

CIE Chemistry IGCSE

Topic 3 - Atoms, Elements and Compounds

Flashcards



What are the relative masses of protons,
neutrons and electrons?



What are the relative masses of protons, neutrons and electrons?

Proton: 1

Neutron: 1

Electron: $1/1836$



What are the relative charges of protons,
neutrons and electrons?



What are the relative charges of protons, neutrons and electrons?

Proton: +1

Neutron: 0

Electron: -1



Why do atoms contain equal numbers of protons and electrons?



Why do atoms contain equal numbers of protons and electrons?

Atoms are stable with no overall charge.

Protons have a relative charge of $+1$ and electrons have a relative charge of -1 so there must be an equal number for the charges to balance.



What does atomic number represent?



What does atomic number represent?

The number of protons in an atomic nucleus.



What does the mass number of an atom mean?



What does the mass number of an atom mean?

The total number of protons and neutrons found in the nucleus of an atom.



How are elements arranged in the modern periodic table?



How are elements arranged in the modern periodic table?

In order of increasing atomic number.

Elements with similar properties are in the same group (column).



Why do elements in the same group
have similar chemical properties?



Why do elements in the same group have similar chemical properties?

Elements in the same group have the same number of electrons in the outer shell which determines how they react.



What does the period (row) number tell you about all the elements in that period?



What does the period (row) number tell you about all the elements in that period?

They have the same number of electron shells e.g. all elements in period 4 have 4 shells of electrons.



What are isotopes?



What are isotopes?

Atoms of an element with the same number of protons but a different number of neutrons.

Isotopes of an element have the same atomic number but different mass numbers.



Why do isotopes have the same
chemical properties? (extended only)



Why do isotopes have the same chemical properties? (extended only)

Because they have the same number of electron in their outer shell so they react in the same way.



What are the two types of isotope?



What are the two types of isotope?

Radioactive and non-radioactive



Give a medical use of radioactive isotopes



Give a medical use of radioactive isotopes

Tracers

Cancer treatment

Lung imaging

Anemia diagnosis



Give an industrial use of radioactive isotopes



Give one industrial use of radioactive isotopes

Smoke alarms

Tracer (e.g. to find leaks in pipes)

Sterilisation



How are electrons arranged in an atom?



How are electrons arranged in an atom?

In shells around the nucleus.

The maximum number of electrons in the first three shells is 2, 8, 8. The first shell can hold two electrons and the second and third can hold eight.



What is the most stable electron configuration?



What is the most stable electron configuration?

A full outer shell of electrons.

For the first three shells this is either (2), (2,8) or (2,8,8).

Atoms react in order to gain a full outer shell of electrons so that they become more stable.



Which group are the noble gases in the periodic table?



Which group are the noble gases in the periodic table?

Group 8

(Also known as group 0)



Why are the noble gases very unreactive?



Why are the noble gases very unreactive?

The noble gases all have a full outer shell meaning they already have the most stable electron configuration. As a result, they do not react easily.



What is the difference between an element and a compound?



What is the difference between an element and a compound?

An element is a substance made up of only one type of atom whereas a compound is made up of two or more chemically combined elements.



What is a mixture?



What is a mixture?

Contains two or more elements /
compounds which are not chemically
combined.



What is a metal and where are they found in the periodic table?



What is a metal and where are they found in the periodic table?

Metals are found towards the left and bottom of the table.

Metals lose electrons to form positive ions.



What is a non-metal and where are they found in the periodic table?



What is a non-metal and where are they found in the periodic table?

Non-metals are found towards the top right of the periodic table.

Non-metals gain electrons to form negative ions.



What is an alloy?



What is an alloy?

An alloy is a mixture containing a metal and another element (metal or non-metal).



Why are alloys harder than pure metals?



Why are alloys harder than pure metals?

Atoms in pure metals are arranged in uniform rows which can easily slide over each other, making them very malleable.

Alloys contain different sized atoms which distort these layers meaning the layers are unable to slide, increasing the hardness of the material.



What is brass?
What is it used for?



What is brass? What is it used for?

Brass is an alloy of copper and zinc.

