OCR (A) Chemistry A-level

Topic 2.2.2 - Bonding and structure

Flashcards

What are the 3 main types of chemical bonds?

What are the 3 main types of chemical bonds?

- Ionic
- Covalent
- Metallic

Define ionic bonding

Define ionic bonding

The electrostatic attraction between positive and negative ions

Give an example of a ionically bonded substance

Given an example of an ionically bonded substance

NaCl (Sodium Chloride - salt)

Define covalent bonding

Define covalent bonding

Electrostatic attraction between a shared pair of electrons and the nuclei

Define metallic bonding

Define metallic bonding

Electrostatic attraction between the positive metal ions and the sea of delocalised electrons

Electrons in which shell are represented in a dot and cross diagram?

Electrons in which shell are represented in a dot and cross diagram?

The outer shell

Why does giant ionic lattices conduct electricity when liquid but not when solid?

Why does giant ionic lattices conduct electricity when liquid but not when solid?

In solid state the ions are in fixed positions and thus cannot move. When they are in liquid state the ions are mobile and thus can freely carry the charge

Giant ionic lattices have high or low melting and boiling point? Explain your answer

Giant ionic lattices have high or low melting and boiling point? Explain your answer

They have high melting and boiling point because a large amount of energy is required to overcome the electrostatic bonds

In what type of solvents do ionic lattices dissolve?

In what type of solvents do ionic lattices dissolve?

Polar solvents

E.g water

Why are ionic compounds soluble in water?

Why are ionic compounds soluble in water?

Water has a polar bond. Hydrogen atoms have a $\square^{+}$ charge and oxygen atoms have a $\square^{-}$ charge. These charges are able to attract charged ions

What is it called when atoms are bonded by a single pair of shared electrons?

What is it called when atoms are bonded by a single pair of shared electrons?

Single bond

How many covalent bonds does carbon form?

How many covalent bonds does carbon form?

4

How many covalent bonds does oxygen form?

How many covalent bonds does oxygen form?

2

What is a lone pair?

What is a lone pair?

Electrons in the outer shell that are not involved in the bonding

What is formed when atoms share two pairs of electrons?

What is formed when atoms share two pairs of electrons?

Double bond

What is formed when atoms share three pairs of electrons?

What is formed when atoms share three pairs of electrons?

Triple bond

What is average bond enthalpy?

What is average bond enthalpy?

Measure of average energy needed to break the bond

What is a dative covalent bond?

What is a dative covalent bond?

A bond where both of the shared electrons are supplied by one atom

How are oxonium ions formed?

How are oxonium ions formed?

Formed when acid is added to water, H_3O^+

What does expansion of the octet mean?

What does expansion of the octet mean?

When a bonded atom has more than 8 electrons in the outer shell

What are the types of covalent structure?

What are the types of covalent structure?

- Simple molecular lattice
- Giant covalent lattice

Describe the bonding in simple molecular structures

Describe the bonding in simple molecular structures?

Atoms within the same molecule are held by strong covalent bonds and different molecules are held by weak intermolecular forces

Why do simple molecular structures have low melting and boiling point?

Why do simple molecular structures have low melting and boiling point?

Small amount of energy is enough to overcome the intermolecular forces

Can simple molecular structures conduct electricity?

Can simple molecular structures conduct electricity?

No, they are non conductors.

Why do simple molecular structures not conduct electricity?

Why do simple molecular structures not conduct electricity?

The have no free charged particles to move around

Simple molecular structures dissolve in what type of solvent?

Simple molecular structures dissolve in what type of solvent?

Non polar solvents

Give examples of giant covalent structures

Give examples of giant covalent structures

- Diamond
- Graphite
- Silicon dioxide, SiO_2

List some properties of giant covalent structures? (3)

List some properties of giant covalent structures

- High melting and boiling point
- Non conductors of electricity, except graphite
- Insoluble in polar and non polar solvents

How does graphite conduct electricity?

How does graphite conduct electricity?

Delocalised electrons present between the layers are able to move freely carrying the charge

Why do giant covalent structures have high melting and boiling point?

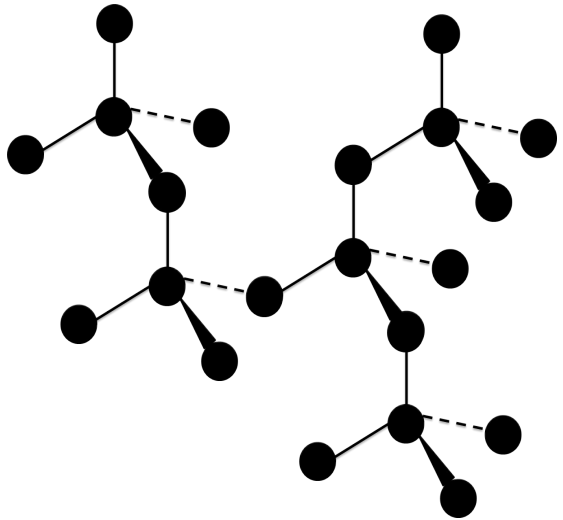
Why do giant covalent structures have high melting and boiling point?

