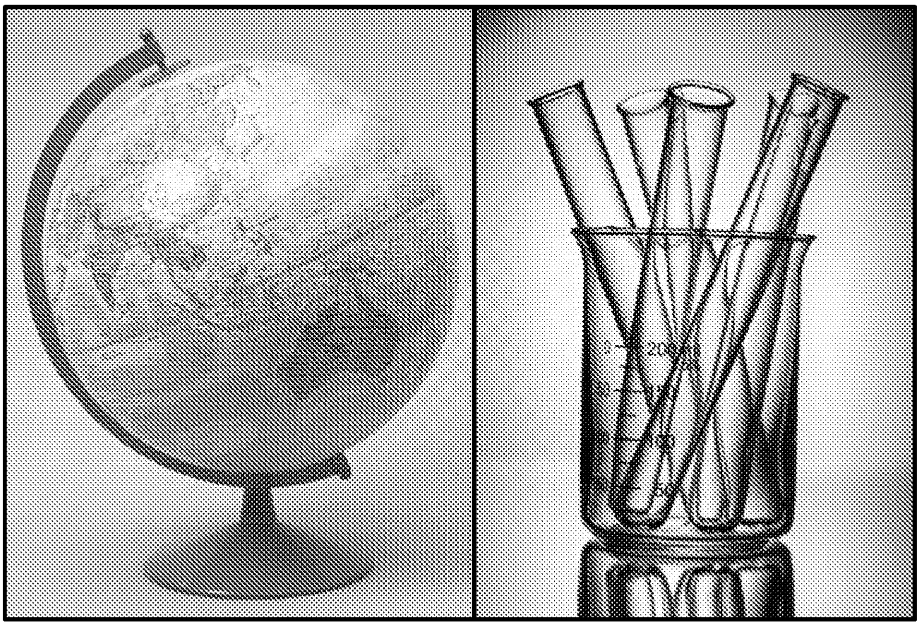
SCIENCE | BTEC LEVEL 2 | EDEXCEL

Teaching Pack

For BTEC First Award in Applied Science
Unit 2: Chemistry and Our Earth

2nd edition, 27th February 2015

endorsed by edexcel



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Contents

Teacher's Introduction

This unit is taught over 30 guided learning hours (GLH). Teachers will have different approaches to the balance between teaching and working on assignments, as well as when they carry out assignment work. This scheme of work suggests splitting the time into 15 teacher-taught hours, nine assignment lessons and six spare lessons for additional assignment time to obtain missed assessment criteria and also catch-up time for pupils who have missed lessons or need extra support. For differentiation purposes, information that only distinction-level students need is marked in a box with a D symbol. 'Did you know' boxes are included to give students some fun extra information about the topic – they do not need to know this information to complete their assignments.

This pack contains the following materials:

1. A single-page overview scheme of work
2. 15 lesson plans
3. Notes for each lessons covering all the learning aims between them
4. Questions in non-write-on and write-on formats to reinforce learning, with answers
5. Assignments covering all the assessment criteria between them

This resource is designed to be flexible in the following ways:

- Proposed assignments tasks have been put into suggested slots after the relevant material has been covered.
- The assignments provided in this pack are designed to be independent of each other so that any one can be substituted if you have a preferred assignment from elsewhere.
- For each lesson there is a lesson plan followed by student notes and questions. Questions are then repeated provided in write-on format. You could use the material in one of the following ways:
    1. Use the notes to support your classroom teaching and then hand out either the non-write-on questions or the write-on questions at the end of the lesson (possibly for homework).
    2. Use the notes to supplement your own notes or the textbook and hand them out at the end of the lesson as a summary with the questions so students can complete the questions using the notes as support.
    3. Just use the questions (either write-on or non-write-on as appropriate) at the end of the lesson and subsequently hand out the notes at revision time.

If using this resource for assessed work, then as with all BTEC assignments they must be **internally verified**. Also you must check suitability with the board* and follow the **important disclaimer notice below**.

* Note: Pearson BTEC / Edexcel currently offer a free Assignment Checking Service.

IMPORTANT DISCLAIMER REGARDING ASSESSMENT: if you choose to use the assignments in this resource for assessed work, it is your responsibility to internally verify them and to check with Edexcel that the material you use is suitable. This includes the requirement from September 2014 not to conduct 'interim assessment' within a Learning Aim. You should **not** use the material in this resource for actual assignments unless you have checked their suitability with Edexcel. The awarding body specifies the level of support that students can be given and you **must** check the level of support given in this pack is appropriate to meet these needs and as necessary **adjust and use the resource appropriately to meet these requirements**. Please check for the most up-to-date information from Edexcel at: *http://www.edexcel.com/btec/Pages/default.aspx*. Note that relevant paperwork for practical work, such as observation sheets, should also be obtained from Edexcel. Assignment details and requirements from the awarding bodies sometimes change after their initial published requirements and so you must check that the resource material here is in line with the latest requirements **before use**.

Also available from ZigZag Education

Assignment Pack

Three more sets of assignments for the new BTEC specification to give you a larger choice of assignments.

For more information please visit:
www.zzed.co.uk/btecassignments

Also available from ZigZag Education

Activity Pack

Worksheet-style activities, starter and plenaries matched to the new BTEC specification to supplement this pack and the textbook and give more variety and different approaches.

Practical sheets:

- Teacher sheets for all the suggested practicals and demonstrations for this unit.
- Student method sheets for all the practical experiments outlined in this scheme of work with observation grids.
- Health and safety guidance for demos and practicals.

For more information please visit:
www.zzed.co.uk/btecactivities

Update: 2nd edition (February 2015)

Following changes to BTEC assessment rules which affect learners registered from 1st September 2014, this resource has been amended to meet these rules:

- Boxes for resubmission dates have been removed from all assignment briefs (pages 32, 47, 67, 82)

In addition, to meet current assessment rules, essential changes have been made, including:

- Assignment briefs each cover one Learning Aim in full. Therefore:
  Assignments 1 and 2 have been merged and edited (page 32)
  Assignments 3, 4 and 5 have been edited (pages 46, 66, 80)
  Teacher's Introduction and Suggested Scheme of Work have been amended accordingly (pages 1, 3)
- Text aimed at students does not refer to Level 1 tasks or criteria (pages 32, 33, 34, 46, 47, 66, 67, 80, 81)
- Each assignment task allows students to access the full range of grades (pages 32, 33, 34, 46, 47, 66, 67, 80, 81)

Other amendments:

- A new 'Important Disclaimer Regarding Assessment' has been added in the introduction (page 1)
- Assignments have been renamed to be consistent with the Learning Aims:
  Merged Assignments 1 and 2 have been renamed Assignment A (page 32)
  Assignment 3 has been renamed Assignment B (page 46)
  Assignment 4 has been renamed Assignment C (page 66)
  Assignment 5 has been renamed Assignment D (page 80)

Suggested Scheme of Work

GLH	LP	Title
1	1	Chemical and Physical Properties of Group 1
2	2	Chemical and Physical Properties of Group 7
3	3	Bonding and Structure: Covalent Bonding
4	4	Bonding and Structure: Ionic Bonding
5	5	Bonding and Structure: Giant Bonding
6 and 7	**Assignment A: Chemical Reactivity and Bonding*	
8	6	Use of Chemicals Based on their Physical Properties
9	7	Use of Chemicals Based on their Chemical Properties
10 and 11	**Assignment B: Use of Chemicals Based on their Chemical and Ph*	
12	8	The Factors Involved in the Rate of Chemical Reactions: Part 1
13	[illegible]	The Factors Involved in the Rate of Chemical Reactions
14	[illegible]	The Factors Involved in the Rate of Chemical Reactions
15	11	The Factors Involved in the Rate of Chemical Reactions
16	12	The Factors Involved in the Rate of Chemical Reactions
17	13	The Factors Involved in the Rate of Chemical Reactions
18, 19 and 20	**Assignment C: The Factors Involved in the Rate of Chemical Reac*	
21	14	The Factors that Are Affecting the Earth and its Enviro Factors
22	15	The Factors that Are Affecting the Earth and its Enviro Factors and Sustainable Development Issues
23 and 24	**Assignment D: The Factors Affecting the Earth and its Environm Activity Factors and Sustainable Development Issues*	
25–30	***Opportunity for catch-up and obtaining missing assignment cri*	

Suggested S
* = assign
** = oppor obtain

Learning Aims Note

'All pupils should' aims are levelled at Level 1 and pass students, **'most pupils should'** aims are levelled at merit students and **'some pupils should'** aims are levelled at distinction students.

Lesson Plan 1: Chemical and Physical Prope

Learning Aims

All pupils should:	Classify group 1 elements based upon their phys Describe the physical and chemical properties of
Most pupils should:	Describe trends in the physical and chemical pro
Some pupils should:	Explain the trends in chemical properties of grou electronic structure.

Key words: Group 1 metals, properties, reactivity, trends, electron arrang

Starter

Ask pupils to make a list of all the properties of metals. Pupils may be gui hard/soft, shiny/dull, brittle/malleable, etc.

Main

1. Review lists of properties and discuss.
2. Brief introduction of group 1 metals and the similarities and d other metals, i.e. reactivity, density, softness.
3. Demonstration of group 1 metals. React pea sized amounts of l potassium in a trough of water surrounded by safety screens.

   Use this opportunity to continue teaching about reactivity wit properties and trends. Note products formed.
4. Discuss why they react in the way they do. Reference to electr trend.
5. Show YouTube video **http://www.youtube.com/watch?v=cqeVEFFzz**
6. Answer Questions 1–7 from the pack.
7. Elicit answers during class discussion.

Plenary

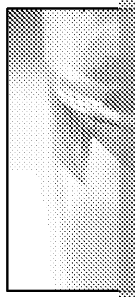
Properties list: Create a list of properties of group 1 and transition metals, match a list of properties as either properties of group 1 metals, transition

Group 1 Metals

Your teacher may have already shown you the group 1 metals, or the alkali meta

As the name suggests they are all metals, but they behave in very different ways f
be familiar with such as iron, steel or copper.

In order down the periodic table the group 1 metals are:



Lithium (Li)
Sodium (Na)
Potassium (K)
Rubidium (Rb)
Caesium (Cs)
Francium (Fr)

Like many metals, group 1 metals are all shiny and silvery in colour when they ar
react with the oxygen in the air to form a metal oxide and turn grey/black. As yo
with oxygen more readily.

Unlike other metals, group 1 metals are very soft and can be cut easily with a kni
metals become softer.

Group 1 metals also have relatively low **melting points** (the temperature they turn into a liquid) and **boiling points** (the temperature they turn into a gas). Some will even melt if heated to the temperature of a warm cup of tea!

Metal	Melting Poi
Lithium	180
Sodium	98
Potassium	64
Rubidium	39

Compare this to iron which has a melting point of 1538 °C and a boiling point of 2

The general trend is as you go down the group the melting and boiling points de

Reactivity with Water

Group 1 metals also behave differently when placed in water. If you place other m
probably sink to the bottom. However, if a group 1 metal is placed in water it wil

The reason for this is because group 1 metals are less dense than the water.

If you have seen the group 1 metals placed in water you will also have noticed th

Clear signs of a reaction include a gas being given off; in the case of group 1 meta
sound, a change in temperature and you may have witnessed a small flame or a

Group 1 metals react with water; the trend is, as you go down the group they b
word equation for a group 1 metal reacting with water is:

Metal + Water → Metal Hydroxide + Hydrogen

So,

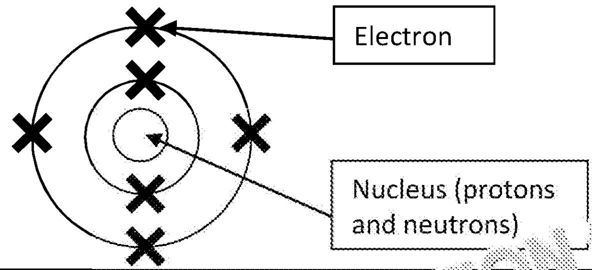
Lithium + Water → Lithium Hydroxide + Hydroge
Sodium + Water → Sodium Hydroxide + Hydroge

And so on.

So why do the group 1 metals behave in the way that they do?
The answer lies in the electronic configuration of the atoms.

KS3 Reminder

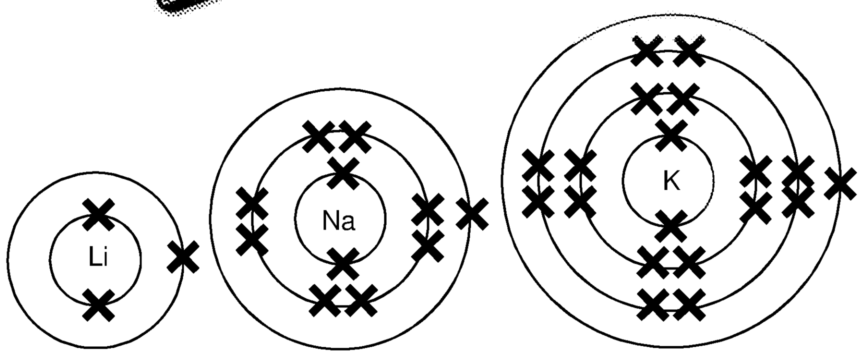
Atoms are the smallest unit of matter and are made up of three things: protons (… charge) and electrons (negative charge). The protons and neutrons are arranged … atom, we call this the nucleus, the electrons orbit around the outside of the nucle…



Electron Shells

Electrons are arranged withi… filled from the inside outwar… 2 electrons and all other shel… For exam le, if you were dra… (… si m), you would dra… …, eight in the second and…

In the … the group 1 metals they all have one electron in the outer she…



Lithium **Sodium** **Potassium**

The fact that they have one electron in their outer shell is responsible for many o… when a group 1 metal reacts it does so by losing its outer electron to make a full … How easily they do this reflects how easily they react.

As you can see the outer electron on a potassium atom is much further away fro… electron on a lithium atom. This means that the force between the nucleus and t… force between the negatively charged electrons and the positively charged proto… place, is weaker for the potassium's outer electron and so it is more easily libera… potassium than lithium.

Electronic configuration is also responsible for the decre… melting and boiling … group. As you can see in the diagram, as you go d… the group an additional sh… means that the atom gets bigger. The lar… atom is the weaker the forces of … neighbouring atom and if the for… weak then they are more easily separate… reduced forces of attra… between atoms that are responsible for their relativ…

Summary … roperties

Metal	Boiling Points	Melting Points	Reactivity with Air
Lithium Sodium Potassium Rubidium Caesium Francium	High ↑ Low	High ↑ Low	Low ↓ High

Group 1 Questions

1. Describe the physical properties of the group 1 metals and for the prop trend as you go down the group.
2. Describe the chemical properties of group 1 metals and for each prope as you go down the group.
3. Predict the melting and boiling points of caesium and francium.
4. Complete the word equations for the following reactions:
   a. Lithium + Water → ____________________ + ______________
   b. Sodium + Water → ____________________ ______________
   c. Potassium + Water → ____________________ + ______________
5. Describe what happens when a group 1 metal reacts with water.
6. Explain the trend in the reactivity of group 1 metals with water. You n explain your answer.
7. Explain the trend in the melting and boiling points of group 1 metals. help explain your answer.

Group 1 Questions

1. Describe the physical properties of the group 1 metals and for the pro trend as you go down the group.

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2. Describe the chemical properties of group 1 metals and for each prope as you go down the group.

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   ....

   ....

3. Predict the melting and boiling points of caesium and francium.

   ....

4. Complete the word equations for the following reactions:

   a. Lithium + Water → ____________________ + ____________________

   b. Sodium + Water → ____________________ + ____________________

   c. Potassium + Water → ____________________ + ____________________

5. Describe what happens when a group 1 metal reacts with water.

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6. Explain the trend in the reactivity of group 1 metals with water. You explain your answer.

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7. Explain the trend in melting and boiling points of group 1 metals. help explain your answer.

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Lesson Plan 2: Chemical and Physical Prope

Learning Aims

All pupils should:	Classify group 7 elements based upon their phys Describe the physical and chemical properties of
Most pupils should:	Describe trends in the physical and chemical pro
Some pupils should:	Explain the trends in chemical properties of grou electronic structure.

Key words: Group 7, properties, reactivity/di pl nent, trends, electron

Starter

Review of pu ing. Copy the following equations of group 1 me and ask pu complete them:

Sodium + ________________ → sodium hydroxide + hydrogen

________________ + water → lithium hydroxide + ________________

Rubidium + water → ________________ + ________________

________________ + water → caesium hydroxide + ________________

Main

1. Review answers.
2. Discuss the properties of group 7, including state at room temper points. Discuss the link between melting and boiling points and s
3. Stress trends of reactivity.
4. Class practical of displacements of potassium halides and haloge samples of 1.0 mol dm^{-3} potassium chloride solution, 1.0 mol dm and 1.0 mol dm^{-3} potassium bromide solution with separate samp water and chlorine water in a spotting tile. Pupils should observe will indicate that a displacement reaction has occurred.
5. Explain trends in terms of electron arrangem
6. Answer Questions 1–6 from the cl
7. Elicit answers from cla

Plenary

Properties match: Create a list of properties of group 1 and 7 elements and 'will not conduct electricity' and 'no free charge'). Pupils should match ea explanation. This is a higher order activity building on the previous plena

Group 7 Halogens

The group 7 elements are commonly called the halogens. In order down the peri

Fluorine (F)
Chlorine (Cl)
Bromine (Br)
Iodine (I)
Astatine (At)

Reactivity: High ↑ Low

All halogens are non-metals but at room temperature and pressure they appear in different states and colours.

Element	
Fluorine	
Chlorine	
Bromine	L
Iodine	

The halogens also have relatively low **melting points** (the temperature they turn into a liquid) and **boiling points** (the temperature they turn into a gas).

Element	Meltin
Fluorine	
Chlorine	
Bromine	
Iodine	

The general trend is as you go down the group the melting and boiling points inc boiling points of an element that determine its state, i.e. if the melting and boilin then at room temperature it will be a gas. If the melting point is below 20 °C but will be a liquid at room temperature. And if both the melting and boiling points a solid at room temperature.

Like nearly all non-metals, the halogens will not conduct electricity; this is becau bonds with its neighbouring atoms. So, there is no trend in electrical conductivit bonding later.

Reactivity of the Halogens

The reactivity of the halogens is the exact opposite of the reactivity of the group 7 the halogens become **less reactive**. We will see why a little later on.

Displacement Reactions

Halogens take part in a chemical reaction called a displacement reaction. A displ reactive halogen displaces (switches places with) the less reactive halogen from its sounds complicated but let's look at an example (remember as you go down gro reactive).

If you take potassium iodide solution and react it with bromine dissolved in wate place:

Potassium Iodide + Bromine → Potassium Bromide +

The reason for this chemical reaction is because bromine is more reactive than io (switches places with) the iodine. This works for all sorts of solutions so:

Sodium Iodide + Bromine → Sodium Bromide + Iod
Lithium Iodide + Bromine → Lithium Bromide + Iod
Etc.

