

Prior Knowledge Review

Answer the questions below:

1. State the chemical symbol for carbon.

C

2. Carbon has an atomic number of 6. State its electron configuration.

2,4

3. State the type of bonding found in water.

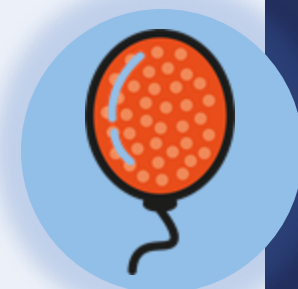
Covalent

4. Give an example of a giant covalent network.

Diamond, graphite, silicon dioxide

5. Define a compound.

Two or more elements chemically bonded together



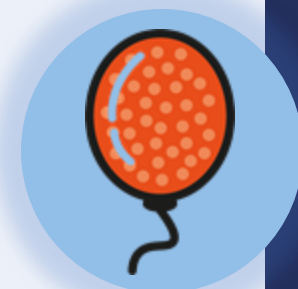
Prior Knowledge Review

Do Now:

1. State the chemical symbol for carbon.
2. Carbon has an atomic number of 6. State its electron configuration.
3. State the type of bonding found in water.
4. Give an example of a giant covalent network.
5. Define a compound.

Drill:

1. State the chemical formula for carbon dioxide.
2. Name the type of bonding found in carbon dioxide.
3. Draw a dot and cross diagram to show the bonding in a molecule of carbon dioxide.

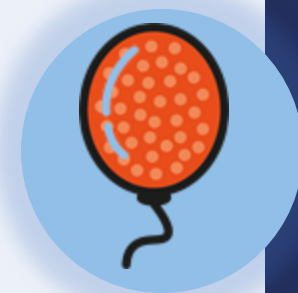


Prior Knowledge Review

Read Now:

Covalent bonding takes place between non-metal atoms, where they share electrons to achieve a full outer shell and stable electron arrangement. Some covalent structures are molecules, which are small groups of non-metal atoms held together by strong covalent bonds. Some molecules can actually be very large, including one of the largest naturally-occurring molecules: DNA. Covalent bonding can also be found in giant covalent structures, such as diamond and graphite, which involve huge numbers of atoms covalently bonded to other atoms.

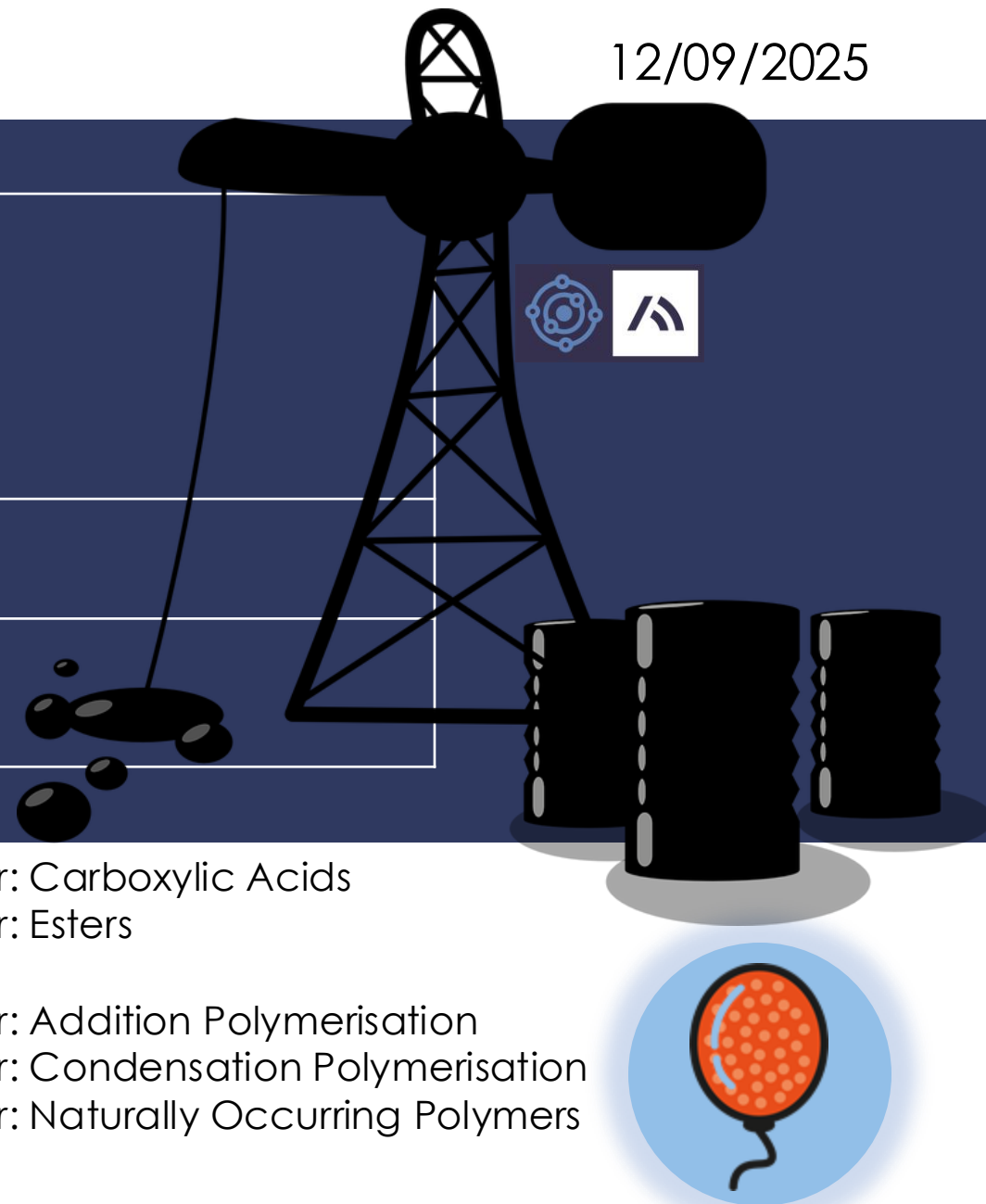
1. Identify the type of elements between which covalent bonds are formed.
2. Explain why atoms make bonds.
3. Explain what is meant by a stable electron arrangement.
4. Define a molecule.
5. Give an example of a giant covalent structure.



