like, the binding energy of an exciton (in units of the Rydberg constant) is closest to

1. 2×10^{-3}
2. 2×10^{-4}
3. 8×10^{-4}
4. 3×10^{-3}

Q7. [June 2025] . 5.0 marks

Solid State Physics > Semiconductor Physics

CSIR NET	2025 June	5M	SSP

A semiconductor has the dispersion relation $E = E_0 - A\cos(\alpha k_x)$, where A and α are positive constants. The effective electron mass close to the minimum energy is

1. $\frac{\hbar^2}{A^2\alpha}$
2. $\frac{1}{4}\frac{\hbar^2}{A^2\alpha}$
3. $\frac{\hbar^2}{A\alpha^2}$
4. $\frac{1}{2}\frac{\hbar^2}{A\alpha^2}$

Answer Key

7 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Solid State Physics	Semiconductor Physics	**3**
Q2	Solid State Physics	Semiconductor Physics	**3**
Q3	Solid State Physics	Semiconductor Physics	**4**
Q4	Solid State Physics	Semiconductor Physics	**4**
Q5	Solid State Physics	Semiconductor Physics	**4**
Q6	Solid State Physics	Semiconductor Physics	**3**
Q7	Solid State Physics	Semiconductor Physics	**3**

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