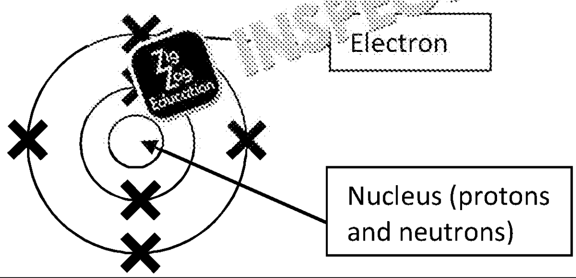
- What would happen if you reacted sodium chloride and fluorine? Well, fluo chlorine so there would be a reaction.

Sodium Chloride + Fluorine → Sodium Fluoride + Ch

- So, what would happen if you reacted sodium fluoride and iodine? Well, in t the two halogens so nothing would happen.

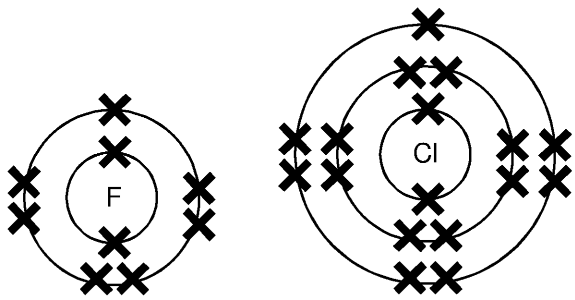
So, why do the group 7 halogens behave in the way that they do? Just like with t in the electronic configuration of the atoms.

KS3 Reminder
Atoms are the smallest unit of matter and are made up of three things: protons (p charge) and electrons (negative charge). The protons and neutrons are arranged atom, we call this the nucleus, the electrons orbit around the outside of the nucle



Electron Shells
Electrons are arranged with filled from the inside outwa 2 electrons and all other she For example, if you were dra (magnesium), you would dra shell, eight in the second an

The group 1 metals had one electron in their outer shell; the group 7 haloge outer shell.



Fluorine **Chlorine**

When a halogen reacts it gains one electron from a different atom to make a full you can see on the diagram above, as you go down the group the atoms get larg your work with the group 1 metals the closer an electron is to the nucleus the str between the negatively charged outer electrons and the positively charged nucle gaining an extra electron so if the outer electron shell is closer to the nucleus the it more easily attracts the extra electron and so reacts more readily. So, the smal reactive it is.

Summary of Properties

Element	Boiling Points	Melting Points	Reacti
Fluorine Chlorine Bromine Iodine Astatine	Low ↓ High	Low ↓ High	Hig ↑ Lov

Group 7 Questions

1. Describe the physical properties of the group 7 halogens and for two p the trend as you go down the group.
2. Make a comparison table between the physical properties of the grou metals you previously studied.
3. Describe the trend of reactivity of group 7 halogens.
4. Predict the melting and boiling points for astatine.
5. Complete the word equations for the following reactions:
   a. Sodium Bromide + Fluorine → ____________________ + ________
   b. Sodium Bromide + Chlorine → ____________________ + ________
   c. Sodium Bromide + Bromine → ____________________ + ________
   d. Sodium Bromide + Iodine → ____________________ + ________
   e. Lithium Iodide + Chlorine → ____________________ + ________
6. Explain why a trend is seen of decreasing reactivity as you go down g diagrams to help explain your answer.

Group 7 Questions

1. Describe the physical properties of the group 7 halogens and for two p the trend as you go down the group.

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2. Make a comparison table between the physical properties of the grou metals you previously studied.

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3. Describe the trend of reactivity of group 7 halogens.

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4. Predict the melting and boiling points for astatine.

   ....

5. Complete the word equations for the following reactions:

   a. Sodium Bromide + Fluorine → ____________________ + ________

   b. Sodium Bromide + Chlorine → ____________________ + ________

   c. Sodium Bromide + Bromine → ____________________ + ________

   d. Sodium Bromide + Iodine → ____________________ + ________

   e. Lithium Iodide + Chlorine → ____________________ + ________

6. Explain why a trend is seen of decreasing reactivity as you go down g diagrams to help explain your answer.

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Lesson Plan 3: Bonding and Structure: Cov

Learning Aims

All pupils should:	Describe properties of covalent substances. Classify substances as covalent. Draw dot-and-cross diagrams of simple covalent
Most pupils should:	Explain the properties of covalent substances. Describe the formation of covalent substances.
Some pupils should:	Relate properties of compounds to their bonding

Key words: Atomic structure, covalent bonding, examples, properties, do

Starter

Review of previous learning. Draw and label an atom.

Main

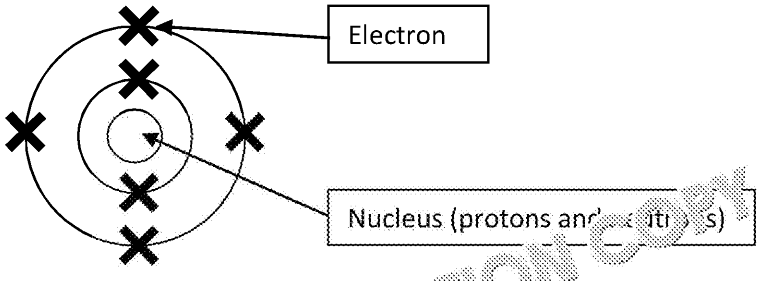
1. Review answers and choose a pupil with a good example to draw it o
2. Explain the concept of bonding in general and relate to electron a
3. Explain covalent bonding with drawn examples. Use examples in then two different types of atom, e.g. oxygen and water.
4. Pupils copy diagrams as an example of a worked example.
5. Discuss properties, including low melting and boiling points and
6. Relate properties to bonding and weak intermolecular forces betw charge.
7. Pupils asked to draw their own dot-and-cross examples, e.g. methane
8. Elicit answers. Different pupils selected to draw their answers on boa pupils if they have a wrong answer as this gives a good opportunity t (assuming a non-judgemental environment is in place).

Plenary

Covalent compounds: spot the mistake. Create diagrams of covalent comp Pupils should indicate the mistakes in the diagrams.

Bonding and Structure

Atoms are the smallest unit of matter and are made up of three things: **protons,**
protons and neutrons are arranged together in the middle of the atom; we call t
orbit around the outside of the nucleus in orbitals or shells.



As we are looking at bon... forget about the protons and neutrons for
on the electr...

Electrons or... nucleus in shells, but the first shell is small so can only fit two
the other shells can hold up to eight electrons each.

Electrons fill up the shells from the inner shell to the outer shell; the inner shells
placing electrons in the next shell.

Atoms behave as if the aim of every atom is to get a full outer shell, some eleme
have a full outer shell; others aren't so lucky and need to do something about it.
ways, gain electrons, lose electrons or share electrons, and they do this by reacti
at each of these ways in turn.

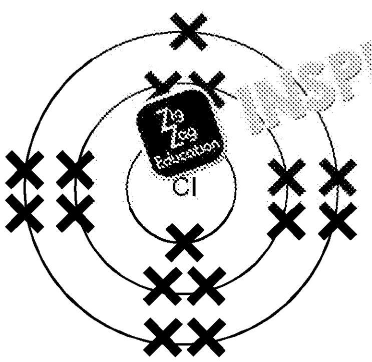
Covalent Bonding

Covalent bonding is one way atoms bond together. This method involves the **sha**
like if you had half a set of Pokémon cards and your best friend had the other ha
together to make one complete set.

Let's take a look at an example.

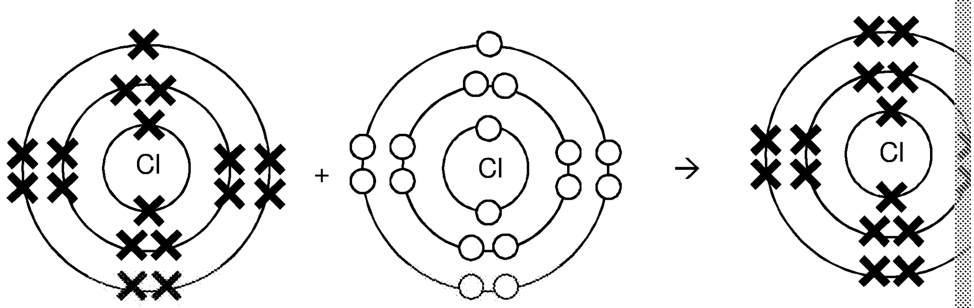
Chlorine has 17 electrons (we can find the number of electrons an atom has on t
there under the heading 'atomic number'; an easy cheat is it will be the smaller
symbol).

So, based on the rule that the first two electrons go in... st inner shell and
leaves another seven electrons to go in the thi...



So, as atoms prefer to have a full outer shell then fluorine has a choice. The two
to a shared pair of electrons (we will look at the alternative later); we call this sh
covalent bonding.

The first thing that happens is the chlorine atom needs to find another atom tha
This could be any number of other elements but let's keep this simple and conce

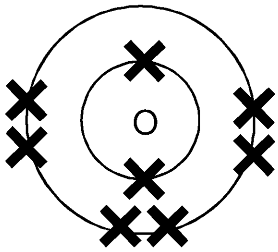


We call this a dot-and-cross diagram.

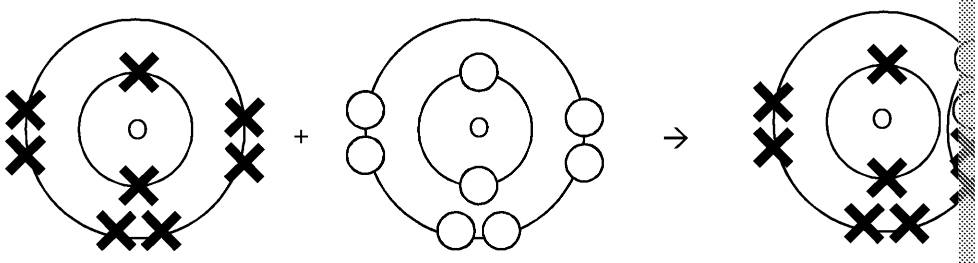
The formula for the chlorine molecule is: Cl_2

Let's look at another example.

Oxygen has eight electrons, so we place two in the first shell and the remaining s

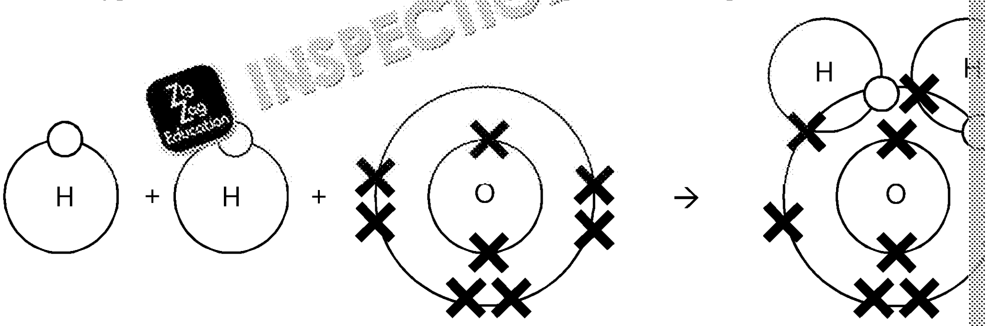


Remember, as atoms prefer to have a full outer shell then oxygen has to find and
total of eight. It has a number of options; just like before it can bond with anothe
pairs of electrons are shared we call this a double covalent bond.



The formula for this oxygen molecule is: O_2

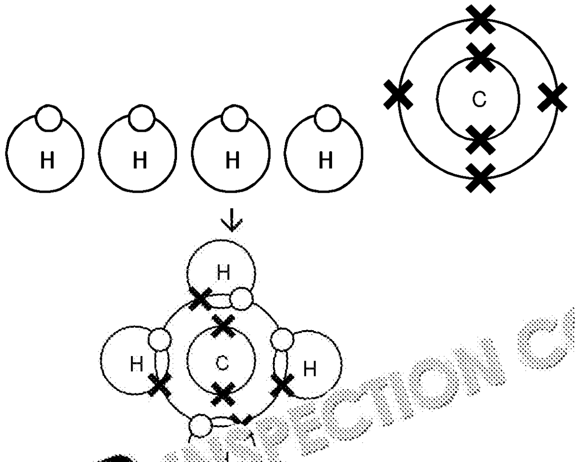
Or it could bond with a different type of atom, for example hydrogen. Hydrogen
find another one to fill up its only shell. Oxygen needs to find another two electr
one, oxygen will need to react with two hydrogen atoms to get a full outer shell.

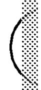


The formula for this water molecule is: H_2O

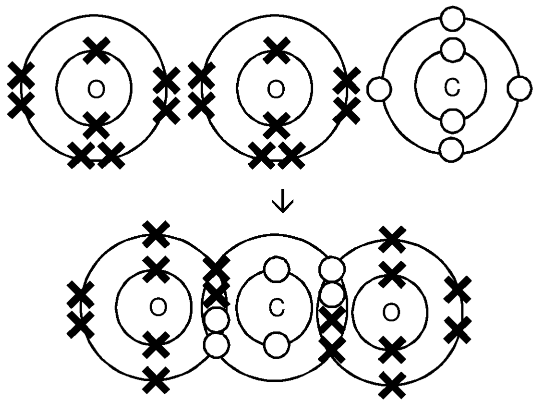
Other examples include methane, formed from the covalent bonding of four hydrogen atoms to one carbon atom…

… Hydrogen, fo
bonding of two
other…





… and carbon dioxide, formed from the covalent bonding of two oxygen atoms to one carbon atom



Covalently bonded compounds are molecules, so two oxygen atoms react to form

$O + O \rightarrow O_2$

Atom Atom Molecule

Two chlorine atoms react to form a chlorine molecule.

$Cl + Cl \rightarrow Cl_2$

Atom Atom Molecule

And two hydrogen atoms and an oxygen atom form a water molecule.

$H + H + O \rightarrow H_2O$

Atom Atom Atom Molecule

And four hydrogen atoms and a carbon atom form a methane molecule.

$H + H + H + H + C \rightarrow CH_4$

Atom Atom Atom Atom Atom Molecule

Two hydrogen atoms react to form a hydrogen molecule.

$H + H \rightarrow H_2$

Atom Atom Molecule

And two oxygen atoms and a carbon atom form a carbon dioxide molecule.

$O + O + C \rightarrow CO_2$

Atom Atom Atom Molecule

Properties of Simple Covalent Substances

Covalent compounds *only* form between **non-metals**.

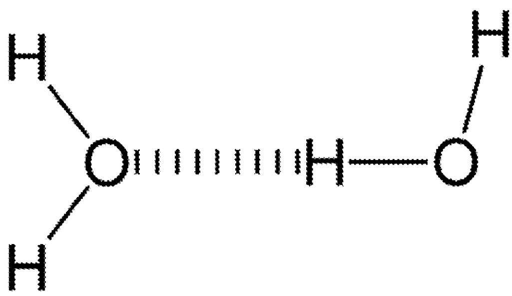
Conductivity

Covalent molecules do not conduct because there are no free electrons and no f

Melting and Boiling Points

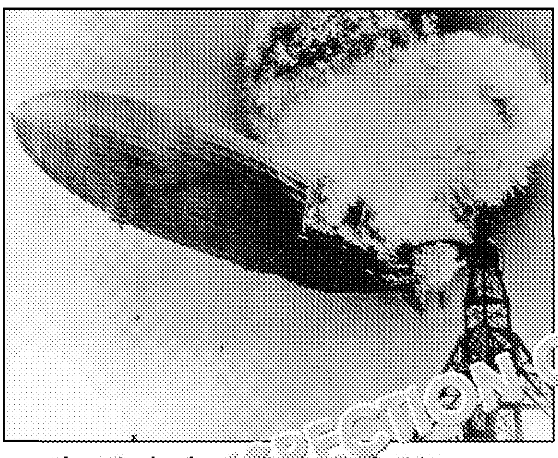
The fact that the molecules have no overall charge also means that each molecu other molecules; we call this force of attraction intermolecular forces. These we that each molecule will easily separate itself from other molecules. This results in points. So, covalent compounds tend to be gases or sometimes liquids at room te intermolecular forces are not strong the covalent bonds between atoms is strong

Compound	Melting point (°C)	Boiling poin
Oxygen	-223	-183
Chlorine	-102	-34
Water	0	100



Dashed lines represent the i two water molecules. Solid li covalent bonds between ato

D



The Hindenburg disaster of 1937

The weak forces of attractio and the fact that hydrogen i for use in blimps and balloo lighter than air allowed the the Hindenburg disaster of 1 and crew. Hydrogen is so re entire blimp to explode. He unreactive and will not exp

Lesson Plan 4: Bonding and Structure: Io

Learning Aims

All pupils should:	Describe properties of ionic substances. Classify substances as ionic. Compare properties of ionic and covalent substa Draw dot-and-cross diagrams of simple ionic sul
Most pupils should:	Explain the properties of ionic substances. Describe the formation of ionic substances.
Some pupils should:	Relate properties of compounds to their bonding

Key words: Atomic structure, ionic bonding, examples, properties, dot-an

Starter

Draw a covalent compound not already drawn.

Main

1. Review answers and choose a student with a good example to draw i
2. Review covalent compounds. Include electron arrangement an
3. Explain ionic bonding with drawn examples.
4. Demo of conductivity of compounds. Demonstrate the non-co compounds and solid ionic compounds and then dissolved/m Electrical conductivity of compounds can be tested by placing electrolysis cell. Demonstrate distilled water, solid sodium chl water and solid sodium chloride. Electrical conductivity will b bulb. It is recommended that this is carried out as a demonstra appropriate ventilation as chlorine gas is evolved in the electro cupboard if you have the facility to do so.
5. Discuss properties, including high melting and boiling points compare to covalent compounds.
6. Explain properties in terms of electron arrangement and high e
7. Pupils asked to draw their own dot-and-cross examples, e.g. lithium
8. Elicit answers. Different pupils selected to draw their answers on boa pupils if they have a wrong answer as this gives a good opportunity t (assuming a non-judgemental environment is in place).

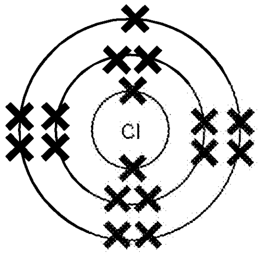
Plenary

Compound properties splat. On one side of the board write 'ionic' on the Split the class into two, with a representative for each team at the board. A give ionic or covalent as an answer, they answer by 'splatting' the correct

Ionic Bonding

There is another way atoms can bond with other atoms that does not involve sha
gain and loss of electrons. We call this **ionic bonding**.

Let's take another look at that chlorine atom.



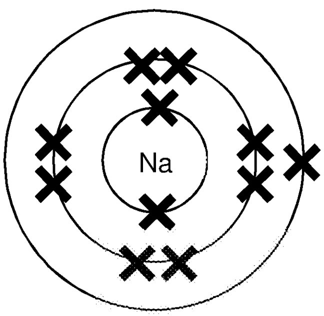
To have a full outer shell ... atom needs one extra electron in its outer
from anoth... m; ... ly it cannot take the electron from another chlorine
atom would ... nly have six electrons in its outer shell. Instead it must find an

We have already looked at an entire group of atoms that only have one electron
group 1 metals.