Prior Knowledge Review

C5.1.1

Science
Mastery



➤ C5.1.1 Prior Knowledge Review

C5.1.2 Crude Oil and Hydrocarbons

C5.1.3 Fractional Distillation

C5.1.4 Combustion of Hydrocarbons

C5.1.5 Cracking

C5.1.6 Taking it Further: Alkenes

C5.1.7 Taking it Further: Alcohols

C5.1.8 Taking it Further: Producing Ethanol by Fermentation

C5.1.9 Taking it Further: Producing Ethanol from Ethene

C5.1.10 Taking it Further: Carboxylic Acids

C5.1.11 Taking it Further: Esters

C5.1.12 Polymers

C5.1.13 Taking it Further: Addition Polymerisation

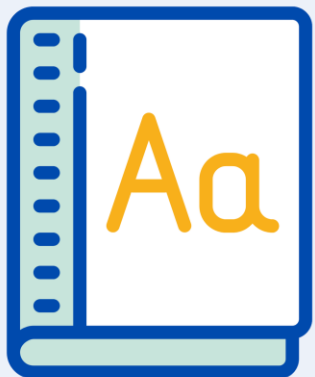
C5.1.14 Taking it Further: Condensation Polymerisation

C5.1.15 Taking it Further: Naturally Occurring Polymers

Following this lesson, students will be able to:

- Identify different types of bonding from chemical formulae
- Describe what happens when a covalent bond is formed
- Use diagrams to show covalent bonding

Key Words:




covalent

molecule

electronic configuration

dot and cross diagram

The Big Idea: Structure Determines Properties



Science
Mastery

Carbon Chemistry

What is crude oil actually made from? Why is so useful? How can we separate it and use it for different things? How is crude oil related to petrol and other fuels?

Organic chemistry is the study of the structure and properties of compounds that contain carbon. One of the biggest sources of carbon compounds is crude oil, which can be separated into many different compounds called hydrocarbons. Humans use these hydrocarbons for many different purposes.

This is the **sixth** unit we are studying as part of the big idea: **Structure Determines Properties**.

In this unit we will learn about what crude oil is and how it can be separated into different useful products. We will learn about different groups of hydrocarbons that can be obtained by fractional distillation of crude oil and the properties of these compounds and the different reactions they are involved in. We will also look at how some of these products can be made into useful polymers.


Chemistry students will also look at other groups of compounds, including alkenes, alcohols and carboxylic acids and reactions involving these compounds.


We will develop our skills in this unit by practising drawing models of covalent bonding in molecules. We will also revisit distillation as a method of separating a mixture based on the boiling points of the substances in it.

