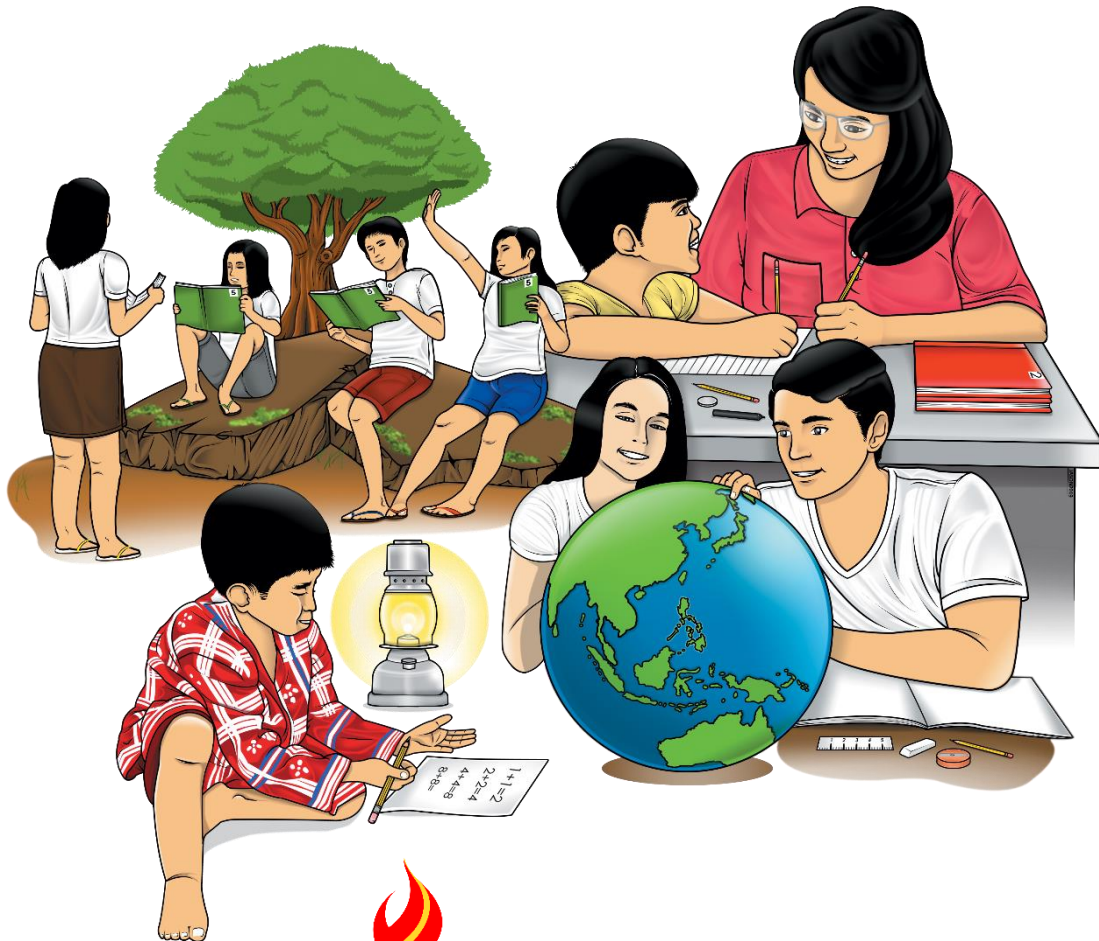


Science

Quarter 2- Matter

Module 4: Carbon Atom: A Unique One



Science – Grade 9

Alternative Delivery Mode

Quarter 2: Matter - Module 4: Carbon Atom: A Unique One

First Edition, 2020

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Science
Quarter 2- Matter
Module 4: Carbon Atom:
A Unique One

Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.



What I Need to Know

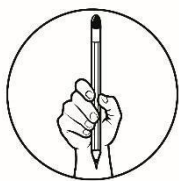
This module was designed and written with you in mind. It is here to help you master Carbon Atom: A Unique One. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course, but the order in which you read them can be changed to correspond with the textbook you are now using.