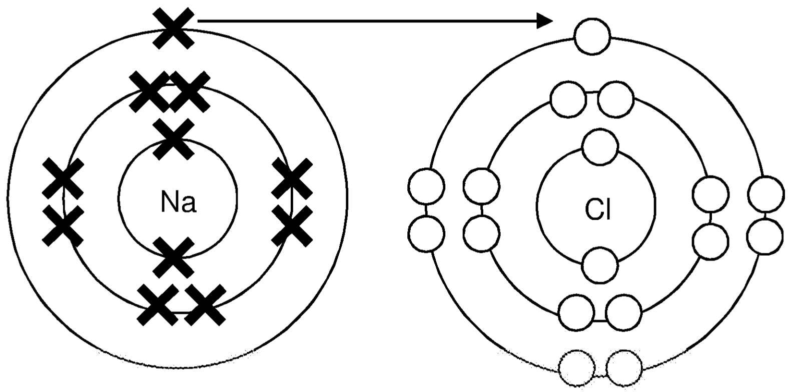
Reminder: In order down the periodic table the group 1 metals are:

Lithium (Li)
Sodium (Na)
Potassium (K)
Rubidium (Rb)
Caesium (Cs)
Francium (Fr)

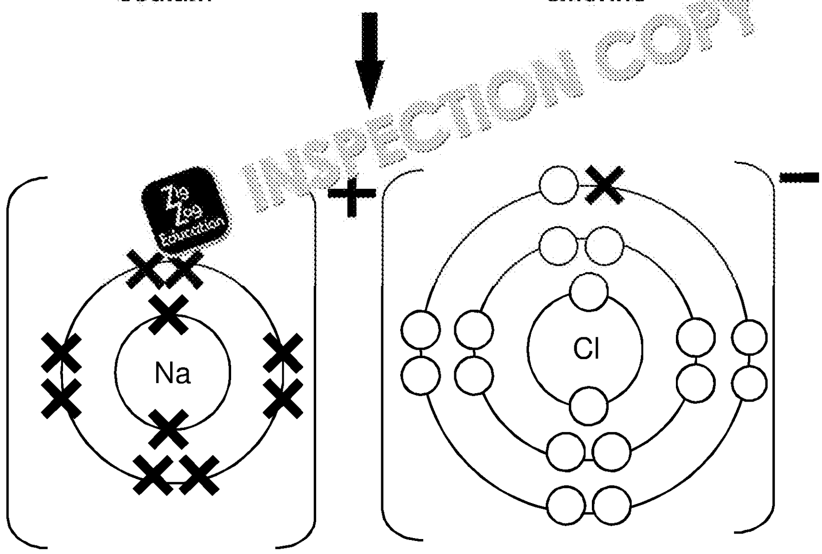
Each of these has an extra electron in its outer shell it needs to get rid of, for exa



An electron is transferred from the outer ... of ... sodium to the outer shell o



Sodium **Chlorine**



Sodium Chloride

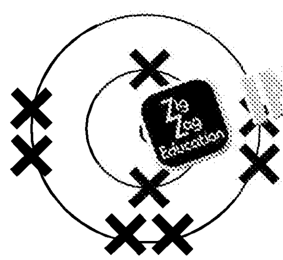
The formula for this sodium chloride molecule is: NaCl

This is because electrons have a negative charge. The transfer of an electron leav
charge and the chlorine with a negative charge. Once they have a charge they ar
they are called a sodium **ion** and a chloride **ion**.

Because they are oppositely charged they are attracted together by very strong e

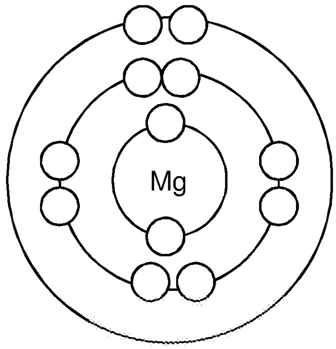
To show that these ions have a charge we surround them with a square bracket a
right corner. It is very important that this is done when you draw your examples
wrong, even if you get the rest correct!

So, now let's take another look at the ox

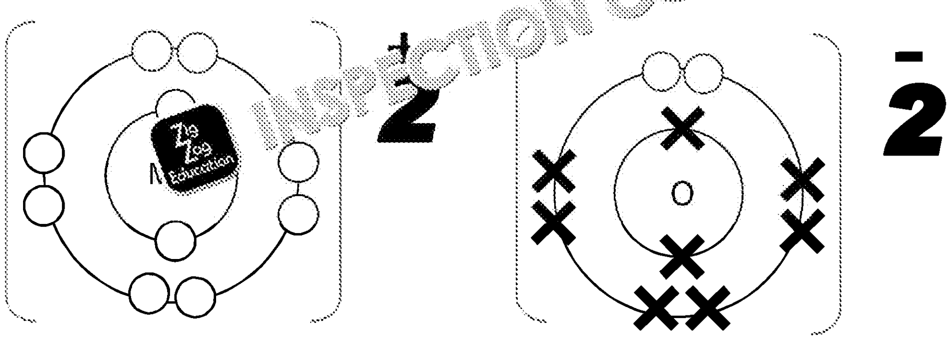


To have a full outer shell the oxygen atom needs two extra electrons in its outer s
electrons from another atom; obviously it cannot take the electron from another
atom would then only have four electrons in its outer shell. Instead it must find a
electrons.

Magnesium atoms have two electrons in their outer shell.



These two electrons are transferred from the outer sh[illegible] the magnesium atom
atom.



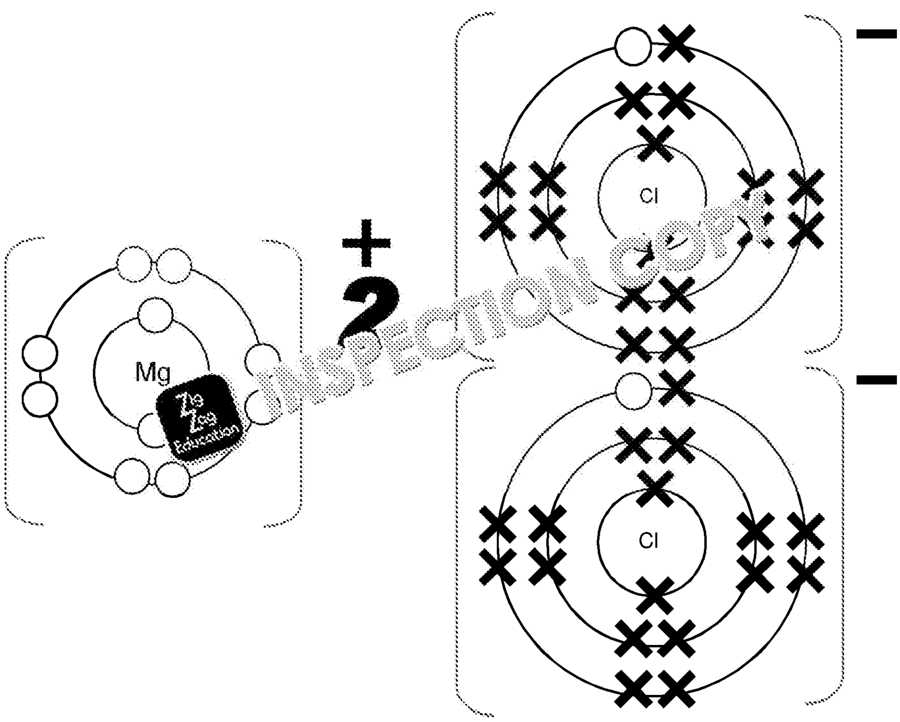
Magnesium Oxide

Because two electrons have been transferred the magnesium **ion** has a charge o
charge of 2-.

The formula for this magnesium oxide molecule is: MgO

Just like in covalent bonding the needed electrons can come from more than one
the magnesium giving up its two electrons to the same atom it could give one ea
atoms. This will form one magnesium ion and two chloride ions which will join to
chloride.

The formula for this magnesium chloride molecule is $MgCl_2$:



Magnesium Chloride

Properties of Ionic Substances

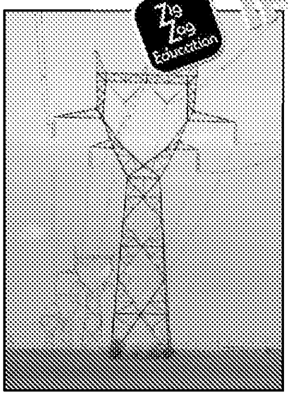
Melting and Boiling Points

Ionic compounds only form between metals and non-metals.

The individual ions stick strongly to each other but also to neighbouring ions, for structures of millions of ions held together by strong continuous bonding. This m high melting and boiling points, i.e. it takes a huge amount of energy to break th

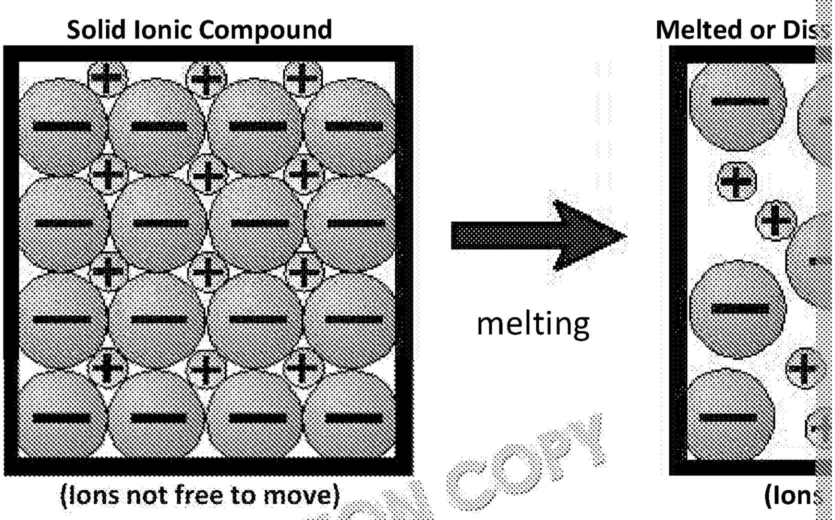
Compound	Melting point (°C)	Boilin
Sodium Chloride	801	
Magnesium Oxide	[illegible]	
Magnesium Chloride	714	

Conductivity



Each of the separate ions in an ionic compound has a c conduct electricity. However, **solid** ionic compounds ca the ions are not free to move. However, if an ionic com ions become free to move from each other. This free c melted ionic compounds can conduct electricity.

> ***Did you know?***
> *As they conduct electricity when dissolved, ionic com They used to contain liquid, but the batteries would f device they were in. Now an ionic paste is used which*



Substance	Melting Point	Boiling Point	Forces
Ionic	High	High	Strong electrosta forces
Simple covalent	Low	Low	Weak intermolecu forces

Lesson Plan 5: Bonding and Structure: Gi

Learning Aims

All pupils should:	Describe properties of ionic and covalent substan Classify substances as ionic or covalent. Compare properties of ionic and covalent substa Draw dot-and-cross diagrams of simple ionic and
Most pupils should:	Explain the properties of ionic and covalent subs Describe the formation of ionic and covalent sub
Some pupils should:	Relate properties of compounds to their bonding

Key words: Giant ..., examples, properties, dot-and-cross diagrams,

Starter
Mix and match. Match the characteristics of ionic and covalent compound

Main

1. Go through answers to starter.
2. Short introduction to giant covalent substances including diamon and free electrons.
3. Explanation of properties including hardness, melting points and
4. Short introduction to giant ionic substances stressing properties (conductivity).
5. Explanation of properties including hardness, melting points and
6. Answer Questions 1–8 from the pack.
7. Elicit answers. Different pupils selected to draw their answers on the picking pupils if they have a wrong answer as this give a good oppor (assuming a non-judgemental environment is in place).

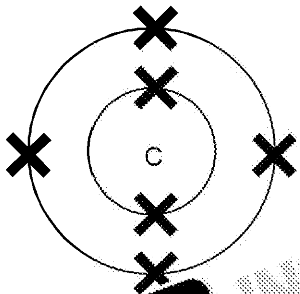
Plenary
Compound bingo. Create bingo cards for each ... containing various compounds. Draw compounds from ... pupils then match their grid w

Giant Covalent and Ionic Substa

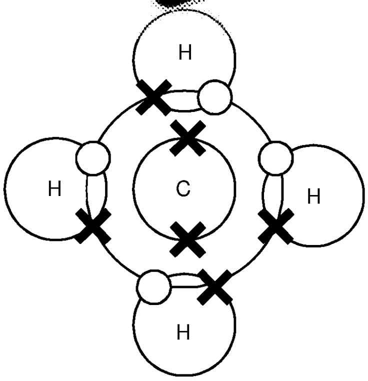
Sometimes atoms do not bond to form simple molecules but instead form more
other atoms forming a network.

Giant Covalent Substances

Carbon, for example, has four electrons in its outer shell.



It can form e covalent molecule such as methane CH_4 (the fuel that your B

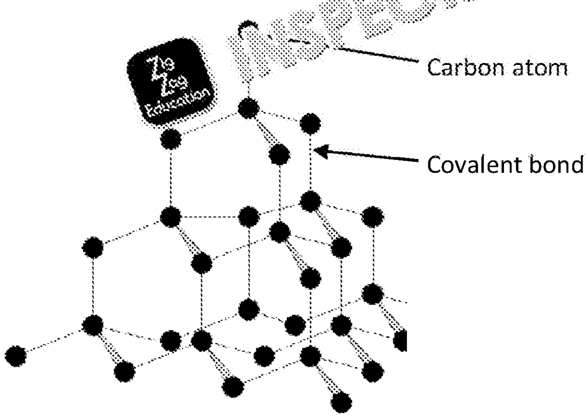


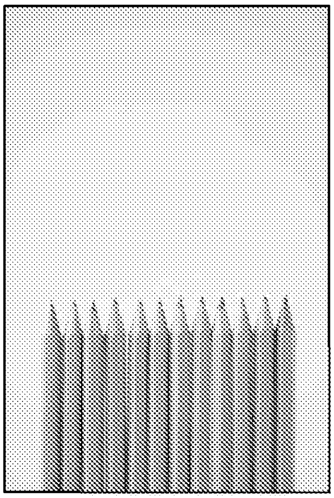
Methane

Or it can also form a giant covalent compound such as diamond. In forming diamond each carbon atom forms covalent bonds with a further four carbon atoms, each of those four join with another four and so on.

This results in a complex network of carbon atoms all held together by very stron covalent bonds.

This has an effect on the properties resulting in **very high melting and boiling points** (the melting point of diamond is 3550 °C, its boiling point is 4872 °C) and making them very hard. Diamond is in fact the hardest substance known. As diamond does not contain freely moving electrons or ions it will not conduct electricity.





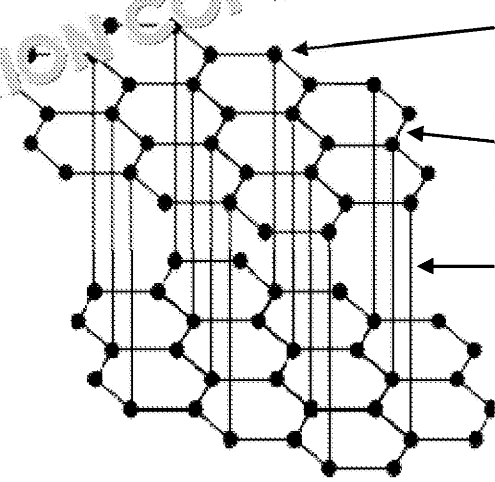
Graphite is very useful in pencils

Carbon can also form graphite. It does this by form
atom covalently bonded to another three carbon a

This way of bonding results in each atom having a s
is free to move (delocalised); this means that there
one of the few non-metals that can actually condu
diamond, has a very high melting point.

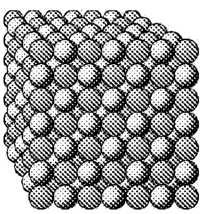
D

Each graphite layer is only weakly held to the o
past each other, making graphite very useful in p
layer behind on the page as it is dragged across
useful as a lubricant as it reduces the friction be



Giant Ionic Substances

Similarly sodium chloride, the molecules of which are formed by ionic bonding, c
giant structure to form a **lattice network**. (Sodium chloride is the scientific name



Each ion bonds ionically to multiple other ions. Giant ionic co
properties as the previous ionic compounds we looked at, i.e.
and only **conduct electricity when molten or dissolved** and te
temperature.

D

Applications of Giant Ionic and Giant Covalent Substances

Diamond, the hardest natural substance known to man, is not only used to mak
it is so hard it is ideal for use in drill bits as they will cut through even the tough

The fact that ionic substances dissolve, and that dissolved ionic compounds con
fantastic for use as electrolytes. An electrolyte is a substance with free charge
through it. For example passing electricity through sodium chloride solution (el
hydrogen, chlorine and sodium hydroxide, all of which are very useful in ind
convert vegetable oils into spreads because it causes the oils to thicken, chlorin
purification and sodium hydroxide can be reacted with fat to create soap.

Summary of Properties

Substance	Melting Point	Boiling Point
Giant ionic	High	High
Giant covalent	High	High

Bonding Questions

1. Describe and compare four properties of simple covalent, giant covale
   You may use a table to help you.
2. For each type of compound (simple covalent, giant covalent and gian
   the way it does. You must consider their boiling points, melting point
   You may use a table to help you.
3. You have been presented with a number of substances and asked to d
   each substance has and suggest what each substance could be.
   a. Substance A is a gas.
   b. Substance B is a solid but does not dissolve. It does not conduct a
      point.
   c. Substance C is a solid with a high melting point that does not con
      once dissolved it does.
   d. Substance D is a liquid but does not conduct electricity.
   e. Substance E is a solid with a high melting point and conducts eve
   f. Substance F has a low melting point.
4. Draw dot-and-cross diagrams for the following substances and give t
   a. Hydrogen
   b. Sodium chloride
   c. Carbon dioxide
   d. Water
   e. Magnesium oxide
   f. Lithium chloride
   g. Chlorine
   h. Methane
   i. Oxygen
   j. Magnesium chloride
5. Pick one ionic and one covalent compound from the list in Question 4
   formation of the molecule. You can use diagrams to help you.
6. Explain why diamond can be used as a drill bit. You must state the pr
   and relate this to its structure and bonding.
7. Explain why graphite is used in pencils and also as a lubricant. You m
   makes it suitable and relate this to its structure and bonding.
8. An electrolyte is something that makes another substance electrically
   sodium chloride would make a good electrolyte. You must state
   suitable and relate this to its structure and bonding.

Bonding Questions

1. Describe and compare four properties of simple covalent, giant covale
   You may use a table to help you.

2. For each type of compound (simple covalent, giant covalent and gian
   the way it does. You must [illegible] their boiling points, melting point
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      ....

   b. Substance B is a solid but does not dissolve. It does not conduct a
      point.

