



POSTAL BOOK PACKAGE 2025

ELECTRICAL ENGINEERING

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CONVENTIONAL Practice Sets

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Introduction to Engineering Materials

Q1 Discuss the difference in covalent bonding in carbon as:

- (i) diamond (ii) graphite

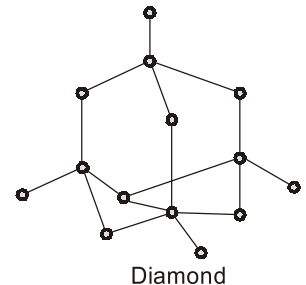
Solution:

(i) **Covalent bonding of Carbon in diamond:**

In diamond, every carbon atom bonds with four other adjoining atoms in a continuous network. No electrons are left unbonded. This results in very strong bonds between carbon atoms and is responsible for the great hardness of diamonds and their clear colourless appearance. Their great density bends light more than other crystals do making their appearance so spectacular.

Valence electrons of carbon atoms in diamonds are bonded to 4 electrons in **Tetrahedral arrangement**. The covalent bond is very strong, this makes diamonds have high melting points, the covalent bond in three dimensional structure causes diamond to become the hardest material.

The bonding of electrons, diamonds have tetrahedral shaped structures. Tetrahedral is one of the strongest structures. Diamond forces more carbon atoms into a smaller denser package. Since there are no free electrons to wander through the structure, diamonds are excellent insulators. The brilliance and fire of cut diamonds is due to a very high index of refraction (2.42) and the strong dispersion of light, properties which are related to the structure of diamonds.



(ii) **Covalent bonding of Carbon in Graphite:**

In graphite, each carbon atom shares electrons with only three neighbouring carbon atoms, leaving the fourth electron relatively free to roam around from one carbon atom to another, in much the same way as metals do. The carbon atoms form a network consisting of layers of interconnected carbons able to slide against each other making in a pencil. Unlike diamond, graphite is soft, pitch black in colour, and conducts electricity due to the free roaming valence electrons.

Valence electrons of graphite are only bonded to 3 valence electrons, so the covalent bond in hexagonal ring. Graphite is softer than diamond because they are held by weak intermolecular force. Graphite sheet like array of carbon atoms joined with minimal pressure.

Q2 (a) What is the value of directional bond angle in diamond and also write the coordination number of diamond cubic structure?

- (b) An electric field in a medium having relative permittivity '7' is passed into medium of relative permittivity of '2'. If \vec{E} makes an angle of 60° with the boundary normal then what angle does the field make with normal in the second medium?

Solution:

- (a) As we know that diamond structure has sp^3 hybrid covalent bond and each of its atom has four bonds. The directional bond angle in diamond structure is 109.5° . There are tetrahedral coordination of carbon atoms, hence the coordination number of diamond cubic structure is **Four (4)**.