The module focuses on achieving this learning competency:

Explain how the structure of the carbon atom affects the type of bonds form. (S9MT-IIg-h-17)

After going through this module, you are expected to:

- discuss why carbon is a unique atom;
- differentiate organic from inorganic compounds; and,
- recognize the importance of organic and inorganic compounds in human body.



What I Know

Choose the letter of the best answer. Write your answer on a separate sheet of paper.

1. Which of the following statement best describes organic compound?
 - A. Organic compounds are composed mainly of carbon and hydrogen.
 - B. Organic compounds are compounds that contain carbon atoms only.
 - C. Organic compounds are compounds that are produced by living things.
 - D. Organic compounds are compounds that contain carbon and oxygen only.
2. How do carbon atoms form many organic compounds?
 - A. By attracting other elements toward themselves to form bond
 - B. By sharing their electrons with other metal and non-metal elements
 - C. By transferring their electrons to the atoms of surrounding elements
 - D. By forming mainly bonds with other carbon atoms and other elements
3. How many number of bond/s the carbon atom can form?
 - A. 1
 - B. 2
 - C. 3
 - D. 4
4. CH₄ is methane, what type of compound is this?
 - A. inorganic
 - B. organic
 - C. reactive
 - D. a crystal
5. Which are TRUE about organic compounds?
 - I. Organic compounds contain calcium.
 - II. Organic compounds contain carbon.
 - III. Organic compounds can be produced by living organisms.
 - IV. Organic compounds can be produced artificially.
 - A. I, II and III only
 - B. I and III only
 - C. II and III only
 - D. II, III and IV only
6. Why are carbon atoms able to form many organic compounds?
 - A. Carbon atoms attract electrons from other atoms.
 - B. Carbon atoms have strong attraction to other elements.
 - C. Carbon atoms can form many types of bonds with other carbon.
 - D. none of the above
7. Which of the following best describe inorganic compounds?
 - A. It contains carbon and hydrogen atom.
 - B. It does not contain carbon and hydrogen atom.
 - C. It can either be A or B.
 - D. None of the given.
8. Which of the given compound is organic?
 - A. HBr
 - B. C₈H₁₈
 - C. NO₂
 - D. CuSO₄

9. Which of the given compound is inorganic?

A. CH_3OH

B. CaO

C. C_8H_{18}

D. $\text{C}_{18}\text{H}_{36}\text{O}_2$

10 Which of the following components makes the carbon atom a unique one?

A. valence electron

C. strength

B. bond

D. all of the above

Lesson

1

Carbon Atom: A Unique One

In the previous module, you have learned about ions and how they are formed. In this module, you will learn about the nature of carbon atom. You are going to figure out what is the difference between organic and inorganic compounds.

Here are some key questions for you to ponder after finishing this module:

1. Why carbon is a unique atom?
2. What is the difference between organic and inorganic compounds?
3. What are the types of organic compounds?
4. What are the characteristics of inorganic compounds?



What's In

Let's recall your understanding in concepts of Chemical Bond. Supply the correct letter to determine what is being described in the given statement. Write your answer on a separate sheet of paper.

1. This type of bond involves the transfer of electrons from one atom (usually a metal) to another (usually a nonmetal)

I			N		C
---	--	--	---	--	---

B			N	
---	--	--	---	--

2. This atom loses electron and becomes positively charge ion

	A	T		O	
--	---	---	--	---	--

3. This atom loses electron and becomes negatively charge ion

A		I		N
---	--	---	--	---

4. This type of bond involves sharing of valence electrons

C		V		L		N	
---	--	---	--	---	--	---	--

B			N	
---	--	--	---	--



What's New



Hi student! This is teacher Yhel. We're both working from home, but this can't stop us from discovering new concepts! Today, we will discover why carbon is unique among atoms. Below is a table listing the characteristics that make the carbon atom unique.