      ....

   c. Substance C is a solid with a high melting point that does not con
      once dissolved it does.

      ....

   d. Substance D is a liquid but does not conduct electricity.

      ....

   e. Substance E is a solid with a high melting point and conducts eve

      ....

   f. Substance F has a low melting point.

      ....

4. Draw dot-and-cross diagrams for the following substances and give t
   a. Hydrogen

   b. Sodium chloride

   c. Carbon dioxide

   d. Water

e. Magnesium oxide

Formula: ________________

f. Lithium chloride

Formula: ________________

g. Chlorine

Formula: ________________

h. Methane

Formula: ________________

i. Oxygen

Formula: ________________

j. Magnesium chloride

Formula: ________________

5. Pick one ionic and one covalent compound from the list in Question 4 formation of the molecule. You can use diagrams to help you.

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8. An electrolyte is something that makes another substance electrically sodium chloride would make a good basic electrolyte. You must state suitable and relate this to its structure and bonding.

....

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....

Pupil's Name:		
Start Date:	Deadline:	Da

Chemical Reactivity and Bonding

Scenario

ChemCorp is an international chemical company which manufactures and supplie educational institutions and governments. They are keen to increase links with sc public. As such they have set up an educational department. A a new member of t to work with a local secondary school and a local university to carry out the follow

Task 1

You have be ec o work with a local secondary school to carry out the fol

1. Classify ements from the group 1 elements and two elements from t upon their physical properties. You can use the following information to h
   Here you should classify the elements based on physical properties which ar group but are different to elements in another group.

Metal	Melting Point (°C)	Boiling Point (°C)	Colour
Bromine	-7	59	Red/brown
Chlorine	-101	-35	Pale green
Fluorine	-220	-188	Pale yellow
Iodine	113	183	Black/purple
Lithium	180	1330	Silvery
Potassium	64	760	Silvery
Rubidium	39	688	Silvery
Sodium	98	892	Silvery

2. Make a fact sheet for Year 10 pupils describing the physical and chemical elements of the periodic table.
   Give an account of the physical and chemical properties which are similar w different to elements in another group. This could include boiling and melti reactivity with water, displacement reactions, etc.

3. Create a poster describing the trends in the physical and chemical proper
   For each of the properties you have listed you sh iv an account of how down the group. This could include boili a d ng points, electrical co displacement reactions, etc.

4. Prepare a talk w explain the trends in chemical properties of gro as a re h electronic structure.
   For eac properties you described you should offer a reason why the they do.

Task 2

The local university has asked you to help their new lab technicians with
produce a poster in which you:

1. Describe four properties of ionic substances and four properties of c
Here you should state the physical properties which are similar to a sp elements of another type of substance. You should also give an account boiling and melting points, electrical conductivity, forces, etc.

2. Use the data provided below to classify at least six substances as ion

Compound	Melting Point (°C)	Boiling Point (°C)	Elec Condu
Chlorine	-102	[illegible]34	N
Magnesium Chloride	7[illegible]	1412	If mo diss
Magnesium [illegible]	2852	3600	If mo diss
Oxygen	-223	-183	N
Sodium Chloride	801	1413	If mo diss
Water	0	100	N

3. Compare the properties of ionic and simple and giant covalent subst
Say how the properties of ionic and covalent substances are different f Properties could include boiling and melting points, electrical conduct

4. Include dot-and-cross diagrams to help describe the formation of sin including sodium chloride, magnesium oxide, magnesium chloride, w dioxide, methane and oxygen.
Using your diagrams you should give an account of how both types of s constituent atoms.

5. Explain the properties of ionic and simple and giant covalent substa for sodium chloride, hydrogen gas, diamond and graphite and use di and their chemical bonds are formed.
For each of the properties you described you should also give a reason substances behave in the way that they do. Remember to relate the pro

6. Relate the applications of graphite, oxygen and sodium chloride to th and for each describe one application whic[illegible] [illegible]nt upon its struct
Here you should include within your [illegible] a comment on how th way they bond together. F[illegible] [illegible] substances listed, you should d which property th[illegible] [illegible] – an example for the group 0 elemen is: helium i[illegible] [illegible]oons because it is lighter than air and will ther

Learner's name:	Start Date:

Learner's declaration:
I certify that the work submitted for this assignment is my own. I have clearly refe… work. I understand that false declaration is a form of malpractice.

Learner's Signature: Date

Learner's comments for the assessor:

Teacher's/assessor's name:

Marking Criteria

Task:	Crit…	…earner must:
1	2A.P1	Describe the physical and chemical properties of group 1 and 7 elements.
	2A.M1	Describe trends in the physical and chemical properties of grou… and 7 elements.
	2A.D1	Explain the trends in chemical properties of group 1 and 7 elements in terms of electronic structure.
2	2A.P2	Compare properties of ionic and covalent substances.
	2A.P3	Draw dot-and-cross diagrams of simple ionic and covalent substances.
	2A.M2	Explain the properties of ionic and covalent substances.
	2A.M3	Describe the formation of ionic and covalent substances.
	2A.D2	Relate applications of compounds to their properties and to the… bonding and structure.

Deadline:

Summative feedback:

Date assessed:

Internal verifier's name:

Internal verifier's feed…k

Date

If a learner has not met the Level 2 criteria, they can be assessed on the Level…

1A.1	Classify group 1 and 7 elements based upon their physical properties.
1A.2	Describe the properties of ionic and covalent substances.
1A.3	Classify substances as ionic or covalent.

Lesson Plan 6: Use of Chemicals Based on their

Learning Aims

All pupils should:	Describe physical properties of chemical substan Describe how chemical substances are used base properties.
Most pupils should:	Explain how physical and chemical properties of them suitable for their uses.
Some pupils should:	Assess the suitability of different types of substa

Key words: Physical and chemical change, electrical conductivity, therm boiling points, solubility, viscosity, questions.

Starter

Define the term 'properties'.

Main

1. Elicit answer from class.
2. Description and examples of the difference between physical a melting ice / boiling water and a hydrogen oxygen rocket.
3. Description of some properties with an explanation of substan properties, e.g. copper's electrical conductivity / wire, alumini cooking pans, etc.
4. Pupils to work in pairs to come up with their own examples.
5. Elicit answers from class.

   Areas to cover: electrical and thermal conductivity, melting an viscosity.
6. Demonstrate solubility and viscosity. Try to dissolve salt and w polystyrene in acetone. For viscosity, ask pupils to pour a sma measuring cylinder and then ask them to pour thick wallpape cylinder. This can be expanded into a circus activity instead if
7. Answer Questions 1–10 from the pack.
8. Obtain answers from class.
9. Class practical of the electrical conductivity of some everyday series of everyday items, such as pencils, ice cream sticks, rubb Determine their electrical conductivity by placing them in a cir
10. Review and discuss class findings.

Plenary

Pupils work in pairs. Each person writes five questions (with answers) an One point is gained for every question they get correct; one point is lost fo The winner is the one with the most points after all ten questions have bee

Physical Properties

Everything has a number of different properties. These properties help us identif
that you can identify your friends by the properties on their face: nose, eye colou
to determine the function of substances in the same way that you may want to b
good at sport.

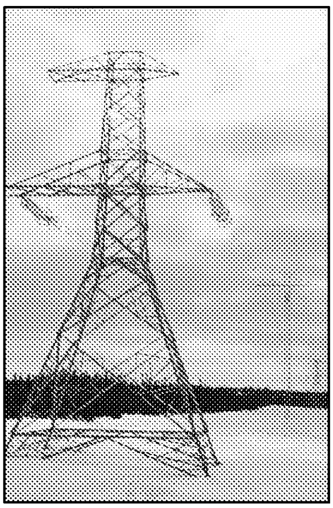
There are two basic types of properties that we will consider. The first is physica
chemical properties. So, what's the difference?

Physical properties are those things that do not change the chemical nature of a s
hardness, density, electrical conductivity, thermal cond[illegible], melting and boili
(how runny it is).

Chemical properties are those th[illegible] change the chemical nature of a sub
how easily something bu[illegible] something will react with oxygen to form ar

We will tak[illegible] a[illegible] both of these properties and see how and why we use cert
based on the[illegible]properties.

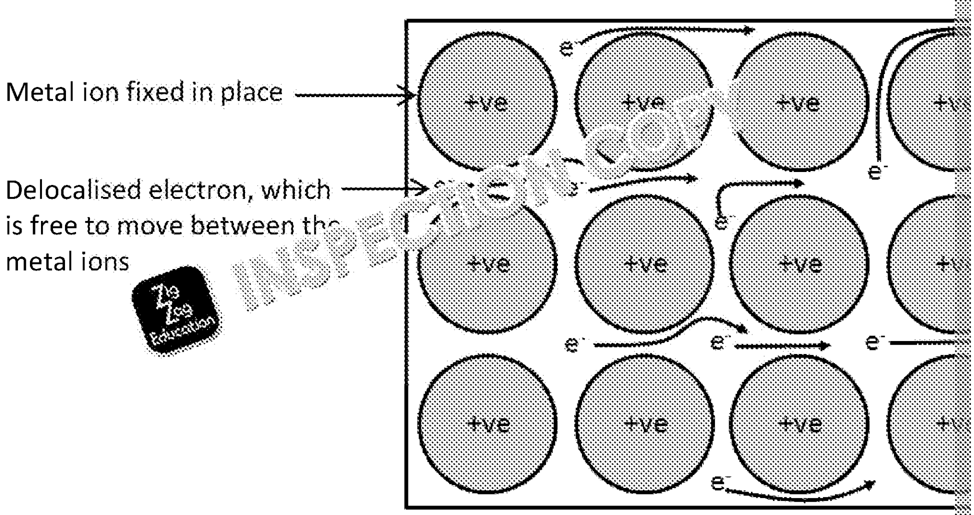
Electrical Conductivity



Look around you; I expect wherever you look you wi
electricity. We have already seen that many things d
without substances that do our lives would be very d

Metals in general are a great chemical substance to
why?

There are a number of physical properties that mak
that metals are ductile. This means that they can be
addition metals are malleable – this means that elec
the metal breaking. Secondly their structure contai
delocalised electrons. These electrons cause the me
allow the metal to conduct electricity because these
end of the wire to the next carrying energy with the



Representation of electrica

Thermal Conductivity

Thermal conductivity means how easily heat energy can flow through an object. If you look around your home or classroom you will see a number of different obje that have been made out of material because of their thermal conductivity.

For example radiators are made out of metal because metal is a good thermal conductor for the same reasons as it is a good electrical conductor.

Sometimes we want things to stop thermal conductivity. We call things that are poor thermal conductors insulators.

You may have fibreglass, wool or paper insulation in your roof space or walls. The reason for this is that they are all poor thermal conductors. This means that they will reduce the amount of energy you will need to heat your house. In addition th will trap air within their particles; air is a good insulator. These materials are flammable so can be treated to improve their flame retardant properties.

> ***Did you know?***
> *Pizzas are transported between restaurants and houses in cardboard boxes bec thermal conductor – the box makes it harder for the heat from the pizza to esca*

Melting and Boiling Points

We have looked a lot at melting and boiling points. Look back over your work on bonding if you need to remind yourself about factors that control a substance's melting and boiling points.

Melting and boiling points are important when we choose which material we wil make an object out of. For example lead is a good thermal conductor but it woul make very poor saucepan material because it melts at 320 °C, well below the temperature of your average gas cooker. On top of this you would probably die o lead poisoning too.

Many machines and processes involve hot liquids flowing through tubes. These tubes can be made of metal but this can often be problematic because of expens and ease of use. Often these liquids flow through plastic tubes. Not all plastics would be suitable though as different plastics have different melting points.

Solubility in Different Solvents

A solution is made by adding a solute into a solvent. When we think of dissolvin solution we often think of pouring something like salt (the solute) into water (the other solvents out there.

Pour the same salt into the hexane and nothing will happen, yet if you pl will dissolve it ... won't dissolve in water. That's why nail polish will r with aceton

The knowledge of what will dissolve in what is important. We learnt before that aluminium oxide will only conduct electricity if molten or dissolved. In the proces pure aluminium, electricity needs to be passed through it. This could be one by h molten, but as its melting point is 2072 °C, this would be very expensive.

In industry, aluminium oxide can be dissolved in a substance called cryolite to re be heated to 1012 °C before it melts, so although melting it still requires a great energy compared to melting aluminium oxide.

Viscosity

Viscosity is a measure of how easily something flows, for example water will flow very easily and so can be said to have a low viscosity, whilst treacle flows poorly and therefore can be said to have a high viscosity.

We rely on the viscosity of substances every day. When you place your foot on a brake in a car it slows the car. This is owing to a complex series of hydraulics that relies on the fact that the viscous glycol-ether fluid will not compress; other less viscous fluids would be less effective.

Viscosity is also crucial in lubricating engines. Thick oils are used to lubricate engine parts. It is slippery and therefore reduces friction between parts. However, it needs to be viscous otherwise it would simply flow off the parts.

Viscosity is also important in the pharmaceutical industry to make sure make-up … consistency. Sun cream would not be good if it were as viscous as water because i… it was rubbed in. Likewise make-up would be of little benefit if its viscosity did no…

> ***Did you know?***
> *Other examples of the importance of viscosity include paint and tomato sauce. …*
> *advertising its tomato ketchup as viscous. They claim the official speed limit of it…*

Physical Properties Questions

1. Is ice melting a physical or chemical change?
2. Is magnesium burning in air a physical or chemical change?
3. Is acid neutralising an alkali a physical or chemical change?
4. Describe the physical properties of silver, and describe how these pro
5. Describe the physical properties of helium, and describe how these pr
6. Describe the physical properties that make copper a suitable substanc
7. Describe the physical properties that make woo[illegible]itable substance
8. Describe the physical properties tha[illegible]aluminium a suitable subs
9. Describe the physical pr[illegible]at make acetone a suitable substan
10. Describ[illegible] properties that make oil a suitable substance for

Physical Properties Questions

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2. Is magnesium burning in air a physical or chemical change? ....

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   ....

   ....

6. Describe the physical properties that make copper a suitable substanc

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7. Describe the physical properties that make wood a suitable substance

   ....

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8. Describe the physical properties that make aluminium a suitable subs

   ....

   ....

   ....

9. Describe the physical properties that make [illegible] a suitable substan

   ....

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   ....

10. Describe the physical properties that make oil a suitable substance for

   ....

   ....

   ....

Lesson Plan 7: Use of Chemicals Based on their C

Learning Aims

All pupils should:	Describe chemical properties of chemical substan Describe how chemical substances are used based
Most pupils should:	Explain how chemical properties of chemical su for their uses.
Some pupils should:	Assess the suitability of different types of substa

Key words: Physical and chemical changes, electrical conductivity, therma boiling points, solubility, viscosity, sodium azide, argon welding, silicon c extinguishers, questions.

Starter

Pupils are to be given three items and asked which property makes them s in windows, metal radiators, rubber on wires, etc.

Main

1. Elicit answers from class.
2. Describe chemical substances and the properties they have that m function including, but not limited to:
   - sodium azide in airbags
   Show video: **http://www.youtube.com/watch?v=A2fAgW_1nD**
   - argon in welding
   Show video: **http://www.youtube.com/watch?v=X-iYJrKrv5U&**
   - silicon in computer chips.
   - carbon dioxide in fire extinguishers
3. Answer Questions 1–9 from the pack.
4. Obtain answers from class.

Plenary

Spot the useful property: Pupils to spot items in classroom with properties function.

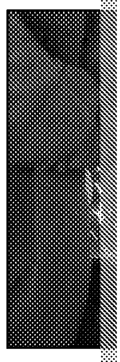
Chemical Properties

Sodium Azide

Sodium azide (NaN_3) is a colourless
containing sodium and nitrogen. It
responsible for deploying airbags i
another solid object an electrical s
electrical signal is a controlled det
azide to rapidly decompose into tw
and nitrogen gas. The nitrogen gas
airbag. It does this because nitroge
gas [illegible] when it is locked up

$$2NaN_3 \rightarrow 2Na +$$

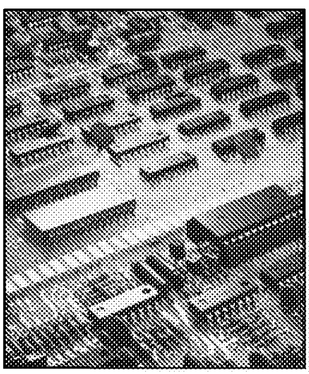
Argon



Argon is a noble gas; this means that it has a full outer shell of electrons. As you may remember from your work with the group 1 metals and the halogens, atoms like to have a full outer shell. The fact that argon already has a full outer shell means that it will not react with other chemicals.

The fact that it does not react with other substances is important in arc welding. In arc welding a power supply causes a hot electric arc to form. This electric arc is hot enough to melt metal and therefore allows two pieces of metal to be joined together. Without argon the heat would
the metal and the surrounding gases in the air such as oxygen. This would weake
protective gas, surrounding the working area and preventing any unwanted chem

Silicon



All computers, whether your treasured Xbox or your h
silicon chips. Tiny transistors in the chip are the key. C
around those transistors turning on and off and varyi
the device and allowing it to perform the desired calc

Silicon is a good material to use because its crystalline
other substances such as impurities. This is called dop
type of impurity in the silicon you change the electric
the desired level. In addition, a modified form of dopi
dioxide which is a good insulator.

Carbon Dioxide

For a fire to burn it needs oxygen, heat and fuel. If you remove any of these
will burn out. Carbon dioxide fire extinguishers work by removing the oxygen so
surrounding the area in carbon dioxide gas. The gas coming out is also very cold
cools the area. The reason carbon dioxide gas is used is that it is a cheap, non-rea
so when it is placed on the fire no chemical reactions occur.

D

Hydrogen, for example, would be no use, even though it may remove the oxy
would promptly react with the oxygen creating an explosion far greater than yo
original problem!

D Helium

Reactivity is a measure of how easily a substance will undergo a chemical react
sodium, are used for certain applications because they are very reactive. Othe
certain applications because they are unreactive and will not undergo a chemic
In addition to being unreactive, helium is also not very dense, so it can be used
balloons will float in air and will not explode if exposed to a flame or spark, unl
hydrogen.

Helium can also be used in diving tanks in place of nitrogen. Air in the atmosph
approximately 80% nitrogen and 20% oxygen. This is safe at normal pressure, b
that divers are exposed to, nitrogen will dissolve in the blood. If a diver used a
and resurfaced too quickly, the nitrogen would sudden[illegible] the out of the blood
would cause a condition known as the bends. T[illegible]on the blood would b
fizzy drink – nothing happens when the [illegible] under pressure in the bottle wi
lid is opened and the pressure i[illegible], the fizzy drink suddenly expands as t
The bends can be fat[illegible] is used inside diving tanks instead of nitrogen
the blood [illegible] sa[illegible]ay.

