SCIENCE | BTEC LEVEL 2 | EDEXCEL

Teaching Pack

For BTEC First Award in Applied Science

Unit 5: Applications of Chemical Substances

2nd Edition, 2nd March 2015

POD 4718

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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 eight teacher-taught hours, seven assignment lessons and fifteen spare lessons for additional assignment time to obtain missed assessment criteria and also catch-up time for students who have missed lessons or need extra support. For differentiation purposes, information that only distinction-level students need is marked in a boxes with a D symbol. 'Did you know' boxes are included to give students some fun or useful 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. Eight lesson plans
3. Notes for each lesson covering all the learning aims between them
4. Questions in non-write-on and write-on format 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 assignment 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**. You must also 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**.

Update (July 2014)

A new 'Important Disclaimer Regarding Assessment' has been added in the introduction.

Update: 2nd edition (March 2015)

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

- Resubmission dates have been removed from all assignment briefs (pages 14, 39, 52)

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

- Assignment briefs each cover one Learning Aim in full. Therefore:
  - Assignments 2, 3, 4 and 5 have been merged and edited (page 39–43)
  - 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 (all assignments and mark sheets)
- Each assignment task allows students to access the full range of grades (all assignments and mark sheets)

Other amendments: assignments have been renamed to be consistent with the Learning Aims:

- Assignment 1 has been renamed Assignment A (page 14)
- Merged assignments 2, 3, 4 and 5 have been renamed Assignment B (page 39)
- Assignment 6 has been renamed Assignment C (page 52)

Suggested Scheme of Work

GLH	LP	Title
1	1	Exothermic and Endothermic Reactions
2	2	Exothermic and Endothermic Reactions – Practical
3	**Assignment A: Exothermic and Endothermic Reactions*	
4	3	Simple Distillation of Crude Oil
5	4	Fractional Distillation of Crude Oil
6	5	Structural and Displayed Formulae of Organic Molecul
7	6	Test Tube Reactions to Identify O[illegible]c Molecules
8	7	Uses of Organic Mole[illegible]es [illegible] Society
9–12	**Assignment B: Org[illegible]nds Used in Society*	
13	8	Ex[illegible]ses of Nanochemicals and New Materials
14–15	*[illegible]: Explore the Uses of Nanochemicals and New Materi*	
16–30	*[illegible]ortunity for catch-up and obtaining missing assignment criter*	

Learning Aims Note
'All students should' aims are levelled at Level 1 and Pass students, **'most students should'** aims are levelled at Merit students and **'some students should'** aims are levelled at Distinction students.

	C
	S
	S

Sugg	
* =	assig
** =	oppo obta

Lesson Plan 1: Exothermic and Endotherm

Learning Aims

All students should:	Know that exothermic reactions are reactions th endothermic reactions as reactions that take in h Know how to measure temperature changes for and endothermic reactions using primary data. changes as positive or negative.
Most students should:	Be able to link temperature changes to heat ener Know how heat/enthalpy change is associated w making. Be able to draw and interpret simple en exothermic and endothermic reactions.
Some students should:	Use $mC\Delta T$ to determine the amount of heat ene endothermic reactions.

Note: This lesson provides an opportunity to assess students' maths skills.

Keywords: exothermic and endothermic reaction, making and breaking bo coffee cup calorimeter, $mC\Delta T$

Starter

Ask students to list the telltale signs of a chemical reaction.

Main

1. Elicit answers from class. They will probably say a rise in temperature
2. Point out that sometimes temperature goes up and sometimes it
3. Demo of an exothermic reaction, e.g. a couple of spatulas of mag hydrochloric acid. Allow class to feel the temperature before and
4. Demo of an endothermic reaction, e.g. a couple of spatulas of am Allow class to feel the temperature before and after.
5. Demo of heat pack. Activate a hand-warming heat pack by snap pass it around the class so they can feel the increase in temperat
6. Define 'exothermic' and 'endothermic' in relation to change in te
7. Explanation of exothermic and endothermic reaction in terms of forming.
8. Description and explanation of simple energy diagrams.
9. Demo of a coffee cup calorimeter and explanation of its use.
10. Demonstrate the use of $mC\Delta T$ to calculate enthalpy changes.
11. Questions 1–10 from the pack.
12. Go through answers.

Plenary

Exothermic and endothermic tweet: students to explain both in only 140 c

Chemical Reactions

You may have noticed that chemical reactions have some telltale signs. Sometimes there is a fizz or gas is given off, there may be a change of state (e.g. solid to liquid), there could even be an explosion. But there is nearly always a change in temperature and we can tell from the change in temperature if the reaction is **exothermic** or **endothermic**.

Exothermic Reactions

If you place magnesium ribbon in hydrochloric acid you will notice that the resulting solution gets hotter. Chemical reactions that evolve (release) heat energy and sh[illegible] an increase in temperature are called exoth[illegible] e[illegible]ons. Other examples include respiration and [illegible] reactions, neutralisation reactions [illegible] [illegible]tion of alcohols.

> ***Did you kno***
> *It is really i*
> *the chemic*
> *to know ho*
> *given off or*
> *otherwise t*
> *not manufa*

Endothe[illegible] eactions

You may not [illegible]e noticed a drop in temperature during a chemical reaction before as endothermic reactions are far less obvious. Sodium carbonate added to vinegar is an example of endothermic reaction. Endothermic reactions absorb (take in) heat energy.

What Causes Exothermic and Endothermic Reactions?

During a chemical reaction the bonds holding the atoms of the reactants togethe holding the atoms of the products together must be formed.

Breaking bonds takes in energy whilst making bonds releases energy. So:

If the energy needed to break the bonds is less than the energy released when t extra energy is released as heat which causes an increase in temperature in the s

→ **exothermic**

If more energy is needed to break bonds than is released from the breaking bond absorbed (taken in) from the surroundings causing the temperature of the surro

→ **endothermic**

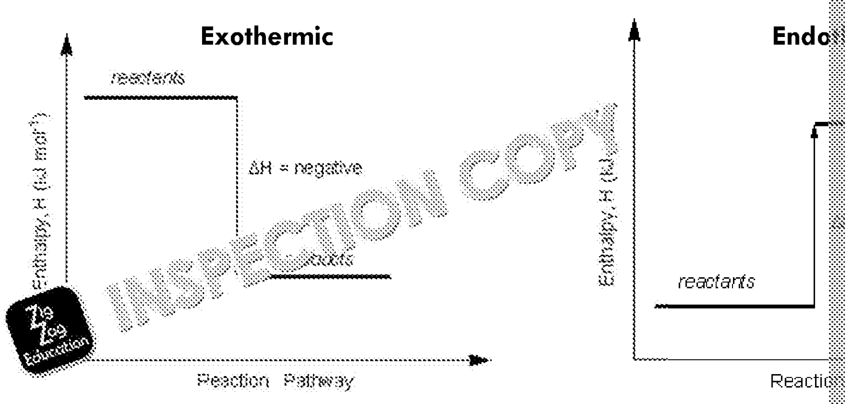
It is important to note that it is the surroundings (usually water) that are changin

> ***Did you know?***
> *The exoth[illegible] [illegible] endothermic nature of some chemical rea*
> *t[illegible] everyday lives. For example, hand warmers and se*
> *ex[illegible]hermic reactions to produce heat and cold packs use endo*
> *absorb heat from hot objects such as sprained ankles!*

In an exothermic reaction the products have less energy than the reactants. We s
a negative enthalpy change (heat change) because overall heat energy was lost t

In an endothermic reaction the products have more energy than the reactants. We
a positive enthalpy change (heat change) because overall heat energy was absorbe

This can be shown by these simple energy profile diagrams:

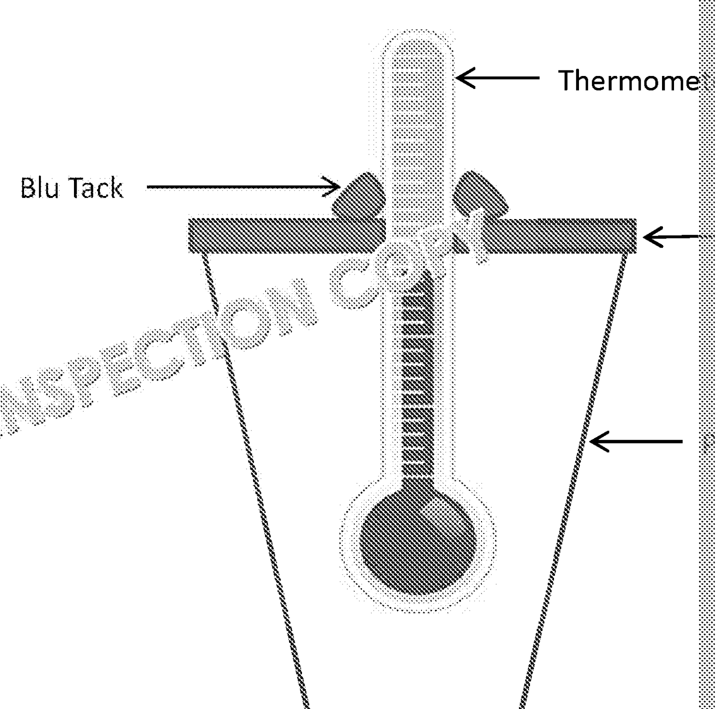


Heat/Enthalpy Change

Most of the chemical reactions you will look at will take place in aqueous conditi
responsible for absorbing the heat energy evolved in exothermic reactions and fo
needed in endothermic reactions.

You can calculate the temperature change very basically in class using a 'coffee c
the name we give something that measures energy changes).

A coffee cup calorimeter is simply a polystyrene cup with a lid. We use this becau
insulator so it keeps the heat in. Through the middle of the lid you make a very s
thermometer. Secure the thermometer with Blu tack so that the bulb is about 5



Using a Coffee Cup Calorimeter

Assume we are going to measure the change in temperature during the reaction hydrochloric acid.

1. First you weigh the mass of the hydrochloric acid (1 cm^3 of acid will weigh 1
2. Record the mass – we will assume the acid weighed 30 g.
3. The acid is then poured into the cup.
4. The temperature is measured by placing the lid and thermometer on top.
5. Record the starting temperature – we will assume that it is 20 °C.
6. Then add the magnesium.
7. Quickly replace the lid and wait until the thermometer stops showing a char
8. Record the final temperature – we will assume that this is 65 °C.

To calculate the temperature change we can use the equation:

Temperature Change °C = Final Temperature °C – Starting Te

So, for our example: Temperature Change = 65 °C – 20 °C = 45 °

As the temperature change is positive we know this reaction is exothermic. (This profile diagram which shows the amount of energy in the products.)

The calculation we have just done does not tell us how much heat ene water.

You can calculate the amount of heat energy absorbed or taken from the during a chemical reaction by using the equation:

$$Q = mC\Delta$$

Where: Q = heat or enthalpy change (J) (i.e. the heat energy absorbed b
m = mass of liquid (g)
C = specific heat capacity ($J\ g^{-1}\ K^{-1}$) (the energy needed to raise 1 °C)
ΔT = change in temperature (K) (the triangle is called delta and

This sounds complicated, but we will work through an example on the n

D

For our example we already know two things:

- m = the mass (the mass of the acid 30 g, we only need to worry abo the solid)
- ΔT = the change in temperature (45 °C)
- The specific heat capacity (C) for water (and the acid) is 4.18

So our calculation is simply: 30 × 4.18 × 45 = 5 643 Joules (J). This tells us transferred into the surroundings.