Carbon Atom: A unique one	
Valence Electron	Carbon atoms' four valence electrons can be shared by different particles that have electrons to share, consequently framing covalent (shared-electron) bonds. They can even be shared by other carbon particles, which can also impart electrons to other carbon molecules, etc., framing long strings of carbon atoms that cling to one another like links in a chain.
Bond Length	Carbon atom has the ability to form long carbon-to-carbon chains. It can tie with one another in straight chains, yet in complex branching, similar to the parts of a tree. These can even join "head-to-tail" to make rings of carbon particles. There is basically no restriction to the number or unpredictability of the branches or the quantity of rings that can be connected to carbon atom, and hence no restriction to the quantity of various particles that can be shaped.
Strength	The carbon-carbon single bond is a sigma bond and is formed between one hybridized orbital from each of the carbon atoms. Sigma bonds are the strongest kind of covalent bond. They are framed by head-on overlapping between nuclear orbitals. Sigma bonding is mostly characterized for diatomic atoms utilizing the language and tools of symmetry groups.
Multiple Bond Formation	It can impart not just one electron to another atom to form a single bond, it can likewise share two or three electrons, framing a double or triple bond. This makes for countless possible bond blends at better places, making huge number of various potential molecules. Furthermore, a particle that varies by even one atom or one bond position is a molecule of a different compound.



What is It

Organic Compound

Organic compounds are group of compounds that **contain** the element carbon and hydrogen. It consistently contains carbon with other different elements that are required for living creatures to work. Carbon is the key component since it has four electrons in an external electron shell that can hold eight electrons. Subsequently, it can form numerous kinds of bonds with other carbon molecules and components; for example, hydrogen, oxygen, nitrogen, phosphorous, sulfur, and halogens (fluorine, chlorine, bromine, and iodine). Hydrocarbons and proteins are genuine example of organic compounds that can form long chains and complex structures.

The organic compounds comprised of these particles are the bases for chemical reaction in the cells of plants and creatures – responses that give the vitality for discovering food for reproduction and for the various processes important for life.

Types of Organic Compounds and Its Characteristics

The four kinds of organic compounds are hydrocarbons, lipids, proteins and nucleic acids, and they perform various functions in a living cell. While numerous organic compounds are not polar particles and in this way don't dissolve well in the water of a cell, they frequently disintegrate in organic compounds. For instance, while carbohydrates, such as sugar, are marginally polar and dissolve in water, fats don't. However, fats break down in other natural solvents, for example, ethers. When in solution, the four kinds of organic compounds interact and form new compounds as they come inside a living tissue.

1. **Carbohydrates.** Carbohydrates are biochemical that is made of one or more simple sugar molecules. Living things use carbohydrates as an energy source.
2. **Lipids.** Lipids are biochemical that does not dissolve in water. Fats, oils, and waxes are examples of lipids. One of the functions of lipids in living things is to store energy.
3. **Proteins.** Proteins are huge molecules with complex structures that permit them to take on significant functions in organic chemical reactions. It is usually present in animal products, though it also exists in other sources, such as nuts and legumes. Proteins do most of the work in cells and are essential for the organization, function, and regulation of the body's tissues and organs.
4. **Nucleic Acids.** Nucleic acids are the chief information-carrying molecules of the cell. The term nucleic acid is the overall name for DNA and RNA. They lead the development of protein synthesis and control the inherited characteristics of every living thing.

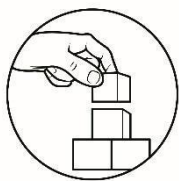
Inorganic Compound

An inorganic compound is a compound that **does not contain** both carbon and hydrogen. A great many inorganic compounds do contain hydrogen atoms, such as water (H₂O) and the hydrochloric acid (HCl) produced by your stomach. In contrast, only a handful of inorganic compounds contain carbon atoms. Carbon dioxide (CO₂) is one of the few examples.

Characteristics of Inorganic Compounds

Inorganic compounds contain some kind of metal (alkali, alkaline, transition and so forth.), they will in general have the capacity to conduct electricity. For instance, while in the solid stage, inorganic compounds are poor conductors of electricity. In any case, in the liquid state, inorganic compounds are profoundly conductive. In this stage, inorganic compounds' electrons can move uninhibitedly, and this development of electrons is noted as electricity.