Strong covalent bonds within the molecules need to be broken which requires a lot of energy

Draw and describe the structure of a diamond

Draw and describe the structure of a diamond

3D tetrahedral structure of C atoms, with each C atom bonded to four others



What does the shape of a molecule depend on?

What does the shape of a molecule depend on?

Number of electron pairs in the outer shell

Number of these electrons which are bonded and lone pairs

What is the shape, diagram and bond angle in a shape with 2 bonded pairs and 0 lone pairs?

What is the shape, diagram and bond angle in a shape with 2 bonded pairs and 0 lone pairs?

Linear

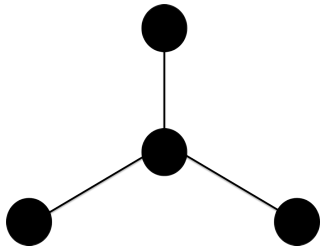
180°

What is the shape, diagram and bond angle in a shape with 3 bonding pairs and 0 lone pairs?

What is the shape, diagram and bond angle in a shape with 3 bonding pairs and 0 lone pairs?

Trigonal planar

120°

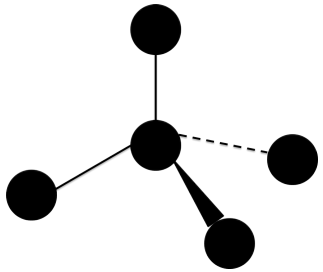


What is the shape, diagram and bond angle in a shape with 4 bonded pairs and 0 lone pairs?

What is the shape, diagram and bond angle in a shape with 4 bonded pairs and 0 lone pairs?

Tetrahedral

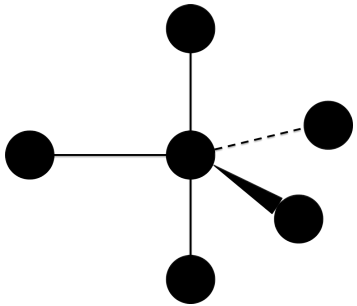
109.5°



What is the shape,diagram and bond angle in a shape with 5 bonded pairs and 0 lone pairs?

What is the shape, diagram and bond angle in a shape with 5 bonded pairs and 0 lone pairs?

Trigonal bipyramid



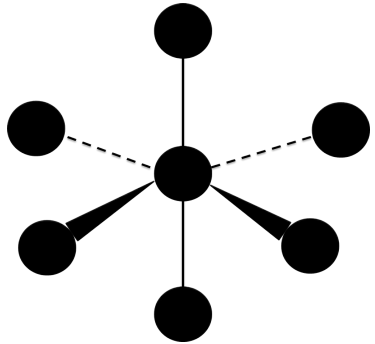
90° and 120°

What is the shape, diagram and bond angle in a shape with 6 bonded pairs and 0 lone pairs?

What is the shape, diagram and bond angle in a shape with 6 bonded pairs and 0 lone pairs?

Octahedral

90°



What is the shape, diagram and bond angle in a shape with 3 bonded pairs and 1 lone pairs?

What is the shape, diagram and bond angle in a shape with 3 bonded pairs and 1 lone pairs?

Pyramidal

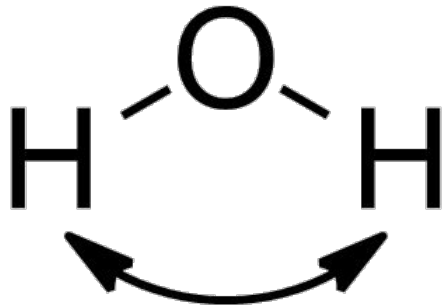
107°

What is the shape, diagram and bond angle in a shape with 2 bonded pairs and 2 lone pairs?

What is the shape, diagram and bond angle in a shape with 2 bonded pairs and 2 lone pairs?

Non linear

104.5°



104.5°

By how many degrees does each lone pair reduce the bond angle?

By how many degrees does each lone pair reduce the bond angle?

2.5°

Define electronegativity

Define electronegativity

The ability of an atom to attract the pair of electrons (the electron density) in a covalent bond

In which direction of the periodic table does electronegativity increase?

In which direction of the periodic table does electronegativity increase?

Top right, towards fluorine

What does it mean when the bond is non-polar?

What does it mean when the bond is non-polar?

The electrons in the bond are evenly distributed

What is the most electronegative element?

What is the most electronegative element?

