



HindPhotostat



Hind Photostat & Book Store

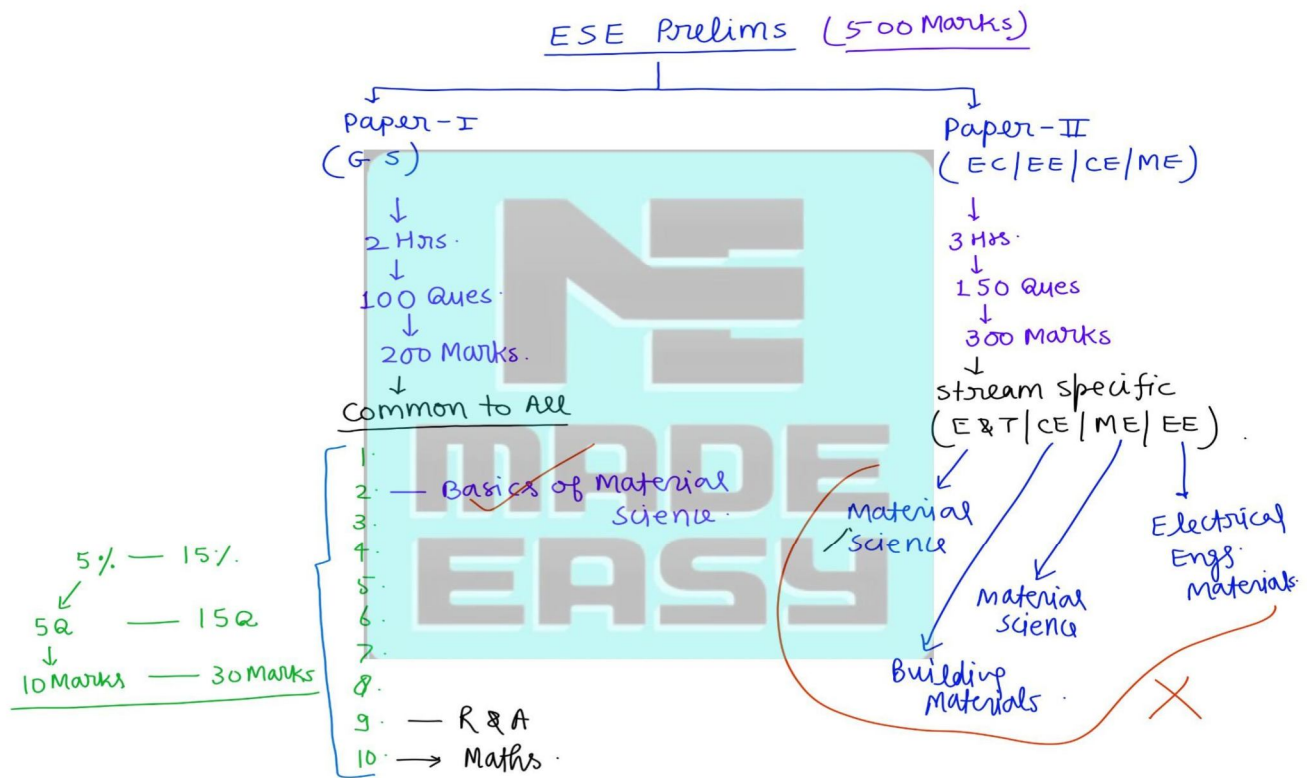
Best Quality Classroom Topper Hand Written Notes to Crack GATE, IES, PSU's & Other Government Competitive/ Entrance Exams

MADE EASY
ESE GS PRELIMS PAPER-1
Topper Handwritten Notes
Basic of Material Science
By-Suneel Tiwari Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

Visit us:-www.hindphotostat.com

Courier Facility All Over India
(DTDC & INDIA POST)
Mob-9311989030



Basics of Material Science

⇒ Material science involves investigating the relationship between the structure and properties of materials.

Material science does not deal with the study of strength or stiffness behaviour of engineering components such as buildings, machines or automobiles etc rather it deals with the study of strength or stiffness behaviour (or other properties) of the materials with which these engineering structures has been designed.

Material:

Material can be defined as something that consists of matter. It is the stuff by which something can be made.

↓
पदार्थ

⇒ Engineering materials can be broadly classified as —

- ① Metals and alloys.
- ② Ceramics
- ③ Polymers
- ④ Composites
- ⑤ Advanced Materials
 - Semiconductors
 - Biomaterials
 - Smart materials
 - Nanomaterials.

Structure:

Structure of a material usually relates to the arrangement of its internal components (atoms, molecules etc).

① Subatomic structure

② Atomic structures

③ Nanostructures

④ Microstructure

⑤ Macrostructure

↓
The structure which can be observed with naked eyes.

Nuclear structure

Electronic structure

↓
Arrangement of electrons in the various orbits of an atom.

→ The structures which can be observed with the help of an optical microscope.

study of particles like electrons, protons etc.

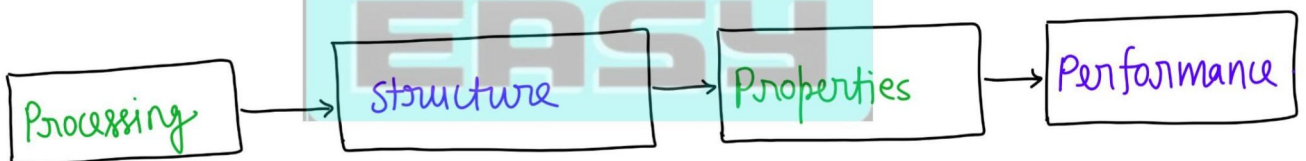
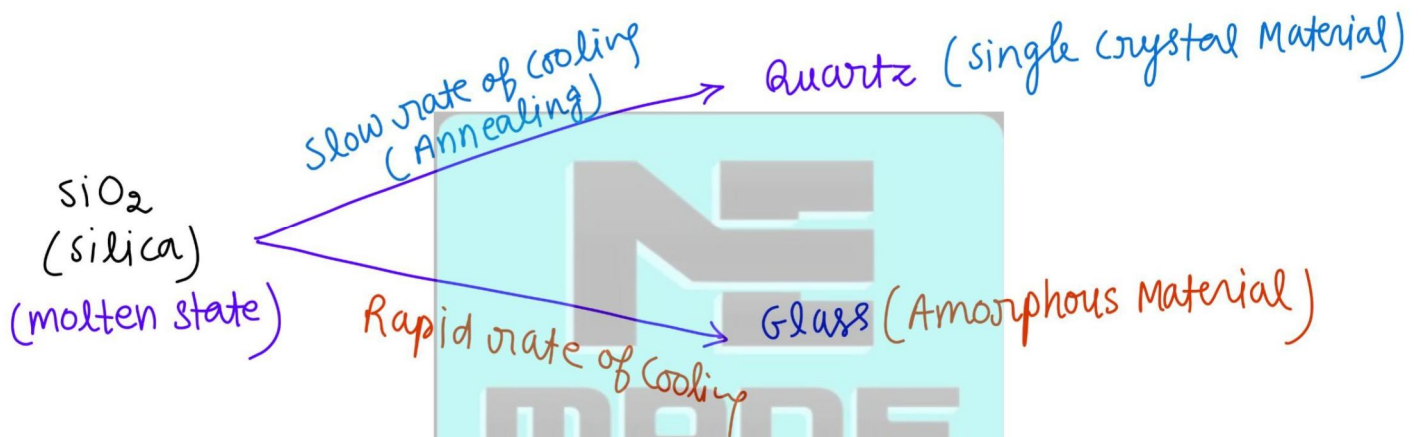
It is studied with the help of Nuclear Magnetic Resonance (NMR) and Mossbauer studies.

Properties of Material:

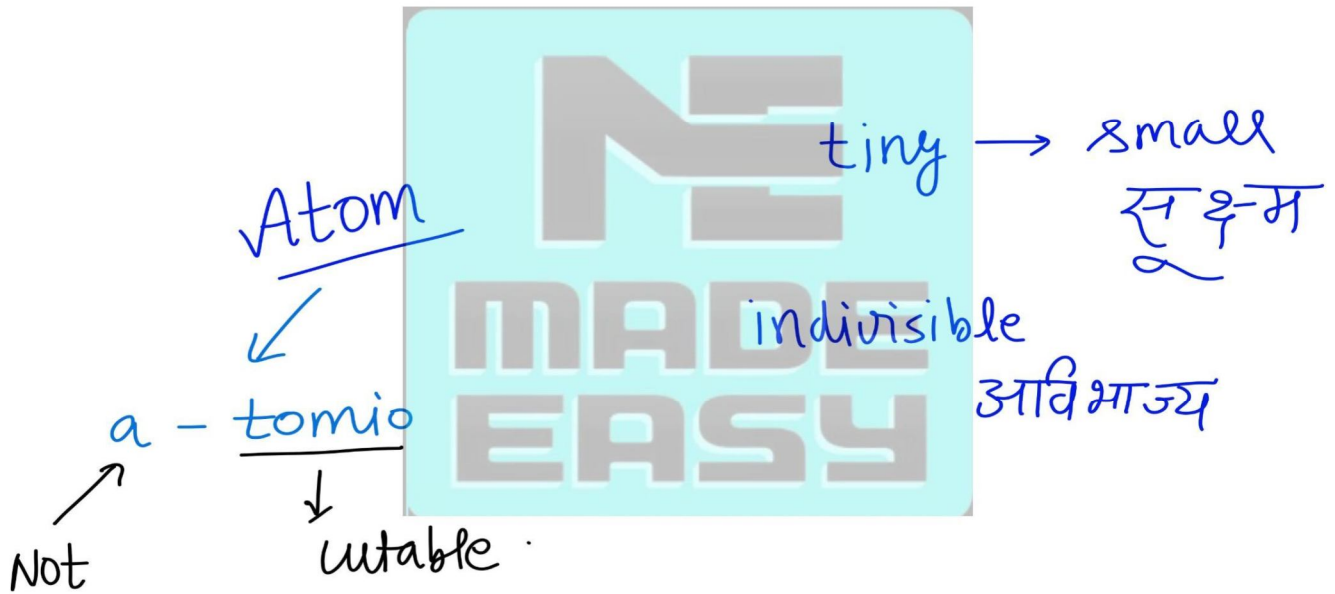
- ⇒ A property is a material trait in terms of the kind and magnitude of response to a specific imposed stimulus (excitation).
- ⇒ Generally definitions of properties are made independent of shape and size of material.

Mechanical properties
Electrical properties
Magnetic properties
Thermal properties
optical properties
deteriorative properties.

1-5



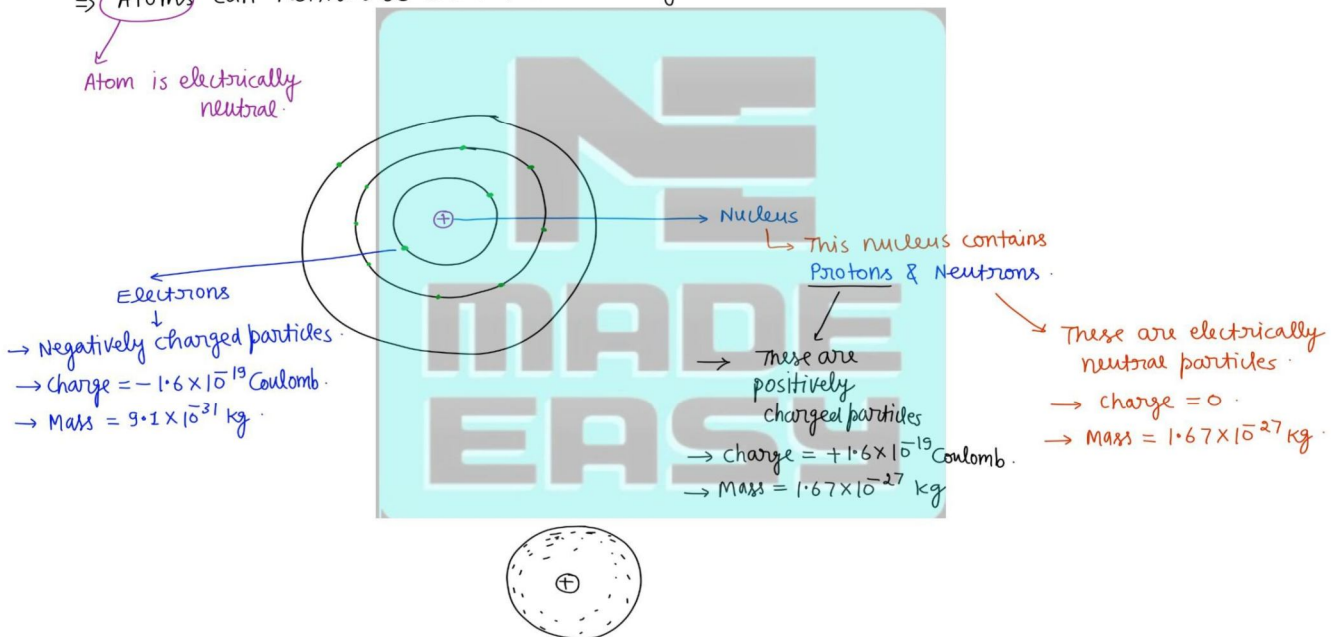
Sir John Dalton

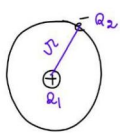


⇒ Matter is made of some tiny indivisible structures known as atoms.

⇒ Atoms can neither be created nor destroyed.

Atom is electrically neutral.





$$F = \frac{1}{4\pi\epsilon_0} \frac{Q_1 Q_2}{r^2}$$

Electrostatic force
(Coulombic forces)

Attractive

Between positive and negative charges.

Between unlike charges.

Repulsive

Between positive-positive or negative-negative charges.

Between like charges.

$\epsilon_0 \rightarrow$ Permittivity of free space.

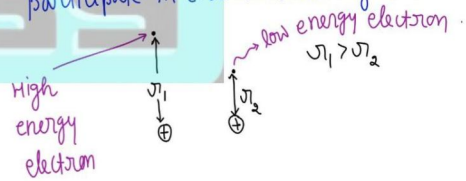
$$\epsilon_0 = 8.854 \times 10^{-12} \text{ Farad/meter}$$

\Rightarrow The greater the distance of an electron from the nucleus, higher is its total energy.

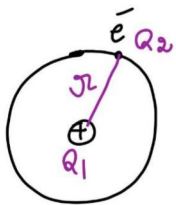
\Rightarrow An electron orbiting very close to the nucleus (in the inner orbits) is tightly bound to the nucleus and possesses very small amount of energy. So it would be difficult to knock-out this electron from its orbit.

On the other hand an electron orbiting far away from the nucleus (in the outermost orbit (valence orbit))

is loosely bound to the nucleus and possesses greater amount of energy, so this electron can be easily knocked out of its orbit. This is the reason why valence electrons participate in chemical bonding and chemical reaction etc.

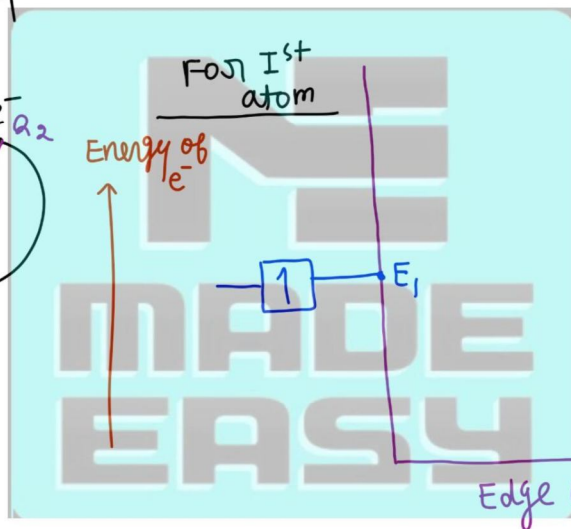
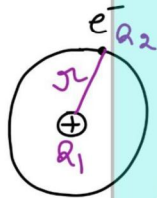


H

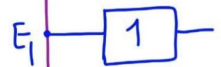


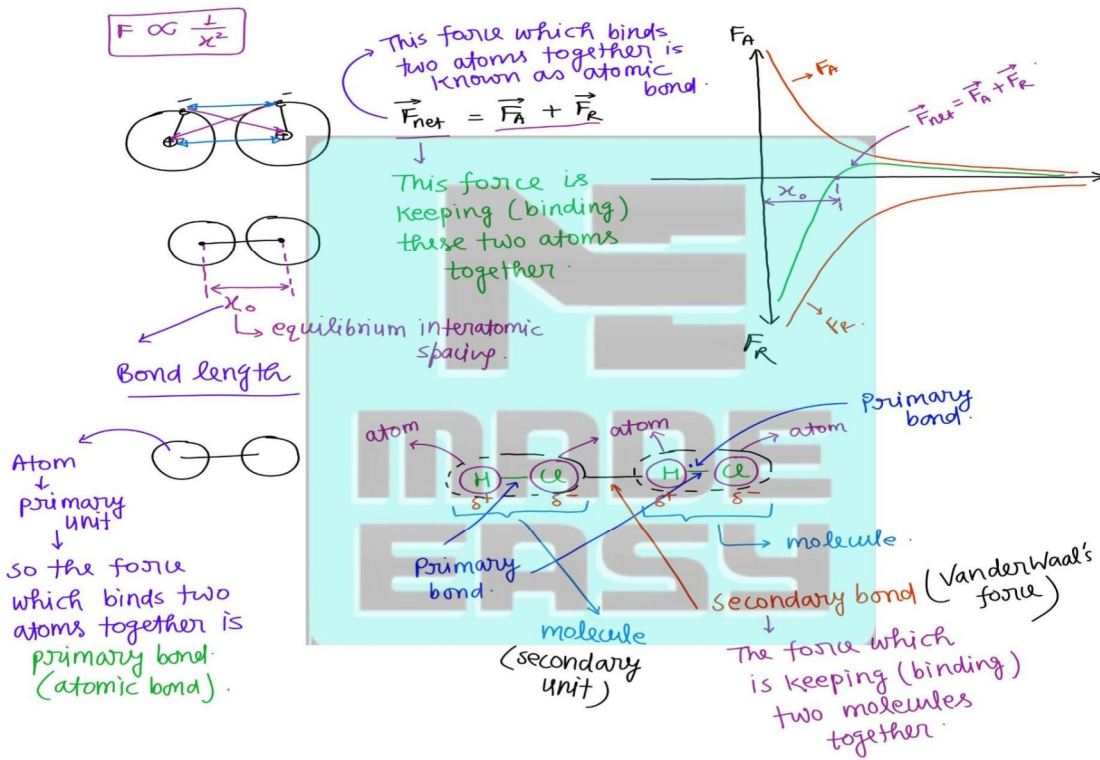
$$F = \frac{1}{4\pi\epsilon_0} \frac{Q_1 Q_2}{r^2}$$

H

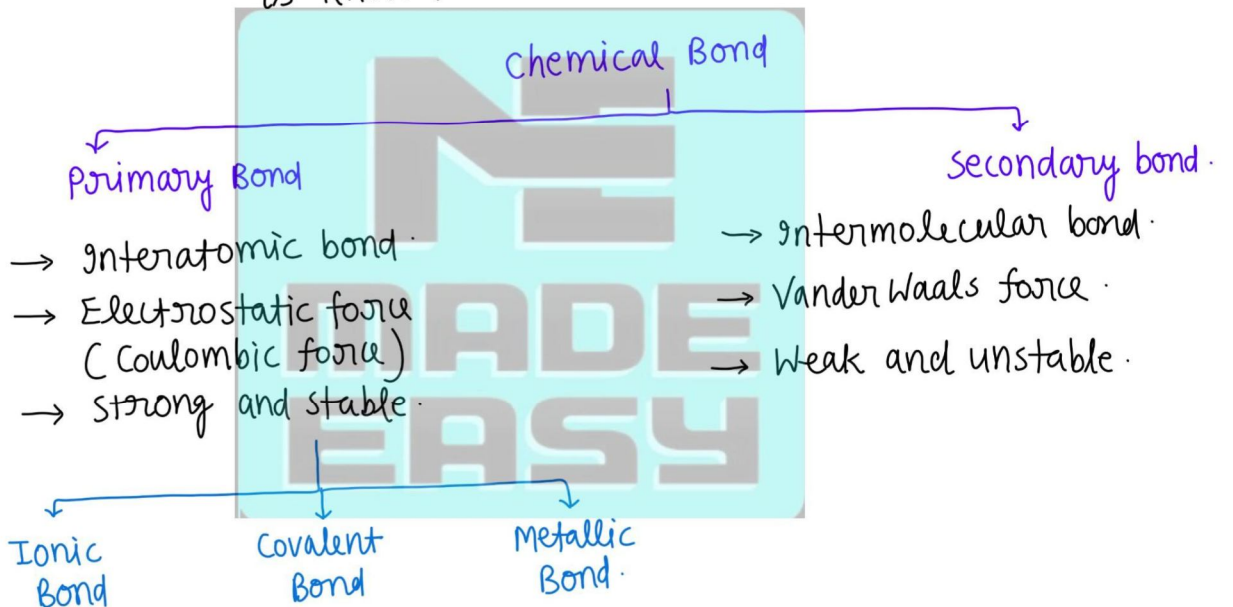


For IInd atom

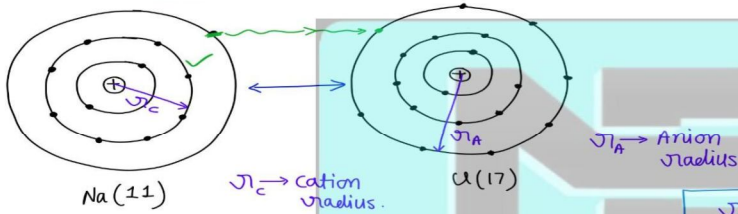
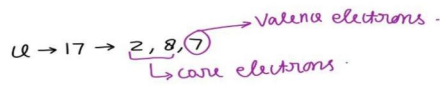
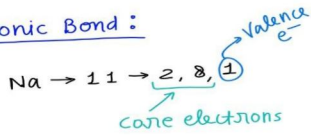




Chemical Bond: The binding force between atoms or molecules is known as chemical bond.

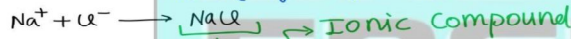
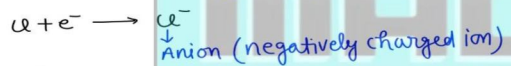
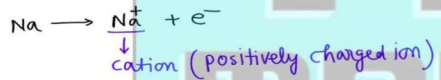


Ionic Bond :



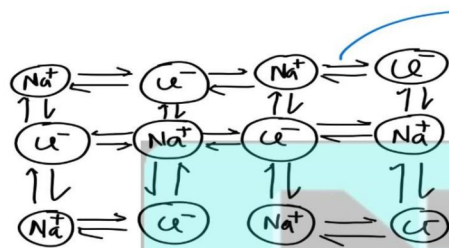
I	II	III	IV	V	VI	VII	VIII
H				N	O	F	He
Li	Be	B	C	N	O	F	Ne
Na	Mg	Al	Si	P	S	Cl	Ar
K	Ca	Ga	Ge	As	Se	Br	Kr

metals (I-III, Na, K)
 Non-metals (IV-VII, C, Si, Ge, N, P, As, O, S, Se, F, Cl, Br, I)



r_c < r_a
 ↓
 cations are smaller in size than anions.

- ⇒ Ionic bond is formed between a cation and anion z.e. between a metallic and a non-metallic element.
- ⇒ Ionic bond is the strongest bond (as it is the force between two oppositely charged ions).
- ⇒ Ionic bond is basically Coulombic force between cation and anion.



Ionic bond is non-directional bond z.e. it does not have any specific direction. It can be formed in any direction.

Ionic bonds are non-directional bond

The magnitude of bond is equal in all directions around an ion.

It follows that for ionic materials to be stable all cations must have as much nearest neighbors anions in 3-dimensional as possible and vice-versa.