

# OCR (B) Chemistry GCSE

## C2 - Chemical Patterns

### Flashcards

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# What were the main ideas in Dalton's atomic model?



# What were the main ideas in Dalton's atomic model?

- Atoms are tiny solid balls that can't be broken down.
- All atoms of an element are identical and atoms of different elements are different.
- Atoms from different elements combine to make compounds.
- Atoms are rearranged during a chemical reaction to make new substances.



What did Thomson discover? How did the atomic model change with this discovery?



What did Thomson discover? How did the atomic model change with this discovery?

He discovered electrons, realising that atoms could be broken down further.

Devised the Plum Pudding model: Tiny negatively charged electrons were scattered through a positively charged sphere.



What did Rutherford discover? How did the atomic model change with this discovery?



# What did Rutherford discover? How did the atomic model change with this discovery?

Gold foil experiment: When positively charged particles were fired at gold foil, he expected all of them to pass through but some bounced back.

He concluded that atoms must have a positive nucleus in the centre which contains most of the mass.



# How did Bohr change the atomic model?





# How did Bohr change the atomic model?

He suggested that electrons move in orbits around the nucleus. He came up with the idea of electrons existing in shells.



# Describe the structure of an atom



Describe the structure of an atom

Small central nucleus made up of protons and neutrons.

Electrons orbit (move around) the nucleus in shells.



Compare the size of the nuclear radius  
of an atom to its atomic radius



Compare the size of the nuclear radius of an atom to its atomic radius

Nuclear radius is much smaller than the atomic radius.



Where is most of the mass concentrated  
to in an atom?



Where is most of the mass concentrated to in an atom?

In the nucleus



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



Which is larger: an atom or a small molecule?



Which is larger: an atom or a small molecule?

A small molecule is larger.

Atoms are about  $10^{-10}$  m across.

Molecules contain two or more atoms.



Which is smaller: an atom or an object that can be seen with the naked eye?



Which is smaller: an atom or an object that can be seen with the naked eye?

An atom.

Objects are made up of millions of atoms.



# What is meant by the term atomic number?





What is meant by the term atomic number?

The number of protons in the nucleus of an atom. All atoms of an element have the same atomic number and this number is unique to each element.



What is meant by the term mass number?



# What is meant by the term mass number?

The total number of protons and neutrons in the nucleus of an atom. Usually, atoms of different elements have different mass numbers but this isn't always the case.



Oxygen has the mass number 16 and the atomic number 8. Calculate the number of protons, neutrons and electrons in oxygen.



Oxygen has the mass number 16 and the atomic number 8. Calculate the number of protons, neutrons and electrons in oxygen.

Protons = atomic number = 8

Electrons = atomic number = 8

Neutrons = mass number - atomic number =  $16 - 8 = 8$



Chlorine-37 has the mass number 37 and the atomic number 17. Calculate the number of protons, neutrons and electrons in  $^{37}\text{Cl}$ .



Chlorine-37 has the mass number 37 and the atomic number 17. Calculate the number of protons, neutrons and electrons in  $^{37}\text{Cl}$ .

Protons = atomic number = 17

Electrons = atomic number = 17

Neutrons = mass number - atomic number =  $37 - 17 = 20$



# What is an isotope?





## What is an isotope?

An atom of an element with the same number of protons and electrons but different number of neutrons. Isotopes have the same atomic number but a different mass number.



How is an element's position in the Periodic Table related to the arrangement of electrons in its atoms?



# How is an element's position in the Periodic Table related to the arrangement of electrons in its atoms?

- Number of shells - period number
- Number of electrons in outer shell - group number
- Total number of electrons - atomic number



How is an element's position in the Periodic Table related to the its atomic number?



How is an element's position in the Periodic Table related to its atomic number?

The periodic table is arranged in order of increasing atomic number.



# How did Mendeleev organise the elements?



## How did Mendeleev organise the elements?

- In order of increasing atomic mass.
- Placed elements with similar chemical properties into groups.
- Left gaps for undiscovered elements.
- Some elements switched places to keep groups consistent.



Why did the discovery of new elements support Mendeleev's decision to leave gaps in his periodic table?