Chemical Properties Questions

1. With reference to its chemical properties explain why sodium azide is
2. With reference to its chemical properties explain why silicon is used i
3. With reference to its chemical properties explain why carbon dioxide and explain why hydrogen is not used.
4. Would neon be a suitable material to use as a protective gas in arc we with specific reference to its chemical properties.
5. Pick a substance, other than those mentioned, that would be a suitabl Explain your answer with specific reference to its physical and chemi
6. For each of the following fictional substances predict its state at room information provided.
   i. Tritanium, melting point 245 °C, boiling point 1701 °C
   ii. Ranyardium, melting point -190 °C, boiling point -120 °C
   iii. Joesentium, melting point -10 °C, boiling point 62 °C
   iv. Dilithium, melting point 1000 °C, boiling point 1232 °C
7. Compare the melting points of the four substan[illegible] Question 6. Wh material to line an oven with and why?
8. Tritanium is extremely uns[illegible] temperatures. Ranyardium is temperatures. Joes[illegible] pink liquid. Dilithium is an ionic solid.

   Whic[illegible] would be suited for the following purposes?
   i. El[illegible]te
   ii. Explosive
   iii. To fill a blimp
9. Pick any two chemical products. Create a poster/leaflet about why the properties are useful.

Chemical Properties Questions

1. With reference to its chemical properties explain why sodium azide is

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Explain your answer with specific reference to its physical and chemi

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   ii. Ranyardium, melting point -190 °C, boiling point -120 °C ....

   iii. Joesentium, melting point -10 °C, boiling point 62 °C ....

   iv. Dilithium, melting point 1000 °C, boiling point 1232 °C.................

7. Compare the melting points of the four substances in Question 6. Wh material to line an oven with and why?

   ....

   ....

   ....

8. Tritani[illegible] is extremely unstable at high temperatures. Ranyardium is temperatures. Joesentium is a pink liquid. Dilithium is an ionic solid.

   Which element would be suited for the following purposes?

   i. Electrolyte...

   ii. Explosive...

   iii. To fill a blimp ....

9. Pick any two chemical products. Create a poster/leaflet about why the properties are useful.

Assignment B: Use of Chemicals Based on their Chemical an

Pupil's Name:		
Start Date:	Deadline:	Dat

Investigate How Uses of Chemical Substances Depend o Physical Properties

Scenario

You are a scientist with several inventions appearing on Dragons' Den. These inv cars, a fire extinguisher and welding apparatus.

Task

First, you are to prepare an introduction to your talk in which you:

1. Describe physical properties of some common chemical substances i conductivity, thermal conductivity, melting and boiling points, solubility

2. Describe how at least two chemical substances are used based on their p electrical conductivity, thermal conductivity, melting and boiling points, viscosity.
   Here you should give an account of why certain substances are used for ce they have.

Then, in relation to your inventions you will:

3. Identify the chemical substances that could be used in each of your prod the physical and chemical properties of the substances would make them products.
   For each of the substances mentioned above you should give an account of product relies on and give a reason why that particular property makes th example for the group 0 element helium (which is not part of this topic) is: it is lighter than air and will therefore float.

4. Assess the suitability of the substances for their use in your product. Ma and chemical property of the substance in turn, explain why the propert and explain why the overall properties make it the most appropriate che
   Here you should make a judgement about how good the substances are at could include a comparison with other substances which do a similar job w hydrogen used to be used in keeping balloons afloat but the fact that hydro helium, an inert gas, is now used in its place. Helium is lighter than air so will f not present a risk to people

Describe: Give an account of, or express the idea of, or give an impr
Explain: Offer reasons for, or a cause of, somethin
Assess: Determining the value, significance and effectiveness

Learner's name:	Start Date:

Learner's declaration:
I certify that the work submitted for this assignment is my own. I have clearly refe
work. I understand that false declaration is a form of malpractice.

Learner's Signature: Date

Learner's comments for the assessor:

Teacher's/assessor's name:

		Marking Criteria
Task:	**Criteria**	**Learner must:**
1	2B.P4	Describe how chemical substances are used based on their phy properties.
	2B.P5	Describe how chemical substances are used based on their chemical properties.
	2B.M4	Explain how physical and chemical properties of chemical substances make them suitable for their uses.
	2B.D3	Assess the suitability of different types of substance for a specif use.

Deadline:

Summative feedback:

Date assessed:

Internal verifier's name:

Internal verifier's feedback:

Date

If a learner has not met the Level 2 criteria, they can be assessed on the Level	
1B.4	Describe the physical properties of chemical substances.
1B.5	Describe the chemical properties of chemical substances.

Lesson Plan 8: The Factors Involved in the R
Reactions: Equations and Rates of R

Learning Aims

All pupils should:	Identify reactants and products including state s and whether reactions are reversible or irreversil Identify the number and types of atoms in b Identify the factors that can affect the rates of che Describe the factors that can affect the rates of ch
Most pupils should:	Explain how differe f c s affect the rate of in

Key words: Equations, word equa i symbol equations, symbols of stat concentration, surfac essure and catalyst on rates of reaction.

Starter

List the signs of a chemical reaction.

Main

1. Go through answers.
2. Description of how to lay out a simple word equation: Reactants
3. Some examples of basic word equations:
   Magnesium + Oxygen → Magnesium Oxide
   Lithium + Water → Lithium Hydroxide + Hydrogen
4. Build on these by conversion to symbol equations.
5. Demonstrate how to represent state symbols.
6. Explanation of how to balance a chemical equation.
7. Explanation of how to calculate the number and types of atoms i
8. Explain the difference between reversible and irreversible reactio manufacture of ammonia.
9. Explain that reaction rates can be changed by a number of differe
10. Describe and explain the effects of:
    - Temperature. Concentration. Surface a ressure. Catalyst
    in relation to particle/collision theor an ision rates. The effe relevant industrial proce c be discussed wherever possib
11. Answer Que om the pack.
12. Go th nswers.
13. Review and discuss results and findings.

Plenary

Science Boggle. Pupils work in groups of five and each write down as ma today as they can in two minutes. After this time they should compare the out any facts they have in common. The winner is the one with the greate can be expanded to find the class winner as well.

Equations

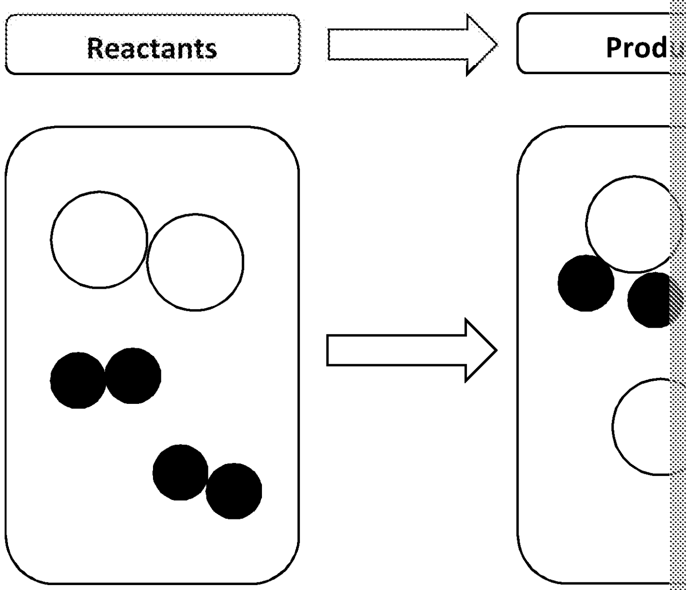
In chemistry we frequently need to represent chemical reactions. Chemical react
chemically combine with other substances to create a different substance. We ca
ways, one is using a word equation and the other is using a symbol equation. We

Word Equations

Words equations are the simplest way to represent a chemical equation. All you n
you started with, the **reactants**, and what you ended with, the **products**.

The reactants always go on the left-hand side.
The products always go on the right-hand side.
Normally we use an arrow to separate them.

Reactants → Products



Some examples of reactions include displacement (see group 7), and neutralisati

Let's take a look at an example. You may have been given a length of magnesium
it in a Bunsen burner and observe what happened. Apart from the blinding light
that you started with a silvery piece of metal and ended up with a white powder
magnesium has reacted with the oxygen in the air to create magnesium oxide. In
has reacted with the oxygen in the air to create magnesium oxide' we can show

Magnesium + Oxygen → Magnesium Oxide

Word equations are great but they don't always show us exactly what is happeni
we need more data such as how many atoms of magnesium are reacting with ho
this we need symbol equations.

Symbol Equations

There are many steps in writing a symbol equation; all but the last step is incomp we need to know a little bit more.

Step 1: First we need to know the symbols of elements which we can look up on symbol equation for the above reaction would be:

$$Mg + O_2 \rightarrow MgO$$

Remember that the first letter of every atomic symbol **must** be a capital letter ar **must** be lower case.

We must also check the formula, for example we must ... because the oxyge form. Also note that the 2 is small and just below ... (subscript).

Step 2: This involves adding in state ... symbols to the equation. Rememb matter are solid, liquid and ... are shown on the equation by (s), (l), and substances ... in water, in which case we say it is aqueous or (aq).

$$Mg_{(s)} + O_{2\,(g)} \rightarrow MgO_{(s)}$$

But it's still not quite right yet. A basic scientific law states 'matter cannot be cre that we must always have the same number of atoms of each element at the enc

$$Mg_{(s)} + O_{2\,(g)} \rightarrow MgO_{(s)}$$

In the reactants we have one magnesium atom and two oxygen atoms.
In the products we have one magnesium atom but only one oxygen atom.

To overcome this we must **balance** the equation. To balance equations we place of the substances in question. At the moment we don't have enough oxygen ato equation; we have one but we need two. To solve this we place a 2 in front of th number in the middle or end of a substance as that would be a different substan beginning. So, it becomes:

$$Mg_{(s)} + O_{2\,(g)} \rightarrow 2MgO_{(s)}$$

That solves the oxygen problem but has created a new problem. Now our produc magnesium atoms on the product side (right) but only one on the reactant side (to place another 2 in front of the Mg. So, it becomes:

$$2Mg_{(s)} + O_{2\,(g)} \rightarrow 2MgO_{(s)}$$

We call this a balanced chemical equation.

Remember!

Step 1
Write the symbol equation and check formula.
$Mg + O_2 \rightarrow MgO$

Step 2
Add the state symbols.
$Mg_{(s)} + O_{2\,(g)} \rightarrow MgO_{(s)}$

Step 3
Balance the equation.
$2Mg_{(s)} + O_{2\,(g)} \rightarrow 2MgO_{(s)}$

Differences be

H_2O means two h oxygen atom. Th the atom immed

Adding a numbe *everything* by th four hydrogen a

Reversible and Irreversible Chemical Reactions

If you burn magnesium in oxygen (a combustion reaction) you end up with m irreversible reaction because the products won't turn back into the products.

Sometimes chemical reactions are reversible. That means that the reactants turn your starting substance. The manufacture of ammonia is a reversible reaction.

The word equation for the manufacture of ammonia is:

$$\text{Nitrogen} + \text{Hydrogen} \rightleftharpoons \text{Ammonia}$$

Notice that in a reversible reaction instead of the arrow ($\rightarrow$) we use in an irreve headed arrow ($\rightleftharpoons$) to show the reaction can go backwards and forwards.

The symbol equation for that reaction is:

$$N_{2\,(g)} + H_{2\,(g)} \rightleftharpoons NH_{3\,(g)}$$

Now balanc

$$N_{2\,(g)} + 3H_{2\,(g)} \rightleftharpoons 2NH_{3\,(g)}$$

Rates of Reaction

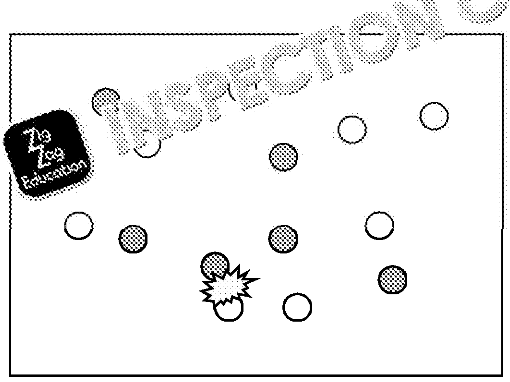
For a chemical reaction to occur particles of the reactants must collide together w reaction; this force is called the **activation energy**. We call this **particle theory** or

There are a number of factors that affect the rate (speed) of a chemical reaction industry speed is money.

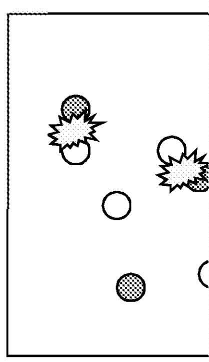
Temperature

One way to increase the rate of reaction is simply to increase the temperature o reactants. Increasing the temperature will increase the amount of energy the rea particles have. Because they have more energy they will move faster; if they are faster, they are more likely to collide with enough force to react.

This is why we place food in fridges and freezers. By cooling the food we slow do chemical reactions that cause the food to go bad.



Low Temperature



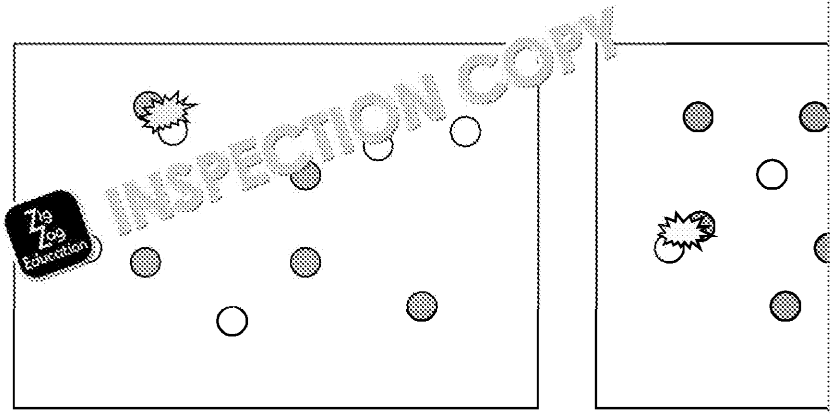
High T

Concentration

Another way to increase the rate of reaction is to increase the concentration of t as adding more reactants.

If we increase the concentration of particles in the reaction we again increase th those particles.

Imagine if two blindfolded people stood at either end of a room and ran towards running into each other would be slim. Now imagine 20 blindfolded people stoo towards each other. The chances of them colliding have increased dramatically. T concentration of reactants.

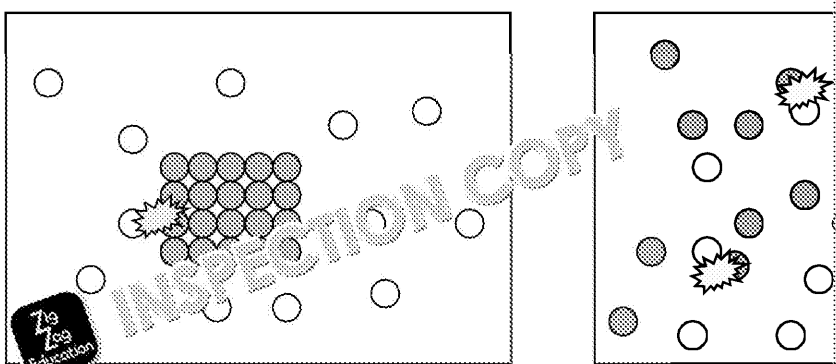


Low Concentration **High Co**

Surface Area

Only the atoms on the surface of the reactant particles can collide with the other surface area we increase the number of particles available to react and therefore collision and increase the rate of reaction.

This can be seen if you drop a marble chip into acid. Only the atoms on the surfa with the acid, the rest are safely on the inside. If you grind the same amount of m the powder into the same amount of acid, most of the atoms will no longer be o surface increasing the rate of a reaction. Therefore, smaller particles react quicke



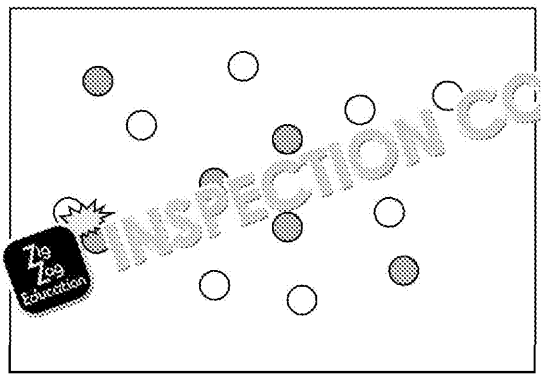
Small Surface Area **Large Su**

You can see this kind of effect in daily life. If you try to melt a chocolate bar in yo must break it up into pieces first. This speeds up the time it takes the heat to per However, this is a physical change rather than a chemical one.

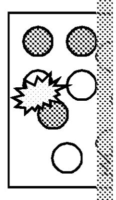
Pressure

If your reactants are gases we can increase the rate of reaction by increasing the pressure you force the particles into a much smaller space. If they are more close chances of a collision and therefore increase the rate of a reaction. In the case of in pressure will favour the reaction which produces the fewest molecules.

Imagine our two blindfolded people now stood in a corridor running towards eac colliding are far greater than it was when they were in the room.



Low Pressure



High P

Catalysts

Sometimes increasing temperature or pressure to increase the rate of a reaction need of fuel to heat and a pressurised container. Another thing we can do to incr add a catalyst.

Catalysts reduce the activation energy needed to cause a reaction. Reactions can they would not have done so previously, such as colder temperatures. Sometimes some of the other methods. Catalysts are often expensive and different reaction good thing is that although catalysts speed up a reaction they do not take part in they remain chemically unchanged at the end of the reaction; therefore they can

Equations and Rates of Reaction Questions

1. State five factors that affect the rate of reaction.
2. For each of the five methods you mentioned **describe** how altering th chemical reaction.
3. For each of the five methods you mentioned **explain** how altering the reaction.
4. For the following chemical reactions, answer the questions below.
   - i. Identify the reactants and products.
   - ii. State whether the reaction is reversible or irreversible.
   - iii. State the type and number of each atom in both the reactants and
   - iv. For each substance identify the state of matter.
     - a. $LiCl_{(s)} + Na_{(s)} \rightarrow NaCl_{(s)} + Li_{(s)}$
     - b. $C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(l)}$
     - c. $6HCl_{(aq)} + Fe_2O_{3(s)} \rightarrow 2FeCl_{3(aq)} + 3H_2O_{(l)}$
     - d. $ICl_{(l)} + Cl_{2(g)} \rightleftharpoons ICl_{3(s)}$

Equations and Rates of Reaction Ques

1. State five factors that affect the rate of reaction.

   1 .... 2 ....

   3 .... 4 ....

   5 ....

2. For each of the five methods you mentioned **describe** how altering th chemical reaction.

   1 ....

   2 ....

   3 ....

   4 ....

   5 ....

3. For each of the five methods you mentioned **explain** how altering the reaction.

   1 ....

   ....

   ....

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   2 ....

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   3 ....

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   4 ....

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   5 ....

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   ....

