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Director's Message

Engineers and scientists from several disciplines have been involved in shaping the revolutionary growth of technology in India. During the last few decades of engineering academics, India has witnessed geometric growth in engineering pass-out candidates. It is noticeable that the level of engineering knowledge has degraded gradually, while on the other hand competition has increased in each competitive examination including GATE and UPSC examinations. Under such scenario high level efforts are required to take an edge over other competitors.



B. Singh (Ex. IES)

The objective of MADE EASY books is to introduce a simplified approach to the overall concepts of related stream in a single book with specific presentation. The topic-wise presentation will help the readers to study & practice the concepts and questions simultaneously, which is very useful for Freshers.

The efforts have been made to provide close and illustrative solutions in lucid style to facilitate understanding and quick tricks are introduced to save time.

Following tips during the study may increase efficiency and may help in order to achieve success.

- Thorough coverage of syllabus of all subjects
- Adopting right source of knowledge, i.e. standard reading text materials
- Develop speed and accuracy in solving questions
- Balanced preparation of technical and non-technical subjects with focus on key subjects
- Practice online and offline modes of tests
- Appear on self assessment tests
- Good examination management
- Maintain self motivation
- Avoid jumbo and vague approach, which is time consuming in solving the questions
- Good planning and time management of daily routine
- Group study and discussions on a regular basis
- Extra emphasis on solving the questions
- Self introspection to find your weaknesses and strengths
- Study the exam pattern to understand the level of questions
- Apply shortcuts and learn standard results and formulae to save time

B. Singh (Ex. IES)

CMD, MADE EASY Group

E&T ENGINEERING

Objective Solved Paper-I

UPSC Engineering Services Examination

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I

UNIT

Materials and Components

Syllabus

Structure and properties of Electrical Engineering materials; Conductors, Semiconductors and Insulators, magnetic, Ferroelectric, Piezoelectric, Ceramic, Optical and Superconducting materials. Passive components and characteristics Resistors, Capacitors and Inductors; Ferrites, Quartz crystal Ceramic resonators, Electromagnetic and Electromechanical components.

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Crystalline Structures

- 1.1 The difference between the number of atoms in a unit cell of a BCC crystal and an FCC crystal is
 (a) 1 (b) 2
 (c) 4 (d) 6

[IES-2000]

- 1.2 When BCC iron is heated, it changes to FCC iron resulting in
 (a) contraction in volume
 (b) increase in volume
 (c) no change in volume
 (d) crack in the material

[IES-2002]

- 1.3 In a silicon crystal, the arrangement of atoms repeats periodically. This type of material is classified as
 (a) Amorphous and non-crystalline
 (b) Non-crystalline and epitaxial
 (c) Epitaxial and single crystal
 (d) Amorphous and single crystal

[IES-2003]

- 1.4 **Assertion (A):** Every material has a different value of energy band gap except metals which have no band gap.

Reason (R): The energy band gap is decided by the equilibrium lattice constant which is different in different materials.

- (a) Both A and R are true and R is the correct explanation of A
 (b) Both A and R are true but R is NOT the correct explanation of A
 (c) A is true but R is false
 (d) A is false but R is true

[IES-2003]

- 1.5 Match **List-I** (Type of Material) with **List-II** (Type of Bonding) and select the correct answer using the codes given below the lists:

List-I

- A. Elemental semiconductor
 B. Hydrogen molecule
 C. Copper
 D. AgI

List-II

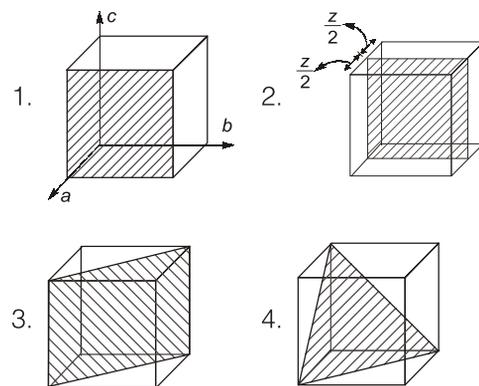
1. Ionic
 2. Covalent
 3. Van der Waals'
 4. Metallic