TASKS:
What subject will this unit focus on? BIOLOGY CHEMISTRY PHYSICS
(circle the correct subject)

There are lots of keywords underlined above. List these into the two columns:

Words I know	Words I haven't seen before





Science
Mastery

To answer before the unit:

1. What are you most excited to learn about in this topic?

2. What do you already know about this topic?

3. Why do you think it's important to learn that structure determines properties?

4. What knowledge from previous science lessons might help us?


5. What questions do you have about this topic?

To answer at the end of the unit:

1. Tick off any words in the 'words I haven't seen before' column that you are now confident with. Circle any you still need more practice to use.

2. What have you most enjoyed about this unit?

3. What more would you like to learn about bonding as part of the big idea: 'Structure Determines Properties'?



This is the fix-it portion of the lesson

The **fix-it** is an opportunity to respond to gaps in knowledge, especially those identified by the previous lesson's exit ticket.

- The teacher should customise this slide as needed, to facilitate
 - **reteach, explanation, demonstration** or **modelling** of ideas and concepts that students have not yet grasped or have misunderstood.
 - **practise** answering specific questions or of key skills.
 - **redrafting** or **improving** previous work.

Word:

Covalent



Comes
from:

Co-

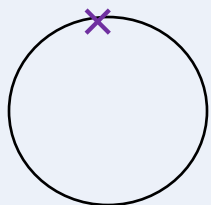
-valent

'together'
'partnered'

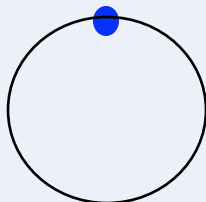
'relating to the valence shell'

Definition:

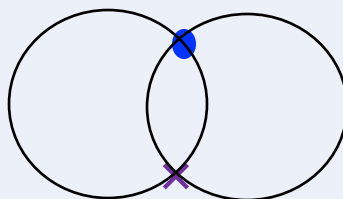
Covalent bonding occurs where two or more non-metal atoms share pairs of electrons in order to achieve a stable electronic configuration



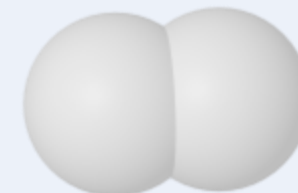
Hydrogen
atom



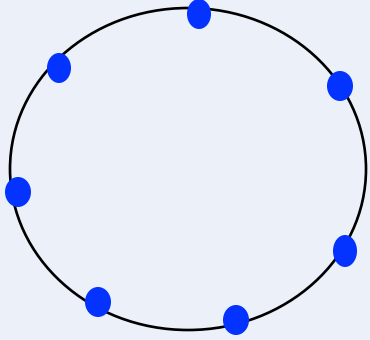
Hydrogen
atom



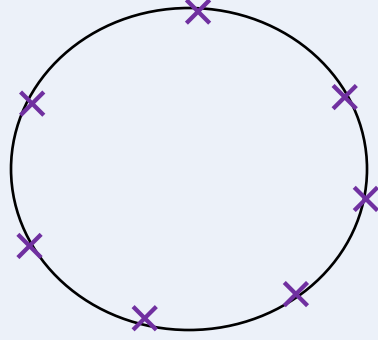
Hydrogen molecule (H₂)



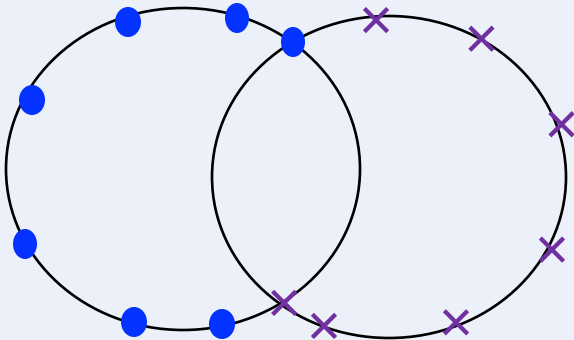
Covalent bonding in chlorine (Cl_2)



Chlorine atom
2, 8, 7

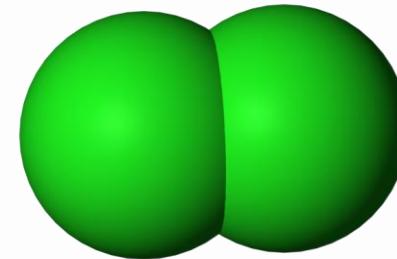
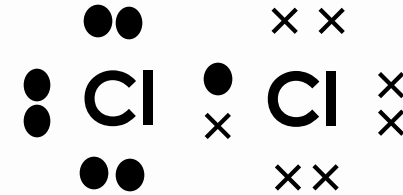
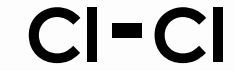