If Q is positive the reaction is ***exothermic*** *(more energy was released from maki break bonds).*

If Q is negative the reaction is ***endot*** *ss energy was released from mak break bonds).*

Sometim pe ature is measured in a unit called Kelvin. A 1 K chang a 1 °C cha so don't worry too much.

0 K is the coldest temperature anything can be, it is also called absolute z -273 °C.

To convert Kelvin to Celsius you add 273.

To convert Celsius to Kelvin you subtract 273.

Exothermic and Endothermic Reactions Questions

1. In terms of heat, what is the difference between an exothermic and an

2. Explain this difference in terms of making and breaking bonds.

3. What does ΔT mean?

4. What does the term 'specific heat capacity' mean?

5. What is the specific heat capacity of water?

6. True or false? The products of an exothermic reaction have more ener

7. True or false? The products of an endothermic reaction have more ene

8. Draw the energy profile diagram for the reaction between magnesium

9. A student mixed 5 g of potassium chloride with 100 g of water. The in was 293 K, the final temperature was 281 K.
   a. Calculate ΔT.
   b. Calculate the enthalpy change using the equation $Q = mC\Delta T$.
   c. State whether the reaction was exothermic or endothermic.
   d. Draw the energy profile diagram for this reaction.

10. A student placed 2 g of sodium into 20 g of water. The initial tempera final temperature was 302 K.
    a. Calculate ΔT.
    b. Calculate the enthalpy change.
    c. State whether the reaction was exothermic or endothermic.
    d. Draw the energy profile diagram for this reaction.

Exothermic and Endothermic Reactions Questions

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a. Calculate ΔT.

....

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....

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....

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a. Calculate ΔT.

....

b. Calculate the enthalpy change.

....

c. State whether the reaction was exothermic or endothermic.

....

d. Draw the energy profile diagram for this reaction.

Lesson Plan 2: Exothermic and Endothermic Re

Learning Aims

All students should:	Measure the temperature changes associated wi Investigate temperature changes associated with reactions using primary data.
Most students should:	Explain why an overall reaction is exothermic or
Some students should:	Calculate the energy changes that take place dur endothermic reactions.

Keywords: Exothermic and endothermic reaction, making and breaking b
coffee cup calorimeter, ΔH

Starter

Demonstrate the coffee cup calorimeter again.

Main

1. **This lesson is dedicated to carrying out exothermic and endot**
   Students must carry out at least two exothermic reactions and o
2. Reactions must be carried out in a coffee cup calorimeter to allo
   distinction assessment criteria. Practical instructions can be foun
   lesson 1.
3. Exothermic reaction: 30 cm^3 of 1 mol hydrochloric acid with 2 g of ma
4. Exothermic reaction: 30 cm^3 of 2 mol hydrochloric acid with 2 g of cal
5. Endothermic reaction: 20 cm^3 of water and a spatula of ammonium ch
6. Students should calculate the temperature changes involved in the re
7. Explain to the students how to calculate the enthalpy changes in the r
   exothermic or endothermic.
8. Go through practical results and ensure all students have correct ansv

Plenary

Just a minute: students must talk about subjects such as exothermic reactions,
a calorimeter or calculating energy changes for one minute without pausin
word, other than those written on a card. Other students can buzz in
is awarded for every mistake spotted and to the person talking when the r
awarded if a student manages to talk for an entire minute without making

Assignment A: Exothermic and Endothermic R

Learner's name:		
Start date:	Deadline:	Da

Investigate and Understand Enthalpy Changes Assoc Reactions

Scenario

You are an experienced laboratory technician at a [illegible] school and on yo have been asked by the head of science to help a new teacher to prepare for endothermic reactions. You decide that the best way to help the new teacher is exothermic and endothermic reactions and demonstrate how they can be carrie

Task 1

This task consists of two parts. First, conduct a set of **experiments** to demon exothermic and endothermic reactions to the new teacher and explain how t Then write a set of **notes** for the teacher.

For the experiments:

Conduct a set of experiments to demonstrate the principles of exothermic an new teacher and explain how the experiments are carried out.

Under guidance from your teacher and your notes, carry out the reaction bet magnesium, the reaction between hydrochloric acid and calcium carbonate a and ammonium chloride. Then measure the temperature changes that occur temperature changes, state if the reactions were exothermic or endothermic *Remember to think about what the temperature change can tell you about the*

For the notes:

After conducting the experiments, you decide to write a set of notes for the te to help them explain the reactions in more detail.

Explain why each of the reactions you carried out was exothermic or endothe temperature changes that occurred. Remember to explain how the water use you to find out if the reactions were exothermic or endothermic.

For each of the reactions, calculate the enthalpy change using the equation yo you have measured the temperature change in degrees Celsius (°C), rememb Kelvin (K) before doing your calculations. Then explain how the enthalpy cha linked to the making and breaking of bonds during the reaction.

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**	**Le... must:**
1	**2A.P**	Investigate temperature changes associated with exothermic ar endothermic reactions using primary data.
	2A.M1	Explain why an overall reaction is exothermic or endothermic.
	2A.D1	Calculate the energy changes that take place during exothermic and endothermic reactions.

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 a... ssed on the Level	
1A.1	Measure the temperature changes associa... wi... chemical reactions.

Lesson Plan 3: Simple Distillation of C

Learning Aims

All students should:	Understand that all substances have discrete boi can be separated according to these boiling poin Carry out simple distillation with some assistanc
Most students should:	Be able to list some uses of distillation. Carry out simple distillation with little assistanc
Some students should:	Carry out simple distillatic[illegible]th skill and no as

Keywords: distillation

Starter

Ask the cla[illegible] list as many ways to separate substances as they can.

Main

1. Go through the students' answers to the starter task and discuss the su identified.
2. Explain the basics of distillation in relation to boiling points.
3. Demo of distillation of synthetic oil (see next page for deta
4. Class practical of distillation of synthetic oil (see next page

Plenary

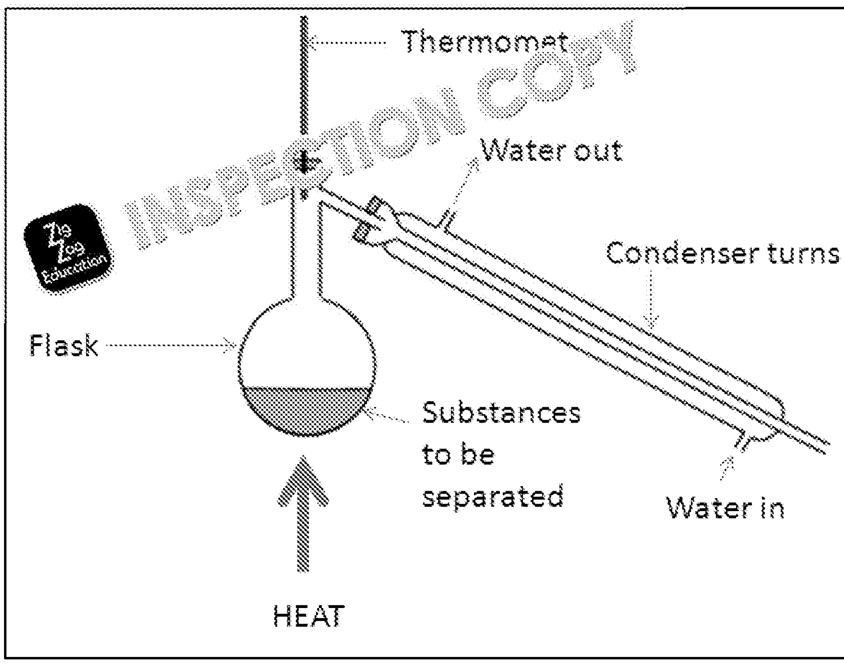
Student as teacher: students to discuss what they learnt in the lesson, wha did well and what they need to find out more about.

Distillation Introduction

There are many ways to separate substances that are mixed together. One such
generally used to separate liquids. Distillation relies on the fact that all substance

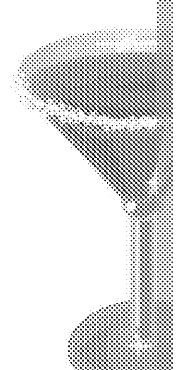
Distillation can be carried out simply in the classroom. Assume you had a mixtur
wanted to separate them. To do this you would use the following equipment:

Distillation – what you should know



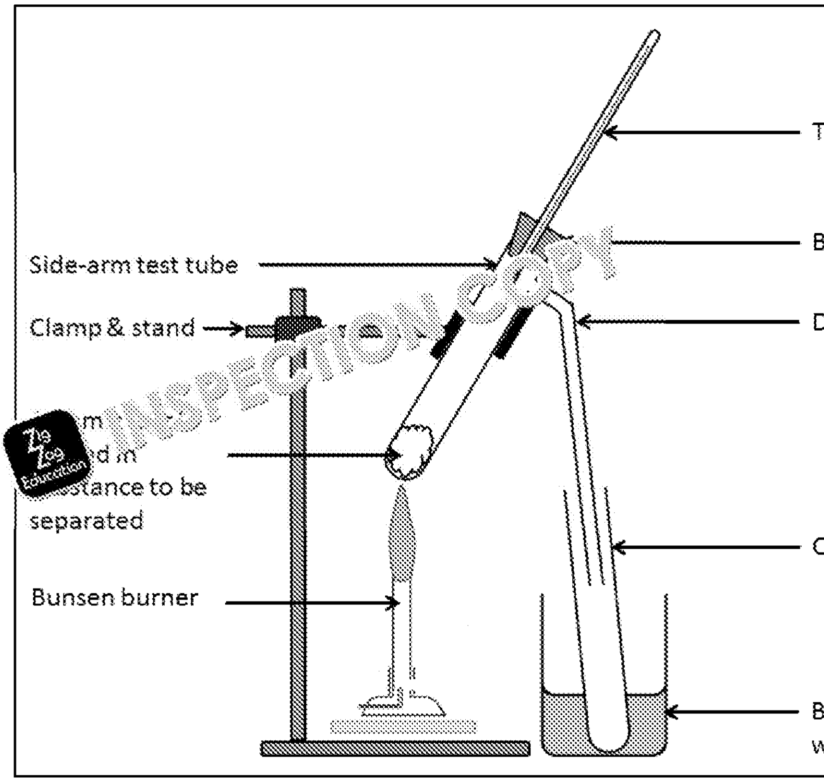
The mixture is placed in a flask and heated gently. Ethanol has a boiling point o
this temperature (you can keep track of the temperature of the gas with the th
turn into a gas until 100 °C. By heating gently it is possible to keep the conditio
which means that the vapour coming off will be ethanol and the water will rem
rises up the flask until it reaches the condenser. The condenser is kept cold by
glass sleeve that covers it. The condenser will reduce the temperature and turn
ethanol which can be collected. Suddenly the mixture may stop bubbling, this m
evaporated and what remains is your water. Otherwise you will be able to spot
evaporated by looking for a rise in the temperature reading on the thermomet
that some of the water is beginning to evaporate. At this stage you should swit
the collected ethanol is as pure as possible.

