# OCR (A) Chemistry GCSE

## Topic 2 - Elements, Compounds and Mixtures

### Flashcards

What is meant when a substance is described as pure? How does the scientific definition of the term differ from the everyday definition?

# What is meant when a substance is described as pure? How does the scientific definition of the term differ from the everyday definition?

Scientifically, a pure substance is made up of a single element or compound.

In everyday, the term ‘pure’ is used to describe something with nothing added to it. For example milk can be called ‘pure milk’ but scientifically it is not pure as it contains a mixture of compounds.

# How can melting points be used to identify a pure substance?

How can melting points be used to identify a pure substance?

A pure substance will have an exact sharp melting point. If a substance is not pure it will melt across a range of temperatures due to the fact that it is contains a mixture of elements / compounds.

What apparatus could be used to measure temperature? Which is the most precise?

What apparatus could be used to measure temperature? Which is the most precise?

Thermometer or temperature probe.

Temperature probe is the most precise as it can record temperature to 2 decimal places.

# What is the meaning of relative atomic mass?

What is the meaning of relative atomic mass?

The average mass of an atom of an element compared to 1/12th the mass of an atom of carbon-12.

# What is the meaning of relative formula mass?

What is the meaning of relative formula mass?

The weighted mean average masses of the formula units compared to 1/12th the mass of an atom of carbon-12.

# What is the meaning of relative molecular mass?

What is the meaning of relative molecular mass?

The mean average mass of one molecule of an element or compound compared to 1/12th the mass of one atom of carbon-12.

# How is relative formula mass calculated?

# How is relative formula mass calculated?

Add together the relative atomic masses of each of the elements in the chemical formula.

What is the relative formula mass of $Ca(OH)_2$?

# What is the relative formula mass of $Ca(OH)_2$?

Calcium relative atomic mass = 40

Oxygen relative atomic mass = 16

Hydrogen relative atomic mass = 1

So formula mass = 40 + 2(16+1) = 74

# What is the empirical formula?

# What is the empirical formula?

The smallest whole number ratio of atoms of each element in a compound.

# What is the molecular formula?

# What is the molecular formula?

The formula that shows the actual number of atoms of each element in the compound.

Write the empirical formulae of $CH_4$ and $C_4H_{10}$?

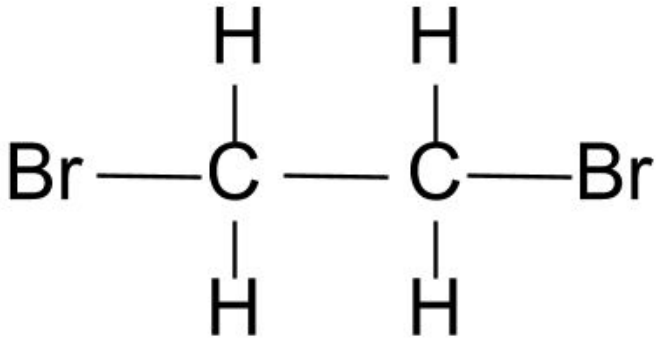
Write the empirical formulae of $CH_4$ and $C_4H_{10}$

$CH_4 \rightarrow CH_4$

$CH_4$ is already in the smallest possible ratio.

$C_4H_{10} \rightarrow C_2H_5$

# What is the molecular and empirical formulae of the compound below?



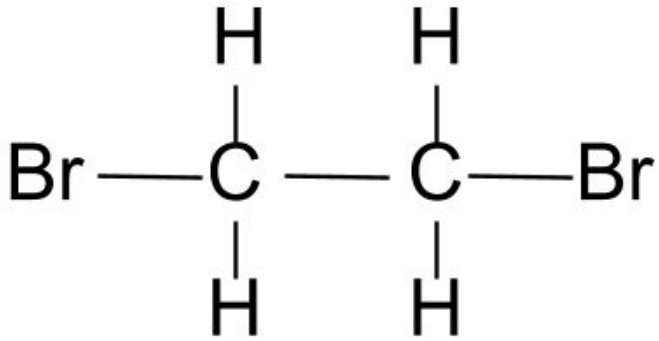
# What is the molecular and empirical formulae of the compound below?

