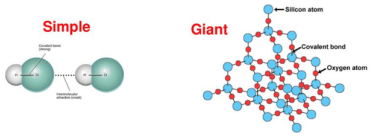
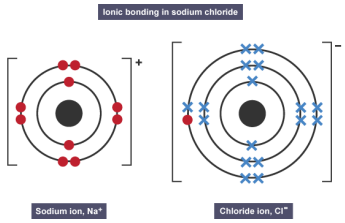
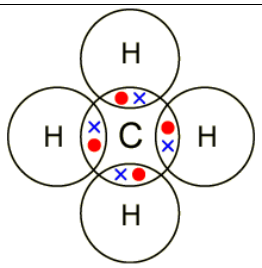
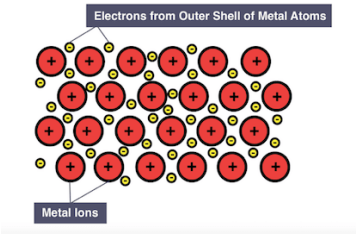
GCSE Chemistry Revision – Model Answers

Types of bonding

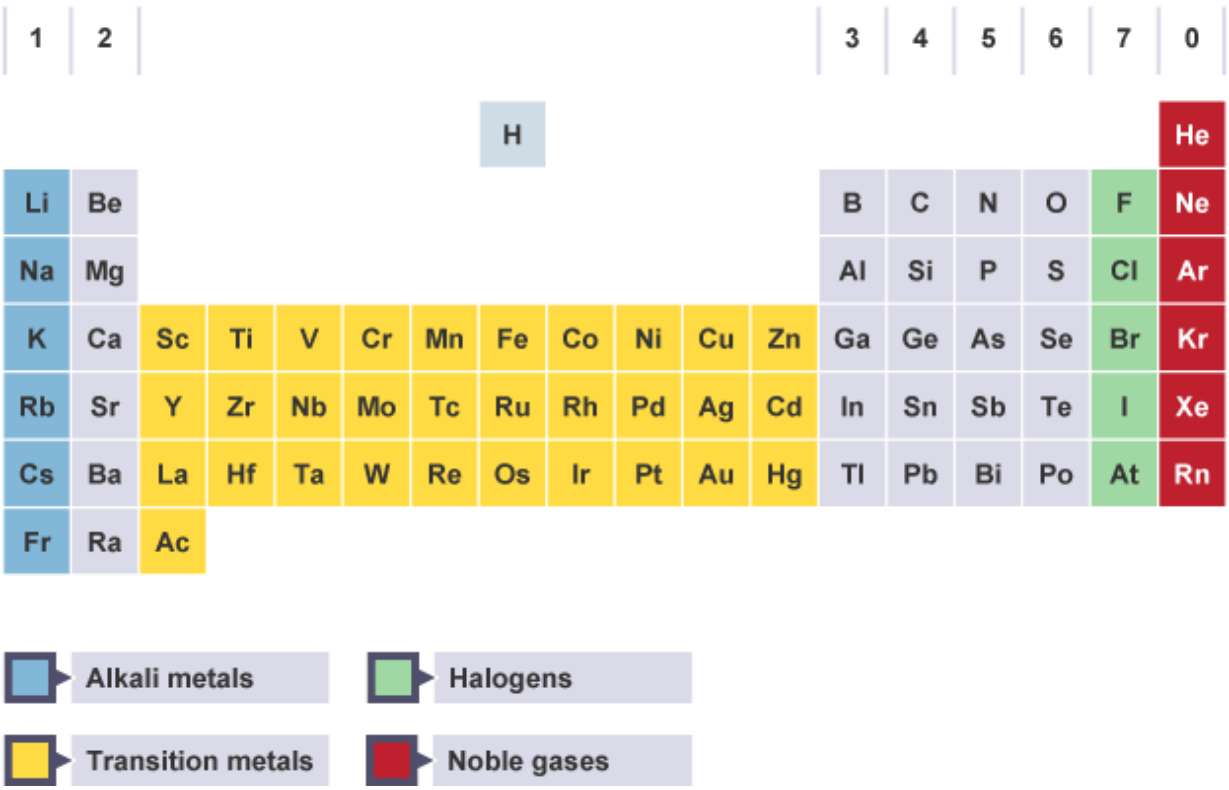
There are three types of bonding: ionic, covalent and metallic.