Chlorine atom
2, 8, 7

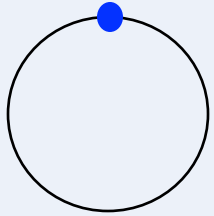


Chlorine molecule
 Cl_2

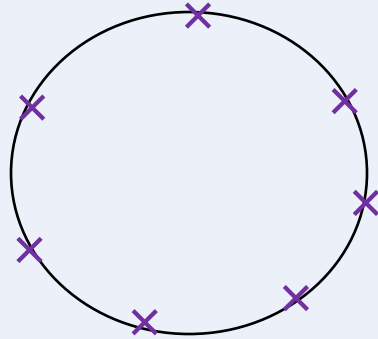
We can also represent this molecule like:



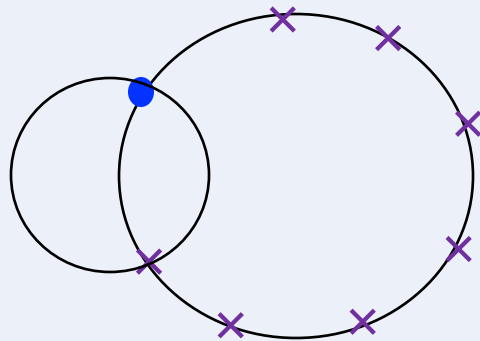
Covalent bonding in hydrogen chloride (HCl)



Hydrogen atom
1

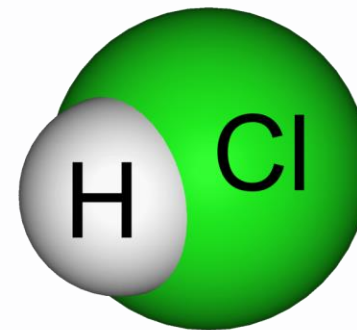
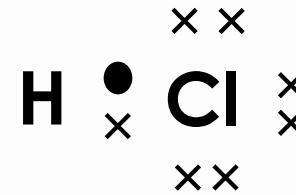


Chlorine atom
2, 8, 7



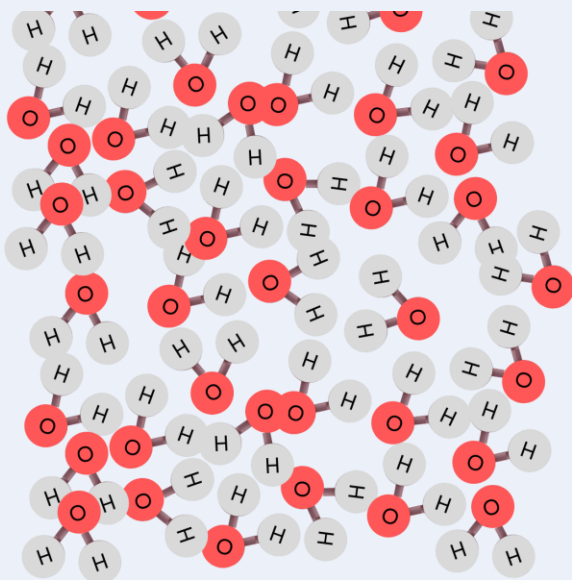
Hydrogen
chloride
molecule
HCl

We can also represent this molecule like:

