

ECE 121

Concept Questions: Materials and Devices

1. What is the number of atoms/m³ of silicon given the density of Si is 2.33 g/cm³ and the atomic weight of Si is 28.1 g/mole. Note that a mole is defined as the quantity of a substance equal to its molecular weight in grams. In any material, the number of molecules contained in a mole is Avagadro's number (6.02×10^{23} atoms/mole).
 - (a) 5×10^{22}
 - (b) 5×10^{24}
 - (c) 5×10^{26}
 - (d) 5×10^{28}
2. A value for ρ of $2 \times 10^{-8} \Omega \cdot \text{m}$ makes the most sense for:
 - (a) gold
 - (b) undoped silicon
 - (c) doped silicon
 - (d) glass
3. Silicon has a native oxide layer when exposed to air. What is the thickness of this layer?
 - (a) 15 μm
 - (b) 1.5 μm
 - (c) 15 nm
 - (d) 1.5 nm

4. Silicon crystallizes in the diamond structure which is a face centered cubic with 4 additional interior atoms. Miller indices identify crystal planes. What crystal plane in silicon has the highest density of atoms?
- (a) [100]
 - (b) [111]
 - (c) [110]
 - (d) [001]
5. The _____ method is a method for producing a large _____ of _____ silicon from a seed that is pulled and rotated from molten Si held in a crucible.
- (a) Czochralski, wafer, polycrystalline
 - (b) Float zone, wafer, single crystal
 - (c) Czochralski, ingot, single crystal
 - (d) Float zone, ingot, polycrystalline
6. The majority carriers in a p-type semiconductor are holes (True/False).
7. Doping silicon with a column V element results in:
- (a) mobile holes that leave behind negatively charged donors
 - (b) free electrons that leave behind positively charged donors
 - (c) mobile holes that leave behind negatively charged acceptors
 - (d) free electrons that leave behind positively charged acceptors
8. Silicon doped with a column III element has a Fermi level energy closer to the conduction band (True/False).

9. When a p-n junction is formed, majority carriers from each side move to low concentration areas creating a charge neutral depletion region at the junction. This area contains:
- (a) positively charged acceptors and negatively charged donors
 - (b) negatively charged acceptors and negatively charged donors
 - (c) positively charged acceptors and positively charged donors
 - (d) negatively charged acceptors and positively charged donors
10. In a MOSFET, an important device feature is
- (a) an exponential increase in current when a positive voltage is applied to the p-type silicon.
 - (b) a linear current response to a positive voltage applied to the n-type silicon.
 - (c) a channel between source and drain that is controlled by voltage applied to the gate.
 - (d) an exponential increase in current when a positive voltage is applied to the n-type silicon.