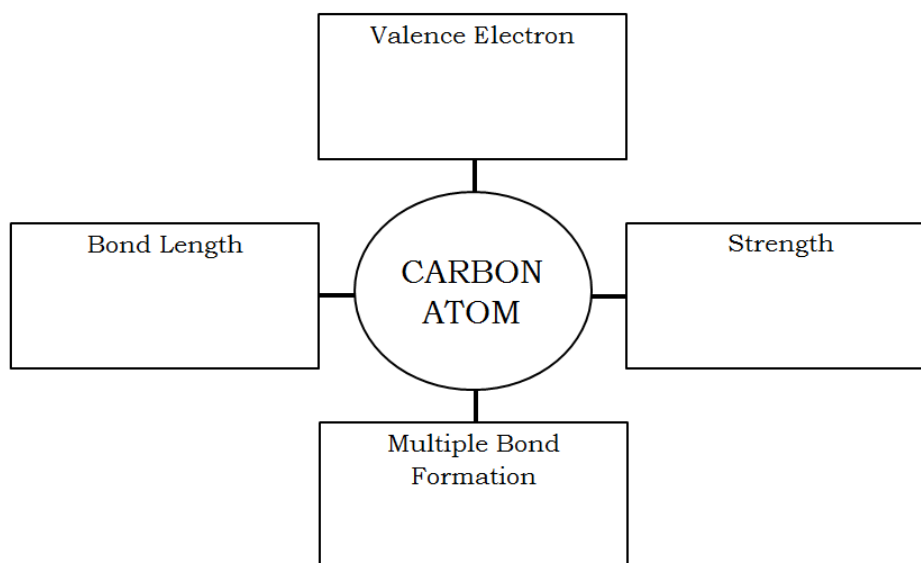
Because of ionic bonding commonly found in inorganic compounds, they are held together tightly and have extremely high melting and boiling points. Another remarkable quality of inorganic compounds is their color. Transition metal inorganic compounds, in any event, sitting on a seat top, are generally profoundly colored, and this is, once more, because of the arrangement of the 'd-block's' electrons. The brilliant and delightful hues seen when firecrackers explode is because of the inorganic metal (generally an alkali or alkaline one) present in the compound. Since inorganic compounds show a special color when consumed, this can be utilized as a 'marker' to recognize the metal involved. Likewise, inorganic compounds are normally highly soluble in water. In other words, they can 'vanish' when put into water since they will basically dissolve. One more uncovering quality of inorganic compounds is their capacity to form crystals.



What's More

Activity 1: Complete Me

Complete the diagram below by describing the characteristics of carbon atom that makes it a unique one. Write your answer on separate sheet of paper.



Activity 2: Getting to Know

A. Choose the element that comprises the given organic compound by checking the appropriate box. Write your answer on separate sheet of paper.

Organic Compound	Carbon	Hydrogen	Oxygen	Nitrogen	Phosphorus
Carbohydrates					
Lipid					
Protein					
Nucleic Acid					

B. Determine the type of organic compound being described by set of phrases below. Write your answer on separate sheet of paper.

Carbohydrates

Lipid

Protein

Nucleic Acid

_____ 1. Stores genetic code

_____ 2. Used for building and support bone and muscle tissue

- _____ 3. DNA and RNA
- _____ 4. Composed of Nucleotides
- _____ 5. Main foundation of energy of living things

Activity 3: Inorganic Search

Analyze the composition of the given formula below then encircle all the inorganic compounds. Write your answer on separate sheet of paper.

HBr	CH ₃ COOH	Na ₂ SO ₄
C ₈ H ₁₈	HF	SO ₃
NO ₂	H ₂ SO ₄	KMnO ₄
MnCl ₂	KCl	NH ₃
CuSO ₄	HNO ₃	CH ₃ OH
NaCl	C ₂ H ₅ OH	CaCO ₃

Activity 4: My Own Identity

Fill out the needed data to differentiate organic from inorganic compounds. Write your answer on separate sheet of paper.

Characteristics	Organic Compounds	Inorganic Compounds
Bonding		
Physical State (room temp)		
Melting Point		
Is it soluble in water?		
Conductivity		

Activity 5: Where do I Belong?

Classify the given compounds below by putting it each compound in the appropriate box. Write your answer on separate sheet of paper.

Benzamide
(C₇H₇NO)

Ascorbic Acid
(HC₆H₇O₆)

Hypophosphorous acid
(H₃PO₂)

Calcium chloride
(CaCl₂)

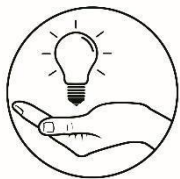
Acetic acid
(C₂H₄O₂)

Sodium sulphite
(Na₂SO₃)

Sulfuric Acid
(H₂SO₄)

Chloral
(C₂HCl₃O)

Organic Compounds	
Inorganic Compounds	



What I Have Learned

Determine the word that correctly completes the statement. Write your answer on a separate sheet of paper.

