

Answers: Charge Transport in Semiconductors

Q1. Thermal Motion

Answer: b) Zero

• In equilibrium, carriers move randomly, so the average *net* velocity is zero. (They still move with thermal velocity $\sim 10^7$ cm/s, but in random directions.)

Q2. Scattering and Mobility

Answer: b) Ionized impurity scattering

• At high doping levels, Coulombic interactions with ionized impurities dominate and reduce mobility.

Q3. Drift and Velocity Saturation

Answer: c) 10^7 cm/s

• In Si at 300 K, electron drift velocity saturates around 1×10^7 cm/s

Q4. Diffusion Current

Answer: b) $J_e = -qD_e \frac{dn}{dx}$

This is Fick's first law for electron diffusion current. The minus sign reflects flow down the concentration gradient.

Q5. Einstein Relation

Answer: c) Thermal voltage

• kT/q is the **thermal voltage**, ~ 26 mV at 300 K. It links mobility (drift) and diffusion in semiconductors.