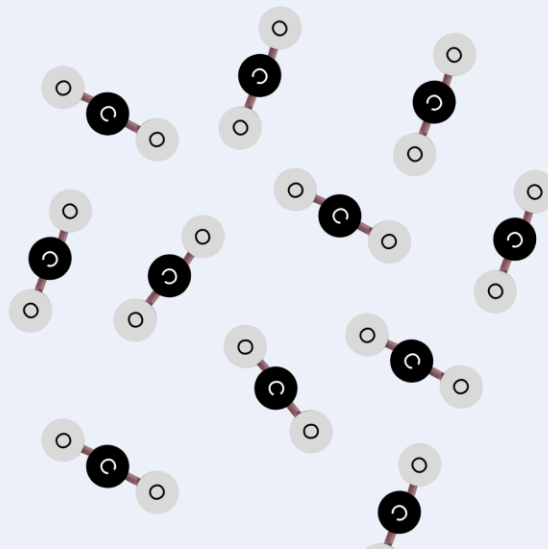


The structure of simple covalent substances

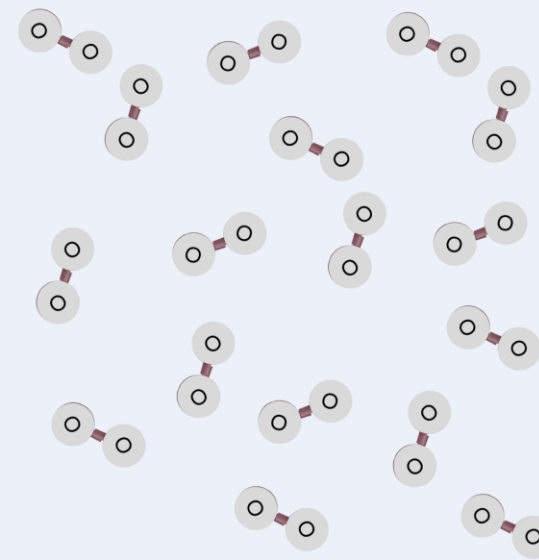
Examples of **simple covalent** substances include



water (H_2O)

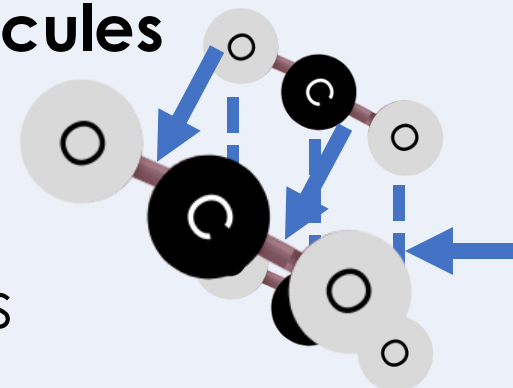


carbon dioxide (CO_2)



oxygen gas (O_2)

- Simple covalent substances consist of **many small molecules**
- **Strong covalent bonds** hold the atoms in a molecule together
- **Weak intermolecular forces** act between the molecules



Properties of covalent substances

There are two categories of covalent substances:

simple covalent substances



- ✓ have **low melting and boiling points**
- ✓ are **liquid or gas** at room temperature
- ✓ **do not conduct electricity**

giant covalent substances

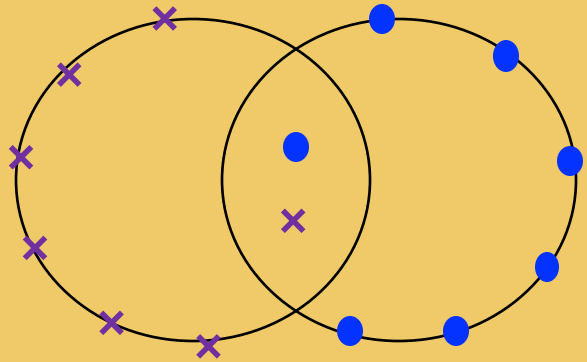


- ✓ have **high melting and boiling points**
- ✓ are **solid at room temperature**
- ✓ **may conduct electricity**

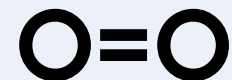
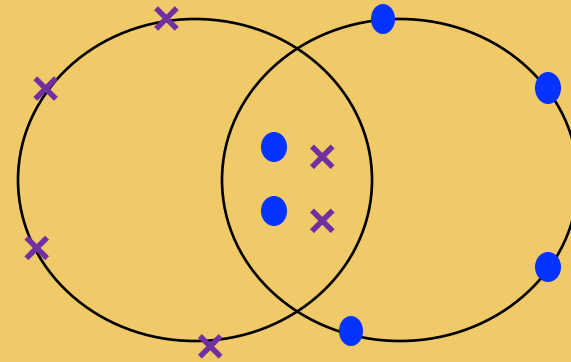
Look at the structure of each type of covalent substance carefully.
Which substances ~~will have a high melting point~~ **will have a high boiling point**?

Who do you agree with?

The bonding in an O_2 molecule looks like this:



The bonding in an O_2 molecule looks like this:



Which statements do you agree with?

