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CANDIDATE
NAME

CANDIDATE
CLASS

CHEMISTRY

0620

FORM 2

INSTRUCTIONS

- Write all notes in your notebook on bonding
- Answer all review questions in your exercise book
- Circle the correct answer for multiple choice questions
- Print out the review questions and paste them in your exercise book

CHEMICAL BONDING

6.1 IONS

- Atoms with incomplete outer electron shells are unstable. Therefore, they gain or lose electrons to attain a full outer electron shell.
- Atoms with 4 to 7 electrons in the outer shell tend to gain electrons that can add up to 8 electrons:
 - For example, the oxygen atom has 6 electrons in the outermost shell. It gains 2 electrons to attain 8 stable outer shell electrons.
 - Chlorine atom has 7 electrons in the outer shell. It gains 1 electron to be stable.
- Atoms with 1 to 3 electrons in the outer shell tend to lose electrons in the outer shell to be stable:
 - For example, magnesium has 2 electrons in the outermost shell. It loses 2 electrons and remains with a full and stable lower outer shell.
 - Sodium has 1 electron in the outer shell. It loses 1 electron to be stable.
 - An exception is the hydrogen atom. It has 1 electron in the shell. It can gain 1 electron to have 2 stable electrons in the shell or can lose its electron and still be stable.
- An atom that has gained or lost electrons is called an ion.
- This atom becomes electrically charged.

❖ TYPES OF IONS

1. CATION

- Cations are ions that carry a positive charge.
- It indicates a loss of electrons.
- They are mainly metals.
- For example, Ca^{2+} means calcium atom has lost 2 electrons.
- Li^+ means lithium has lost 1 electron.
- Remember; caTion has T, therefore posiTively charged ion.

2. ANION

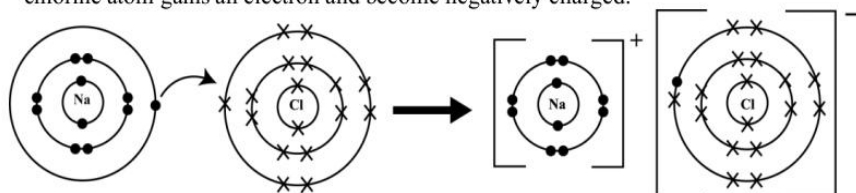
- Anions are ions that carry a negative charge.
- It indicates a gain of electrons.
- They are mainly non-metals.
- For example, O^{2-} means oxygen has gained 2 electrons.
- Cl^- means chlorine has gained 1 electron.
- Remember; aNion has N, therefore Negatively charged ion.

6.2 IONIC BONDING

- Ionic bonding is the type of bonding that involves the transfer of electrons from one atom to another.
- It occurs between metals and non-metals.
- Metals lose electrons and become positively charged.
- Non-metals gain electrons and become negatively charged.
- Bonding can be represented by dot and cross diagrams.

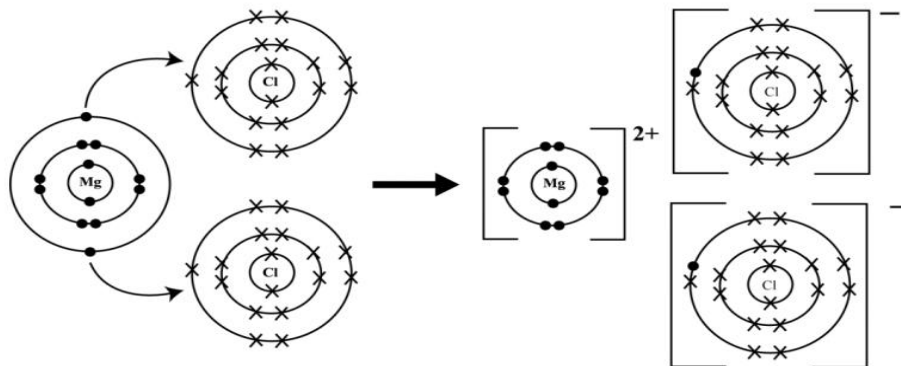
❖ FORMATION OF SODIUM CHLORIDE (NaCl)

- One electron is transferred from sodium atom to chlorine atom.
- Therefore, each sodium atom loses an electron and become positively charged while each chlorine atom gains an electron and become negatively charged.



❖ **FORMATION OF MAGNESIUM CHLORIDE (MgCl_2)**

- Two electrons are transferred from one magnesium to two chlorine atoms.
- Each magnesium atom loses two electrons and becomes positively charged while each chlorine atom gains one electron and becomes negatively charged.



❖ **CRYSTAL LATTICE**

- Ionic substances form a giant crystal lattice.
- Opposite charges attract each other.
- A group of positively and negatively charged ions packed closely to each other form a regular crystal shape.
- For example, a group of Na^+ and Cl^- ions assemble closely together and form a NaCl crystal the common salt.

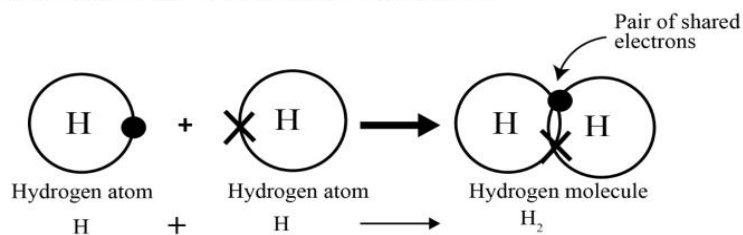
❖ **PROPERTIES OF IONIC COMPOUNDS**

1. They form hard crystalline solid. Ionic compounds have cations and anions closely packed and alternating with each other forming three-dimensional regular crystals.
2. They have a high melting point and boiling point. The Force of attraction between positively and negatively charged ions is strong. Therefore, a large amount of heat energy is required to separate them.
3. They conduct electricity in liquid form. This is because dissolved ionic compounds have free ions that are free to move about carrying electricity. Solid ionic compounds have fixed ions, therefore, cannot conduct electricity.
4. They are soluble in water. Water being a polar molecule, oxygen slightly positively charged and hydrogen slightly negatively charged can dissolve ionic compounds into separate ions. The negatively charged ion is attracted to oxygen and the positively charged ion is attracted to hydrogen. However, some ionic compounds are insoluble in water.

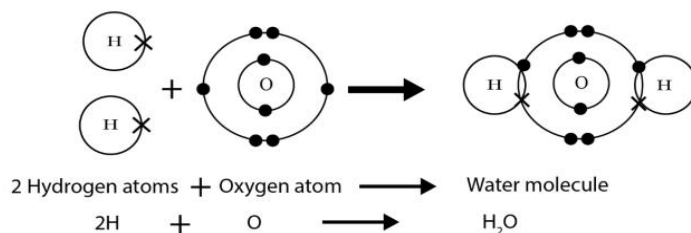
6.3 COVALENT BONDING

- Covalent bonding is a type of bonding formed by sharing of electrons between atoms or molecules.
- It occurs between non-metals.
- An atom or molecule shares its electrons with another atom for both to attain a full outer electron shell.
- The following are examples of covalent bonds.

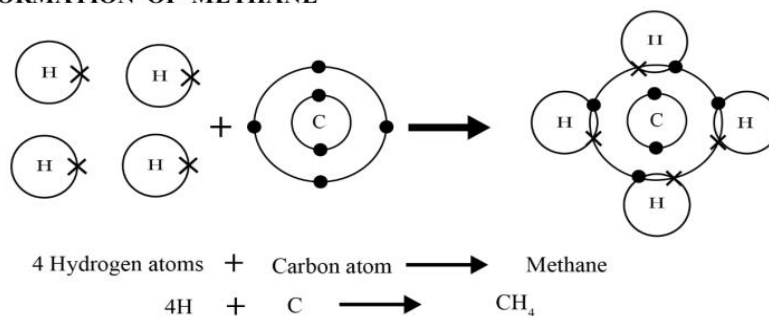
❖ FORMATION OF HYDROGEN MOLECULE



❖ FORMATION OF WATER MOLECULE

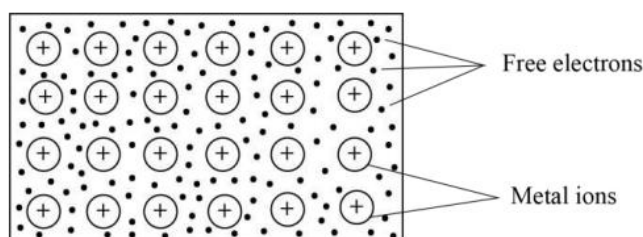


❖ FORMATION OF METHANE



6.4 METALLIC BONDING

- Metallic bonding is the type of bonding that involves sharing of electrons between atoms of metallic elements.
- Each metal atom loses electrons and becomes positively charged.
- This forms a structure of positively charged ions in a sea of delocalised electrons.
- Metals are held by a strong force of attraction between delocalised or free electrons and positively charged ions.
- They form a giant lattice structure.



❖ PROPERTIES OF METALLIC COMPOUNDS

1. They have a high melting point and boiling point. The force of attraction between metal ions and delocalised electrons is very strong. Therefore, a high amount of heat energy is required to break the bond.
2. They are good conductors of electricity. Electricity is carried by free electrons.
3. They are good conductors of heat. Heat is carried by free electrons.
4. They can be bent into a thin wire, a property called ductility and can be stretched into and shape, a property called malleability. The ductility and malleability of metals are due to the nature of the force of attraction between metal ions and free electrons. Layers of metal ions can slide over each other without breaking the force of attraction between metal ions and free electrons.

REVIEW QUESTIONS

1. An element that has gained or lost electron is called
 - A. Cation
 - B. Anion
 - C. Ion
 - D. Molecule
2. When an atom loses an electron, it becomes
 - A. Cation
 - B. Anion
 - C. Neutral
 - D. Molecule
3. When an atom gains an electron, it becomes
 - A. Cation
 - B. Anion
 - C. Neutral
 - D. Molecule
4. What is the formula of the ion when potassium achieves a full outer electron shell?
 - A. K^{2+}
 - B. K^+
 - C. K^-
 - D. K^{2-}
5. What is the name of the ion when chlorine achieves a full outer electron shell?
 - A. Cl^{2+}
 - B. Cl^+
 - C. Cl^-
 - D. Cl^{2-}
6. The bond that involves the transfer of electrons from one atom to another is
 - A. Metallic bond
 - B. Ionic bond
 - C. Covalent bond
 - D. All the above
7. The bond that involves sharing of electrons between atoms of metal is
 - A. Metallic bond
 - B. Ionic bond
 - C. Covalent bond
 - D. All the above
8. The bond that involves the share of electrons between non-metals is
 - A. Metallic bond
 - B. Ionic bond
 - C. Covalent bond
 - D. All the above
9. The bond in MgO is
 - A. Covalent bond
 - B. Ionic bond
 - C. Metallic bond
 - D. None of the above
10. All of the following are properties of the ionic compounds except
 - A. They have low melting and boiling point
 - B. They conduct electricity in molten form
 - C. They are soluble in water
 - D. They form regular solids

11. Why ionic compounds conduct electricity in liquid form
- Because positively and negatively ions are closely packed
 - Because the force of attraction between positively charged and negatively ions is strong
 - Because they have free electrons
 - Because the ions can be attracted to oxygen and hydrogen atoms of water
12. Why ionic compounds have high melting and boiling point
- Because positively and negatively ions are closely packed
 - Because the force of attraction between positively charged and negatively ions is strong
 - Because they have free electrons
 - Because the ions can be attracted to oxygen and hydrogen atoms of water
13. The bond in the oxygen molecule (O₂) is
- Covalent bond
 - Ionic bond
 - Metallic bond
 - None of the above
14. All of the following are properties of covalent compounds except
- They have high melting and boiling point
 - They are insoluble in water
 - They conduct electricity
 - They do not conduct electricity
15. The bond in the copper wire is
- Covalent bond
 - Ionic bond
 - Metallic bond
 - None of the above
16. All of the following are properties of metallic compounds except
- They have high melting and boiling point
 - They are ductile
 - They conduct electricity
 - They do not conduct heat
17. Why metallic compounds are good conductors of electricity
- Because they have a sea of free electrons
 - Because the force of attraction between metal ions and electrons is strong
 - Because metal ions can slide over each other without breaking the metallic bond
 - All the above
18. Using dot and cross diagrams, show the structures of the following compounds (show all shells)
- Magnesium oxide
 - Water
 - Oxygen
19. Two elements X and Y represented by the notations below reacted to form a compound.
- $${}_{11}^{23}\text{X} \quad {}_8^{16}\text{Y}$$
- What changes in electronic structures occurred when atoms X and Y reacted?
 - What type of bonding occurs between X and Y?
 - Draw the structure of the compound formed between X and Y (show outer shell only).
 - What you expect the melting point of the compound formed to be high or low. Give a reason for your answer.
 - Using the actual chemical symbols for X and Y, write down the chemical formula of the compound formed.
20. State four differences between ionic bonding and covalent compounds.