Fluorine

How is a polar bond formed?

How is a polar bond formed?

Bonding atoms have different electronegativities

Why is H_2O polar, whereas CO_2 is non polar?

Why is H_2O polar, whereas CO_2 is non polar?

CO_2 is a symmetrical molecule, so there is no overall dipole

What is meant by intermolecular force?

What is meant by intermolecular force?

Attractive force between neighbouring molecules

What are the 2 types of intermolecular forces?

What are the 2 types of intermolecular forces?

- Hydrogen bonding
- Van der Waals' forces

What is the strongest type of intermolecular force?

What is the strongest type of intermolecular force?

Hydrogen bonding

What are the 2 interactions that can be referred as Van der Waals' forces?

What are the 2 interactions that can be referred as Van der Waals' forces?

- Permanent dipole - induced dipole interaction
- Permanent dipole - permanent dipole interaction

Describe permanent dipole-induced dipole interactions

Describe permanent dipole- induced dipole interactions

- When a molecule with a permanent dipole is close to other non polar molecules it causes the non polar molecule to become slightly polar leading to attraction

Describe permanent dipole-permanent dipole interactions

Describe permanent dipole- permanent dipole interactions

Some molecules with polar bonds have permanent dipoles → forces of attraction between those dipoles and those of neighbouring molecules

Describe London forces

Describe London forces

- London forces are caused by random movements of electrons
- This leads to instantaneous dipoles
- Instantaneous dipole induces a dipole in nearby molecules
- Induced dipoles attract one another

Are London forces greater in smaller or larger molecules?

Are London forces greater in smaller or larger molecules?

Larger due to more electrons

Does boiling point increase or decrease down the noble gas group? Why?

Does boiling point increase or decrease down the noble gas group? Why?

Boiling point increases because the number of electrons increases and hence the strength of London forces also increases

What conditions are needed for hydrogen bonding to occur?

What conditions are needed for hydrogen bonding to occur?

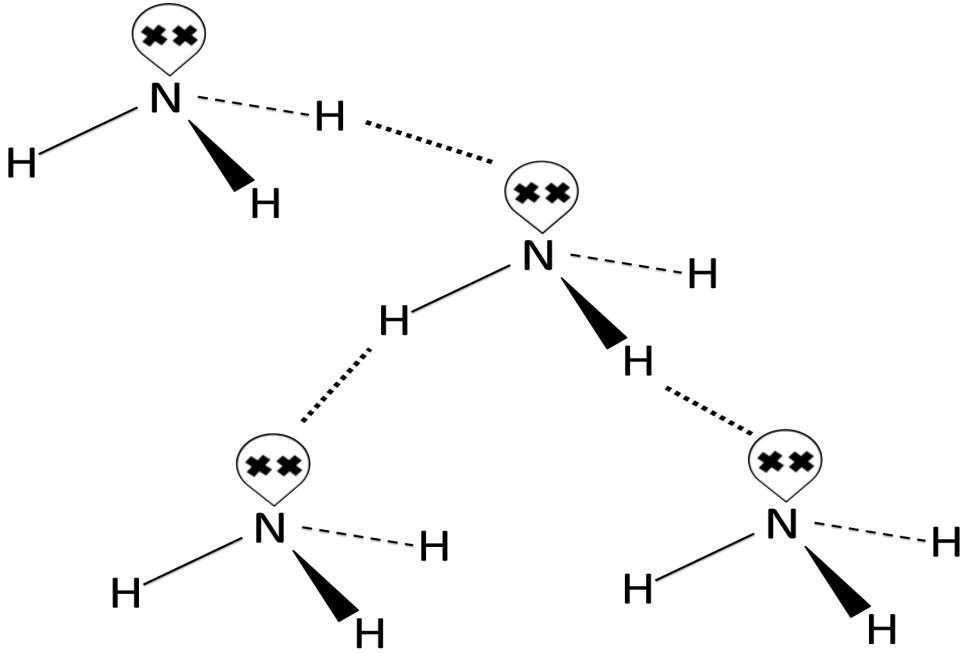
O-H, N-H or F-H bond, lone pair of electrons on O, F, N

Because O, N and F are highly electronegative, H nucleus is left exposed

Strong force of attraction between H nucleus and lone pair of electrons on O, N, F

Draw a diagram of hydrogen bonding

Draw a diagram of hydrogen bonding



Why is ice less dense than liquid water?

Why is ice less dense than liquid water?

- In ice, the water molecules are arranged in a orderly pattern. It has an open lattice with hydrogen bonds.
- In water, the lattice is collapsed and the molecules are closer together.

Why does water have a melting/ boiling point higher than expected?

Why does water have a melting/ boiling point higher than expected?

Hydrogen bonds are stronger than other intermolecular forces so extra strength is required to overcome the forces