4. For the following chemical reactions, answer the questions below.
   i. Identify the reactants and products.
   ii. State whether the reaction is reversible or irreversible.
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   iv. For each substance identify their state of matter.

a. $LiCl_{(s)} + Na_{(s)} \rightarrow NaCl_{(s)} + Li_{(s)}$

i. ....

ii. ....

iii. ....

iv. ....

b. $C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(l)}$

i. ....

ii. ....

iii. ....

iv. ....

c. $6HCl_{(aq)} + Fe_2O_{3(s)} \rightarrow 2FeCl_{3(aq)} + 3H_2O_{(l)}$

i. ....

ii. ....

iii. ....

iv. ....

d. $ICl_{(l)} + Cl_{2(g)} \rightleftharpoons ICl_{3(s)}$

i. ....

ii. ....

iii. ....

iv. ....

Lesson Plan 9: The Factors Involved in the R
Reactions: Temperature

Learning Aims

All pupils should:	Identify the factors that can affect the rates of che factors that can affect the rates of chemical reacti
Most pupils should:	Explain how different factors affect the rate of in

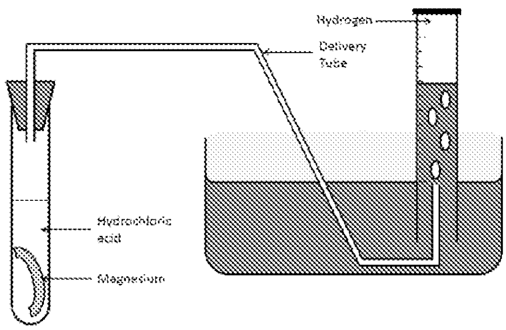
Key words: The effect of temperature on rates of ...

Starter

Recap method

Main

Lesson dedicated to carrying out a class practical on the effect of temp



- 4 cm of magnesium ribbon can be reacted with 10 cm^3 of 1 mol hydro temperatures. Acid can be kept in ice water, room temperature and h *Teacher's cheat: Sometimes the effect of temperature is limited owing to seve pupils will often remove the acid well in advance and temperature may retur overcome this problem you can place 0.5 mol acid in the ice bath, 1 mol acid a acid in the hot water bath, and tell the class it's all 1 mol acid.*
- Pupils should record the time it takes for 50 cm^3 of gas to be produced repeat the experiment three times. Pupils can then use their data to ca reaction for each temperature using the following equation:

$$Rate\ of\ reaction\ (cm^3/s) = \frac{amount\ of\ gas\ produc}{time\ (s)}$$

- Pupils should write up their methods and findings.
- Review findings and discuss explanations.

Plenary

Text it: Pupils to explain how temperature affects rate of reaction in 160 ch

Lesson Plan 10: The Factors Involved in the R
Reactions: Concentration

Learning Aims

All pupils should:	Identify the factors that can affect the rates of che factors that can affect the rates of chemical reacti
Most pupils should:	Explain how different factors affect the rate of in

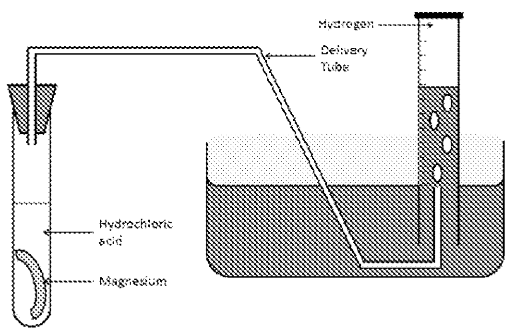
Key words: The effect of concentration on rates of reaction.

Starter

Recap method.

Main

Lesson dedicated to carrying out a class practical on the effect of conce



- 4 cm of magnesium ribbon can be reacted with 10 cm^3 of different con acid: 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 mol.
- Pupils should record the time it takes for 50 cm^3 of gas to be produced repeat the experiment three times. Pupils can then use their data to ca reaction for each concentration of hydrochloric acid using the followi

$$\text{Rate of reaction } (cm^3/s) = \frac{\text{amount of gas produc}}{\text{time } (s)}$$

- Pupils should then write up their methods and findings.
- Review findings and discuss explanations.

Plenary

On a Post-it, pupils should write three things about how concentratio they didn't know at the beginning of the lesson.

Lesson Plan 11: The Factors Involved in the R
Reactions: Surface Area

Learning Aims

All pupils should:	Identify the factors that can affect the rates of che factors that can affect the rates of chemical reacti
Most pupils should:	Explain how different factors affect the rate of in

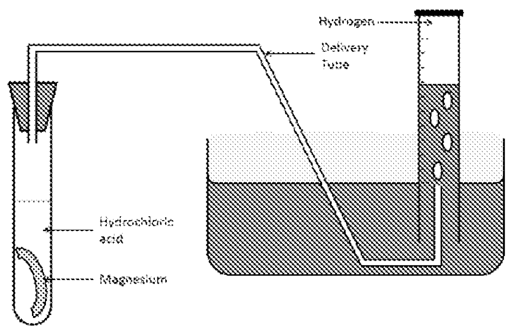
Key words: The effect of surface area on rates of

Starter

Recap method.

Main

Lesson dedicated to carrying out a class practical on the effect of surfa



- Pupils should measure a fixed mass (approx. 2 g) of calcium carbonat calcium carbonate powder. The chips and powder can then be reacted
- Pupils should record the time it takes for 50 cm^3 of gas to be produced repeat the experiment three times. Pupils can then use their data to ca reaction for each condition using the following equation:

$$Rate\ of\ reaction\ (cm^3/s) = \frac{amount\ of\ gas\ produc}{time\ (s)}$$

- Pupils should then write up their methods a d ngs.
- Review findings and discuss exp ns.

Plenary

Just a Min p must talk on subjects for one minute without pausin word, othe the words on the card. Other pupils can buzz in if they s awarded for every point spotted and for the person talking when the min awarded if they manage to talk for an entire minute.

Lesson Plan 12: The Factors Involved in the R
Reactions: Pressure and Catalys

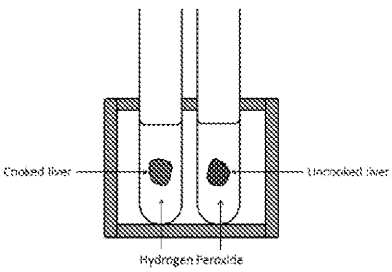
Learning Aims

All pupils should:	Identify the factors that can affect the rates of che factors that can affect the rates of chemical reacti
Most pupils should:	Explain how different factors affect the rate of in

Key words: The effect of pressure and catalysts on rates of reaction.

Starter
Explain the term 'particle theory'.

Main
1. Go through the answer to the starter.
2. Recap how pressure affects the rate of reaction with reference to c
3. Recap how catalysts affect the rate of reaction with reference to co
4. Class practical on the effect of catalysts on reaction rates.



- Pupils should measure a fixed mass of raw liver and an equal mass of samples to separate test tubes containing 10 cm^3 Hydrogen Peroxide.
- Pupils should observe what happens in each test tube to determine th enzymes present in raw liver) on the rate of reaction.
- Pupils should then write up their methods and findings.
- Review findings and discuss explanations.

Plenary
Anagram solver for rates of reaction:
A Cat Reef Is On Tor = Rate of reaction
Raccoon Intent = Concentration
Matter Pure = Temperature
A Saucer Fare = Surface area
Buy Diet Revel = Delivery tube
Last Price = Particles
Dredge Epoxy Rhino = Hydrogen Peroxide
Itchier Only Solo = Collision theory
Classy Tat = Catalysts
Seer Spur = Pressure

Lesson Plan 13: The Factors Involved in the R
Reactions: Industrial Processe

Learning Aims

All pupils should:	Identify the factors that can affect the rates of che Identify reactants and products including state s and whether reactions are reversible or irreversib Describe the factors that can affect the rates of ch number and types of atoms in balanced chemica
Most pupils should:	Explain how different factors affect the rate of in Explain the terms 'yield' and 'atom economy' in reactions
Some pupils should:	Analyse how different factors affect the rate and

Key words: equations, word equations, symbol equations, symbols of stat
process, questions.

Starter

Give some examples of symbol equations missing crucial pieces of inform
and balancing and ask pupils to complete them.
Example:

- $H_2 + O_2 \rightarrow H_2O$
- $CH_4 + O_2 \rightarrow CO_2 + H_2 0$
- $Na + H_2O \rightarrow NaOH + H_2$

Main

1. Elicit answers and ask pupils to draw their answers on the board.
2. Description of yield.
3. Explanation of why yield may not reach 100%.
4. Explanation of how to calculate yield.
5. Description of atom economy.
6. Explanation of how to calculate atom economy.
7. Description of the Haber process.
8. Explanation of the Haber process including reaction vessel condi
9. Answer Questions from the pack.
10. Go through answers with pupils.

Plenary

True or false: Pupils asked a series of true or false statements and must m
vote.

Industrial Processes

Yield

In industry making as much of a product as you can is of vital importance to your product you make the **yield**. In a perfect world the yield would be 100% but in ac reached. 90% yields are considered to be excellent.

There are a number of reasons 100% yields cannot be reached which include ina fact it's a reversible reaction, impurities in your reactants, impurities in your prod reactants.

To calculate the yield we use the equation:

$$\text{Percentage Yield} = \frac{\text{Amount of Product Produced}}{\text{Maximum Amount of Product Poss}}$$

So, for exan
In the reaction

$$2Mg_{(s)} + O_{2\,(g)} \rightarrow 2MgO_{(s)}$$

48 g of Mg was reacted with 32 g of O. The total maximum product is 60 g of Mg

Only 54 g of MgO was produced. So:

$$\text{Percentage Yield} = \frac{54}{60} \times 100 = 90\%$$

This would be considered an excellent yield in industry.

Atom Economy

We learnt earlier that the number of atoms in the products must equal the numb However, not all the products made in a chemical reaction are desirable, i.e. we undesired products 'by-products'.

In the reaction we looked at earlier:

$$2Mg_{(s)} + O_{2\,(g)} \rightarrow 2MgO_{(s)}$$

All of the reacting atoms ended up in the product we wanted. This reaction is sai

However, this is not always the case.

In the thermal decomposition (breaking down using heat) of calcium carbonate t oxide and carbon dioxide.

$$CaCO_{3\,(s)} \rightarrow CaO_{\,(s)} + CO_{2\,(g)}$$

Calcium ox e desirable product whilst the carbon dioxide is the by-produc gone to mak -product we do not have 100% atom economy.

To calculate atom economy we divide the molecular mass of the desired produc total products.

$$\text{Atom Economy} = \frac{\text{Molecular Mass of Desired Produ}}{\text{Molecular Mass of the Total Produ}}$$

To calculate the (relative) molecular mass we need to look up the (relative) ato and add them up.

If you look up the (relative) atomic masses for this equation you will see they are

$$Ca = 40, O = 16 \text{ and } C = 12$$

As the calcium oxide has one Ca and one O, we can calculate the mass as:

$$(40 \times 1) + (16 \times 1) = 56$$

The carbon dioxide has one C and two O. We can calculate the mass as:

$$(12 \times 1) + (16 \times 2) = 44$$

The total mass of the products is therefore:

$$56 + 44 = 100$$

Using the equation:

$$\text{Atom Economy} = \frac{\text{Molecular Mass of Desired Produ}}{\text{Molecular Mass of the Total Produ}}$$

$$\text{Atom Economy} = \frac{56}{100} \times 100 = 56\%$$

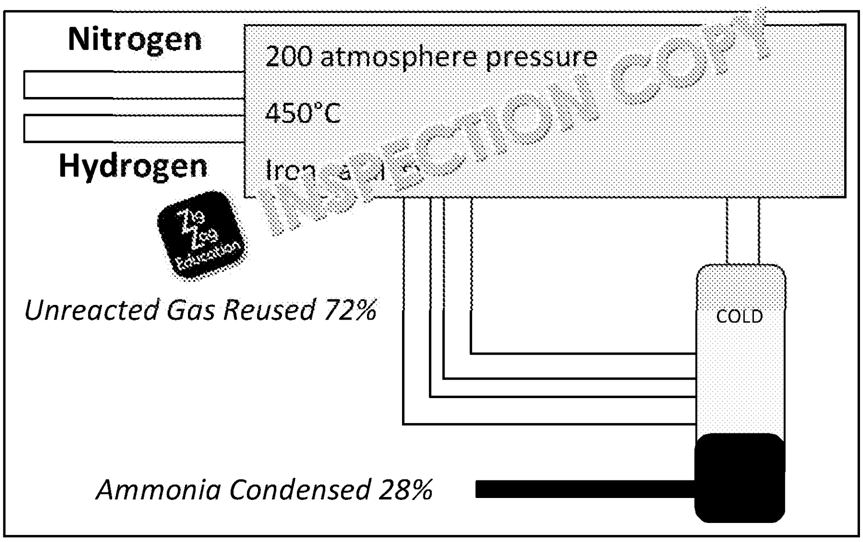
So the thermal decomposition of calcium carbonate has an atom economy of 56

Industrial Processes

An example of using particle theory to improve rates of reaction is in the manufa

$$N_{2\,(g)} + 3H_{2\,(g)} \rightleftharpoons 2NH_{3\,(g)}$$

This is called the Haber process. Nitrogen from the air and hydrogen from natura vessel at a pressure of 200 atmospheres (atm) and 450 °C with an iron catalyst, w of the reaction. Because it is a reversible reaction the yield is small, only about 2 into ammonia – about 72% of the reactants remain at the end of the reaction. In reduces the yield because the forward reaction is exothermic (gives out heat). Th forward reaction because this produces fewer molecules than the backwards rea and reactants (nitrogen and hydrogen) are removed and cooled. This turns the a unreacted hydrogen and nitrogen is reused; this reduces waste and increases pro



The Haber process

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Industrial Processes Questions

1. For a chosen industrial process, describe the methods used to affect th how these methods increase the reaction rate. You should also make r affected.
2. Why do you think they use high temperatures in the Haber process ev yield?
3. In the Haber process increased pressure increases the rate of reaction 200 atm in the Haber process instead of 500 atm?
4. In the reaction:

   $$LiCl_{(s)} + Na_{(s)} \rightarrow NaCl_{(s)} + Li_{(s)}$$

   The $Li_{(s)}$ is the desired product. State what the term 'atom economy' m reaction.

   A researcher carried out the reaction. She calculated that the reaction s however only 15 g were produced. State what the term 'yield' means reaction.

Industrial Processes Questions

1. For a chosen industrial process, describe the methods used to affect th how these methods increase the reaction rate. You should also make r affected.

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2. Why do you think they use high temperatures in the Haber process ev yield?

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3. In the Haber process increased pressure increases the rate of reaction. 200 atm in the Haber process instead of 500 atm?

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The $Li_{(s)}$ is the desired product. State what the term 'atom economy' m reaction.

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A researcher carri... the reaction. She calculated that the reaction s howe... ly ... g were produced. State what the term 'yield' means reactio...

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Assignment C: The Factors Involved in the Rate of Che

Pupil's Name:		
Start Date:	Deadline:	Dat

Investigating the Factors Involved in the Rate of Ch

Scenario

You are a senior lab technician placed in charge of an intern project at a large company. You have been asked to induct your new intern on factors affecting To assist them you produce a help sheet in which you ... the following.

Task

1. State ... ors that can affect the rates of chemical reactions *Ma... o, anything that will change the speed of a chemical reactio*
2. Describe the effect of altering the five factors on the rates of chemical *For each of the factors you listed give an account of how those factors c*
3. Explain how changing some of the different factors affects the rate of t *For each of the factors you described you should give a reason why it ch*
4. Write three chemical equations which you have looked at (including t which you identify reactants and products, include state symbols and reversible or irreversible. *(For example, if you were studying the formation of water from hydroge would be:* $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$*)*
5. Identify the atoms in your balanced chemical equations including the
6. Explain the terms 'yield' and 'atom economy' in relation to the manufa
7. Analyse how different factors and operating conditions, e.g. temperat presence of a catalyst and concentration affect the rate and yield of an *Say how the factors you described are used to improve the process of an*

Learner's name:	Start Date:

Learner's declaration:
I certify that the work submitted for this assignment is my own. I have clearly refe
work. I understand that false declaration is a form of malpractice.

Learner's Signature: Date

Learner's comments for the assessor:

Teacher's/assessor's name:

Task:	Crit	Learner must:
		Marking Criteria
1	2C.	Describe the factors that can affect the rates of chemical reactio
	2C.P7	Identify the number and types of atoms in balanced chemical equations.
	2C.M5	Explain how different factors affect the rate of industrial reactio
	2C.M6	Explain the terms 'yield' and 'atom economy' in relation to spec chemical reactions.
	2C.D4	Analyse how different factors affect the rate and yield of an industrial reaction.

Deadline:

Summative feedback:

Date assessed:

Internal verifier's name:

Internal verifier's feedback:

Date

If a learner has not met the Level ... they can be assessed on the Level	
1C.6	Identify the fact... affect the rates of chemical reactions.
1C.7	Ide... products including state symbols in chemical equa re... are reversible or irreversible.

Lesson Plan 14: The Factors that Are Affecting Environment: Natural Activity Fa

Learning Aims

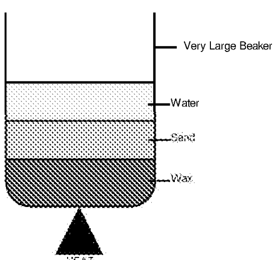
All pupils should:	Identify natural factors that have changed the su Earth. Describe natural factors that have changed the su Earth.

Key words: Structure of the Earth, tectonic plates, c ntal drift, plate b volcanoes, evolution of the atmosphere an c questions.

Starter
Describe t ke the Earth's structure.

Main

1. A reminder of the structure of the Earth, including crust, mant
2. Description of tectonic plates.
3. Explanation of continental drift and convection zones.
4. Description of types of plate boundary.
5. Ask pupils to work in groups to determine the possible effects of eart
6. Discussion of case studies of a volcano eruption and earthqua
7. Explanation of the evolution of the atmosphere and oceans.
8. Demonstration of wax magma simulation. Melt red wax into t and cover it with sand and water. When heated, the wax will sand, mimicking magma.



9. Answer Questions the pack.
10. Go thro a with class.

Plenary
Fastest finger first: pupils to work in small groups. Ask pupils a series of q answers each question first gets to leave first.

Natural Activity Factors

In this section we are going to look at factors that affect the Earth and our enviro
factors such as the movement of tectonic plates and the resulting earthquakes a
activities such as oil consumption.