Why did the discovery of new elements support Mendeleev's decision to leave gaps in his periodic table?

He predicted the properties of undiscovered elements using the properties of the elements surrounding the gap. These predictions matched the properties of the elements when they were discovered.



Why did ordering elements by atomic number support Mendeleev's decision to reorder elements in his periodic table?



Why did ordering elements by atomic number support Mendeleev's decision to reorder elements in his periodic table?

When Mendeleev created his periodic table, atomic number couldn't be determined. It was later discovered that the elements in Mendeleev's arrangement had been ordered in increasing atomic number, despite the fact that some atomic masses had been switched.



# What is a metal?





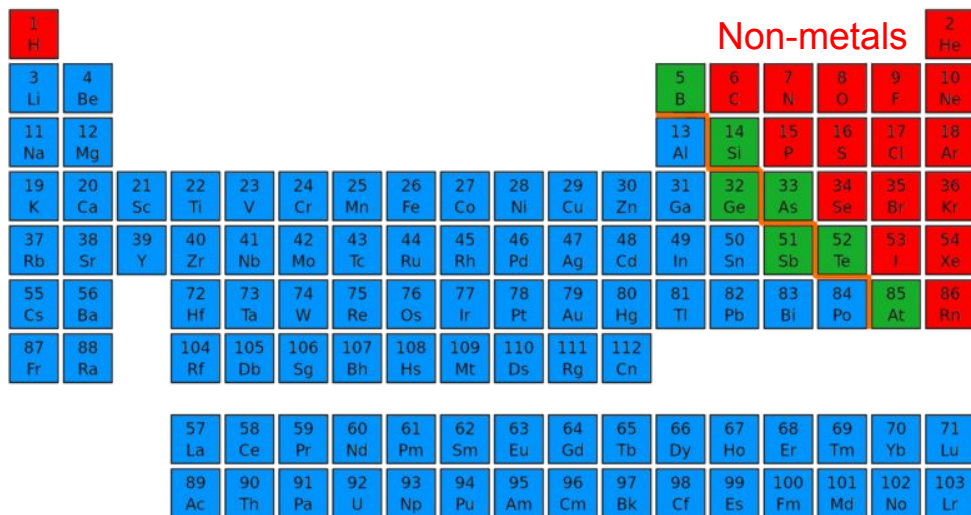
# What is a non-metal?



# What is a non-metal?

An element on the right hand side of the periodic table (red on diagram).

Non-metals react to form negative ions.



The diagram shows a periodic table where elements are color-coded: blue for metals, red for non-metals, and green for metalloids. The non-metals are highlighted in red and labeled 'Non-metals' in red text. The metalloids are highlighted in green.

1 H																	2 He															
3 Li	4 Be																	5 B	6 C	7 N	8 O	9 F	10 Ne									
11 Na	12 Mg																	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar									
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr															
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe															
55 Cs	56 Ba			72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn														
87 Fr	88 Ra			104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn																				
																		57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
																		89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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# What are the general properties of metals?





# What are the general properties of metals?

- Shiny
- Malleable
- High melting points
- Good electrical conductors
- High density
- Mostly solid at room temperature
- Reactivity increases down the groups



# What are the general properties of non-metals?



# What are the general properties of non-metals?

- Dull
- Brittle
- Low boiling points
- Generally poor electrical conductors
- Low density
- Mostly not solid at room temperature
- Reactivity decreases down the groups



What are the physical properties of  
Group 1 elements?



# What are the physical properties of Group 1 elements?

- Soft - can be cut with a knife
- Low melting point
- Low density



What is formed in the reaction between  
Group 1 elements and moist air?



What is formed in the reaction between Group 1 elements and moist air?

Metal oxide (on the surface of the metal).



What is formed in the reaction between  
Group 1 elements and water?





What is formed in the reaction between Group 1 elements and water?

Metal hydroxide and hydrogen.



Describe the reactions of the Group 1 elements lithium, sodium and potassium with water



# Describe the reactions of the Group 1 elements lithium, sodium and potassium with water

Lithium - fizzes steadily and slowly disappears.

Sodium - fizzes rapidly, melts to form a ball and quickly disappears.

Potassium - burns violently with a lilac flame, quickly melts to a ball, reacts rapidly.



What is formed in the reaction between  
Group 1 elements and chlorine?



What is formed in the reaction between Group 1 elements and chlorine?

Metal chloride (a white solid that dissolves in water to form a neutral solution).



What is the trend in reactivity in Group  
1?



What is the trend in reactivity in Group 1?

Reactivity increases down the group.



What are the colours and states of  
Group 7 elements at room temperature  
and pressure?





What are the colours and states of Group 7 elements at room temperature and pressure?

- Chlorine: Yellow-green gas
- Bromine: Deep red liquid
- Iodine: Grey solid



Why are the halogens at different states at room temperature? What is the trend down the group?



Why are the halogens at different states at room temperature? What is the trend down the group?

At room temperature, chlorine is gaseous, bromine is liquid and iodine is solid because they have different melting and boiling points. As you go down the group, melting and boiling point increases.



What are the colours of Group 7 elements as gases?



# What are the colours of Group 7 elements as gases?

- Chlorine: Yellow-green
- Bromine: Orange-brown
- Iodine: Purple



What is meant by diatomic? Are Group 7 elements diatomic?



What is meant by diatomic? Are Group 7 elements diatomic?

A diatomic molecule is a molecule containing only 2 atoms.

Group 7 elements are diatomic.



# Explain the trend in reactivity in Group 7





## Explain the trend in reactivity in Group 7

Reactivity decreases down the group.

As you go down Group 7, the outer shell is further from the nucleus and electron shielding increases. Attraction between the nucleus and outer electrons decreases so it is harder for the atom to gain an electron meaning reactivity decreases.



What is formed in the reaction between  
Group 7 elements and Group 1  
elements?



What is formed in the reaction between Group 7 elements and Group 1 elements?

Metal halides



# What is a displacement reaction?



# What is a displacement reaction?

A reaction in which a more reactive element replaces an element in a compound.



Chlorine is added to potassium bromide.  
Explain whether a reaction will occur.



Chlorine is added to potassium bromide. Explain whether a reaction will occur.

A reaction will take place because chlorine is above bromine in the periodic table so is more reactive than bromine. Chlorine will displace bromine from potassium bromide.



Write a word and symbol equation for the reaction between chlorine and potassium bromide





Write a word and symbol equation for the reaction between chlorine and potassium bromide

Chlorine + potassium bromide → bromine + potassium chloride



Describe how to identify the reactivity pattern of Group 7 elements



Briefly describe how to identify the reactivity pattern of Group 7 elements

Use displacement reactions.

Add chlorine, bromine and iodine into different samples of potassium chloride, potassium bromide and potassium iodide. Observe any changes.



When investigating the reactivity of Group 7 elements using displacement reactions, what results would you expect?



When investigating the reactivity of Group 7 elements using displacement reactions, what results would you expect?

Chlorine is able to displace bromine and iodine. Bromine is able to displace iodine. Iodine is unable to displace chlorine and bromine. Chlorine is most reactive and iodine is least reactive.



# What are the properties of Group 0 elements?



# What are the properties of Group 0 elements?

- Exist as single atoms
- Low melting and boiling points
- Low density
- Gas at room temperature and pressure
- Very unreactive
- Full outer shell of electrons



Why are Group 0 elements very unreactive?





## Why are Group 0 elements very unreactive?

They have a full outer shell of electrons. During a chemical reaction, outer shell electrons are transferred between atoms in order to obtain a full outer shell. Group 0 elements already have a full outer shell so they do not react easily.



# Why are Group 1 and Group 7 elements reactive?



# Why are Group 1 and Group 7 elements reactive?

They don't have a full outer shell of electrons. Group 1 elements lose 1 electron to form positive ions during a reaction while group 7 elements gain 1 electron to form negative ions.



Why are Group 0 elements gases at room temperature and pressure?



# Why are Group 0 elements gases at room temperature and pressure?

There are only weak forces of attraction between the atoms so little energy is required to overcome these forces for the element to become a gas. This means the boiling point is low so they are gases at room temperature and pressure.



How is the arrangement of electrons related to the reactions of elements?



# How is the arrangement of electrons related to the reactions of elements?

- Only outer shell electrons are involved when a substance reacts.
- The number of outer shell electrons affects how an atom reacts.
- Atomic number is equal to the number of electrons in an atom.



Why do elements in the same group react in the similar ways?





Why do elements in the same group react in the similar ways?

They have the same number of outer shell electrons.



# What is an ionic bond?



## What is an ionic bond?

A bond formed due to the strong electrostatic forces of attraction between oppositely charged ions. Ionic bonds are formed when electrons are transferred from one atom to another.



# Describe how cations and anions form



Describe how cations and anions form

Metals lose electrons to form cations  
(positive).

Non-metals gain electrons to form anions  
(negative).



What is the arrangement of ions in an ionic compound called?



What is the arrangement of ions in an ionic compound called?

Giant ionic lattice



$\text{Na}^+$  has the mass number 23 and the atomic number 11. Calculate the number of protons, neutrons and electrons in a sodium ion.





$\text{Na}^+$  has the mass number 23 and the atomic number 11. Calculate the number of protons, neutrons and electrons in a sodium ion.

Protons = atomic number = 11

Electrons = atomic number - electrons lost =  $11 - 1 = 10$

Neutrons = mass number - atomic number =  $23 - 11 = 12$



$S^{2-}$  has the mass number 32 and the atomic number 16. Calculate the number of protons, neutrons and electrons in a sulfur ion.



$S^{2-}$  has the mass number 32 and the atomic number 16. Calculate the number of protons, neutrons and electrons in a sulfur ion.

Protons = atomic number = 16

Electrons = atomic number + electrons gained =  $16 + 2 = 18$

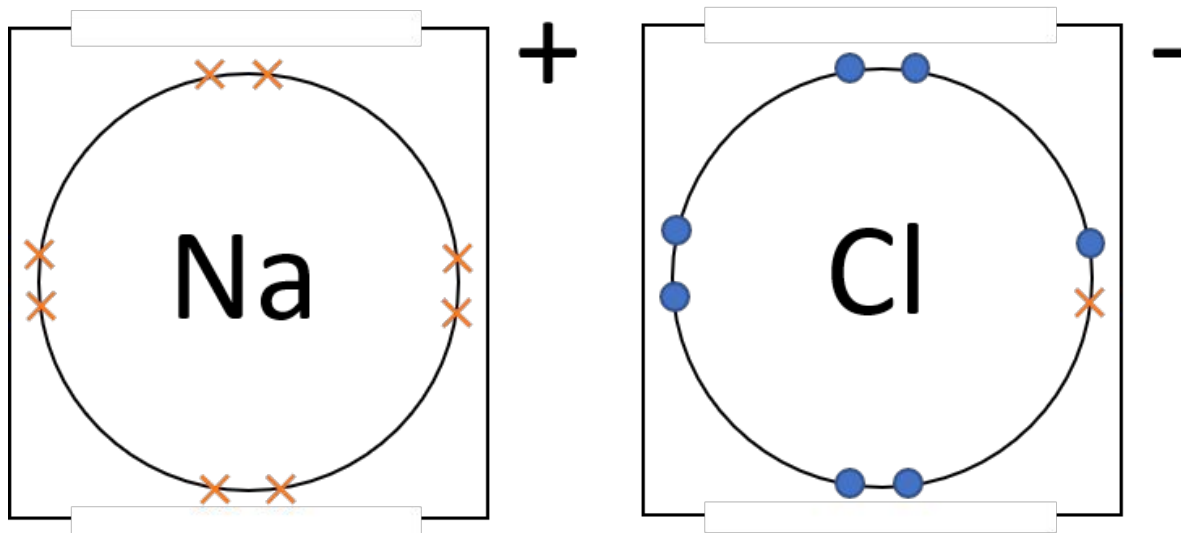
Neutrons = mass number - atomic number =  $32 - 16 = 16$



Draw a dot and cross diagram for sodium chloride, showing outer shell electrons only



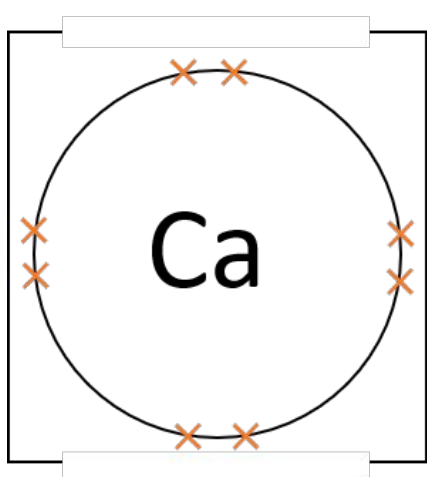
Draw a dot and cross diagram for sodium chloride, showing outer shell electrons only



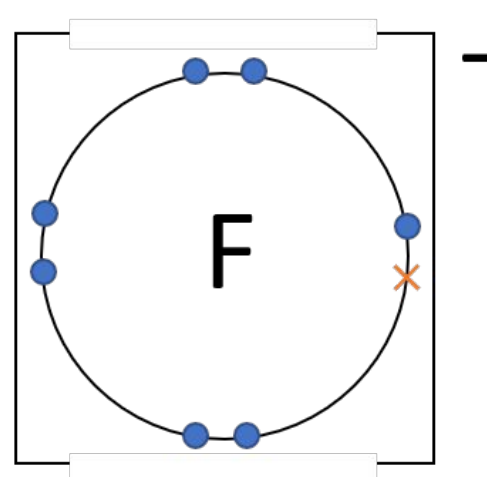
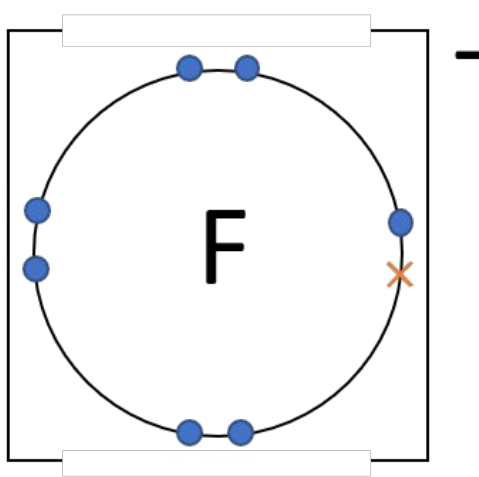
Draw a dot and cross diagram for calcium fluoride, showing outer shell electrons only



Draw a dot and cross diagram for calcium fluoride, showing outer shell electrons only



2+



# What are the general properties of ionic compounds?





# What are the general properties of ionic compounds?

- High melting points
- Conduct electricity when molten or aqueous (dissolved in water)
- Many are soluble



# Why do ionic compounds have high melting points?



Why do ionic compounds have high melting points?

They contain many strong electrostatic forces of attraction between the oppositely charged ions which require a lot of energy to overcome.



Why do ionic compounds conduct electricity when molten or aqueous but not when solid?



Why do ionic compounds conduct electricity when molten or aqueous but not when solid?

They contain charged particles that can move when molten or aqueous. When solid, the ions are fixed in the ionic lattice so can't move to carry charge.



What has to happen for a substance to melt?



What has to happen for a substance to melt?

Energy needs to be transferred to the substance to overcome some of the forces between the particles.



Why are the melting points of ionic compounds generally higher than simple covalent substances and metals?





# Why are the melting points of ionic compounds generally higher than simple covalent substances and metals?

The electrostatic forces of attraction between ions in ionic compounds are stronger than the forces between simple covalent molecules and between metal ions and electrons in metallic bonding. This means ionic compounds require more energy to overcome the forces of attraction and so have a higher melting point.



Why are the melting points of ionic compounds generally lower than giant covalent substances?



Why are the melting points of ionic compounds generally lower than giant covalent substances?

Covalent bonds are stronger than ionic bonds so require more energy to break meaning a higher melting point.



What are the limitations of using dot and cross diagrams to represent ionic compounds?



# What are the limitations of using dot and cross diagrams to represent ionic compounds?

- Don't show the arrangement of ions in space.
- Suggest the ions are paired rather than in a giant lattice.



What are the limitations of using 3D diagrams to represent ionic compounds?



What are the limitations of using 3D diagrams to represent ionic compounds?

- Are not shown to scale.
- Don't show how the ions formed.
- Don't show what the forces of attraction between the ions are.

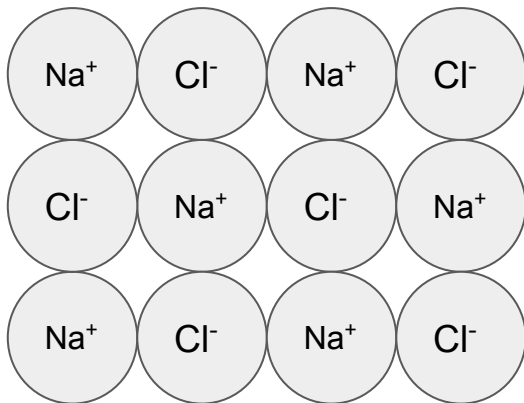


Draw a 2D diagram to represent NaCl





# Draw a 2D diagram to represent NaCl



Write the formula for sodium oxide



Write the formula for sodium oxide



Write the formula for potassium carbonate



Write the formula for potassium carbonate



Write the formula for sulfuric acid



Write the formula for sulfuric acid



Write the formula for lithium bromide





Write the formula for lithium bromide

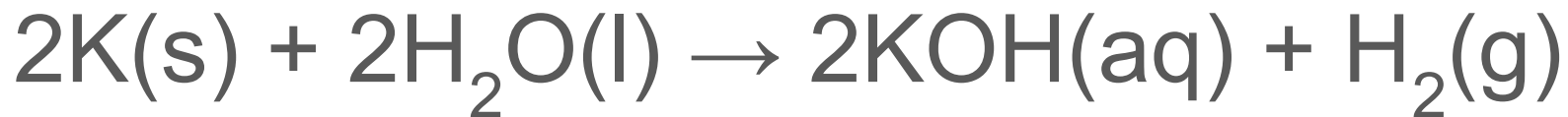
LiBr



Write a balanced symbol equation for the reaction between potassium and water



Write a balanced symbol equation for the reaction between potassium and water



When does the name of an ionic compound end in -ide? Give an example



When does the name of an ionic compound end in -ide? Give an example

When the compound only contains 2 elements.

E.g. Potassium iodide (KI), lithium chloride (LiCl), iron(II) sulfide (FeS).



When does the name of an ionic compound end in -ate? Give an example



When does the name of an ionic compound end in -ate? Give an example

When the compound contains at least three elements, one of them being oxygen.

E.g. calcium carbonate ( $\text{CaCO}_3$ ), iron(II) sulfate ( $\text{FeSO}_4$ ).



# What are the 4 state symbols?





# What are the 4 state symbols?

(s) - solid

(l) - liquid

(g) - gas

(aq) - aqueous (dissolved in water)



# What are the general properties of transition metals?



# What are the general properties of transition metals?

- High melting points
- High density
- Less reactive than Group 1 elements
- Some are very unreactive
- Can be used as catalysts
- Form coloured ions



# What are the uses and properties of copper?



# What are the uses and properties of copper?

Uses: electrical wires, printed circuit boards, water pipes.

Properties: conducts electricity, ductile, doesn't react with water, malleable.



# What are the uses and properties of iron?



# What are the uses and properties of iron?

Uses: building material, catalyst in Haber process, mixed with other elements to make steel.

Properties: strong, malleable, speeds up the rate of certain reactions, reacts with water and air to form rust.



# What are the uses and properties of chromium?





# What are the uses and properties of chromium?

Uses: coat other metals, catalyst in industry.

Properties: shiny when polished, resistant to corrosion, speeds up the rate of certain reactions.



# What are the uses and properties of silver?



# What are the uses and properties of silver?

Uses: jewellery, printed circuit boards and electrical contacts.

Properties: doesn't react with air or water, good electrical conductor.



# What are the uses and properties of gold?



What are the uses and properties of gold?

Uses: jewellery, electrical connectors.

Properties: doesn't react with air or water, malleable, good electrical conductor.