Covalent molecules
contain metal and
non-metal atoms

Covalent
molecules
contain non-
metal atoms

A covalent bond
involves sharing
of electrons

A covalent
bond involves
the formation
of ions

Drill

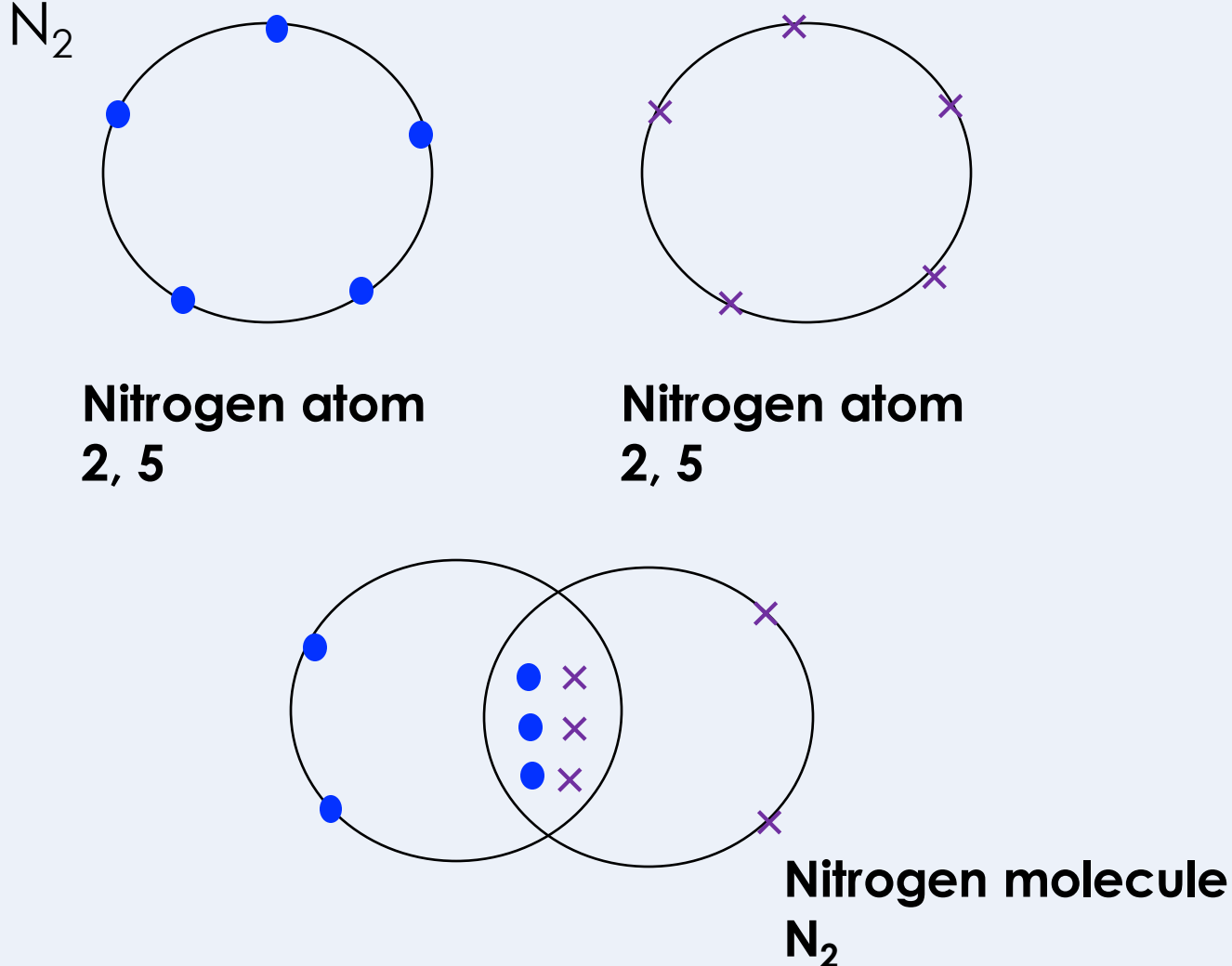
1. What type of elements are bonded during covalent bonding?
2. What happens during covalent bonding?
3. How is a single covalent bond represented?
4. How is a double covalent bond represented?
5. What is a double covalent bond?
6. What is the formula for methane?
7. State one example of a simple covalent substance.
8. What state of matter are simple covalent substances at room temperature?
9. Are covalent bonds weak or strong?
10. Name the forces that act between molecules in a simple covalent substance.
11. Explain the electrical conductivity of water.

Drill answers

1. Non-metals
2. During covalent bonding, non-metals share pairs of electrons.
3. A single covalent bond is represented by a single line, e.g. H-H
4. A double covalent bond is represented by a double line, e.g. O=O
5. A double covalent bond is 2 shared pairs of electrons
6. The formula for methane is CH₄
7. Water, oxygen, and carbon dioxide are examples of simple covalent substances
8. Liquid and gas
9. Covalent bonds are strong
10. Intermolecular forces
11. Water is a simple covalent substance. Its molecules are neutral and do not have any free electrons or ions to carry a charge. Therefore, water does not conduct electricity.