Molecular formula:

$C_2H_4Br_2$

Empirical formula:

$CH_2Br$



# What is an alloy?

# What is an alloy?

A mixture of two or more metals.

# Why are alloys commonly used instead of pure metals?

# Why are alloys commonly used instead of pure metals?

Alloys can be engineered to have more desirable properties than pure metals. Alloys are often harder and stronger than pure metals because the different sized atoms within an alloy distort the layers so they can't slide over each other as easily.

Many useful materials are formulations of mixtures. Explain what this means.

Many useful materials are formulations of mixtures. Explain what this means.

A formulation is a mixture containing exact quantities of different substances. The quantities have been refined and tested to ensure the material has optimum properties for its purpose.

# Give examples of materials which are formulations of mixtures

# Give examples of materials which are formulations of mixtures

- Sunscreen
- Medicine
- Perfume
- Drinks
- And many many more....

State which process can be used to separate an insoluble salt from a solution. How does it work?

# State which process can be used to separate an insoluble salt from a solution. How does it work?

Filtration:

- Put filter paper in a funnel and place it over an empty conical flask.
- Pour the mixture of the insoluble salt and solution through the funnel. Use distilled water to wash any of the salt left in the beaker through the funnel.
- Remove the filter paper and evaporate the water from the residue if the salt is being collected. The solution will collect in the conical flask.

What process can be used to separate a soluble salt from a solution? How does it work?

# What process can be used to separate a soluble salt from a solution? How does it work?

Crystallisation:

- Gently heat the solution in an evaporating basin to increase the concentration of the solution.
- Remove from the heat and allow the solution to cool.
- Slowly the salt crystals will form as the rest of the water evaporates.

# When is simple distillation used as a separation technique?

When is simple distillation used as a separation technique?

To separate one liquid from a mixture of liquids that have different boiling points.

# Describe the process of separating ethanol from a mixture of ethanol and water using simple distillation

# Describe the process of separating ethanol from a mixture of ethanol and water using simple distillation

- Place mixture in a round bottomed flask. Connect to a condenser with a beaker at the end. Cold water should enter the condenser at the bottom and leave at the top.
- Heat the flask.
- Ethanol has a lower boiling point than water so will evaporate and enter the condenser first.
- Vapours cool in the condenser and drip into the beaker.

What substance is the process of fractional distillation commonly used to separate? Why?

What substance is the process of fractional distillation commonly used to separate? Why?

Crude oil.

Fractional distillation can separate several substances in a mixture if they have different boiling points. This is useful for crude oil as it allows the separation of the hydrocarbons it contains.

# How does the process of fractional distillation work to separate crude oil?

# How does the process of fractional distillation work to separate crude oil?

1. The oil is heated until it evaporates.
2. The vapours enter the fractionating column. The column has a temperature gradient with temperature decreasing up the column.
3. DIfferent compounds have different boiling points. The vapours slowly rise up the column and condense at different fractions depending on their boiling point.
4. The separated hydrocarbons are converted into products for the petrochemical industry.

# What is chromatography? What does it involve?

# What is chromatography? What does it involve?

Chromatography is a process used to separate a mixture of soluble substances.

It involves a stationary and a mobile phase. Separation depends the distribution of substances between the two phases.

# What are the specific phases used in paper chromatography?

What are the specific phases used in paper chromatography?

Stationary phase: Paper

Mobile phase: Solvent

# What are the specific phases used in thin layer chromatography (TLC)?

# What are the specific phases used in thin layer chromatography (TLC)?

Stationary phase: Thin layer of an inert substance supported on an unreactive surface.

Mobile phase: Solvent.