Did you kn…
…used in the alcohol
…ry to make alcohol stronger.



Another approach:

If your sample contains more than two different substances you can use a differe
This will be discussed in greater detail later on.



Place a small amount of mineral wool in the bottom of the side-arm test tube. To
substance to be separated. You need to make sure that the bulb of the thermom
the side-arm as this is the temperature of the gas at that point in the tube, i.e. th
out of the tube. Heat the bottom of the side-arm test tube very gently with the lo
too hard all the substances will boil off at the same time. Each substance will boi
you simply need to change the collecting tube at regular intervals. For example i
substances which had boiling points of 40 °C, 100 °C, 204 °C and 245 °C you woul
when the thermometer read about 50 °C and 110°C, you can stop heating when t
255 °C as the final substance will be left behind in the original tube. You can then
runny they are), colour, smell and flammability of the substances (to compare th
15 cm away from your nose and waft the smell towards you with your hand).

Lesson Plan 4: Fractional Distillation of

Learning Aims

All students should:	Identify the uses of the main fractions from the d Describe the fractional distillation of crude oil to products.
Most students should:	Explain how fractional distillation separates com boiling ranges.
Some students should:	Analyse the relationship between the boiling ran chain of fractions.

Keywords: fractional distillation, crude oil, fraction names and uses

Starter
Ask students to draw and label the distillation set-up from the previous le

Main

1. Recap distillation theory.
2. Point out that simple distillation is only good for separating two
3. If more liquids are to be separated then fractional distillation is
4. Explain fractional distillation.
5. Show the following video (14 minutes) which explains the extraction
   http://www.youtube.com/watch?v=9Py8-Xy9MKo&feature=related
6. Answer Questions 1–3 from the pack.
7. Go through answers.

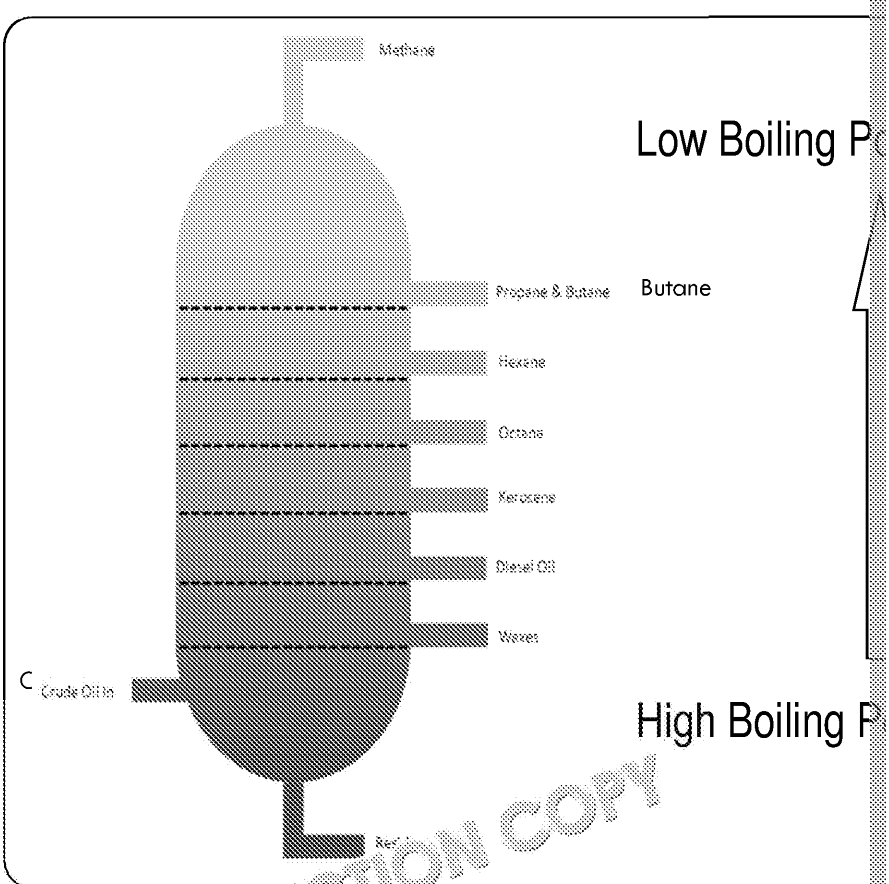
Plenary
Paired work: students to write four questions and answers relating to the l
One point is gained for every question their partner gets wrong, the partn
question they get correct.

Fractional Distillation

Sometimes the mixtures that need separating contain more than one substance, more complicated methods are used. This is the case with crude oil.

When crude oil is brought up to the surface it looks like a thick black liquid. But i great many different chemicals, each of which have different boiling ranges, whi to make them useful. The uses of the fraction depend on the size of the molecul

Fractional distillation works in the following way: The crude oil is pumped into a approximately 350 °C. This high temperature causes most of the substances to tu column. The substances with higher boiling points, su... bitumen, fall to the bo call this separated portion a fraction. As the gases rise up the column, the intern the gases reach about one fifth of the way up the temperature will be around 30 fraction will start to condense to a liquid and can be collected. The rest of the m to rise until it reaches about 270 °C. At this temperature the diesel fraction will s collected. This repeats at each level collecting fraction after fraction until all tha rises right to the top and can be bottled.



After fractional distillation we are left with a series of useful fractions.

Fraction	Use	Molec
Methane	Natural gas for fuel	
Propane and butane	Bottled gas and lighters, etc.	
Hexane/octane	Petrol for car fuel	
Kerosene	Jet fuel	
Diesel (fuel) oil	Diesel fuel and industrial heating	
Waxes	Candle making	
Residue	Bitumen for road surfaces	

D So, why do each of the substances boil at different temperatures?

The substances contained within crude oil are all **hydrocarbons**. That means they are compounds made entirely of carbon and hydrogen atom[s]. They are arranged as a chain of carbon atoms with hydrogen atoms com[ing] off the sides (much more on this later).

The longer the chain, the higher the boiling point.

So, the smaller chains rise to the top of the fractionating column whilst th[e] longer chain hydrocarbons gather at the bottom.

You can think of the boiling points in terms of spaghetti. If you have a pl[ate] full of long spaghetti the strands become tangled and will require a lot of energy to separate them. However if you had small spaghetti hoops they [will] not become tangled and will require little energy to separate.

Fractional Distillation Questions

1. Give the uses of five crude oil fractions.
2. Using a detailed labelled diagram of a fractionating column, explain h[ow it] works. You must refer to the boiling ranges of the fractions.
3. Describe and explain the relationship between chain length and boilin[g point].
4. Hexane is a 6 carbon chain length molecule and has a boiling point of [...] point of octane (8 carbon chain length).

Fractional Distillation Questions

1. Give the uses of five crude oil fractions.

   1) ....

   2) ....

   3) ....

   4) ....

   5) ....

2. Using a detailed labelled diagram of a fractionating column explain h
works. You must reference the boiling ranges of the fractions.

....

....

....

....

....

....

....

3. Describe and explain the relationship between chain length and boilin

....

4. Hexane is a 6 carbon chain length molecule and has a boiling point of
point of octane (8 carbon chain length).

....

Lesson Plan 5: Structural and Displayed Form Molecules

Learning Aims

All students should:	Name alkanes and alkenes from structural and d Draw accurately the structural and displayed for Know that bonds are represented by straight line
Most students should:	Describe the bonding and structure of organic m

Keywords: alkanes, alkenes, bonding, other organic molecules

Starter

Ask students to list many uses of the fractions from fractional distillatio

Main

1. Go through answers to the starter.
2. Explain that most of the fractions are alkanes.
3. Describe what an alkane is with reference to hydrogen and carb bonds.
4. Explain the nomenclature of alkanes. Students should at least k
5. Explain how to draw alkanes.
6. Ask students to draw and label the structural and displayed formula
7. Describe what an alkene is with reference to double bond.
8. Describe the nomenclature of alkenes.
9. Ask students to draw and label the structural and displayed formula
10. Describe briefly the uses of other organic compounds including chloroethene, dichloromethane and poly(chloroethene).
11. Ask students to draw examples.
12. Answer Questions 1 ... pack.

Plenary

On a Post-it students are to write three things they know about organ didn't know when they walked in the room.

Organic Molecules

Organic molecules are simply molecules that are based on carbon such as the hy section on fractional distillation.

The simplest type of organic molecule is called an **alkane**.

Alkanes

All alkanes contain carbon and hydrogen atoms only, the carbon atoms form a chain, or spine, down the middle with hydrogen atoms coming off the sides. These atoms are all bonded together by single covalent bonds.

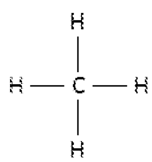
The simplest alkane is methane.

Methane contains 1 carbon atom and 4 hydrogen atoms and can be shown in a number of ways:

Structural =

or

Displayed =



Each line in the displayed formula of an alkane represents a single covalent bond, i.e. a pair of shared electrons.

The displayed formula shows all the bonds within the molecule. The structural formula can be thought of as a condensed version of the displayed formula, but it still shows the order in which the atoms are joined up.

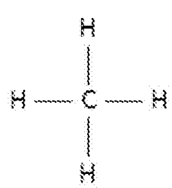
The general formula of alkanes is: C_nH_{2n+2} (where n = the number o

Alkane Formulae

Methane:

Structural = CH_4

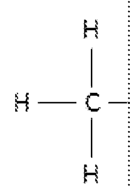
Displayed =



Propane:

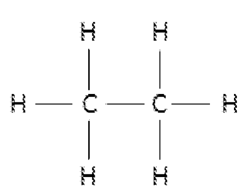
Structural = CH

Displayed =



Structural = CH_3CH_3

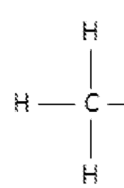
Displayed =



Butane:

Structural = CH

Displayed =



Alkenes

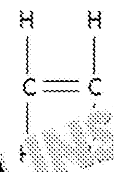
All alkenes, like alkanes, contain carbon and hydrogen atoms only. As with alkanes the carbon atoms form a chain, or spine, down the middle with hydrogen atoms coming off the sides. However the difference is that between two of the carbon atoms is a double covalent bond, like alkanes all the other bonds are single covalent bonds. The simplest alkene is ethene.

Ethene contains two carbon atoms and four hydrogen atoms and can be shown in a number of ways:

Structural = $CH_2{=}CH_2$

or

Displayed =



Each line in the displayed formula of an alkene represents a single covalent bond, i.e. a pair of shared electrons. Each double line represents a double covalent bond, i.e. two pairs of shared electrons.

The structural formula shows the atoms in the molecule whereas the displayed f… within the molecule.