I: Drawing covalent bonding diagrams

Use dot-and-cross diagrams to show the covalent bonding in a nitrogen molecule, N_2

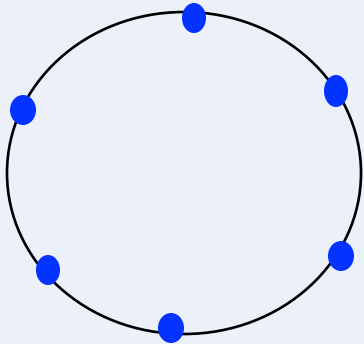


Steps to Success

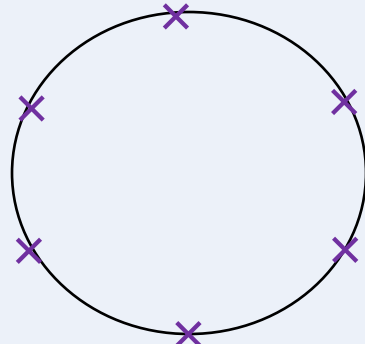
1. **Draw the electronic configuration** of the reacting atoms using dots for one type of atom and crosses for the other. Only draw the valence shell.
2. **Count** how many electrons each atom will need to share in order to get a full valence shell.
3. **Draw the atoms** overlapping with any shared electrons in the middle

We: Drawing covalent bonding diagrams

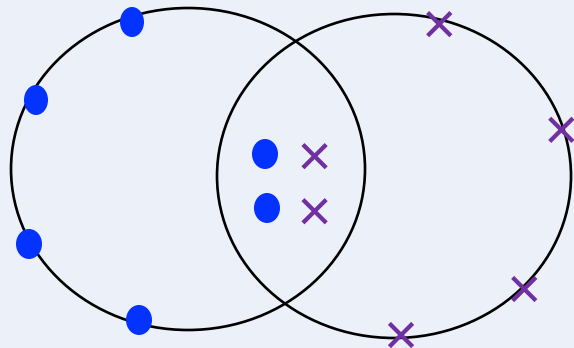
Use dot-and-cross diagrams to show the covalent bonding in an oxygen molecule, O_2