# Describe how to carry out paper or thin layer chromatography?

# Describe how to carry out paper or thin layer chromatography?

A pencil line is drawn 2 cm up from the base of the stationary phase. A dot of the mixture being tested is placed on this line. The stationary phase is then placed in a beaker with 1 cm of solvent. The solvent travels up the stationary phase and the mixture is dissolved into the mobile phase. The substances separate depending on how soluble they are in the solvent.

# Why must the solvent level be below the pencil line in paper chromatography and TLC?

Why must the solvent level be below the pencil line in paper chromatography and TLC?

To prevent the solvent submerging the substance being tested and washing it away.

# Why is pencil used to draw the baseline in paper chromatography?

Why is pencil used to draw the baseline in paper chromatography?

Pencil is insoluble so will not affect the results of the experiment. Ink is soluble so would travel through the solvent and alter the results.

# What is an Rf value?

# What is an Rf value?

## Rf - Retention factor

The Rf value is a ratio between the distance travelled by the dissolved substance (the solute) and the distance travelled by the solvent.

# How do you calculate Rf from a chromatogram?

# How do you calculate Rf from a chromatogram?

$$Rf = \frac{\text{Distance travelled by substance}}{\text{Distance travelled by solvent}}$$

# When is gas chromatography used?

# When is gas chromatography used?

Gas chromatography is used to separate mixtures of volatile liquids.

# What are the specific phases used in gas chromatography?

What are the specific phases used in gas chromatography?

Stationary phase: Solid / liquid on solid support

Mobile phase: Inert carrier gas

# How does gas chromatography separate a mixture of compounds?

# How does gas chromatography separate a mixture of compounds?

A gas (mobile phase) is used to carry substances through a column packed with a solid (stationary phase). The substances travel through the column at different speeds so are separated. The time they take to reach the detector is called the retention time. This can be used to identify each substance.

# How can chromatography be used to distinguish between pure and impure substances?

How can chromatography be used to distinguish between pure and impure substances?

Pure - one spot on chromatogram (paper/ TLC) or one peak on one peak on graph (gas chromatography).

Impure - multiple spots / peaks.

# What are metals and where are they found in the periodic table?

What are metals and where are they found in the periodic table?

Metals are elements which react to form positive ions.

They are found on the left side of the periodic table.

# What are non-metals and where are they found in the periodic table?

What are non-metals and where are they found in the periodic table?

Non-metals are elements which react to form negative ions.

They are found towards the top right of the periodic table.

# What are the general properties of metals?

# What are the general properties of metals?

- Shiny
- Good conductors
- Dense
- Malleable and ductile
- High melting and boiling points

# What are the general properties of non-metals?

# What are the general properties of non-metals?

- Dull appearance
- Poor conductors
- Lower density than metals
- Low melting and boiling points
- Brittle

# What is formed when a metal reacts with oxygen?

What is formed when a metal reacts with oxygen?

Metal oxide

# How are positive and negative ions formed?

# How are positive and negative ions formed?

Positive ions are formed when a metal loses an electron.

Negative ions are formed when a non-metal gains an electron.

What is the chemical equation for the reaction between magnesium and oxygen?

What is the chemical equation for the reaction between magnesium and oxygen?

$2Mg + O_2 \rightarrow 2MgO$

Mg forms the ion $Mg^{2+}$ and oxygen forms the ion $O^{2-}$.

# How are elements arranged in the periodic table?

# How are elements arranged in the periodic table?

Elements are arranged in order of increasing atomic number so that elements in the same group (column) have similar properties.

# Why do elements in the same column have similar properties?

Why do elements in the same column have similar properties?

They have the same number of outer shell electrons. This determines how they react.

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

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

They all have the same number of shells of electrons.

e.g. all elements in period 4 have 4 electron shells.

What does group (column) number tell you about all the elements in that group?

What does group (column) number tell you about all the elements in that group?