An ionic bond is the electrostatic attraction between oppositely charged ions.	A covalent bond is the electrostatic attraction between positive nuclei and shared pair of electrons.	A metallic bond is the electrostatic attraction between positive metal ions and delocalised electrons.
Ionic bonds occur between metals and non-metals. The metal gives electron/(s) to the non-metal.	Covalent bonds occur between two non-metals.	Metallic bonds are found in metals.
Ionic compounds have high melting and boiling points. This is because there are many strong ionic bonds which require a lot of energy to overcome.	Giant covalent structures have high melting and boiling points. This is because there are many strong covalent bonds which require a lot of energy to overcome. Simple covalent molecules have low melting and boiling points. This is because the covalent bonds are not broken. Weak intermolecular forces (WIMF) are broken which do not require much energy to overcome. 	Metals have high melting and boiling points. This is because there are many strong metallic bonds which require a lot of energy to overcome.

Ionic compounds can conduct electricity when in aqueous or molten state. This is because the ions are free to move and carry the charge.	Covalent compounds do not conduct electricity as they do not have free electrons to move and carry the charge. *Note: The exception here is graphite.*	Metals are good conductors. They have a sea of delocalised electrons which are free to move and carry the charge.
		

Group 1 and 7 Reactivity

Group 1 Reactivity	Group 7 Reactivity
• Elements in Group 1 must lose an electron to achieve a full outer shell • Reactivity increases as you move down the group • This is because atoms increase in size as you move down the group • There is more shielding from the positive attraction of the nucleus and it becomes easier to lose the outer electron	• Elements in Group 7 must gain an electron to achieve a full outer shell • Reactivity decreases as you move down the group • This is because atoms increase in size as you move down the group • There is more shielding from the positive attraction of the nucleus and it becomes harder to gain an extra electron



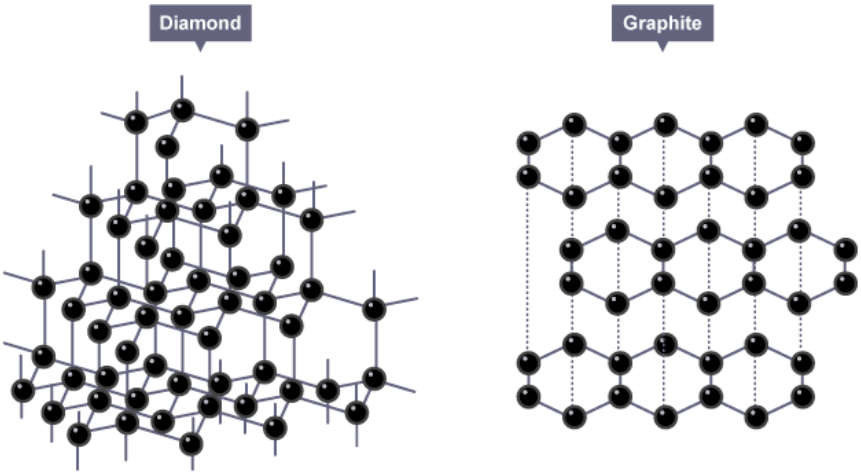
Properties of Graphite and Diamond

Graphite and diamond are allotropes of carbon. The different arrangements of carbon atoms give them very different properties:

- Diamond is hard as it has a tetrahedral arrangement of carbon atoms. Graphite is soft because the carbon atoms are arranged in layers, connected by weak intermolecular forces. These are easily broken, allowing the layers to slide over one another