Oxygen atom
2, 6



Oxygen atom
2, 6



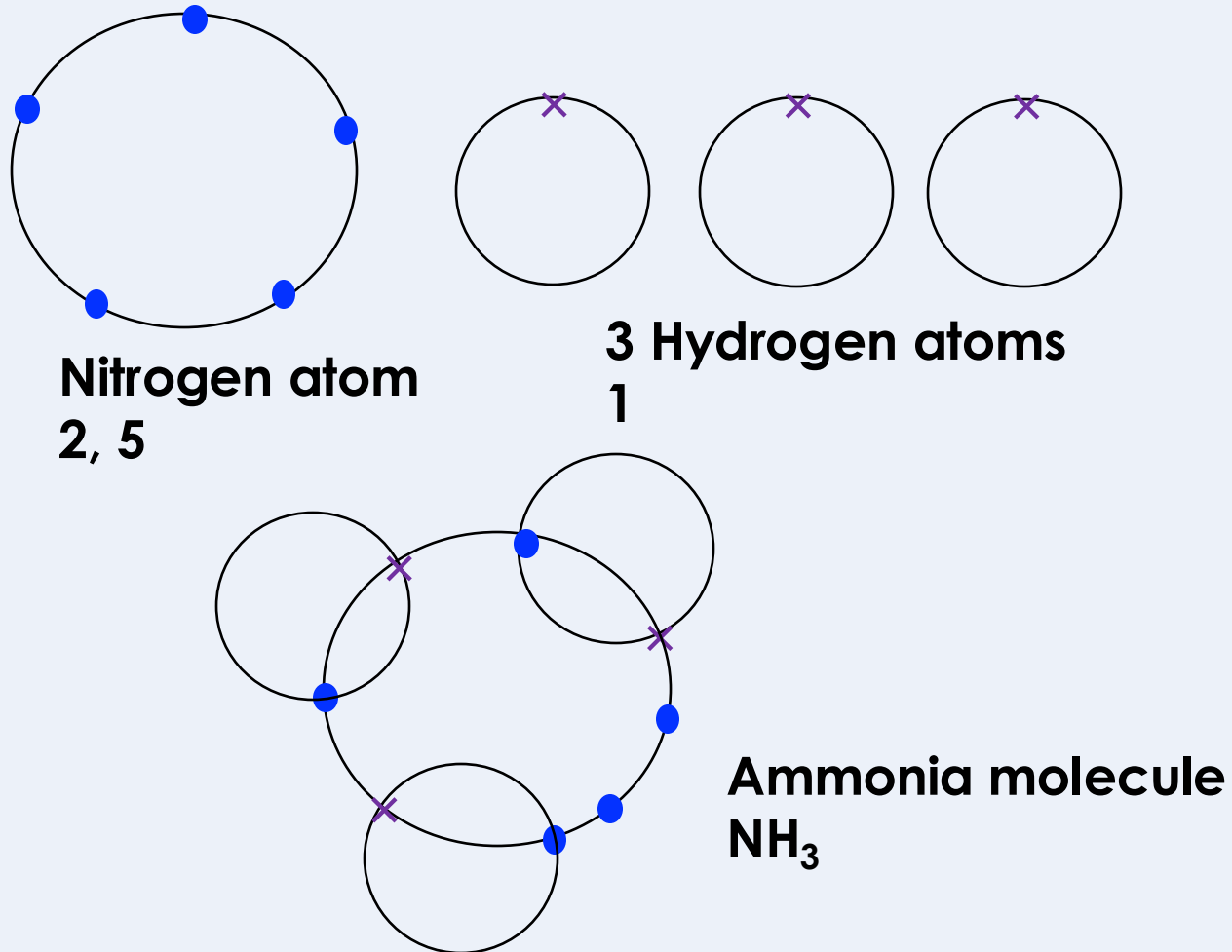
Oxygen molecule
 O_2

Steps to Success

1. **Draw the electronic configuration** of the reacting atoms using dots for one type of atom and crosses for the other. Only draw the valence shell.
2. **Count** how many electrons each atom will need to share in order to get a full valence shell.
3. **Draw the atoms** overlapping with any shared electrons in the middle

You: Drawing covalent bonding diagrams

Use dot-and-cross diagrams to show the covalent bonding in an ammonia molecule, NH_3



Steps to Success

1. **Draw the electronic configuration** of the reacting atoms using dots for one type of atom and crosses for the other. Only draw the valence shell.
2. **Count** how many electrons each atom will need to share in order to get a full valence shell.
3. **Draw the atoms** overlapping with any shared electrons in the middle

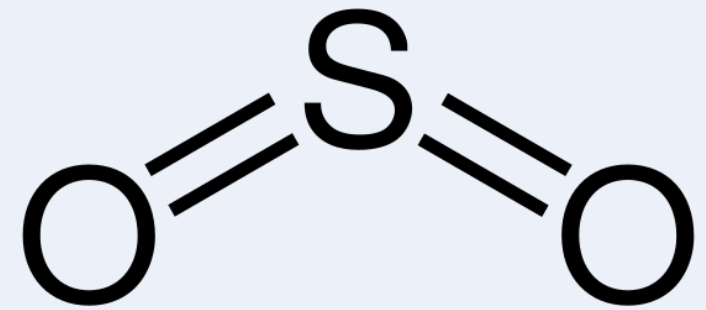
Answer the questions below.

1. Which answer correctly defines covalent bonding?

- ☒ A. Covalent bonding occurs where two or more non-metal atoms share pairs of electrons in order to achieve a stable electronic configuration
- ☐ B. Covalent bonding occurs where two or more metal atoms share pairs of electrons in order to achieve a stable electronic configuration
- ☐ C. Covalent bonding occurs where electrons are transferred from one atom to another in order to achieve a stable electronic configuration

2. How many pairs of electrons are shared, and how many covalent bonds are shown in this diagram?

- ☐ A. 4 pairs of electrons are shared, and there are two single covalent bonds
- ☐ B. 2 pairs of electrons are shared, and there are two double covalent bonds
- ☒ C. 4 pairs of electrons are shared, and there are two double covalent bonds



Answer the questions below.

3. Why doesn't pure water conduct electricity?

- ☐ A. It isn't a solid
- ☐ B. Pure water does conduct electricity
- ☒ C. It does not contain any free electrons

Lesson C5.1.1

What was good about this lesson?

What can we do to improve this lesson?

[Send us your feedback by clicking this link](#)
or by emailing sciencemastery@arkonline.org
Thank you!