The Earth

The Earth has four main layers:

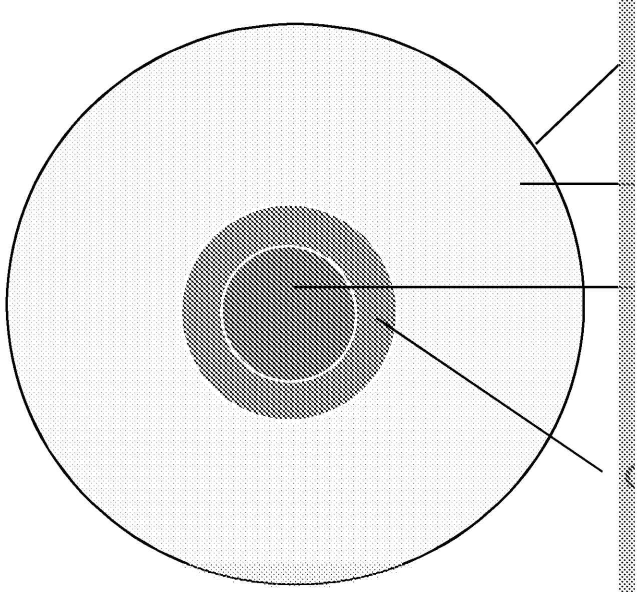
The crust
- Solid rock about 20 km thick

The mantle
- Molten rock about half the Earth's [illegible]r

Outer core
- Molten iron and [illegible]

Inner core
- Solid iro[illegible] nickel

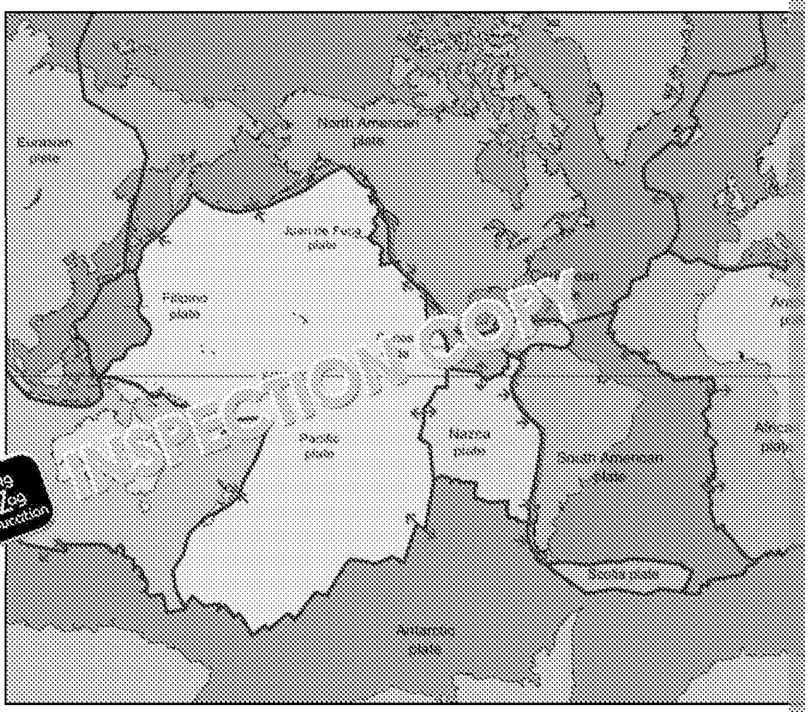
(The crust and upper part of the mantle are called the lithosphere.)



Earth's layers

Did you know?
The Earth's diameter is [illegible], that means that if you were to drill a hole stra
jump dow[illegible] you about 45 minutes to reach the centre. This is unlik
deepest a[illegible] as ever drilled is around 3km. In fact, most mines only go to a
means if you imagine the Earth to be the size of an apple we would not even ha
skin.

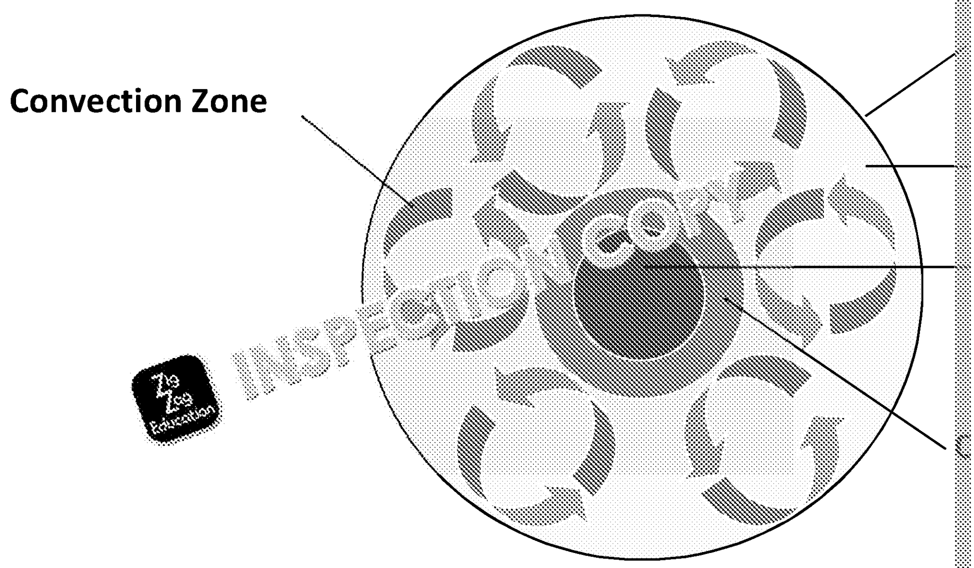
The crust is a very thin layer of solidified rock that covers the outside of the Eart
like the shell of a broken egg. The areas between the cracks are called **tectonic p**
tectonic plates leads to a series of phenomena. These include volcanoes, earthq



Earth's Tectonic Plates

So, what causes these massive plates of rock to move?

The answer is in something called **convection zones** or **convection currents**. The
flow (molten rock in the mantle). The magma is heated by the breakdown of nuc
The magma rises up to the crust, where it flows under the solidified layer, and ca
plates to move because of the friction between the magma and the underside of
your hand along the underside of your school desk; the friction will cause your d
movement is only slight. The plates move at an average speed of about 1 cm per



Volcanoes and earthquakes normally occur at plate boundaries (the area betwee
three main types, which are based on what happens to the land:

Constructive

- These are mainly under oceans. Plates move apart and more igneous rock fo
  such as the mid-oceanic ridge. This is an area where volcanoes can form.

Destructive

- Plates move together so that one is pushed under the other (**subducted**); th
  mountain chains, earthquakes, and volcanoes.

Conservative

- Plates slide past each other (San Andreas Fault) so that no land is created or
  each other, and then move suddenly; this creates earthquakes.

Continental Drift – The Theory

In the seventeenth century Francis Bacon noted that the coast of South America w
like a jigsaw [illegible]. Fossil records on both sides suggested that at one point both
addition the [illegible] on both sides were the same. In 1915 Alfred Wegener put forw
He suggested that there had once been a massive supercontinent called **Pangaea**
different sections and the land masses moved all over the world, a process they s

Volcano Effects

Volcanoes are the ejection of molten rock from the mantle through gaps in the c

Mount St Helens is one such volcano found on the West Coast of the USA in Washington state. On 18th May 1980 Mount St Helens, that had been silent for decades, started to stir. A noticeable rise in the landscape was visible. Luckily the mountain was closed and many people evacuated, probably saving thousands of lives. When the volcano did explode it was immense. First came the biggest land in recorded history, one entire side of the mountain was lost. Then came the explosion. The blast of ash and lava was thrown up to 80,000 feet into the air (pl travel at about 33,000 feet). Mudslides, caused by the displaced land and the me glacier that was on the mountain, travelled 50 miles. The pyroclastic flow was thought to reach a speed of 1050 kph. Fifty-seven people and tens of thousands large animals were killed. Around 200 houses and hundreds of square miles of la were laid to waste and crops for miles around were wiped out. Countless tonnes carbon dioxide gas were released into the atmosphere. The cost of the explosion $1 billion dollars (approximately $3 billion in today's money). The force of the bla ranges in estimates from 500–1000 Hiroshima-sized atomic bombs.

Earthquake Effects

Earthquakes are rapid movements of the tectonic plates in the Earth's crust.

On 11th March 2011 a magnitude 9 earthquake struck 400 km of the coast of Toky Tohoku earthquake was measured as one of the five biggest earthquakes in reco history. The quake caused a tsunami 133 feet high, wiping out over 100,000 build and causing a nuclear disaster at the Fukushima nuclear power station. Estimate but around 16,000 people were killed, thousands of people were missing and aro 5,000 people were injured in the earthquake and resulting tsunami. The financia still to be calculated but estimates are in the tens of billions of US dollars in struc damage and hundreds of billions of US dollars in economic costs, making this the expensive natural disaster of recorded time.

Evolution of the Atmosphere and Oceans

Today the Earth's atmosphere is 78% nitrogen, 21% oxygen and 1% carbon dioxide and other gases such as argon. It has not always been that way.

When the Earth was formed approximately 4.5 billion years ago it was a molten ball of rock and metal. It was far too hot for an atmosphere as it would be would be blown off by the heat.

The Earth cooled and allowed the formation of an atmosphere. The Earth's original atmosphere was formed by volcanic activity; volcanoes erupted with far more regularity than today and some lasted for thousands or millions of years. This early atmosphere consisted of mainly carbon dioxide, nitrogen, ammonia, methane and water vapour. This water vapour eventually condensed as the Earth cooled to form the seas and oceans.

This state remained until life [illegible] about a billion years later. These early org carbon dioxide [illegible] the atmosphere and produce oxygen. Over the many years tha began to rise [illegible]er. The carbon dioxide levels continued to drop. As the oceans into the water this carbon dioxide would later be made into carbonate rocks. A g lost to the atmosphere in the formation of oil. Animals and plants would take the environment and lock it into their shells and cells. When they got trapped under eventually cause the creation of oil; this carbon was lost from the carbon cycle.

The oxygen also had another effect. It reacted with the methane and the ammon atmosphere.

$$4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$$
$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

This continued until around 200 million years ago when our current atmosphere

Natural Activity Factors Questions

1. Identify two natural factors that affect the Earth or the atmosphere.
2. For both of the natural factors you listed describe how they occur a Earth and the atmosphere.
3. Describe how natural factors have, over billions of years, changed the the surface of the Earth's crust.

Natural Activity Factors Questions

1. Identify two natural factors that affect the Earth or the atmosphere.

   1 .... 2 ....

2. For both of the natural factors you listed describe how they occur a[nd ...]
   Earth and the atmosphere.

   1 ....

   ....

   ....

   2 ....

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3. Describe how natural factors have, over billions of years, changed the [...]
   the surface of the Earth's crust.

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Lesson Plan 15: The Factors that Are Affecting Environment: Human Activity Factors and Susta Issues

Learning Aims

All pupils should:	Identify natural factors that have changed the surfa Earth. Identify the human activities that affect the Earth a Describe natural factors that have changed the surf Earth. Describe the human activities that affect the Earth a
Most pupils should:	Discuss the extent to which human activity has cha compared with natural activity.
Some pupils should:	Evaluate possible solutions to changes in the enviro or human activity.

Key words: Human activity, greenhouse effect, causes of greenhouse effec questions.

Starter

Ask the class to list as many ways as possible that humans are extracting r atmosphere.

Main

For all points use locally relevant examples were possible.

1. Elicit answers from the class discussing each point in turn.
   Topics to be covered include but are not limited to:
   - Land pollution, e.g. mining
   - Sea salt extraction
   - Fractional distillat
   - Fossil fuels
2. Discussion of how these methods are damaging the environment
3. Discussion of how else we damage the environment.
4. Explanation of greenhouse effect and causes, for example:
   - Travel
   - Industry
   - Chemical processi
   - Waste material
5. Ask the class to work in small groups to discuss methods to overcom development).
6. Elicit answers and discuss in turn. Topics to be covered include b
   - Solar
   - Wind
   - Geothermal
   - Hydroelectric
   - Tidal
7. Discussion of the problems associated with these solutions.
8. Answer Questions 1–4 from the pack.
9. Go through answers.

Plenary

Human or nature debate: Pupils to debate which has the most effect on th

Human Activity Factors

Land

Humans have had a massive impact on the Earth and its atmosphere. These effects can be measured locally and globally. For thousands of years humans have mined the Earth's crust for precious metal to use. For most of that time the effects were localised damage to the environment. As the population grew and methods for metal ore extraction became more sophisticated that damage increased. More recently we have become dependent upon other materials extracted from the crust including oil, coal and natural gas, which are collectively called fossil fuels.


A salt evaporation pond

We can also extract needed chemicals from
ancient method whereby shallow pools are
connected to the sea by channels which can
the channels are then closed and the water
warming of the Sun. This leaves behind the
of around four gallons of sea water results i

Air

Materials are also extracted from the air. We looked previously at the Haber process of ammonia manufacture. This method requires nitrogen from the air. The method of extraction is called fractional distillation. The air is cooled to a liquid and gently heated. Each gas has its own boiling point so will evaporated at different times. These gases can then be collected and used as needed. Gases such as nitrogen and oxygen can be collected in this way.

Energy

Arguably the biggest human impact on the
desire for energy sources. Not only can ext
but also the use of the energy.

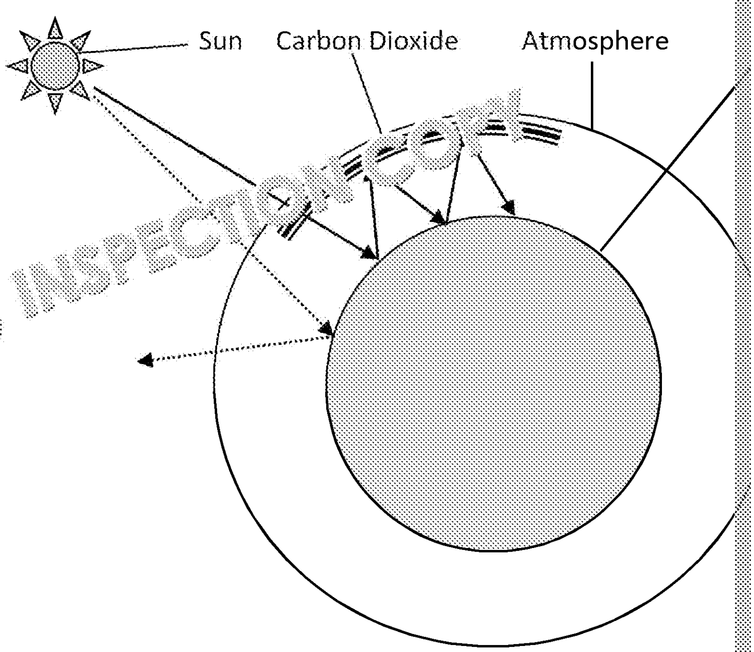
We rely greatly on fossil fuels to get our en
or diesel in your car or the coal that runs t
electricity you use to switch your TV. Wher
dioxide is released into the atmosphere. Y
carbon dioxide was locked into the fossil fu

Many scientists and politicians believe tha
responsible for global warming via the gre

The Greenhouse Effect

Normally the Sun's rays travel through the atmosphere and reflect off the Earth's the rays travel through the air and back out again they warm the atmosphere.

However, if carbon dioxide forms in the atmosphere something else happens. Th by the greenhouse gases and travels through the atmosphere but on their return dioxide and reflected back to Earth. Each time the rays travel through the air the This is thought to lead to global warming.



The Greenhouse Effect

The predicted effects of Global warming are well known; they include melting ice change in weather, increased desert formation and unstable weather patterns.

Travel

Planes and car transport are blamed for a great deal of the carbon dioxide in our The average car will make about 1.5 tonnes of carbon dioxide annually.

Industry

Our environment is also badly damaged by industrial methods. Burning fuels to m products not only releases carbon dioxide, which has a global effect of helping to global warming, but also produces smoke, which has a more local effect. Smoke is made of particles of burned material. These can block the Sun causing global dimming, but also cause local problems such as smog (SMoke fOG) and damage to lungs.

Chemical Processing and Waste Material

The manufacture of chemicals and products also has damaging effects. On top of the added demand for fuel, which is required to process materials, there is the added problem of waste material disposal. Normally waste material needs to be burned or added to landfill to be disposed of. This includes not only the waste material from factories but also from homes. About 145 million tonnes of personal solid waste is produced every year in the UK. On top of this a great deal of waste is also produced in mining, agriculture and sewage treatment, totalling around 400 million tonnes.

Sustainable Development Issu

Human Choices

Sustainable development means continuing to advance but in a way that can be
period without or with very limited damage. There are a number of ways we our
caused as well as the larger country and worldwide solutions.

Personally you can cut your waste and carbon footprint by minimising the produ
overpackaged food. This reduces the energy need to make it as well as eliminati
reduce the amount of energy you use, such as electricity. Products can also be re
plastic bags after one use they can be used time and again. Recycling is another
waste can go to other uses. Food scraps and waste can be collected and used as
be recycled back into paper products. Plastic bottles can be recycled into garden fur
also make environmental choices in the way that you travel, whether you ride yo
the car.

We also have choices about how we generate our energy. We rely on fossil fuel
we use domestically and in industry by generating energy in other ways. Nuclear
electricity via nuclear fission. This form of energy production is free from carbon
not cause global warming. Some people are concerned that the radioactive wast
not stored correctly and that power stations could be the target of a terrorist att

D

Human Solutions

Renewable Energy

There are many ways of generating electricity renewably (from natural sources t
won't run out). These include:

- Solar (sun)
- Wind power
- Geothermal (heat from the Earth's crust)
- Hydroelectric (from moving water, e.g. through dams)
- Tidal

Many people see problems with these methods too. Hydroelectric generally req
farms are noisy and unsightly. Tidal can damage coastal areas.

Biofuels

People are also trying to develop alternative fuels such as biodiesel and ethanol.
plants, the idea being that the carbon dioxide produced when you burn the fuel
plants and the carbon dioxide it removes from the atmosphere in photosynthesi

Nuclear Fusion

Nuclear fusion is the way energy is released inside stars. The extreme heat and p
atoms of their electrons thus turning them into PLASMA. These nuclei (atoms wi
bombarded together with such force that they actually stick together to form lar
vast amounts of energy. The reactant in this process is hydrogen and the produc
is no radioactive by-product and no carbon emissions, making this a completely
addition, there is no chance of a catastrophic meltdown as the process requires
malfunction in the reactor would stop the reaction very quickly.

The problem is that as yet we are unable to harness this energy very well. Resea
number of decades but with limited success. In the reactor the plasma is heated
passing an electric current through it. It must be at very high temperatures beca
force between the two positively charged nuclei will not be overcome. Also a ma
prevent the plasma from touching the reaction vessel and cooling down. This ha
future though as it could easily supply as much energy as we need from nothing
of sea water.

Human Activity Factors and Sustainable Development Is

1. Identify four human activities that have environmental consequences
2. For three of the human activities you identified describe the negative environment.
3. For two of the human activities you identified describe how choices m negative effects and worsen them.
4. Choose three environmentally damaging activities, these can either be and explain how their damaging effects could be reduced or minimise solutions you give highlighting any possible downsides as well as the cost to the environment, monetary cost to the consumer, cost of replac benefits of solutions. You should also consider natural solutions inclu building near fault lines etc.

Human Activity Factors and Sustainable Developme

1. Identify four human activities that have environmental consequences

   1 .... 2 ....

   3 .... 4 ....

2. For three of the human activities you identified describe the negative environment.

   1 ....

   ....

   2 ....

   ....

