Problems Solutions Chapter 1

Solutions for the problems in chapter 1 of the book Electronic Devices 9th edition.

1. A neutral atom with atomic number 6 will have 6 electrons and 6 protons.

2. The maximum number of electrons that can exist in an given atom shell n is calculated by the formula

$$N = 2n^2$$

This means that the maximum number of electronics in the third shell of an atom is

$$2 \cdot 3^2 = 2 \cdot 9 = 18$$

3. Materials are categorized into three groups called isolators, semiconductors, and conductors. Isolators have the largest band gap between the conduction band and valence band. Semiconductors will have a smaller band gap than isolators. Conductors have an overlap between the conduction band and the valence band.

4. There are several types of atoms that have four valence electrons, for example silicon and germanium. These types of atoms are classified as semiconductors.

5. A single atom in a silicon crystal forms four covalent bounds.

6. Adding heat to silicon will cause valence electrons to become free electrons, this increases the conductivity.

7. The valencen band and the conduction band are the two energy bands at which current is produced in silicon.

8. Doping intentionally introduces impurities into an extremely pure intrinsic semiconductor for the purpose of modulating its electrical properties. N-doping increases the number of free electrons by adding impurity atoms that have five valence electrons. P-doping increases the number of holes by adding impurity atoms that have three valence electrons.

9. Antimony is a chemical element that can be used as a dopant to create n-type silicon.

Boron is a chemical element that can be used as a dopant to create p-type silicon.

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