They all have the same number of outer electrons.

e.g. all elements in group 2 have 2 electrons in their outer shell

# Describe the difference between a covalent and ionic bond

# Describe the difference between a covalent and ionic bond

- A covalent bond forms when two non-metals share a pair of electrons.
- An ionic bond forms between a positive metal ion and negative non-metal ion.
- Covalent bonds only occur between non-metals and they do not involve any charged particles while ionic bonds include both metal and non-metal ions.

# Describe the bonding in an ionic compound

# Describe the bonding in an ionic compound

Ionic bonds form between positive metal ions and negative non-metal ions.

Ionic compounds are held together by the electrostatic attraction between these oppositely charged ions.

# Why do ionic compounds have high melting and boiling points?

Why do ionic compounds have high melting and boiling points?

The strong electrostatic forces of attraction between oppositely charged ions require a lot of energy to overcome.

# When do ionic compounds conduct electricity? Why?

# When do ionic compounds conduct electricity? Why?

Ionic compounds conduct electricity when molten or aqueous because the ions are free to move to carry charge. When solid, the ions are fixed in the ionic lattice so don't conduct electricity.

# Describe the bonding in simple molecules

# Describe the bonding in simple molecules

Covalent bonds, formed when two non-metals share a pair of electrons.

# Why do simple molecules have low boiling points despite containing strong covalent bonds?

# Why do simple molecules have low boiling points despite containing strong covalent bonds?

To change state, simple molecules need to overcome the intermolecular forces, not the covalent bonds.

Simple molecules are held together by weak intermolecular forces which require little energy to overcome.

# Why are simple molecules unable to conduct electricity?

Why are simple molecules unable to conduct electricity?

They have no overall charge.

# How and why do boiling points of simple molecules change as the size of the molecules increases?

# How and why do boiling points of simple molecules change as the size of the molecules increases?

As the size of the molecule increases, the strength of the intermolecular forces also increases.

Larger simple molecules have higher boiling points as more energy is required to overcome the intermolecular forces.

# Describe the bonding in giant covalent structures

# Describe the bonding in giant covalent structures

Many strong covalent bonds (shared pair of electrons).

# Why do giant covalent structures have very high melting points?

# Why do giant covalent structures have very high melting points?

All of the atoms in the structure are covalently bonded to other atoms. These strong covalent bonds must be broken to melt the substance which requires a lot of energy meaning the melting point is very high.

# What type of bonds are found in polymers?

# What type of bonds are found in polymers?

## Covalent bonds

# Why are polymers solids at room temperature?

# Why are polymers solids at room temperature?

Polymers are simple molecules so their melting point depends on the strength of the intermolecular forces. As the molecules are very large, the intermolecular forces are strong so require a lot of energy to overcome in order to melt the polymer.

# Describe the structure and bonding in metals

# Describe the structure and bonding in metals

## Metallic bonding

Giant structure with positive metal ions held in a sea of delocalised electrons.

# Why are metals able to conduct electricity?

# Why are metals able to conduct electricity?

The delocalised electrons are free to move throughout the structure so can carry charge through the metal.

# Why are metals typically very malleable?

# Why are metals typically very malleable?

The atoms in metals are arranged in uniform rows that can easily slide over one another. This allows metals to be bent and shaped.

# Why do metals have relatively high melting points?

# Why do metals have relatively high melting points?

They have very strong metallic bonding. A lot of energy is required to overcome the electrostatic attraction between the positive ions and negative electrons.