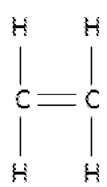
The general formula of alkenes is: C_nH_{2n} (where n = the number of car…

Alkene Formulae

Ethene:

Structural = $CH_2{=}CH_2$

Displayed =



Propene:

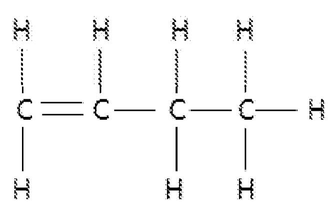
Structural =

Displayed =

Butene:

Structural = $CH_2{=}CH.CH_2CH_3$

Displayed =



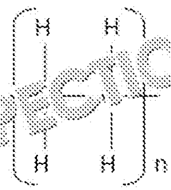
The … betw… atoms. … the ca… bonds … ato…

Other Organic Molecules

Whilst alkanes are chiefly used as fuel, alkenes are put to other uses. For exampl
joined together or **polymerised** to form poly(ethene) or polythene. For this to ha
and the 'sticky ends' join together to make a long chain molecule. Because there
molecules involved we cannot possibly draw them all so instead we draw one mo
and with an 'n' after to show many, many more identical molecules are joined o

Poly(ethene):

Structural = $(CH_2CH_2)_n$

Displayed =


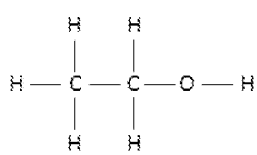
Note the l
and the fa
bond has be
'sticky end
b

Other useful and common organic compounds include:

- ethanol (used in alcoholic drinks)
- ethanoic acid (used in vinegar)
- chloroethene (polymerised to make the plastic poly(chloroethene) known a
- dichloromethane (used as a solvent)

Ethanol:

Structural = CH_3CH_2OH

Displayed =


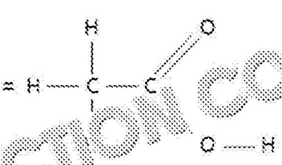
Poly(chloroethen

Structural =

Displayed =

Ethanoic Acid:

Structural = CH_3COOH

Displayed =


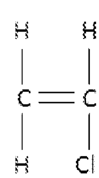
Dichloromethan

Structural =

Displayed = H –

Chloroethene:

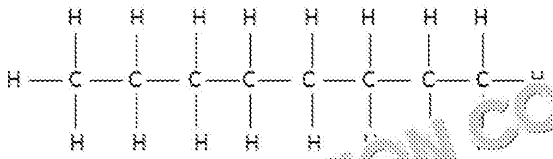
Structural = $CH_2{=}CHCl$

Displayed =


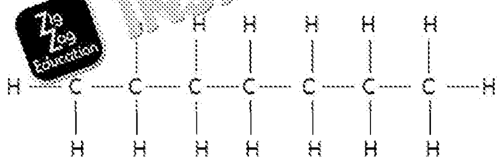
Organic Molecules Questions

1. Name and draw the displayed formula for the following compounds:
   a. $CH_3CH_2CH_2CH_3$
   b. $CH_3CH_2CH_2CH_2CH_3$
   c. $CH_3CH_2CH_2CH_2CH_2CH_3$

2. Name the following compounds:
   a.



   b.



3. Draw the structural and displayed formulae for:
   a. pentene
   b. hexene

4. What do the single and double lines that connect atoms represent?

Organic Molecules Questions

1. Name and draw the displayed formula for the following compounds:

   a. $CH_3CH_2CH_2CH_3$

   ....

   b. $CH_3CH_2CH_2CH_2CH_3$

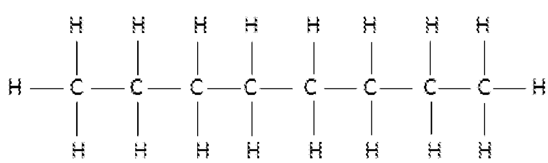
   ....

   c. $CH_3CH_2CH_2CH_2CH_2CH_3$

   ....

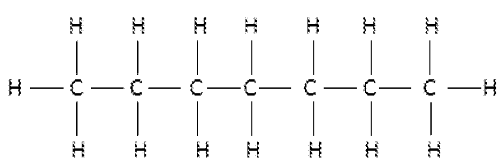
2. Name the following compounds:

   a.



....

   b.



....

3. Draw the structural and displayed formulae for:

   a. pentene

   ....

   b. hexane

   ....

4. What do the single and double lines that connect atoms represent?

   ....

   ....

Lesson Plan 6: Test Tube Reactions to Identify (
Molecules

Learning Aims

All students should:	Identify an alkene and an alkane using primary Identify an alkene and a carboxylic acid using pr
Most students should:	Explain how a series of experiments can be used compounds based on their solubility and reactio
Some students should:	Explain the results of experiments to identify org their reaction type, structural and displayed forn

Keywords: identification, alkanes, alkenes, carboxylic acids, alcohols

Starter

Ask students to list as many organic compounds as they can.

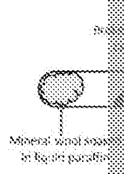
Main

1. Go through answers to the starter.

2. Explain the need to be able to tell the difference between differe

3. Explain and demonstrate the bromine test, sodium carbonate te dichromate test.

4. Students to carry out tests to distinguish between alkanes and alkenes. To each add bromine water and observe results (cracking is a possible experiment).



5. Students to carry out tests to distinguish between alkenes and carboxylic acids. To each add a spatula of sodium carbonate and observe results.

6. Students to carry out test to tell the presence of alcohol. Add 5 cm^3 of solution to alcohol and gently heat and observe results.

7. Students to carry out test on an unknown sample and identify it base be presented with unknown samples and asked to identify them usin above and in the lesson assessment.

8. Answer questions 1–7 from the pack.

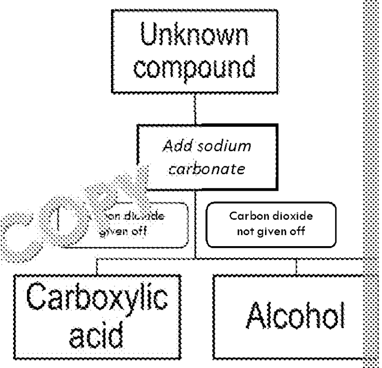
Plenary

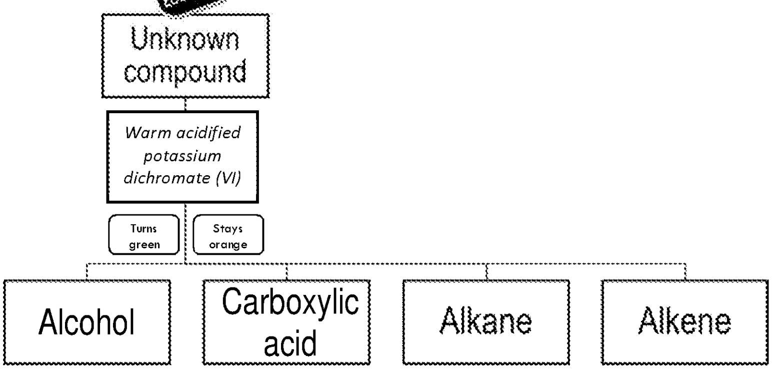
Beat the teacher: students to try to come up with questions relating to the unable to answer. Award a prize to the most inventive/difficult question.

Identifying Organic Molecule

Sometimes it is important to be able to distinguish between different organic co
number of different tests we can do to find out.

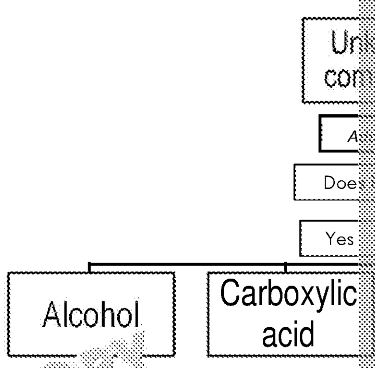
Carboxylic acids, such as ethanoic acid, will react with sodium carbonate to give off carbon dioxide gas – effervesce (this is an example of a neutralisation reaction so pH will change) whilst alcohols, alkanes and alkenes will not give off a gas.

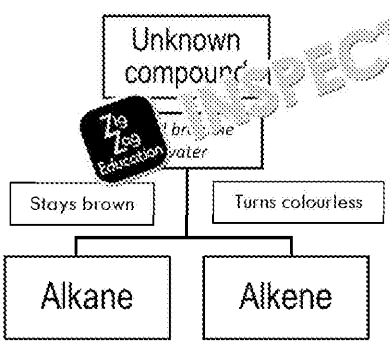




Alcohols, such
warmed with
(VI) and will tu
example of an
carboxylic acid
react.

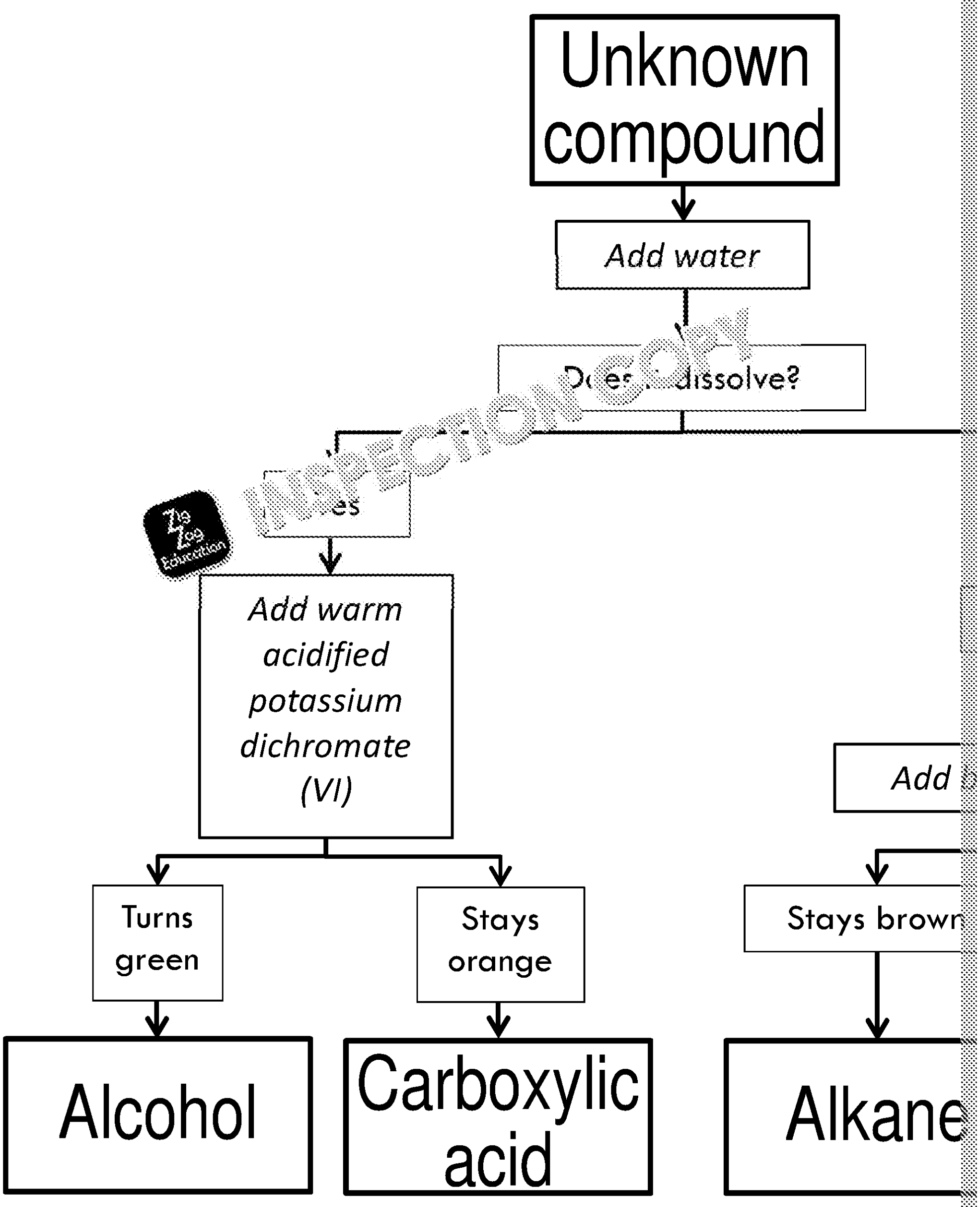
Neither **alkanes** nor **alkenes** are soluble in water and so can be discriminated from other organic compounds based on this property, such as alcohol which is soluble in water, but they cannot be distinguished from each other using this method.