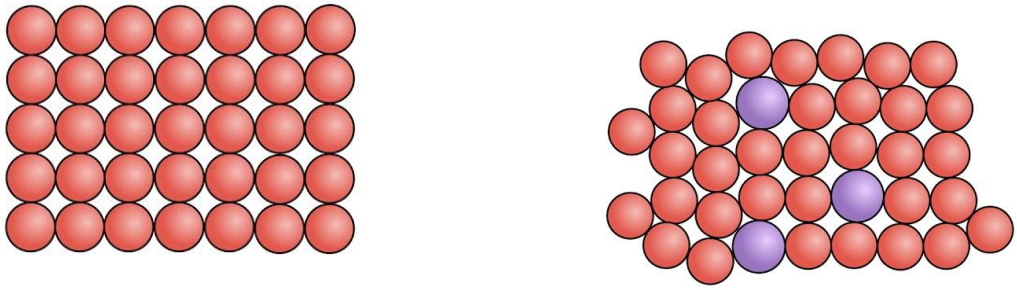
- Diamond does not conduct electricity. Each carbon atom is bonded to four other atoms, leaving no free electrons. Graphite conducts electricity. Each carbon atom is bonded to three other atoms. The free electrons move and carry the charge.

Diamond and graphite have high melting and boiling points. This is because there are many strong covalent bonds which require a lot of energy to overcome.



Alloys

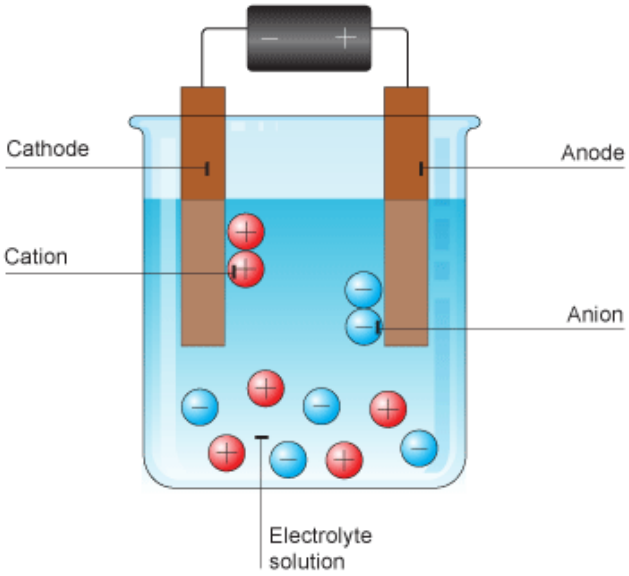
An alloy is a metal combined with one or more other elements. Alloys are stronger than metals because the particles are different sizes. This disrupts the regular arrangement of metal atoms and prevents the layers from sliding over each other.



Electrolysis

Electro (=electricity) lysis (= splitting) means the process of using electricity to separate an ionic substance. There are two scenarios for electrolysis:

1. Electrolysis of melts, i.e. liquid ionic substances
2. Electrolysis of aqueous solutions, i.e. ionic substances dissolved in water



For electrolysis of melts, work out the ions present and which electrodes they will move to. Cations move to the cathode (negative electrode) and anions move to the anode (positive electrode).

You can write half equations to show what is happening. For example, molten lead bromide.
At cathode: $Pb^{2+} + 2e^- \rightarrow Pb$
At anode: $2Br^- \rightarrow Br_2 + 2e^-$

For electrolysis of aqueous solutions, hydrogen ions and hydroxide ions are also present. Apply the following rules to work out the products.