# Draw a dot and cross diagram for methane, $CH_4$

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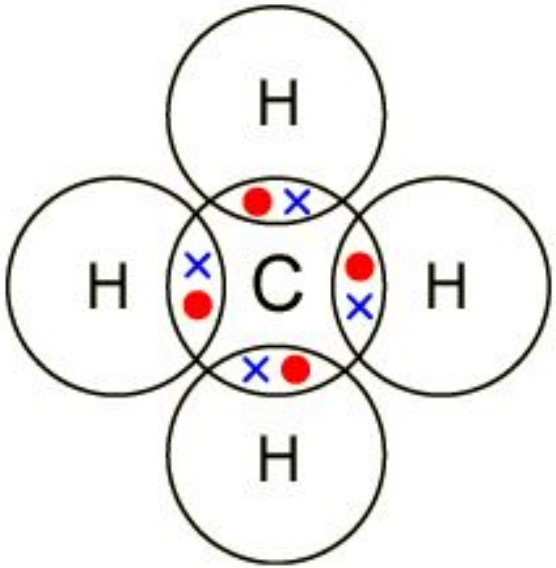
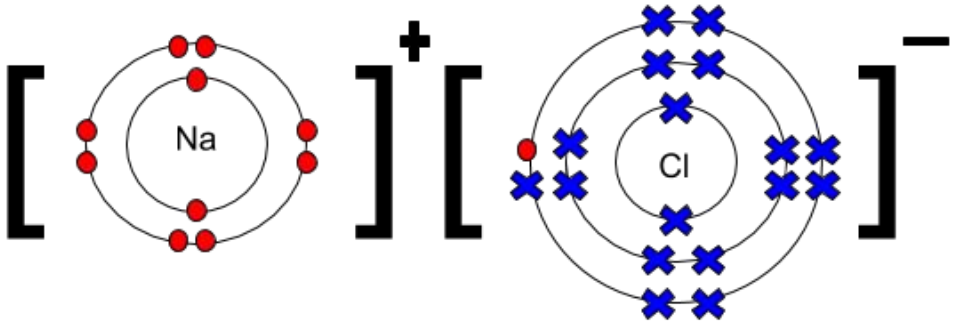


# Draw a dot and cross diagram for NaCl

# Draw a dot and cross diagram for NaCl



# What is a limitation of dot and cross diagrams?

What is a limitation of dot and cross diagrams?

Don’t show the 3D arrangement of molecules.

What is a benefit of using ball and stick models to represent molecules? In what way are they limited?

What is a benefit of using ball and stick models to represent molecules? In what way are they limited?

+ They show the 3D shape and how atoms are bonded.
- They don't model electrons.

What is the highest electron configuration when looking at the first three shells?

What is the highest electron configuration when looking at the first three shells?

2, 8, 8

# What is the most desirable electron configuration?

# What is the most desirable electron configuration?

All atoms want to have a full outer shell so this would be 8 electrons in the outer shell (or 2 if the atom only has one shell).

# Why are the noble gases (group 0) very unreactive?

# Why are the noble gases (group 0) very unreactive?

They have very stable electron configurations due to their full outer shell of electrons. This means they don't want to lose or gain electrons so are unreactive.

Why might an element with the electron arrangement of 2, 8, 1 be very reactive?

Why might an element with the electron arrangement of 2, 8, 1 be very reactive?

It's very reactive because it can lose an electron (becoming a positive ion) to obtain the stable configuration 2,8.

# How did Mendeleev order his early periodic table?

# How did Mendeleev order his early periodic table?

In order of increasing atomic mass.

In some places, the order was changed slightly so that elements of similar properties would be grouped in the same column.

# Why did Mendeleev leave gaps in his periodic table?

# Why did Mendeleev leave gaps in his periodic table?

For undiscovered elements. He used elements around these gaps to predict properties of the missing elements.

Some elements in Mendeleev's table did not fit with the expected properties. How has this been modified in the modern periodic table?

Some elements in Mendeleev's table did not fit with the expected properties. How has this been modified in the modern periodic table?

The elements are now ordered by increasing atomic number rather than increasing atomic mass.

# How many covalent bonds can carbon form?

# How many covalent bonds can carbon form?

Four

# What are organic compounds?

# What are organic compounds?

Compounds containing carbon covalently bonded to other atoms.

# Why is there such an array of natural and synthetic organic compounds?

Why is there such an array of natural and synthetic organic compounds?

Because carbon can form families of similar compounds, chains and rings.

# Describe the structure of graphite

# Describe the structure of graphite

- Each carbon atom bonded to 3 other carbon atoms.
- Layers of hexagonal rings of carbon atoms.
- One delocalised electron per carbon atom.