Alkenes, such as ethene, will
rapidly turn it colourless (an e
whilst alkanes will not decolo

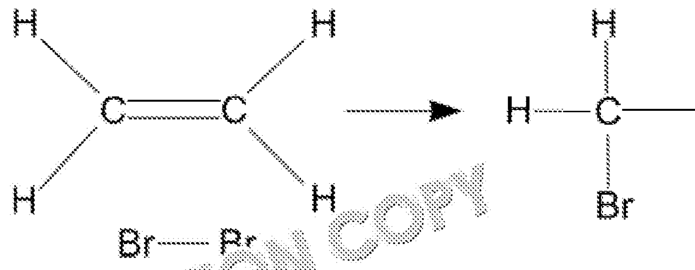
If these chemical tests are carried out in the correct order it is possible to quickly
compounds.



D

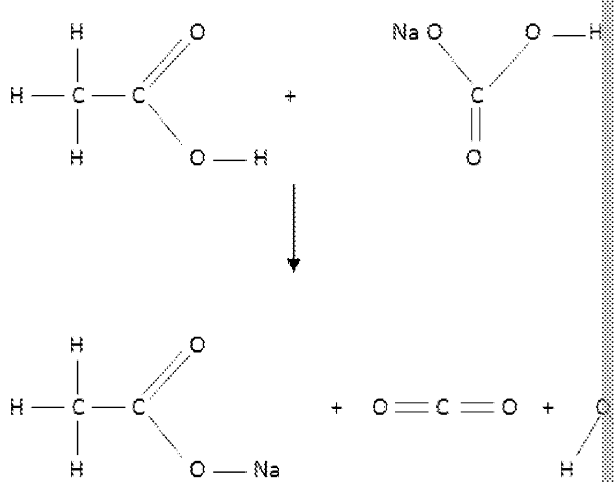
Reaction of Alkenes with Bromine

The reaction of bromine with alkenes is an addition reaction. The double and replaced with bromine atoms which themselves break the single bon brown colour whilst the product, 1,2-dibromoethane, is colourless.

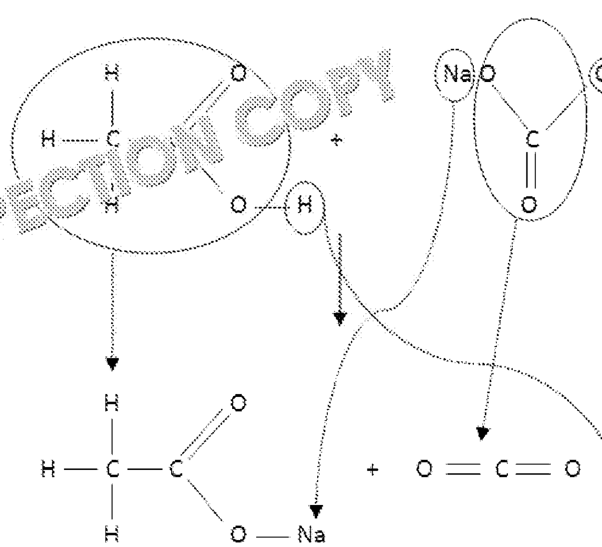


Reactic Carboxylic Acids with Sodium Bicarbonate

Ethanoic Acid + Sodium Bicarbonate → Sodium Acetate + Carbon Dioxid



Mechanism:



Identifying Organic Molecules Questions

1. Describe the method to distinguish between butane and butene.

2. Describe the method to distinguish between ethanoic acid and hexene.

3. You have an unknown organic compound you suspect is an alkane, a
   Using a flow diagram explain how you would use chemical tests to id

4. What type of reaction is the bromine test?

5. What type of reaction is the acidified potassium dichromate test?

6. What type of reaction is the sodium bicarbonate test?

7. Using diagrams to help, explain the bromine test for alkenes.

8. A sample of an organic compound effervesced when sodium carbona
   compound must it have been?

Identifying Organic Molecules Questions

1. Describe the method to distinguish between butane and butene.

   ....

2. Describe the method to distinguish between ethanoic acid and hexene

   ....

3. You have an unknown organic compound you suspect is either an alk acid. Using a flow diagram explain how you would use chemical tests

4. What type of reaction is the bromine test?

   ....

5. What type of reaction is the acidified potassium dichromate test?

   ....

6. What type of reaction is the sodium bicarbonate test?

   ....

7. Using diagrams to help, explain the bromine test for alkenes.

   ....

   ....

8. A sample of an organic compound effervesced when sodium carbona compound must it have been?

   ....

Lesson Plan 7: Uses of Organic Molecule

Learning Aims

All students should:	Identify uses of ethene, ethanol and ethanoic aci Describe the uses of organic compounds in our s
Most students should:	Explain the problems associated with the use of o
Some students should:	Evaluate the benefits and d backs of using or

Keywords: uses of organic cor po ethane, ethanol, ethanoic acid, chl with organic compou s

Starter

Students asked to draw heptane, propene and ethanol.

Main

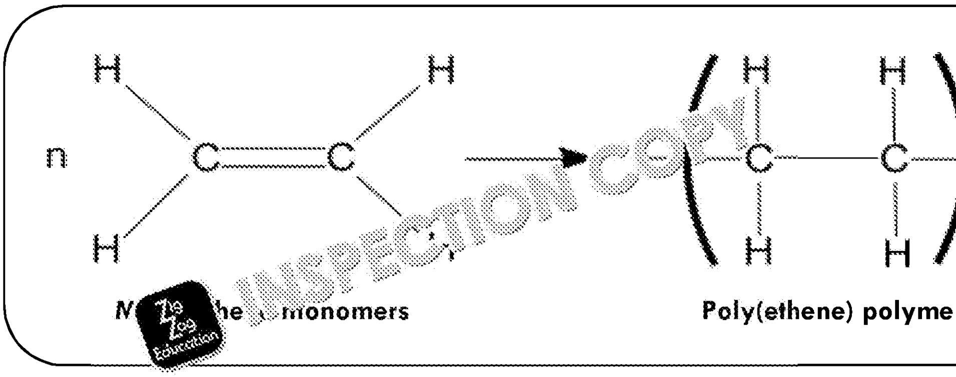
1. Ask students to come and draw on the board. Discuss answers with c
2. Discuss the uses of ethane.
3. Discuss the uses of ethanol.
4. Discuss the uses of ethanoic acid.
5. Discuss the uses of chloroethene.
6. Discuss the uses of PVC.
7. Discuss the uses of dichloromethane.
8. Discuss the uses of PTFE.
9. Class discussion of the problems with usi ganic materials.
10. Answer Questions 1 and 2 fr e pack.
11. Go through a

Plenary

Class debate on the pros and cons of using organic molecules. Class to be given the task of making the case for the continued use of organic compou argues the cons of using them.

Uses of Organic Compounds

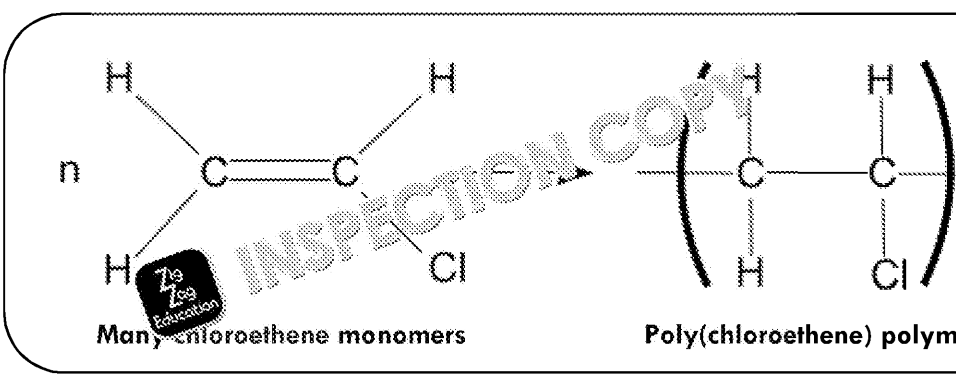
Alkenes are very useful in industry. **Ethene** for example can be used (as a feedsto make the plastic poly(ethene) which you probably know best for its use in plastic Ethene is the **monomer** in this reaction, monomer means single unit. Many ethe molecules are stuck together in a long line in a reaction called a polymerisation reaction to form the **polymer** poly(ethene).

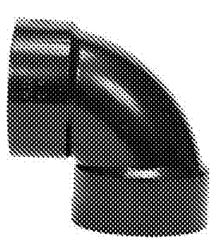


Ethene (a raw material) can also be reacted with steam and a phosphoric acid catalyst to make ethanol. In addition ethanol can be made by the fermentation o sugars. **Ethanol** is an alcohol which can be used in alcoholic drinks and as a solve to dissolve substances. Ethanol is a solvent used in aftershave and perfume, as a antiseptic (sterilisation agent) to clean wounds and surfaces, it is also found in products like vanilla essence and countless industrial uses as a feedstock. In addition ethanol is becoming more commonly used as a biofuel for cars.

Ethanoic acid is also very useful. Not only is it the acid found in vinegar which ma taste even better, but it can be used as a pickling agent to preserve food such as onions. In addition ethanoic acid can also be used as a feedstock to make chemic esters which themselves have many useful properties and can be found in paint a

Chloroethene (CH_2=CHCl) is another monomer that can be polymerised to make polymer poly(chloroethene) or PVC and uPVC.