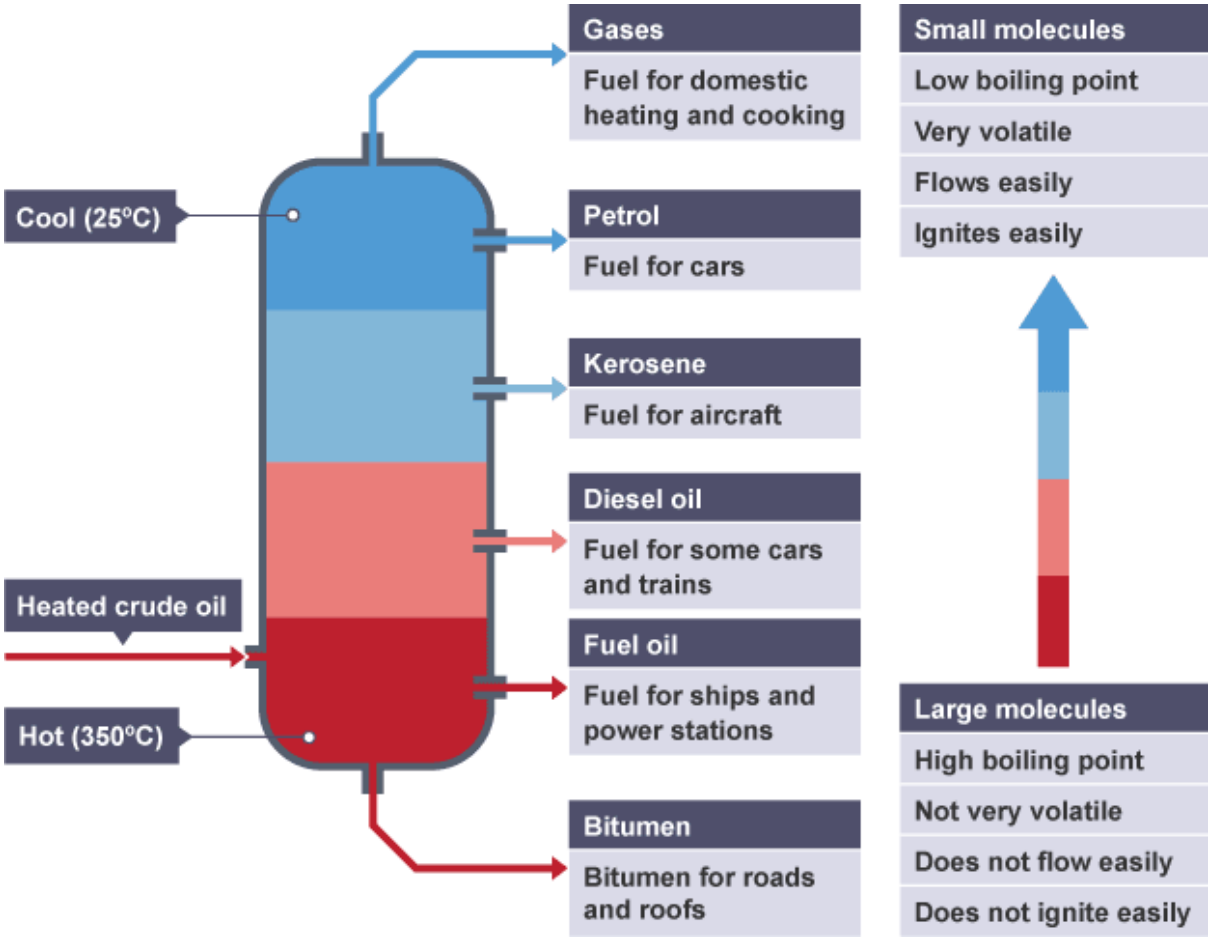
- At cathode, the least reactive element will be produced. Consider, is the positive metal ion less reactive than hydrogen? If the answer is no, hydrogen is produced.
- At anode, if halides are present, then the corresponding halogen is produced. If no halide is present, oxygen and water are produced.

Head over to Chemsheets to practice finding the products of electrolysis reactions and writing half equations.

Fractional distillation of crude oil

Crude oil can be broken down by fractional distillation. The hydrocarbon fractions are separated by boiling point and differ in their properties. You need to recall the order of the	We remember it using the mnemonic: Really Good

fractions, their uses and properties, such as viscosity, volatility and flammability.	Kangaroos Don't Forget Roo (- Baby Kangaroo) This stands for: Residue, Gasoline, Kerosene, Diesel, Fuel Oil, Residue (– specifically Bitumen)



Identifying substances

There is a lot to remember when it comes to qualitative chemistry. We break it down into: metal tests, cation tests (- remember "cats are positive", i.e. positive ion tests), and anion tests (negative ion tests).

Flame tests for metals

Element	Flame colour
Calcium	Orange-Red
Copper	Blue-Green
Lead	Blue/White
Barium	Light Green
Potassium	Lilac
Sodium	Yellow