# Describe the properties of graphite

# Describe the properties of graphite

- Soft/ slippery because the weak intermolecular forces between layers allow the layers to slide over one another.
- Electrical conductor because it contains delocalised electrons which are free to carry charge.

# Describe the structure of diamond

# Describe the structure of diamond

- Each carbon atom is covalently bonded to four other carbon atoms.
- No charged particles.

# Describe the properties of diamond

# Describe the properties of diamond

- Very hard and very high melting point due to strong covalent bonds.
- Doesn’t conduct electricity because there are no charged particles.

# What is a fullerene?

# What is a fullerene?

A molecule made up of carbon atoms, shaped like a closed tube or hollow ball.

# Name two fullerenes

# Name two fullerenes

Graphene

$C_{60}$ (buckminsterfullerene)

# What are the properties and uses of fullerenes?

# What are the properties and uses of fullerenes?

- They have a large surface area so are useful for trapping catalysts onto their surfaces.
- Hollow structure makes them useful for capturing substances by forming around the target molecule. Useful for targeted drug delivery systems.

# Why is graphene useful in electronics?

# Why is graphene useful in electronics?

- It is extremely strong
- It has free electrons so can conduct electricity
- It's only one atom thick (single layer of graphite)

Energy is transferred to the surroundings during which changes of state?

Energy is transferred to the surroundings during which changes of state?

Condensing

Freezing

# Energy is transferred to a substance during which changes of state?

Energy is transferred to a substance during which changes of state?

Evaporating

Melting

Substance A melts at -200ºC and boils at -183ºC. What state is A at -174ºC?

Substance A melts at -200ºC and boils at -183ºC. What state is A at -174ºC?

Liquid

Substance B melts at -5ºC and boils at 23ºC. What state is A at -7ºC?

Substance B melts at -5ºC and boils at 23ºC. What state is A at -7ºC?

Solid

Do individual atoms have the same physical properties of the substance that contains them? Explain your answer

Do individual atoms have the same physical properties of the substance that contains them? Explain your answer

No, physical properties of a substance depend on the bonds it contains as well as the strength and arrangement of these bonds.

In terms of size, how do nanoparticles compare to atoms?

(Chemistry only)

In terms of size, how do nanoparticles compare to atoms? (Chemistry only)

Nanoparticles are 1-100 nanometres across.

They contain a few hundred atoms so they are approximately 100 times larger than atoms.

# Compare the surface area to volume ratio of particles and nanoparticles? (Chemistry only)

Compare the surface area to volume ratio of particles and nanoparticles? (Chemistry only)

Nanoparticles have a much larger surface area to volume ratio.

# Why are nanoparticles very reactive?
# (Chemistry only)

# Why are nanoparticles very reactive? (Chemistry only)

They have a very high surface area to volume ratio so there are more reaction sites.

# Why are nanoparticles useful catalysts? (Chemistry only)

# Why are nanoparticles useful catalysts? (Chemistry only)

Nanoparticles have a very high surface area to volume ratio so they provide more reaction sites.

# How can you calculate the surface area to volume ratio?

(Chemistry only)

How can you calculate the surface area to volume ratio? (Chemistry only)

Surface area to volume ratio =

Surface area ÷ Volume

Why might nanotubes be suitable for making electrical circuits for computers?

(Chemistry only)

Why might nanotubes be suitable for making electrical circuits for computers? (Chemistry only)

- They are electrical conductors.
- They are very small so take up little space in the computer.
- They are lightweight.

# Why might nanoparticles be used in sunscreen?

(Chemistry only)

# Why might nanoparticles be used in sunscreen? (Chemistry only)

They block UV light without leaving visible white marks on the skin.

# What are some of the risks associated with nanoparticulate materials? (Chemistry only)

# What are some of the risks associated with nanoparticulate materials? (Chemistry only)

- Little research has been conducted so there are many unknown factors.
- They may be harmful to health. They could enter the bloodstream and are not easily disposed of by the body.