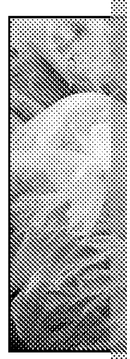
PVC and uPVC are cheap and durable plastics that have co pipes and hoses, clothes, toys, laminates, windows, doors, equipment such as syringes and many, many more. PVC ha be plasticised or unplasticised. It can be made flexible or s strong and chemically stable, it is not toxic and easily steri

Dichloromethane is another organic compound commonly used as an industrial solvent. It can be found in paint stripper, degreaser and aerosol spray propellant

Polytetrafluoroethene (PTFE for short) is an organic compound only containing carbon and fluorine atoms. It is most commonly known under the name Teflon™ has fantastic non-stick properties. As such it is used in many products where frict is an issue. It can be used to coat cookware like saucepans and frying pans, as we a coating to low-friction bearings to reduce wear and tear and also reduce energ usage. PTFE is also used as a coating to pipework and containers and can be usec a lubricant.

Problems with Organic Molecu

There are associated problems with using organic compounds. Whilst most organic compounds are quite reactive, some are unreactive and stable which can be a problem when it comes to disposal. PVC, poly(ethene), and many other organic molecules are not biodegradable and so build up in the environment and in landfill sites. Plastic bags have recently become the focus of widespread attack for their polluting nature. In addition to this if incinerated harmful dioxins are released. Dioxins are toxic chemicals which can poison humans and animals alike. They can also build up in the food chain so if animals become polluted with dioxins from industry they may get inside you if you eat them. One of the clear issues with dioxins is its carcinogenic properties; this means that it is known to be linked with increased chances of developing cancer. In addition PVC is sometimes mixed with chemicals that disrupt the hormones in animals.



Another problem with using organic molecules is that they are made from crude resource and so will run out. Very recently (2012), studies have found large quan pieces of plastic) building up around our coastlines. Research suggests that arou environment is made up of this microplastic. This may be a greater problem than evidence suggests it may be entering the food chain. If eaten by animals the mic system and can build up in their cells, if eaten it will then transfer into us. Much c come from domestic washing of clothes. One garment can produce nearly 2000 wash. In addition organic molecules are generally made from crude oil and so are be readily flammable and release dangerous chemicals when they are burned so appropriately ventilated area to prevent explosions, etc.

D

If you are working towards a distinction in your assignment, you should be able to *evaluate* the benefits and potential risks involved with our use of organic materials in society. You should do this by discussing the benefits and potential risks in detail and then come to a conclusion about whether we should continue to use the organic materials. You should then *justify* why you came to this conclusion based on the evidence you have gathered – remember to contrast the benefits against the potential risks or problems.

Did you
Some b
starch
and the
tiny pie

Fully de
10 time

Uses of Organic Molecules Questions

1. Describe the uses of three organic compounds.
2. Make a comparison of the pros and cons of using three different orga
   judgement of whether the benefits outweigh the risks for each materi

Uses of Organic Molecules Questions

1. Describe the uses of three organic compounds.
   1) ....
   ....
   2) ....
   ....
   3) ....
   ....
2. Make a comparison of the pros and cons of using three different orga
   judgement of whether the benefits outweigh the risks for each materi

Assignment B: Organic Compounds Used in S

Learner's name:		
Start date:	Deadline:	Da

Investigate Organic Compounds Used in

Scenario

You work at your local authority as an education officer. You are asked to dev activities for local schools and the public about organic compounds used in soci in four parts: Firstly, you create a leaflet to enthuse yo eople about the c for a variety of uses. Secondly, you create a ser f cational posters on a around the schools in the area. Thirdly, ig an experiment to demonstr identify samples of organic mole ly, you give a talk at a national ed of the uses and potenti ganic molecules.

Task 1

This task consists of four parts: Firstly, create a leaflet to enthuse young people distilling oil for a variety of uses. Secondly, create a series of educational post distribute around the schools in the area. Third, design an experiment to demon identify samples of organic molecules. Finally, give a talk at a national educati the uses and potential risks of organic molecules.

Part 1- Leaflet

Create a leaflet that the company can distribute among young people to enth involved in distilling oil for a variety of uses. The leaflet should cover what oi it is used for in society.

Begin your leaflet by introducing crude oil and describing what it is. Then giv information about some of the main uses of the fractions produced from the Remember to include the main uses of propane and butane.
You could find this information from your notes or from additional research.

Then go into more detail about how we separate the fractions within crude o fractionating column. Annotate the diagram with the different fractions that range. Underneath your diagram, describe how fractional distillation is used different fractions. Then discuss some of the uses of the fractions. If you didn diesel and kerosene in the first part of the task, you should include them here is fully annotated and use it to explain how fractions are separated. Rememb of each fraction in your answer and how this relate e point at which the fractionating column.

Provide the students with m inf ation about how fractional distillation number of carbon at fraction (its chain length) is related to its boil relationsh g values that you find through research. Why does this r

Part 2 - Posters

Create a series of posters to distribute to schools for students to learn from.

Poster 1

Introduce organic molecules by labelling and drawing the structural and the alkanes and alkenes that you have studied. Remember to include the ethane, propane and butane, and the following alkenes: ethene and prop

Make sure that the diagrams are clear, and remember that structural form… organic molecule and displayed formulae show the bonds.

Poster 2
Illustrate poster two by labelling and drawing the structural and display… organic molecules, including the alkanes with five and six carbon atoms … acid, dichloromethane, chloroethene and poly(ethene).
Remember to draw the displayed formulae carefully so the students can se…

Poster 3
On the final poster, redraw the displayed formula of an organic molecule … bonding. Label the single and double bonds in the molecule and explain … in each of the bonds. Then explain what the displayed formula can tell yo… molecule – what does each part of the formula represent?

Part 3 – Experiment and report

You design… experiment to demonstrate to young people how to identify sa… You will be given four unmarked samples: one containing an alkane, one cont… containing a carboxylic acid and one containing another type of substance. Ca… tests to identify which type of substance is in each tube and write up your fin… distribute to the young people. Samples will be given to you by your teacher.

1. Carrying out the experiments

Using the samples given to you by your teacher and under their supervis… you have studied in this unit to identify which of the four substances is a… Then state which samples contain the alkane and alkene in your report.

For the remaining two samples, carry out one of the tests you have studi… carboxylic acid. Then state how you used the results of the test to confir… tube was a carboxylic acid and the substance in the other tube was not. R… changes that you observed and any pH changes you measured.

2. Explaining the results of your experiments

After identifying which of the tubes contained an alkane, an alkene and a… report how you identified the substances based on the results of your ex…
Remember to refer to the observations you made during the experiments a… substances in each of the tubes.

Give more detail about how you identified the substances by explaining … You should do this by drawing the structural and displayed formulae of … and after you carried out your experiments. Then you should explain the … reaction that occurred and how the structure and bonding of the substan… experiment.
Think about how the tests you … changed the structure and bonding of … different substances. … the structure, bonding and formulae of these …

Part 4 - Presentation

Prepare and give a presentation to the attendees at the national education ev… discussing the use of organic molecules before considering the specific benef…

Begin by introducing the various ways that we use organic molecules in … wide range of molecules have many useful applications in society, includ…

- Ethanol, ethanoic acid and ethene
- Poly(ethene) and poly(vinyl chloride) (PVC)

Remember to give at least two uses of ethene in your presentation uses that organic molecules can have in society.

Then go on to introduce the potential risks that organic molecules can ha problems that can result from the use of two organic molecules of your c *Remember to explain the problems in detail so the audience are given all t consider could include both the health and environmental effects of the use*

Conclude your presentation by weighing up (evaluating) the benefits of the problems you identified earlier, and any other general problems you potential problems in detail and come to a conclusion about whether we materials in society.
Remember to contrast the beneficial uses of org[illegible]erials with the ass when you draw your conclusion. Conside[illegible] our extensive use of org justified based on the potential ri[illegible]s.

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:**
Part 1	**2B.P2**	Describe the fractional distillation of crude oil to produce a rang of useful products.
	2B.M2	Explain how fractional distillation separates compounds due to different boiling ranges.
	2B.D2	Analyse the relationship between the boiling range and the len of carbon chain of fractions.
Part 2	**2B.P3**	Draw accurately the structural and displayed formulae of organ molecules.
	2B.M3	Describe the bonding and structure of organic molecules.
Part 3	**2B.P4**	Identify an alkene and a carboxylic acid using primary observati
	2B.M4	Explain how a series of experiments can be used to identify org compounds based on their solubility and reactions.
	2B.D3	Explain the results of experiments to identify organic compoun terms of their reaction type, structural and displayed formulae, bonding.
Part 4	**2B.P5**	Describe the uses of organic compounds in our society.
	2B.M5	Explain the problems associated with the use of organic molecu
	2B.D4	Evaluate the benefits and drawbacks of using organic materials.
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.2	Identify the uses of the main fractions from the distillation of crude oil.
1B.3	Name alkanes and alkenes from structural and displayed formulae.
1B.5	Identify uses of ethene, ethanol and ethanoic acid.
1B.4	Identify an alkene and an alkane using primary observations.

Lesson Plan 8: Explore the Uses of Nanochemicals

Learning Aims

All students should:	Define nanochemicals. Describe a use of nanochemicals, smart and speci
Most students should:	Explain the benefits of using nanochemicals, sma
Some students should:	Evaluate the benefits and drawbacks of using na specialised materials.

Keywords: nanotechnology, nanochemicals, uses of nanochemicals, impli smart materials, specialised materials, Lycra, Kevlar, GORE-TEX, Thinsula

Starter

Students are to list as many units as they can associate with measuring siz

Main

1. Give an introduction to nanochemistry.
2. Discuss the uses of nanochemistry.
3. Outline the implications of using nanochemistry.
4. Show the following video (11 minutes), which provides a good introd **http://www.youtube.com/watch?v=qQnSTuR2vl8&feature=related**
5. Students to work in small groups to independently research sm using information from the pack. Students to make notes.
6. Demo of smart materials, e.g. shape memory alloy such as flex w specific specialised properties.
7. Students answer Questions 1–6 from the pack.
8. Go through answers.

Plenary

Students write a text message on the uses and implications of nanochemis points in only 160 characters. Abbreviations are allowed.

Nanochemistry

The term 'nanochemistry' sounds like a complicated subject but to put it simply i things. You are probably aware of the word 'Nano' whether you realise it or not b tiny MP3 player. But we are talking about technology far, far smaller than even t

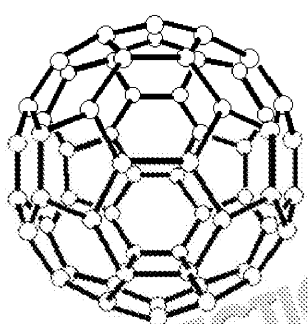
Imagine a rope that could hold your weight but was no thicker than a spider's we Nanotechnology is measured in units of length called **nanometres (nm)**. One nan long, so a human hair is about 50,000 nm in diameter. Or to put it another way, i stretched to the size of the USA, then 1 nanometre would be about the size of a about working with molecules smaller than 100 nm, this is called nanoscale.

Today we mostly use traditional manufacturing methods to make items we need are very simple when compared to nanotechnology. Imagine a razor blade, you m when looked at through a microscope you can see just how uneven a surface it h methods of manufacturing mainly require material to be removed from larger o stone. Nanotechnology is about manipulating individual atoms and placing them such as a molecular car made out of individual atoms.