How we remember it…

Calcium is hot and fiery (orange-red),

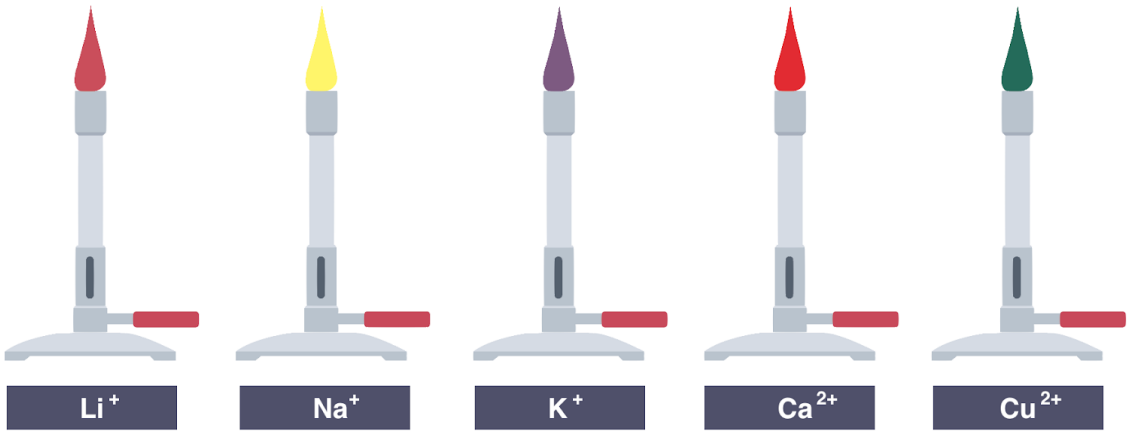
Copper is cold and icy (blue -green),

Lead is pure (white),

For that I'm sure,

Barium is a natural cure (green).

Sodium is sunny yellow. Potassium is purple. Lithium is lipstick red.



Cation tests – add NaOH

Cation	Test
Ammonium	Add NaOH (aq), warm and test NH_3 (g) has evolved with damp red litmus paper. Positive test will turn the paper blue.
Copper	Add NaOH (aq). Positive test is a blue ppt forming. This is a copper hydroxide solid.
Iron (II)	Add NaOH (aq). Positive test is a green ppt forming. This is iron hydroxide which oxidises to Fe (III) hydroxide on standing in air.
Iron (III)	Add NaOH (aq). Positive test is an orange/brown ppt forming. This is Fe (III) hydroxide.

Anion tests – add $AgNO_3$ (aq) and HNO_3(aq)

The exceptions to this rule are sulphate ions and carbonate ions!

Anion	Test
Chloride	Add $AgNO_3$ (aq) and HNO_3(aq). White ppt is formed. This is AgCl.
Bromide	Add $AgNO_3$ (aq) and HNO_3(aq). Cream ppt is formed. This is AgBr.
Iodide	Add $AgNO_3$ (aq) and HNO_3(aq). Yellow ppt is formed. This is AgI.
Sulphate	Add $BaCl_2$ (aq) and HCl(aq). White ppt is formed. This is $BaSO_4$.
Carbonate	Add HNO_3(aq), or other acid, effervescence turns limewater cloudy.

Test yourself

1. (a) Drill heads are made from steel. Steel is an alloy. Explain why alloys are harder than pure metals. (3)

   (b) Drill heads also contain diamonds. Describe, as fully as you can, the structure and bonding in diamond. (4)

2. (a) Graphite is softer than diamond. Explain why. (4)

   (b) Graphite conducts electricity, but diamond does not. Explain why. (3)

3. Potassium bromide can be made by reacting potassium with bromine gas. Explain why it is difficult to be sure whether the reaction between potassium and bromine gas would be more vigorous than the reaction between sodium and chlorine gas. (2)

Mark scheme

1. (a) Because atoms / ions / particles in alloy are different (sizes)

   the layers are distorted

   layers / atoms / ions / particles don't slide or slide less easily (3)

   (b) giant structure or lattice or macromolecule

   strong bonds (between carbon / atoms)

   covalent (bonds)

each carbon / atom forms 4 bonds/ accept tetrahedral structure

2. (a) Graphite: because the layers (of carbon atoms) in graphite can move / slide
this is because there are only weak intermolecular forces or weak forces between layers

Diamond: however, in diamond, each carbon atom is (strongly / covalently) bonded to 4 others
so no carbon / atoms able to move / slide

(b) because graphite has delocalised electrons, which can carry charge / current or move
through the structure. However, diamond has no delocalised electrons

3. Potassium is more reactive than sodium M2 - (but) bromine is less reactive than chlorine