Brass is hard and resistant to corrosion.
It is used for decorative hardware such as plumbing fittings.



What are ions?



What are ions?

Atoms or groups of atoms with a positive or negative charge.



How are ions formed?



How are ions formed?

Positive ions form when an atom loses electrons.

Negative ions form when an atom gains electrons.



What are cations and anions?



What are cations and anions?

Cation - positive ion

Anion - negative ion



How are ionic bonds formed between
group I and group VII elements?



How are ionic bonds formed between group I and group VII elements?

Group I elements lose their only outer shell electron to form $1+$ ions. Group VII elements have seven electrons in their outer shell and can gain the electron lost from the group 1 element to form ions with a $1-$ charge.

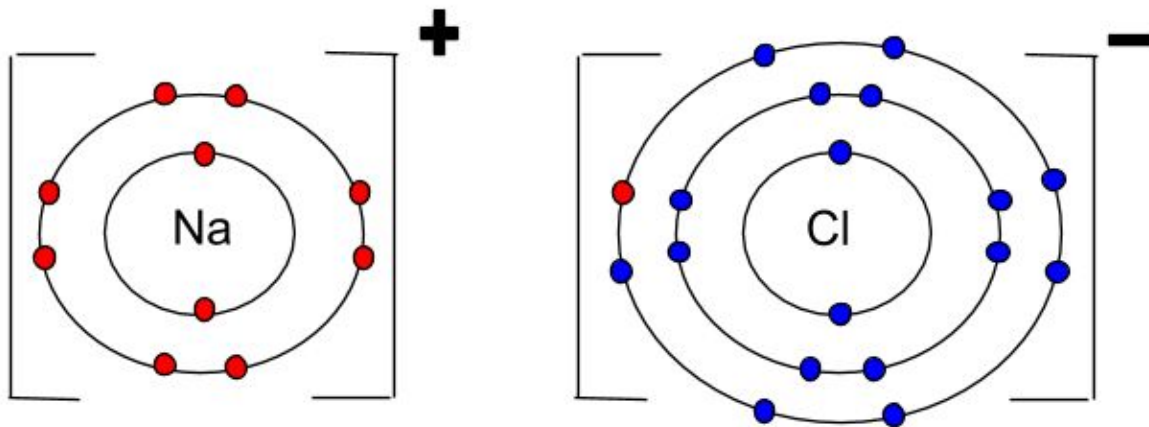
An ionic bond can form between these oppositely charged ions.



Draw the dot and cross diagram for
sodium chloride



Draw the dot and cross diagram for sodium chloride



What types of elements are ionic bonds formed between? (extended only)



What types of elements are ionic bonds formed between? (extended only)

Ionic bonds form between metals and non-metals.

Metal lose electrons to form positive ions.

Non-metals gain electrons to become negative ions.



Describe the structure of an ionic compound (extended only)



Describe the structure of an ionic compound (extended only)

- Giant lattice structure.
- Regular alternating arrangement of positive and negative ions.
- Held together by electrostatic attraction between oppositely charged ions.



What is a covalent bond?



What is a covalent bond?

A bond formed when two non-metals share a pair of electrons.



Why do atoms form covalent bonds?



Why do atoms form covalent bonds?

To obtain a more stable electron configuration (full outer shell like the noble gases).



Give an example of a compound that contains at least one single covalent bond



Give an example of a compound that contains at least one single covalent bond

- H_2 (hydrogen)
- Cl_2 (chlorine)
- H_2O (water)
- CH_4 (methane)
- NH_3 (ammonia)
- HCl (hydrogen chloride/hydrochloric acid)



Explain the formation of the covalent
bonds in carbon dioxide (CO_2)
(extended only)



Explain the formation of the covalent bonds in carbon dioxide (CO_2) (extended only)

Carbon has the electron configuration (2, 4) and oxygen has the electron configuration (2, 6).

The carbon atom forms a double covalent bond with each oxygen atom. This means each oxygen shares two pairs of electrons with the carbon. In total, the carbon will gain 4 electrons as it shares by a total of four electron pairs.



Explain the formation of covalent bonds
in nitrogen (N_2)
(extended only)



Explain the formation of covalent bonds in nitrogen (N_2) (extended only)

A nitrogen atom has the electron configuration (2, 5).

A triple covalent bond forms between the nitrogen atoms with three pairs of electrons shared between them.



Compare the volatility of ionic and covalent compounds



Compare the volatility of ionic and covalent compounds

Volatility is how easily a substance evaporates.

Ionic compounds have high boiling points so they have a low volatility.

Giant covalent compounds have high boiling points so they also have a low volatility.

Simple molecular compounds (covalent) have low boiling points so they have a high volatility.



Compare the solubility of ionic and covalent compounds



Compare the solubility of ionic and covalent compounds

Ionic compounds are generally soluble in water.

Covalent compounds are insoluble in water.



How does electrical conductivity
compare in ionic and covalent
compounds?



How does electrical conductivity compare in ionic and covalent compounds?

Except for graphite, covalent compounds are unable to conduct electricity as they have no free charged particles.

Ionic compounds conduct electricity when aqueous or molten as in these states, the ions are free to move and carry charge.



Why do ionic compounds have high melting and boiling points?

(extended only)



Why do ionic compounds have high melting and boiling points? (extended only)

Ionic compounds have strong electrostatic attraction between the oppositely charged particles. This requires a lot of energy to overcome meaning high melting and boiling points.



Explain the difference in melting and boiling points in the different types of covalent structures
(extended only)



Explain the difference in melting and boiling points in the different types of covalent structures (extended only)

Giant covalent compounds have high melting/boiling points because they have many strong covalent bonds which require a lot of energy to break.

Simple molecular structure have low melting/boiling points because only intermolecular forces need to be overcome during a state change. The intermolecular forces are relatively weak so do not require a lot of energy to overcome.



Name two giant covalent structures
formed from carbon atoms



Name two giant covalent structures formed from carbon atoms

Graphite

Diamond



Describe the structure of graphite



Describe the structure and properties relating to graphite

- Each carbon atom bonded to 3 other carbon atoms.
- Layers of hexagonal rings of carbon atoms.
- Weak intermolecular forces between layers.
- One delocalised electron per carbon atom.



Describe and explain the properties of graphite



Describe and explain the properties of graphite

- Soft/slippery because there are only weak intermolecular forces between layers which allow the layers to slide over one another.
- Electrical conductor because there is one delocalised electron per carbon atom. The delocalised electrons are mobile charges.



Describe the structure of diamond



Describe the structure of diamond

All carbon atom are covalently bonded to four other carbon atoms.

No delocalised electrons.



Describe the properties of diamond



Describe the properties of diamond

- Very hard due to strong covalent bonding.
- Very high melting point due to covalent bonds.
- Doesn't conduct electricity as there are no charged particles.



What are the uses of graphite? Why?



What are the uses of graphite? Why?

- Electrodes because graphite conducts electricity and has a high melting point.
- Lubricant because it's slippery (the layers can slide over each other).



Why is diamond used in cutting tools?



Why is diamond used in cutting tools?

It's very hard



Describe the structure of silicon(IV) oxide
(silicon dioxide) (extended only)



Describe the structure of silicon(IV) oxide (silicon dioxide) (extended only)

- Each silicon atom is covalently bonded to four oxygen atoms.
- Each oxygen atom is covalently bonded to two silicon atoms.
- No delocalised electrons.



Which properties do the structures
silicon dioxide and diamond share?
(extended only)



Which properties do the structures silicon dioxide and diamond share? (extended only)

- Very hard
- Very high melting and boiling points
- Do not conduct electricity
- Insoluble in water



Describe metallic bonding (extended only)



Describe metallic bonding (extended only)

Giant lattice structure with a regular arrangement of positive metal ions held together in a sea of delocalised electrons.



Why are metals able to conduct electricity? (extended only)



Why are metals able to conduct electricity?
(extended only)

The delocalised electrons are free to move and carry charge.



Explain why metals are malleable (extended only)



Explain why metals are malleable (extended only)

The ions are arranged in regular uniform rows. These rows are able to slide over each other easily, making the metal malleable.