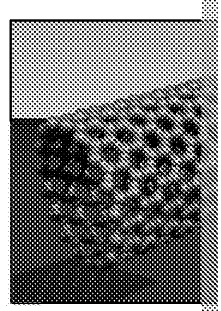
Scale Unit	Comparison to a Metre	Exampl
1 km	1,000 metres	A 10-mi
1 m	1 m	The height of
1 cm	$1/100^{th}$ of a metre	The width
1 mm	$1/1{,}000^{th}$ of a metre	The width
1 µm	$1/1{,}000{,}000^{th}$ of a metre	Half the length of a
1 nm	$1/1{,}000{,}000{,}000^{th}$ of a metre	Four potassium a

Fullerenes

Nanotechnology can be used to make fullerenes such as buckyballs and nanotub



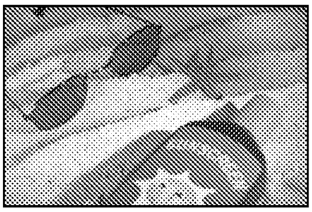
A buckyball



A nan

These are hollow spheres and cylinders of individual carbon atoms that are boun properties such as very high strength, hardness and conductivity; they are also a temperature and pressure. There are a number of ways of manufacturing nanotu 'the laser-aided vaporisation method' this involves a graphite sheet that's placed reactor chamber. A laser is then fired at the sheet, which is turned into a gas (va placed into the reactor chamber. The vapour inside the chamber is then allowed are formed as a result. These tubes tend to be short but by placing them under h together to make longer tubes.

Other Uses of Nanochemicals



Nanochemicals such as zinc oxide or titanium oxide can be used in sun screens to block ultraviolet radiation as these both reflect UV rays. In addition because they are invisible to the naked eye they will not leave white marks.

They can be used in emulsions to contain vitamins in face creams, or in mascara applied easily and are very soft to the touch.

Titanium oxides are also being used on windows to make them self-cleaning. A t coated on the glass and when sun shines on the dirt a chemical reaction breaks i titanium oxide particles cause the water to run off evenly, washing the dirt off to harder to reach windows.

Nanoparticles are also used in textiles; fluorinated carbon chains can be used in to waterproof; silver particles can also be incorporated into fabric to stop bacte growth and smells, you many never have to wash your socks again. Anothe in the incorporation of electronics (crystal nanowires) into materials such as light players or mobile phones and their batteries.

Nanotechnology is also used in the manufacture of sports equipment. Nanotube used to make tennis rackets stronger and lighter, giving the player more control power with greater efficiency. Nanoparticles can also be used inside balls to mai pressure and allowing longer use. They are also used in the manufacture of golf b allowing the balls to fly longer and straighter.

D Potential Implications of Nanochemistry

Scientific research has always included the discovery and development of new materials and new applications, however, some people have put forward a number of concerns regarding the safety of nanoparticles and raised environmental concern over their use.

Did you know
As we don't k
nanoparticle
containing th
shoppers can

Like any new material or technology the argument is that not enough is problems with the use of nanochemistry. Another concern is that nanopa found in sun lotion, are small enough to enter the skin and cause unknow that because they have such a large surface area, a property that makes th chemical reactions in industry, they could also have an effect on the chem biological cells. Further to this some nanoparticles antibacterial properti the essential bacteria that live in our gut should the nanoparticles enter bacteria in the environment. Other concerns have also been raised about human immune system which could leave our bodies defenceless agains previously encountered nanoparticle. Environmental concerns about t include the gradual release of nanoparticles into the environment throug through an industrial accident. Fears are that they could build up in the Recycling has also been an issue for some people. They fear that we may unbiodegradable products that we can't get rid of when we want to. As the risks, and that is many people's biggest concern, that nanoparticles h provide answers to so many problems that we have rushed into using th been done into the long term effects. People are worried about potential about the ethics of using nanochemicals as so little is known about the p

Smart and Specialised Materia

'**Smart materials**' are a number of different substances that behave in different w stimulus.

Shape memory alloys are one example of a smart material. These are metals tha on their conditions. For example, doctors are able to make splints for broken bo The alloy is cooled; when this happens the metal becomes flexible and can be m bone. When the metal warms up inside the body it returns to its normal shape a support to the broken bone. A similar material can be used in tooth braces preve be tightened.

You may have seen shape memory alloys in ey g ss. The frames are made of them to be bent out of shape, sat or e ed in knots without breaking. O the frames return to their r sh pe.

> Disadv s include the high cost of production and that they tend t break.

Another medical use of smart materials is the manufacture of plasters. One of th is the glue. It needs to be strong enough so that it will stay on in daily use but the remove it. This can be painful and could even damage the wound underneath. G until it is subjected to UV light. The UV light causes a reaction to occur in the glu stick to each other and not to the skin and so it falls off. One other use of smart m An ink is placed on the egg shell which is invisible until it is heated. The egg will t you it is cooked after an appropriate amount of time. Similar heat-sensitive mate firefighters' uniforms that change colour after exposure to too much heat. The fi become unsafe to remain in the building.

Specialised materials are those that are suited to a given task. Examples of these TEX, Thinsulate and Lycra.

Lycra is a manmade material that is extremely flexible. Lycra is woven from a polymer containing elastic sections and ridged sections allowing the material to stretch without the loss of all shape. Lycra can be made into any thickness allowing for its use in clothes from underwear to wetsuits. In addition to its elasticity, Lycra is also very lightweight, quick to dry, comfortable and breathable. It is often to be found in tight fitting clothes such as sport clothing.

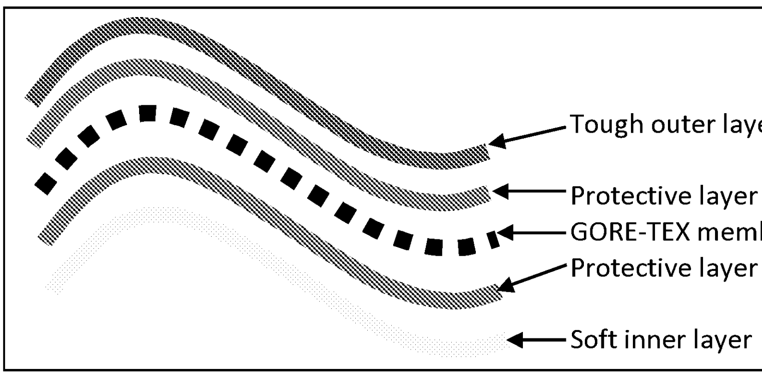
> Lycra can have drawb s it sn't as insulating as other material use heavy wh w

Kevlar is a manmade (synthetic) material spun from very thin thread. The nat
of the fabric gives it some very useful properties. Kevlar is very light which allow
to be used in a number of different ways. Molecular bonds exist between the
threads which give the material extreme strength and are resistant to corrosion.
Kevlar is most famously used in bullet-proof clothing and military and police
uniforms to protect its wearer against bullets and shrapnel from exploded bomb
In addition to this, Kevlar is also used on more day-to-day objects. It can be foun
on snare drums as the strength of the weave allows the drum skin to be pulled
much tighter than normal giving a better sound. Kevlar is also used in tyres givin
them puncture resistance. It is also to be found in ropes giving them extra streng
and allowing ropes to be manufactured much more thinly than normal.

D

The disadvantages of Kevlar are that it absorb... water relatively easy so
environment if not appropriat... ed; it can be difficult to cut and

GORE-T... material that protects its wearer against adverse weather
clothes were ... from materials that stopped the rain but would not have any bre
inside the coat would often become very sweaty and unpleasant. GORE-TEX provide
breathability. GORE-TEX clothes are made in several layers. The GORE-TEX membran
pores per square inch. The pores are thousands of times smaller than a water drople
but allowing the material to breath and so prevents sweating. The other layers provi



Thinsulate is an insulating cloth. It has very thin fibres, thinner than other sy
used to make insulating cloth such as polyester. Its thinness allows a dense weav
which prevents air flow which would normally cause heat to be lost. In addition T
provides insulation even in wet conditions unlike more traditional materials like
gloves, coats and other clothing used in cold weather.

D

If you are working towards a dis... your assignment, you sho
benefits and potential risks ... with using nanochemicals, smart m
materials. You shou... by discussing the benefits and potential ris
conclusi... ut ... ether we should use nanochemicals, smart material
Rememb... clude the concerns that people may have about them as
should then *justify* why you came to this conclusion based on the eviden
remember to contrast the benefits against the potential risks or problems

Remember to find the information you need using both your notes and a
assess the source of the information you gathered and decide whether y
where you got it from and whether the person/organisation who provid
to gain from providing this kind of information about the nanochemical
specialised materials. Remember to consider this in your evaluation too.

Nanochemicals and New Materials Questions

1. Define the terms:
   i. nanoscale
   ii. nanometre
   iii. buckyballs
   iv. nanotubes

2. Describe one production method of nanotubes.

3. Describe how nanochemistry can be used in [illegible], textiles and sp

4. Describe one smart materi[illegible] the properties that make it u

5. Descri[illegible] materials. You must explain the situation it w the m[illegible] by which it meets these needs.

6. Make a comparison of the good and bad factors associated with the u decide whether you think the benefits outweigh the risks. You should assess the information you gather for its reliability.

Nanochemicals and New Materials Questions

1. Define the terms:

   i. nanoscale

   ii. nanometre

   iii. buckyballs

   iv. nanotubes

2. Describe one production method of nanotubes.

3. Describe how nanochemistry can be used in cosmetics, textiles and sp

   Cosmetics

   Textiles

   Sport

4. Describe one smart material and explain the properties that make it u

5. Describe two specialised materials. You must explain the situation it w[...] the methods by which it meets these needs.

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6. Make [...] p[...] [...]or the good and bad factors associated with the us[...] decide [...]her you think the benefits outweigh the risks. You should [...] assess the information you gather for its reliability.

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Assignment C: Explore the Uses of Nanochemicals and

Learner's name:		
Start date:	Deadline:	Da

Explore the Uses of Nanochemicals and New

Scenario

You work as an investigative journalist for a local newspaper and you have jus nanochemical and smart/special material research labo ... y is opening in you people in the area are unlikely to have much inf... ti... about nanochemistry are likely to have some concerns about ... ti... that are being produced. idea of writing an article about ... laboratory and she is impressed with given the green light to ... new laboratory for an article on the first p

Task 1

Write an article about nanochemistry, smart materials and the new laborator

- Start the article by explaining what a nanochemical is.
  Think about what makes a nanochemical different to most of the other
- Then go on to describe in detail some of the uses of the nanochemical laboratory will be producing. Describe to the readers how at least one material and one of the other special types of material can be used.
- After identifying the uses of the nanochemical, smart material and sp that you haven't discussed the specific benefits that each of them has. specific benefits in detail, including why they are more useful than ot the same use.
- Finish the article by researching some of the potential risks of using n and specialised materials, including any concerns that the readers of Explain these potential risks and concerns and then assess how reliab gathered is.
  Think about where you got your information from – do you think that t provided information has a reason to portray the nanochemicals, smar materials in this way?
- Then come to a conclusion about whether we s... d use nanochemic specialised materials. Should the local p... worried about the n benefits of the nanochemicals, ... materials and specialised mater risks?
  Make sure that ... discussed the benefits in detail as well as the p

Learner's name:	Start Date:

Learner's declaration:
I certify that the work submitted for this assignment is my own. I have clearly refer
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**	**Le ... must:**
1	**2C.P**	Describe a use of nanochemicals, smart and specialised materia
	2C.M6	Explain the benefits of using nanochemicals, smart and specialis materials.
	2C.D5	Evaluate the benefits and drawbacks of using nanochemicals, sm and specialised materials.