Codes:

| | A | B | C | D |
|-----|---|---|---|---|
| (a) | 3 | 2 | 1 | 4 |
| (b) | 2 | 3 | 1 | 4 |
| (c) | 2 | 3 | 4 | 1 |
| (d) | 3 | 2 | 4 | 1 |

[IES-2004]

- 1.6 Consider the following crystallographic planes (shaded) using a cube of size z as shown in the diagram:



Which one of the following gives Miller indices of the above planes, in order?

- (a) (100), (200), (100), (111)
 (b) (100), (200), (110), (111)
 (c) (111), (110), (200), (100)
 (d) (200), (111), (110), (100)

[IES-2004]

1.7 Match **List-I** (Material) with **List-II** (Band Gap) and select the correct answer using the codes given below the lists:

| List-I | List-II |
|------------------|----------------|
| A. Metal | 1. 9 eV |
| B. Semimetal | 2. 0.05 eV |
| C. Semiconductor | 3. 1.5 eV |
| D. Insulator | 4. 0 or less |

Codes:

| | A | B | C | D |
|-----|----------|----------|----------|----------|
| (a) | 4 | 2 | 3 | 1 |
| (b) | 4 | 3 | 2 | 1 |
| (c) | 1 | 2 | 3 | 4 |
| (d) | 3 | 2 | 4 | 1 |

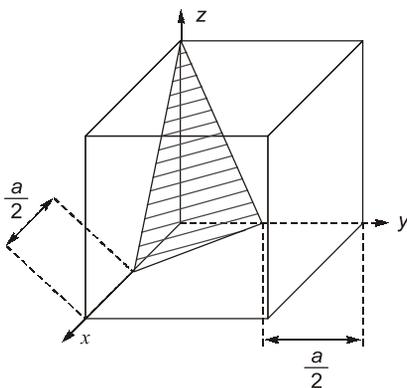
[IES-2004]

1.8 Which one of the following statements is correct? Ionic crystals are

- hard and brittle
- soft and elastic
- hard and corrosive
- soft and inflammable

[IES-2004]

1.9



Each side of the cube shown above is of length a . What are the Miller indices of the shaded surface?

- (100)
- (123)
- (221)
- $\left(\frac{1}{2} \frac{1}{2} 1\right)$

[IES-2005]

1.10 Consider the following statements with regard to FCC structure:

- Number of nearest neighbour atoms is twelve.
- Packing efficiency is 0.74.

3. There is an atom at the body centre of the unit cell.

Which of the statements given above is/are correct?

- 1, 2 and 3
- 1 and 2
- 2 and 3
- 1 and 3

[IES-2005]

1.11 Consider the following statements in respect of graphite:

- It has three coplanar covalent bonds.
- It has good electrical and thermal conductivity.
- Sheets of graphite are held together by Vander Waal's interaction.

Which of the statements given above are correct?

- 1, 2 and 3
- 1 and 2
- 2 and 3
- 1 and 3

[IES-2005]

1.12 Which one of the following exhibits the most well defined X-ray diffraction pattern?

- A polycrystalline aggregate
- An amorphous material
- A single crystalline material
- A plastically deformed crystal

[IES-2005]

1.13 **Assertion (A):** In diamond, carbon atoms are packed in a manner so as to give rise to a very low packing efficiency.

Reason (R): Carbon atoms have low mass number, and hence a smaller radius. Small atoms cannot be packed closely.

- Both A and R are true and R is the correct explanation of A
- Both A and R are true but R is NOT the correct explanation of A
- A is true but R is false
- A is false but R is true

[IES-2005]

1.14 In a crystal lattice, what are the vacancies created by the absence of certain atoms known as?

- Hertz defects
- Schottky defects
- Pauli defects
- Crystal defects

[IES-2006]