   3 ....

   ....

3. For two of the human activities you identified describe how choices m negative effects and worsen them.

   1 ....

   ....

   2 ....

   ....

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   1 ....

   ....

   ....

   ....

   2 ....

   ....

   ....

   ....

   3 ....

   ....

   ....

   ....

Pupil's Name:		
Start Date:	Deadline:	Dat

Understand the Factors Affecting the Earth and i

Scenario
You are a local meteorologist. You have been asked to give a talk at a local co about how humans affect the Earth and the atmosphere.

Task
This task consists of two parts. First, give a talk about how humans affect the produce a l to explain how natural activities have affected the Earth and

For the talk:

1. A section on at least two human activities that affect the Earth and its env
List any human actions which have a negative impact on the Earth and its

2. A description of how these human activities affect the Earth and its envir
For each of the human actions you listed explain how these activities have h

3. An explanation of the possible solutions to changes in the environment o human activities including individual, company and government actions effectiveness of the solutions.
For each of the ways humans have a negative impact you should suggest w that impact and say how effective that method is at combating our negativ

For the leaflet:
At the meeting you are asked to explain how natural activities have affected t help you, you produce a leaflet called 'The Changing Earth'. In it you:

1. Identify three natural factors that have changed the surface of the Earth a
You should include a description of natural activity which has altered the E

2. Describe how these natural factors have changed the Earth and have affe atmosphere.
You should include a description of human activity which has altered the E

3. Compare how much human activity and natural activity have changed th surface. You should consider the effects of events that take place over mi differences between human and natural activity and the choices humans
Here you should compare the damage caused by human actions to the change

Learner's name:	Start Date:

Learner's declaration:
I certify that the work submitted for this assignment is my own. I have clearly refe
work. I understand that false declaration is a form of malpractice.

Learner's Signature: Date:

Learner's comments for the assessor:

Teacher's/assessor's name:

Marking Criteria		
Task:	**Crit[illegible]**	**[illegible]earner must:**
1	**2D.P8**	Describe the human activities that affect the Earth and its environment.
	2D.D5	Evaluate possible solutions to changes in the environment, occurring from natural or human activity.
	2D.P9	Describe natural factors that have changed the surface and atmosphere of the Earth.
	2D.M7	Discuss the extent to which human activity has changed the environment, in comparison to natural activity.

Deadline:

Summative feedback:

Date assessed:

Internal verifier's name:

Internal verifier's feedback:

Date:

If a learner has not met th[illegible] 2 c[illegible]teria, they can be assessed on the Level	
1D.8	Identif[illegible]he [illegible]tivities that affect the Earth and its environment.
1D.9	Ide[illegible]tural factors that have changed the surface and atmosphere of

Answers to Questions

Lesson Plan 1: Group 1 Questions

1. All group 1 metals are shiny, cut easily, have a low density, conduct elec and boiling points. Melting points decrease as you go down the group. B down the group. They become easier to cut as you go down the group.
2. All group 1 metals are reactive with oxygen to form a metal oxide; they d down the group. All group 1 metals are reactive with water to form a me they do so more readily as you go down the group.
3. Caesium = any value less than rubidium. Francium = any value lower tha
4. a. Lithium + Water → Lithium Hydroxide + Hydrogen
   b. Sodium + Water → Sodium Hydroxide + Hydrogen
   c. Potassium + Water → Potassium Hydroxide + Hydrogen
5. Floats, fizzes, produces hydrogen, sparks, flames, ignites, explodes, p
6. When a group 1 metal reacts it does so by losing its outer electron to mak electron. The outer electron on a lithium atom is much closer to the nucl potassium atom. This means that the force between the nucleus and the o electrons in place, is weaker for the potassium's outer electron and so it i reactions are easier for potassium than lithium. Students should also hav diagram of two or more electronic arrangements.
7. Electronic configuration is also responsible for the decreasing melting an the group. As you can see in the diagram as you go down the group an a time. This means that the atom gets bigger. The larger an atom is, the we and its neighbouring atom and if the forces are weak then they are more Students should also have produced an illustrative diagram of two or mo

Lesson Plan 2: Group 7 Questions

1. All halogens are non-metals, colourful, non-conductive, have low meltin gas, liquid and solid. Melting point increases as you go down the group. go down the group.
2.

Group 1	Group 7
Metal	Non-metal
Conduct electricity	Do not conduct electricity
Low melting point	Low melting point
Low boiling point	Low boiling point

3. As you go down the group the halogens become less reactive.
4. Values must be below those of iodine.
5. a. Sodium Bromide + Fluorine → Sodium Fluoride + Bromine
   b. Sodium Bromide + Chlorine → Sodium Chloride + Bromine
   c. Sodium Bromide + Bromine → No Reaction
   d. Sodium Bromide + Iodine → No Reaction
   e. Lithium Iodide + Chlorine → Lithium Chloride + Iodine
6. When a halogen reacts it gains one electron from a different atom to mak electrons. As you go down the group the atoms get larger. With the grou is to the nucleus, the stronger the forces of attraction between the negativ the positively charged nucleus. But in this case the atom is gaining an ext electron shell is closer to the nucleus the force of attraction is greater and extra electron and reacts more readily. So, the smaller the halogen the mo also have produced an illustrative diagram of at least two electronic arra

Lesson Plan 5: Bonding Questions

1.

Substance	Melting point	Boiling point	Electrical conduct
Simple covalent	Low	Low	No
Giant covalent	High	High	No
Giant ionic	High	High	If molten or disso

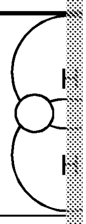
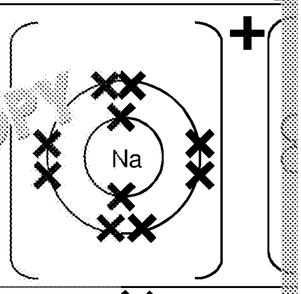
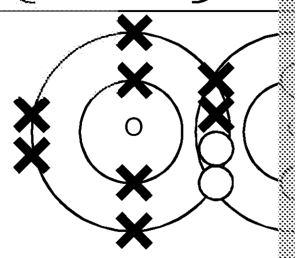
2.

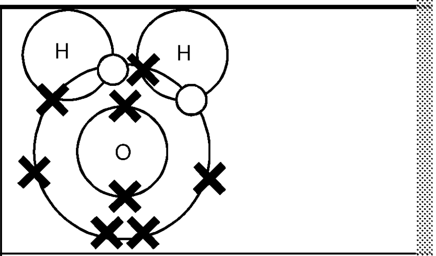
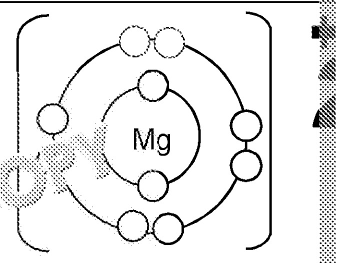
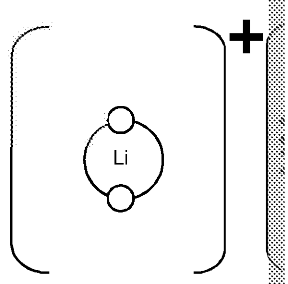
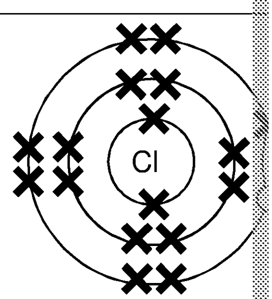
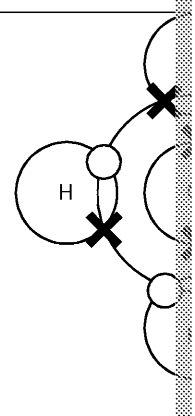
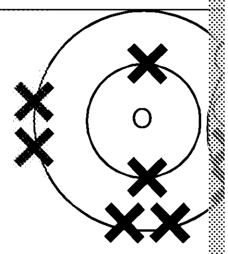
Substance	Melting point	Boiling point	c
Simple covalent	The fact that the molecules have no overall charge also means that each molecule is only very weakly attracted to other molecules; we call this force of attraction intermolecular forces. These weak intermolecular forces mean that each molecule will easily separate itself from other molecules. This results in very low melting points.	The fact that the molecules have no overall charge also means that each molecule is only very weakly attracted to other molecules; we call this force of attraction intermolecular forces. These weak intermolecular forces mean that each molecule will easily separate itself from other molecules. This results in very low boiling points.	Thes have char that to co elect
Giant covalent	A complex network of atoms all held together by very strong covalent bonds. This has an effect on the properties resulting in very high melting points.	A complex network of atoms all held together by very strong covalent bonds. This has an effect on the properties resulting in very high boiling points.	Varie In gr of bo each spare This to me (delo mear free e grap few m can a elect In di other overa mear unab elect

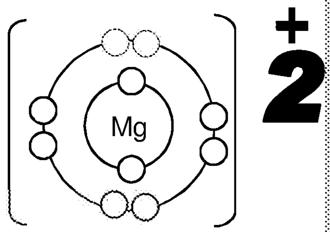
Giant ionic	Individual ions are held together by very strong **electrostatic** forces. This means that the energy needed to separate the ions is very high. This, in turn, results in ionic compounds having very high melting points.	Individual ions are held together by very strong **electrostatic** forces. This means that the energy needed to separate the ions is very high. This, in turn, results in ionic compounds having very high boiling points.	Even the s an io has a final no fr ions that t comp cond How comp or di beco from This mea disso ionic can c elect

3. a. Covalent, e.g. hydrogen, oxygen, etc.
   b. Giant covalent, e.g. diamond, silicon dioxide, etc.
   c. Ionic or giant ionic, e.g. sodium chloride, etc.
   d. Covalent, e.g. water.
   e. Giant covalent, e.g. graphite.
   f. Covalent, e.g. oxygen, water, etc.

4.

a. Hydrogen H_2		
b. Sodium chloride NaCl		
c. [illegible]n dioxide CO_2		

d. Water **H_2O**	
e. Magnesium oxide **MgO**	
f. Lithium chloride **LiCl**	
g. Chlorine **Cl_2**	
h. Methane **CH_4**	
i. Oxygen **O_2**	

j. Magnesium chloride $MgCl_2$	

5. Ionic. ample. Must clearly show the starting atoms and the final n of the e on movement. Covalent. Any example. Must clearly show th molecule with a clear explanation of the electron rearrangement.
6. In diamond a complex network of carbon atoms are all held together by has an effect on the properties resulting in diamond being a very hard su cut through most other things.
7. Graphite can be used in pencils because each layer is only weakly held o dragged over a surface it leaves layers of itself behind. Graphite can be u layer is only weakly held on to the next so if placed on a surface friction
8. Sodium chloride would make a good basic electrolyte because, as it is an dissolve in water releasing a free charge and allowing the flow of electric

Lesson Plan 6: Physical Properties Questions

1. Physical
2. Chemical
3. Chemical
4. Any sensible answer, e.g. malleable so easily shaped, e.g. rings, shiny an frames, excellent conductor, e.g. silver wire.
5. Any sensible answer, e.g. helium is a low density gas which is good for p
6. Any sensible answer, e.g. malleable so is easily drawn into wire, good el resistance in wires, etc.
7. Any sensible answer, e.g. has poor thermal cor y so will insulate flame, etc.
8. Any sensible answer, e.g. lo it reduces the amount of fuel need forces within the en
9. Aceto s hat will readily dissolve the substances found withi
10. Any se answer, e.g. oil is viscous therefore will adhere to engine pa

Lesson Plan 7: Chemical Properties Questions

1. Sodium azide (NaN_3) is a colourless crystalline salt compound containing electrical signal can be used as a controlled detonator to cause the sodium into two different substances: sodium and nitrogen gas. The nitrogen gas airbag. It does this because nitrogen takes up far more space in its gas for solid.
2. Silicon is a good material to use because its crystalline structure allows it such as impurities. This is called doping. By changing the amount and ty change the electrical conductivity of it and can reach the desired level. In doping can turn the silicon into silicon dioxide which is a good insulator.
3. For a fire to continue it needs oxygen, heat and fuel. If you remove any o Carbon dioxide fire extinguishers work by removing the oxygen source b carbon dioxide gas. The gas coming out is also very cold and so cools the gas is used is that it is a cheap, unreactive gas, so, when it is placed on t occur. Hydrogen would not be used as it would promptly react with the ox
4. Yes, a noble gas can be used; this means that it has a full outer shell of already full outer shell means that it will not react with other chem protective gas, surrounding the working area and preventing any unwar
5. Any sensible answer, e.g. cotton, hay, straw. Must mention thermal prop trapped within which is a poor conductor. Should mention fire hazard an retardant.
6. i. solid
   ii. gas
   iii. liquid
   iv. solid
7. Dilithium. ii. and iii. are gas and liquid at room temperature and i would
8. i. dilithium
   ii. tritanium
   iii. ranyardium
9. Any sensible answer. There must be a clear link between property and us

Lesson Plan 8: Equations and Rates of Reaction Questions

1. Temperature, pressure, concentration, surface area, catalyst.
2. Increasing temperature / pressure / concentration / surface area will incre
   Addition of a catalyst increases the rate of reaction.
3. Temperature of the reactants: Increasing the temperature will increase th
   particles have. Because they have more energy they will move faster; if th
   are more likely to collide with enough force.

   Concentration of the reactants: If we increase the concentration of particle
   increase the chances of a collision between those particles.

   Surface area: Only the atoms on the surface of the reactant particles can c
   we increase the surface area we increase the number of particles available
   the chances of a collision and increase the rate of reaction.

   Pressure: If your reactants are gases you can increase the rate of reaction b
   increase the pressure you force the particles into a much smaller space. If
   then you increase the chances of a collision and therefore increase the rat

   Catalysts reduce the activation energy needed to cause a reaction. Reactio
   conditions that they would not have done so previously, such as colder te
   catalysts are used as well as some of the other methods. Catalysts are ofte
   reactions require different catalysts. The good thing is that although catal
   not take part in the reaction. This means that they remain chemically unch
   reaction; therefore they can be reused time and again.
4. a. i. Reactants = lithium chloride, sodium. Products = sodium chlori
      ii. Irreversible.
      iii. Li=1, Cl=1, Na=1 for both products and reactants.
      iv. $LiCl_{(solid)} + Na_{(solid)} \rightarrow NaCl_{(solid)} + Li_{(solid)}$
   b. i. Reactants = propane, oxygen. Products = carbon dioxide and wa
      ii. Irreversible.
      iii. C=3, H=8, O=10 for both products and reactants.
      iv. $C_3H_{8(gas)} + 5O_{2(gas)} \rightarrow 3CO_{2(gas)} + 4H_2O_{(liquid)}$
   c. i. Reactants = hydrochloric acid, iron oxide. Products = iron chlori
      ii. Irreversible.
      iii. H=6, Cl=6, Fe=2, O=3 for both products and reactants.
      iv. $6HCl_{(aqueous)} + Fe_2O_{3(solid)} \rightarrow 2FeCl_{3(aqueous)} + 3H_2O_{(liquid)}$
   d. i. Reactants = iodine monochloride, chlorine. Products = iodine tri
      ii. Reversible.
      iii. I=1, Cl=3 for both products and reactants.
      iv. $ICl_{(liquid)} + Cl_{2(gas)} \rightleftharpoons ICl_{3(solid)}$

Lesson Plan 13: Industrial Processes Questions

1. Any sensible answer, e.g. Haber.

   An example of using particle theory to improve rates of reaction is in the

   $$N_{2\,(g)} + 3H_{2\,(g)} \rightleftharpoons 2NH_{3\,(g)}$$

   The manufacture of ammonia is called the Haber process.

   Nitrogen from the air and hydrogen from natural gas are placed in a reac atmospheres (atm) and 450 °C with an iron catalyst.

   Because it is a reversible reaction the yield is small, only about 28% of the ammonia, about 72% of the reactants remain at the end of the reaction. In reduces the yield because the forward reaction is exothermic (gives out h and reactants (nitrogen and hydrogen) are removed and cooled. This turn and the unreacted hydrogen and nitrogen are reused; this reduces waste a

2. If cold temperatures were used the reaction would be very slow. Yield is gases are reused.

3. 500 atm would be expensive and more dangerous.

4.

$$\text{Atom Economy} = \frac{\text{Molecular Mass of Desired Prod}}{\text{Molecular Mass of the Total Prod}}$$

$$\frac{7}{65.5} \times 100 = 10.69\%$$

$$\text{Percentage Yield} = \frac{\text{Amount of Product Produ}}{\text{Maximum Amount of Product}}$$

$$\frac{15}{24} \times 100 = 62.5\%$$

Lesson Plan 14: Natural Activity Factors Questions

1. Any two from: continental drift, volcanoes, earthquakes.
2. Volcanoes are the ejection of molten rock from the mantle through gaps i occur at plate boundaries and are an example of constructive land forma physical damage as well as release large amounts of carbon dioxide into
   Earthquakes are rapid movements of the tectonic plates in the Earth's cru boundaries. These can cause large-scale physical damage as well as large
   Continental drift is the movement of large land masses by convection zo moving and can cause mountain formation, volcanoes and earthquakes.
3. Today the Earth's atmosphere is 78% nitrogen, 21% oxygen and 1% carbo as argon. It has not always been that way. When the Earth was formed a ago it was a molten ball of rock and metal. It was too hot for an atmos blown off by the heat.
   The Earth cooled and allowed the formation of an atmosphere. The Earth formed by volcanic activity; volcanoes erupted with far more regularity t thous n ions of years. This early atmosphere consisted of mainl ammo thane and water vapour. This water vapour eventually con form the seas and oceans.
   This state remained until life appeared about a billion years later. These take in the carbon dioxide in the atmosphere and produce oxygen. Over the levels of oxygen began to rise further. The carbon dioxide levels conti grew carbon dioxide dissolved into the water; this carbon dioxide would rocks. A great deal of carbon dioxide was lost to the atmosphere in the fo plants would take the carbon dioxide from the environment and lock it i they got trapped under the mudslides that would eventually cause the c lost from the carbon cycle.
   The oxygen also had another effect. It reacted with the methane and the a the atmosphere.

   $$4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$$

   $$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

   This continued until around 200 million years ago when our current atm reached.

Lesson Plan 15: Human Activity Factors and Sustainable Development I

1. Any sensible answers, e.g. fossil fuel extraction, burning fuels, mining, in
2. Any sensible answers, e.g. mining damages the local area / increased tra
3. Any sensible answers, e.g. people can reduce the damage they do to the e amount of energy they consume. This can be done by simple things such phone chargers, using other forms of transport, etc.
4. Any sensible answer, e.g. fossil fuel use. Pupils must describe at least one problem and give a description of an evaluation which highlights the nega soluti

The Periodic Table of Elem

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

1	2									
							1 **H** hydrogen 1			
7 **Li** lithium 3	9 **Be** beryllium 4									
23 **Na** sodium 11	24 **Mg** magnesium 12									
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111

***** The lanthanoids (atomic numbers 58–71) and the actinoids (atomic numbers 90–103) have bee***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole n