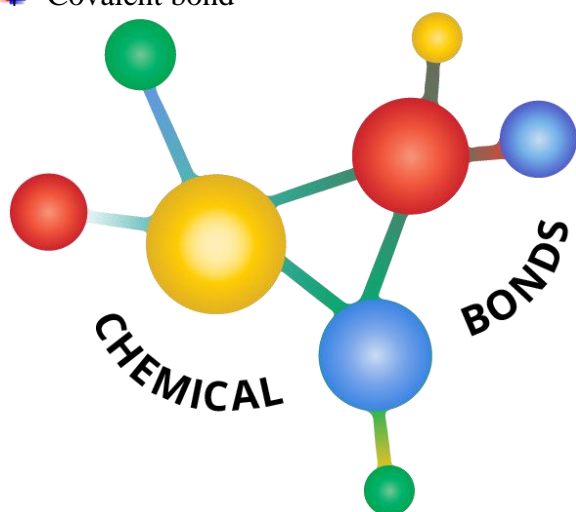


Chemical bond:

A chemical bond is a force that holds atoms together to form molecules or compounds.

There are different types of chemical bonds:

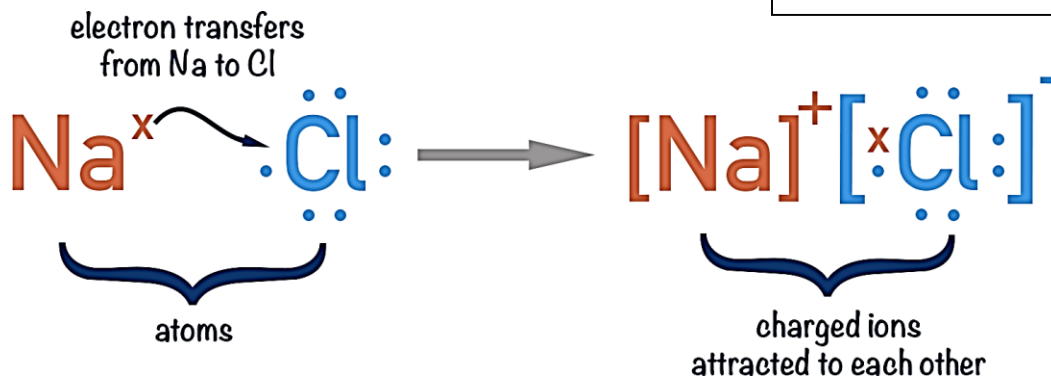
- + Ionic bond
- + Covalent bond



Ionic bond:

Ionic bonds form as a result of electrostatic forces between atoms, typically between a metal and a non-metal. It is formed by complete transfer of electrons.

For example, NaCl, CaCl₂, KI, CaO etc.



Related SLO

Students' Learning Outcomes

- Discuss formation of ionic bonds as a result of electrostatic forces between atoms (e.g. NaCl)
- Discuss types and formation of covalent bond as a result of mutual sharing of electrons between atoms (e.g. H₂, O₂, N₂).
- Name certain ionic and covalent compounds.
- Draw cross and dot structures showing formation of ionic compounds and covalent compounds.

Knowledge based MCQ's

1. What is a chemical bond?

- a. A force that holds atoms together to form compounds. ✓
- b. A force that separates atoms.
- c. A type of atom.
- d. A type of electron.

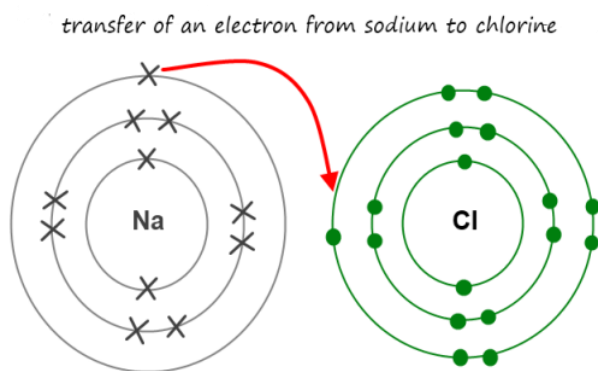
Short Question

1. What is an ionic bond? Give examples.

Formation of Ionic Bonds:

Electron Transfer:

- ❖ **Sodium (Na)** is a metal with one electron in its outermost shell. Its atomic number is 11. It tends to lose this electron to achieve a stable electron configuration (similar to the nearest noble gas, neon).
- ❖ **Chlorine (Cl)** is a non-metal with seven electrons in its outermost shell. Its atomic number is 17. It tends to gain one electron to complete its valence shell and achieve a stable electron configuration (similar to the nearest noble gas, argon).



Ion Formation:

- ❖ When sodium loses an electron, it becomes a positively charged ion (cation), denoted as Na^+ .



- ❖ When chlorine gains an electron, it becomes a negatively charged ion (anion), denoted as Cl^- .



Short Question

5. What is electronic configuration of sodium and chlorine:
 Ans: Sodium= 2, 8, 1
 Chlorine= 2, 8, 7



Short Question

2. How do metals get stability?

Knowledge based MCQ's

2. What type of bond is typically formed between a metal and a non-metal?

- a. Covalent bond
- b. Hydrogen bond
- c. Ionic bond ✓
- d. Metallic bond

Short Question

- 3. Write formation of sodium and chloride ions.
- 4. What is atomic number of sodium and chloride

Understanding based MCQ's

3. Which of the following best describes the formation of a sodium ion (Na^+)?

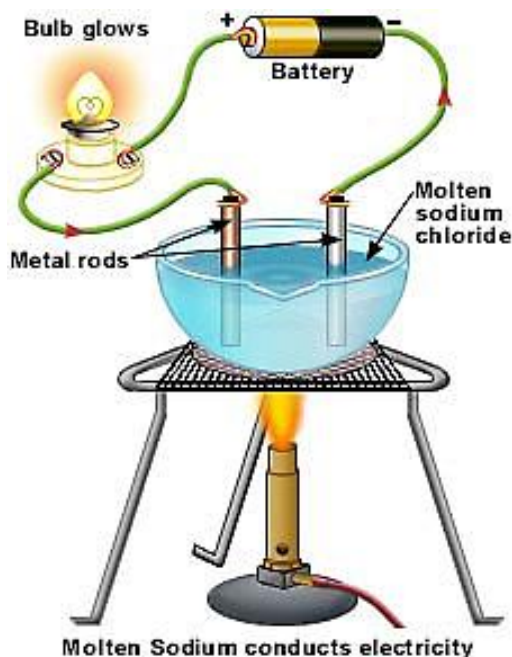
- a. Sodium gains an electron.
- b. Sodium loses an electron. ✓
- c. Sodium shares an electron.
- d. Sodium gains two electrons.

Electrostatic Attraction:

The positively charged sodium ion (Na^+) and the negatively charged chloride ion (Cl^-) attract each other due to electrostatic forces. This attraction holds the ions together, forming an ionic bond.

Properties of Ionic Bonds:

- ❖ **Strong Bonds:** Ionic bonds are generally strong due to the significant electrostatic forces between oppositely charged ions.
- ❖ **Formation of Crystalline Structures:** In a solid state, ionic compounds like NaCl form a crystalline lattice where each ion is surrounded by oppositely charged ions, creating a repeating pattern.
- ❖ **High Melting and Boiling Points:** The strong attraction between ions results in ionic compounds having high melting and boiling points.
- ❖ **Electrical Conductivity:** In the solid state, ionic compounds do not conduct electricity. However, when dissolved in water or melted, the ions are free to move, allowing the solution or molten compound to conduct electricity.
- ❖ Example: Sodium Chloride (NaCl)



Knowledge based MCQ's

4. In what state do ionic compounds conduct electricity?

- a. Solid state
- b. Liquid state ✓
- c. Gaseous state
- d. All states

Short Question

6. Why do ionic compounds have high melting and boiling points?

Q: Define covalent bond. Also give examples.

Covalent bond is formed by mutual sharing of electrons between atoms.

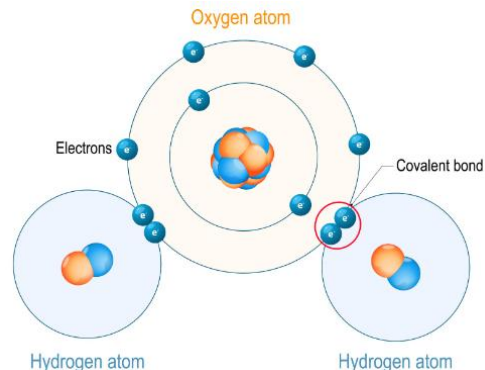
- ❖ This type of bonding typically occurs between non-metal atoms.

Example: HBr, HCl, NH₃, H₂O etc.

Types of covalent Bonds:

Single Covalent Bonds:

- It is formed when two atoms share one pair of electrons.
- It is represented by a single line (—).
- Example: Hydrogen molecule (H₂).
- Each hydrogen atom has one electron. By sharing their electrons, both hydrogen atoms achieve a stable configuration with two electrons in their valence shells (duplet rule).



Short Question

7. What do you know about single covalent bond? Give example.

8. How hydrogen molecule is formed?

Formation of single bond in hydrogen:

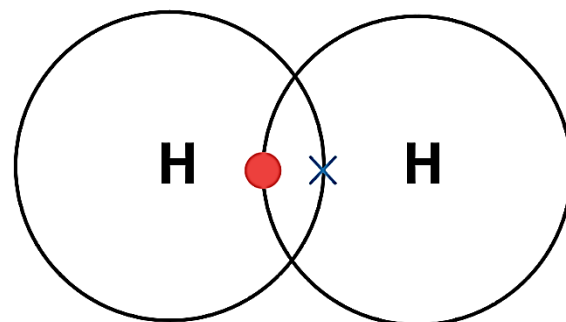
Atoms Involved: Two hydrogen atoms (H₂).

- **Electron Sharing:**
 - ❖ Each hydrogen atom has one electron.
 - ❖ By sharing their single electrons, both hydrogen atoms can achieve a stable electron configuration.
- **Covalent Bond:** The shared pair of electrons form a single covalent bond.
- **Molecule Formation:** $H + H \rightarrow H_2$

Knowledge based MCQ's

5. Which type of bond is formed by mutual sharing of electrons?

- Ionic bond
- Covalent bond ✓
- Hydrogen bond
- None of these



Double Covalent Bonds:

- It is formed when two atoms share two pairs of electrons.
- It is represented by a double line (=)
- Example: Oxygen molecule (O₂).
- Each oxygen atom has six electrons in its valence shell and needs two more to complete its octet. By sharing two pairs of electrons, both oxygen atoms achieve a stable configuration with eight electrons in their valence shells (octet rule).

Short Question

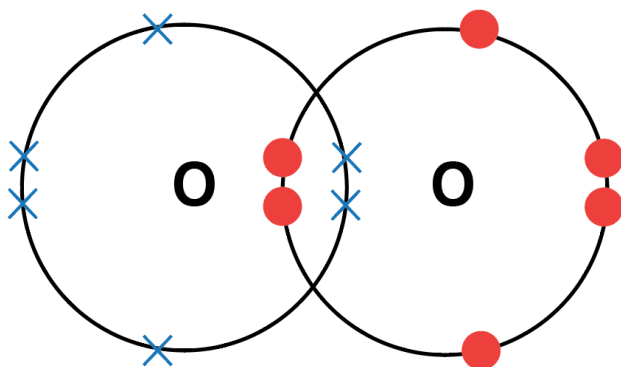
9. Define double covalent bond with examples.

10. Write the formation of oxygen.

Formation of double bond in oxygen:

Atoms Involved: Two oxygen atoms (O₂).

- **Electron Sharing:**
 - ❖ Each oxygen atom has six electrons in its valence shell.
 - ❖ Each oxygen atom needs two more electrons to complete its octet.
 - ❖ By sharing two pairs of electrons, both oxygen atoms can achieve a stable electron configuration.
- **Covalent Bond:** The two shared pairs of electrons form a double covalent bond.
- **Molecule Formation:** $O + O \rightarrow O_2$



Understanding based MCQ's

6. What is the primary difference between single, double, and triple covalent bonds?

- a. The type of atoms involved
- b. The number of electron pairs shared between atoms ✓
- c. The type of molecule formed
- d. The type of ions formed

Triple Covalent Bonds:

- It is formed when two atoms share three pairs of electrons.
- It is represented by a triple line (\equiv)
- Example: Nitrogen molecule (N_2).
- Each nitrogen atom has five electrons in its valence shell and needs three more to complete its octet. By sharing three pairs of electrons, both nitrogen atoms achieve a stable configuration with eight electrons in their valence shells (octet rule).

Short Question

11. What is triple covalent bond? Explain with examples.
12. Write the formation of nitrogen molecule.

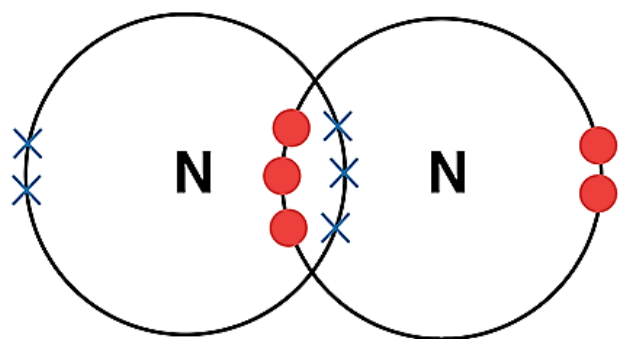
Formation of triple bond in Nitrogen:

Atoms Involved: Two nitrogen atoms (N_2).

- **Electron Sharing:**
 - ❖ Each nitrogen atom has five electrons in its valence shell.
 - ❖ Each nitrogen atom needs three more electrons to complete its octet.
 - ❖ By sharing three pairs of electrons, both nitrogen atoms can achieve a stable electron configuration.
- **Covalent Bond:** The three shared pairs of electrons form a triple covalent bond.
- **Molecule Formation:** $N + N \rightarrow N_2$

Short Question

13. How triple covalent bond is represented?



Knowledge based MCQ's

7. Which type of bond would you expect between two nitrogen atoms?
- Single covalent bond
 - Double covalent bond
 - Triple covalent bond ✓
 - Ionic bond

Characteristics of Covalent Bonds:

- **Bond Strength:** The strength of covalent bonds depends on the number of shared electron pairs. Triple bonds are stronger than double bonds, which are stronger than single bonds.
- **Bond Length:** The distance between the nuclei of the bonded atoms. Single bonds are longer than double bonds, which are longer than triple bonds.
- **Polarity:** Covalent bonds can be polar or non-polar.

Polar	Non-polar
If the atoms sharing electrons have different electro negativities, the bond is polar (e.g., H ₂ O).	If the atoms have similar electro negativities, the bond is nonpolar (e.g., H ₂ , O ₂ , N ₂).

Understanding based MCQ's

8. Why are covalent bonds between atoms of similar electro negativities non-polar?

- Because they involve the transfer of electrons.
- Because the electrons are equally shared. ✓
- Because one atom attracts the electrons more strongly.
- Because they form ions.

1. During ionic bond formation, atom which loses electron becomes charged:			
a. Positive	b. negative	c. neutral	d. anion
Reason: When an atom loses an electron, it has more protons than electrons, giving it a net positive charge.			
2. Which elements have complete valence shell?			
a. Noble gases	b. Halogens	c. Metals	d. Alkalis
Reason: Noble gases have a complete valence shell, which makes them chemically stable and less reactive.			
3. The atomic number of sodium is:			
a. 23	b. 24	c. 11	d. 12
Reason: Sodium (Na) has 11 protons in its nucleus, so its atomic number is 11.			
4. Which of the following have a single covalent bond?			
a. H ₂	b. CO ₂	c. N ₂	d. O ₂
Reason: Hydrogen molecules (H ₂) have a single covalent bond between two hydrogen atoms.			
5. _____ is the force that unite the atoms together to form a molecule.			
a. Chemical equation	b. Chemical energy	c. Chemical bond	d. Sign
Reason: A chemical bond is the force that holds atoms together in a molecule.			
6. The atoms of metals have _____ electrons in their valence shell.			
a. 1-2	b. 1-3	c. 1-4	d. 1-5
Reason: Metals typically have 1 or 3 electrons in their valence shell and tend to lose these electrons to form positive ions.			
7. The atomic number of chlorine is:			
a. 15	b. 16	c. 17	d. 18
Reason: Chlorine (Cl) has 17 protons in its nucleus, so its atomic number is 17.			
8. Which of the following is an example of ionic compound:			
a. Water	b. Carbon dioxide	c. Hydrochloric acid	d. Sodium chloride
Reason: Sodium chloride (NaCl) is formed from the ionic bonding of sodium (Na) and chlorine (Cl) ions.			
9. There are _____ types of covalent bonds.			
a. One	b. Two	c. Three	d. Four
Reason: The three types of covalent bonds are single, double, and triple bonds, depending on how many pairs of electrons are shared between atoms.			
10. This bond is formed is formed by mutual sharing of electrons.			

a. Covalent	b. Ionic	c. Hydrogen	d. Metallic
Reason: Covalent bonds involve the mutual sharing of one or more pairs of electrons between atoms.			
11. Nitrogen atom has _____ covalent bonding.			
a. Single	b. Double	c. Triple	d. None of these
Reason: A nitrogen atom (N ₂) forms a triple covalent bond with another nitrogen atom, sharing three pairs of electrons.			
12. The atoms of nonmetals have _____ electrons in their valence shell.			
a. 5-6	b. 5-7	c. 5-8	d. 5-9
Reason: Nonmetals typically have 5 to 7 electrons in their valence shell and need to gain or share electrons to achieve a full valence shell.			
13. Triple covalent bond is formed by mutual sharing of _____ pair of electrons.			
a. One	b. Two	c. Three	d. Four
Reason: A triple covalent bond involves the sharing of three pairs of electrons between two atoms.			