1. Carbon atom is a unique type of atom. It is being distinguished through is remarkably different _____, _____, _____ and its ability to have multiple bond formation.
2. The carbon-carbon single bond is a _____ bond and is formed between one hybridized orbital from each of the carbon atoms.
3. Organic compounds are type of compounds that contain _____ and _____. It can be hydrocarbon, lipid, protein and nucleic acid.
4. _____ are compound that do not contain both carbon and hydrogen.
5. Inorganic compounds have the capacity to _____, have extremely _____ and _____, remarkable quality of color, highly soluble in water and are able to form crystals.



What I Can Do

Organic Compound Poster Project

Make an informational poster that describes the exceptional properties of the organic compounds such as proteins, carbohydrates, lipids that contain carbon and different components, for example, hydrogen, oxygen, phosphorus, nitrogen, or sulfur. Include the following components:

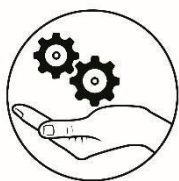
- ✓ Select one of the following organic compounds to explore: proteins, carbohydrates, or lipids.
- ✓ Recognize which components are in your chosen compound-carbon.
- ✓ Provide at any rate 6 examples of your organic molecules.
- ✓ Give a clarification of why they are essential to mankind.
- ✓ Think of your own title
- ✓ Include your name and section in front of your poster.
- ✓ You may utilize your reading material, class notes, and so forth to help you in your research. Be bright and inventive.
- ✓ Materials to be used can be pictures (from magazines) and drawings where suitable.
- ✓ Put your poster in a short bond paper



Assessment

Choose the letter of the best answer. Write your answers on a separate sheet of paper.

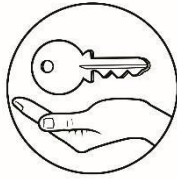
- Which components makes the carbon atom a unique one?
A. valence electron C. strength
B. bond D. all of the above
- Which statement best describes inorganic compound?
A. Inorganic compounds are compounds do that not contain carbon and hydrogen.
B. Inorganic compounds are compounds that do not contain carbon atoms only.
C. Inorganic compounds are compounds that produced by living things.
D. Inorganic compounds are compounds that contain carbon and oxygen only.
- What type of compound is this $C_6H_{12}O_6$ commonly known as table sugar?
A. inorganic B. organic C. reactive D. a crystal
- Which of the given compound is NOT an inorganic compound?
A. HBr B. C_8H_{18} C. NO_2 D. $CuSO_4$
- Which of the given compound is NOT an organic compound?
A. CH_3OH B. CaO C. C_8H_{18} D. $C_{18}H_{36}O_2$
- Which of the best describes organic compound?
A. It contains carbon and hydrogen atom.
B. It does not contain carbon and hydrogen atom.
C. It can either be A or B.
D. None of the given
- Which of the following are types of organic compound?
A. lipids C. nucleic acid
B. protein D. all of the above
- Which of the following are the main compositions of organic compound?
A. carbon and hydrogen
B. carbon and oxygen
C. oxygen and hydrogen
D. carbon, hydrogen and oxygen
- Which of the following has the highest melting and boiling point?
A. inorganic B. organic C. lipid D. protein
- Which of the following characteristics best describe inorganic compound?
A. remarkable quality of color C. can able to form crystals
B. highly soluble in water D all of the above



Additional Activities

Put a check mark (/) on the appropriate box to tell whether the given compound is organic or inorganic compound. Write your answer on a separate sheet of paper.

Compounds	Organic Compound	Inorganic Compound
HCl		
CH ₄		
(NH ₄) ₂ SO ₃		
C ₃ H ₆ O		
Al ₄ C ₃		
CH ₃ COOH		
PbBr ₃		
H ₂ O		
FeO ₃		
NaOH		



Answer Key

Carbon Atom	Valence Electron Carbon atoms four valence electrons can be shared by different particles that have electrons to share; consequently forming covalent (shared-electron) bonds.	Bond Length It has ability to form long carbon-to-carbon chains. It can be to one another in straight chains, yet in complex branching.	Strength The carbon-carbon single bond is a sigma bond and is formed
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ACTIVITY 1 * students' answer may vary

What's More?

C O V A L E N T B O N D

A N I O N

C A T I O N

I O N I C B O N D

What's In?

1. A
2. D
3. D
4. B
5. D
6. C
7. B
8. B
9. B
10. D

What I Know

Multiple Bond Formation	It can impart not just a one electron to another atom to form a single bond, however it can likewise share two or three electrons, forming a double or triple bond.
-------------------------	---

ACTIVITY 2

A.

Organic Compound	Carbon	Hydrogen	Oxygen	Nitrogen	Phosphorus
Nucleic Acid	/	/	/	/	/
Protein	/	/	/	/	/
Lipid	/	/	/	/	/
Carbohydrates	/	/	/	/	/

B.

1. Nucleic Acids
2. Proteins
3. Nucleic Acids
4. Nucleic Acids
5. Carbohydrates
6. Carbohydrates
7. Proteins
8. Lipids
9. Proteins
10. Lipids

ACTIVITY 3

HBr	CH_3COOH	Na_2SO_4
C_2H_6	HF	SO_2
NO_2	H_2SO_4	$KMnO_4$
$MnCl_2$	KCl	NH_3
$CaSO_4$	HNO_3	CH_3OH
$NaCl$	C_2H_5OH	$CaCO_3$

- Carbon atom is a unique type of atom. It is being distinguished through its remarkably different valence electrons, bond length, strength and its ability to have multiple bond formation.
- The carbon-carbon single bond is a sigma bond and is formed between one hybridized orbital from each of the carbon atoms.
- Organic compounds are type of compounds that contain carbon and hydrogen atom. It can be hydrocarbon, lipid, protein and nucleic acid.

Directions: Fill in the blank with the word/s that will complete the statement

What I have learned

Organic Compounds	Acetic acid (C ₂ H ₄ O ₂) Benzamide (C ₇ H ₇ NO) Ascorbic Acid (HC ₆ H ₇ O ₆) Chloral (C ₂ HCl ₃ O)
Inorganic Compounds	Hypophosphorous acid (H ₂ PO ₃) Calcium chloride (CaCl ₂) Sodium sulphate (Na ₂ SO ₄) Sulfuric Acid (H ₂ SO ₄)

ACTIVITY 5

Characteristics	Bonding	Physical State (room temp)	Melting Point	Is it soluble in water?	Conductivity
Organic Compounds	Covalent	Gas or liquid	Low Melting Point	No	Nonconductor
Inorganic Compounds	Ionic	Solid	High Melting Point	Yes	Conductor in solution

ACTIVITY 4

Compounds	Organic Compound	Inorganic Compound
HCl	/	
CH ₄	/	
(NH ₄) ₂ SO ₄	/	
C ₂ H ₆ O	/	
Al ₂ O ₃	/	
CH ₃ COOH	/	
PBr ₃	/	
H ₂ O	/	
Fe ₂ O ₃	/	
NaOH	/	

ADDITIONAL ACTIVITIES

1.D	6.A
2.A	7.D
3.B	8.A
4.B	9.A
5.B	10.D

Assessment

- Varies on students' output

What I can do

- Inorganic compounds are compound that does not contain both carbon and hydrogen.
- Inorganic compounds have the capacity to conduct electricity, have extremely high melting and boiling points, remarkable quality of color, highly soluble in water and can able to form crystals.

References

Books:

Alvarez, Liza A., Dave G. Angeles, Hernan L. Apurada, Ma. Pillar P. Carmona, Oliver A., Lahorra, Judith f. Marcaida, Ma. Regaele A. Olarte. Science 9 - Learner's Module. DepEd - Instructional Materials Council Secretariat (DepEd-IMCS). Pasig city: FEP Printing Corporation, 2014.

Websites:

Kitchiner, J. 2018. "Elements and Electron Configuration." Accessed January 16, 2020. <https://www.tes.com/teaching-resource/elements-and-electron-configuration-match-up-11378967>

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