Deadline:

Summative feedback:

Date assessed:

Internal verifier's name:

Internal verifier's feedback:

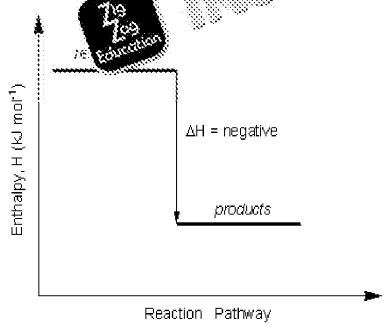
Date:

If a learner has not met the Level 2 criteria, they can be ... ssed on the Level	
1C.6	Define nanochemicals.

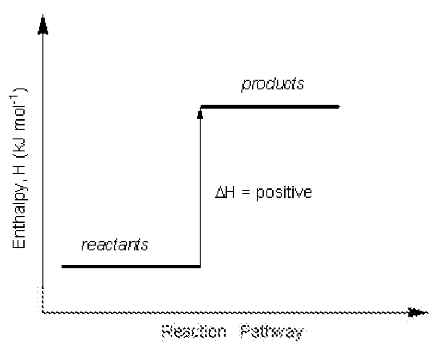
Answers to Questions

Lesson Plan 1: Exothermic and Endothermic Reactions Questions

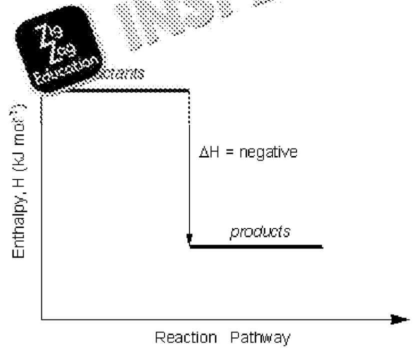
1. Exothermic reactions lose heat to their surroundings, whilst endothermic
   their surroundings.
2. If the energy needed to break the bonds is less than the energy released w
   then the reaction is exothermic.
   If more energy is needed to break bonds than is released from the breakin
   endothermic.
3. Change in temperature
4. The energy needed to raise 1 g of a substance by 1 K or 1 °C.
5. 4.18 J g^{-1} K^{-1}
6. False
7. True
8. Exothermic graph:



9. a. -12 K
   b. -5,016 J
   c. endothermic
   d. products must show more energy than reactants



10. a. 9 K
    b. 752.4 J
    c. exothermic
    d. products must show less energy than reactants



Lesson Plan 4: Fractional Distillation Questions

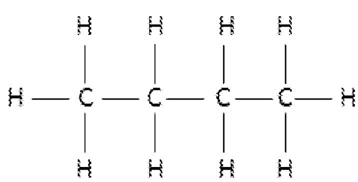
1. Any of:

Fraction	Use
Methane	Natural gas for f
Propane and butane	Bottled gas and light
Hexane/octane (gasoline)	Petrol for car fu
Kerosene	Jet fuel
Diesel oil	Diesel fuel and industri
Residue	Bitumen for road su

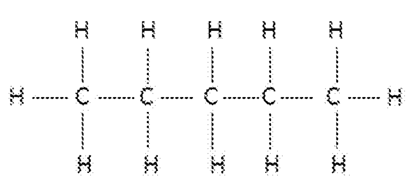
2. Diagram drawn and labelled. The crude oil is [illegible] ed into a large chamb 350 °C. This high temperature causes [illegible] the substances to turn into a The substances with higher [illegible] points, such as bitumen, fall to the bo the gases rise up th[illegible] the internal temperature decreases. When th the wa[illegible] the [illegible]ature will be around 300 °C, at this temperature th start to [illegible]nse into a liquid and can be collected. The rest of the mixtur rise until it reaches about 270 °C. At this temperature the diesel fraction w collected. This happens at each level collecting fraction after fraction unti which rises right to the top and can be bottled.
3. The longer the chain length the higher the boiling point.
4. Any number higher than hexane but lower than 300 °C

Lesson Plan 5: Organic Molecules Questions

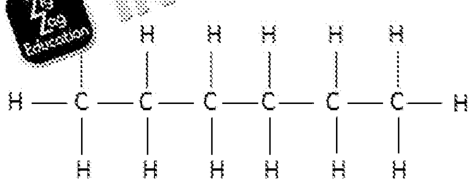
1. a. Butane



b. Pentane

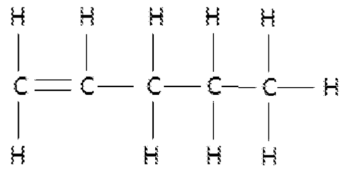


c. Hexane

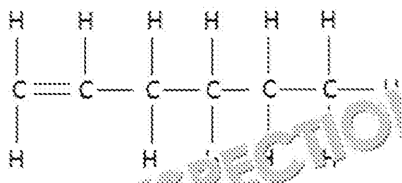


2. a. Octane
   b. Heptane

3 a. $CH_2{=}CHCH_2CH_2CH_3$



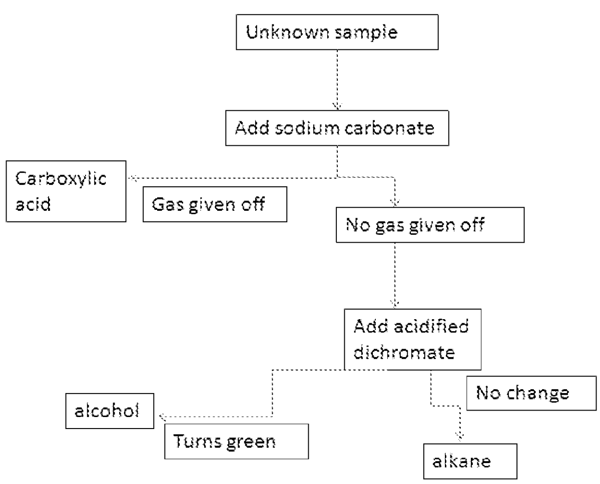
b. $CH_2{=}CHCH_2CH_2CH_2CH_3$



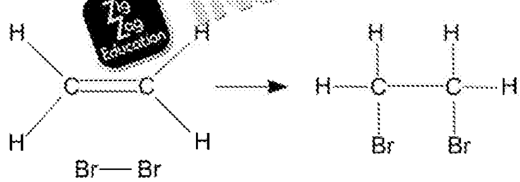
4. Single [illegible] are single covalent bonds (one shared pair of electrons). D[illegible] covalent bonds (two shared pairs of electrons).

Lesson Plan 6: Identifying Organic Molecules Questions

1. Add bromine water. Butene will decolourise it, butane will not.
2. Add sodium carbonate. Only the acid will react and give off gas.
3.



4. Addition
5. Oxidation
6. Neutralisation
7. The double bond in the alkene is b[illegible] an[illegible] replaced with bromine atom[illegible] single bond between them. [illegible] is a brown colour whilst the product[illegible] colourless.



8. Carboxylic acid

Lesson Plan 7: Uses of Organic Molecules Questions

1. Any three from:
   - Ethene used to make ethanol.
   - Ethanol used as solvent, in drinks, antiseptic, industrial uses, biofuel
   - Ethanoic acid used in vinegar and pickles, used to make esters.
   - Chloroethene monomer used to make PVC used to make windows,
   - Dichloromethane used as an industrial solvent, paint stripper, degre
   - PTFE used to reduce friction, e.g. in bearings, etc.
2. Any three pros listed, e.g. a mention of things we wouldn't have without cost, i.e. normally cheap; they are versatile; list of things needing organic unreactive, etc.

   Any three cons listed, e.g. non-biodegradable, hard to dispose of; build u burnt; releases dioxins which are toxic, entering food chains, etc.

   Must come to a conclusion either way, conclusion is unimportant, so long

Lesson Plan 8: Smart Chemicals and New Materials Questions

1. i. Structures smaller than 100 nm
   ii. One billionth of a metre
   iii. Nanoscopic hollow ball of carbon atoms
   iv. Nanoscopic hollow cylinder of carbon atoms
2. The laser-aided vaporisation method involves a graphite sheet that's plac reactor chamber. A laser is then fired at the sheet, which is vaporised. A the reactor chamber. The vapour inside the chamber is then allowed to co formed as a result.
3. Cosmetics: any from; in sun cream to reflect UV light; in mascara to impr to contain vitamins, etc.

   Textiles: any from; to waterproof them; to add electronics; to add antibac

   Sport: any from; to make equipment lighter and stronger; to allow balls t to allow balls to fly longer and straighter.
4. Any from:
   - **Shape memory alloys**: doctors are able to make splints for broken bo alloys. The alloy is cooled; when this happens the metal becomes fle around the broken bone. When the metal warms up inside the body and becomes ridged providing support to the broken bone.

     Shape memory alloys can be used in tooth braces preventing the nee

     Shape memory alloys in eye-glasses. The frames are made of a flexib bent out of shape, sat on and even tied in knots without breaking. O the frames return to their normal shape.
   - **Plasters**: a glue has been made that is strong until it is subjected to U reaction to occur in the glue molecules that makes them stick to each it falls off.
   - **S[illegible]ing egg**: an ink is placed on the egg shell which is invisible u they display a message to inform you it is cooked after an appropria

     Heat-sensitive materials can also be built into firefighters' uniforms exposure to too much heat. The firefighter then knows when it has b building, etc.

5. Any from:
   - **Lycra** is a manmade material that is extremely flexible. Lycra is wov elastic sections and ridged sections allowing the material to stretch v Lycra can be made into any thickness allowing for its use in clothes f addition to its elasticity, Lycra is also very lightweight, quick to dry, is often to be found in tight fitting clothes such as sport clothing.
   - **Kevlar** is a synthetic material spun from very thin thread. The natur useful properties. Kevlar is very light which allows it to be used in a Molecular bonds exist between the threads which give the material e resistant to corrosion. Kevlar is most famously used in bullet proof c uniforms to protect its wearer against bullets and shrapnel from exp Kevlar is also used on more day-to-day objects. It can be found on sn weave allows the drum skin to be pulled much tighter than normal g also used in tyres giving greater puncture resistance. It is also to be fou strength and also allows ropes to be manufactured much more thinly t
   - **GORE-TEX** is a material that protects its wearer against adverse wea w of clothes were made from materials that stopped the rain b breathability. Therefore conditions inside the coat would often becor GORE-TEX provides both waterproofing and breathability. GORE-T layers. The GORE-TEX membrane has over a billion microscopic por are thousands of times smaller than a water droplet and so are impe material to breath and so prevents sweating. The other layers provid
   - **Thinsulate** is an insulating cloth. It has very thin fibre, thinner than traditionally used to make insulating cloth such as polyester. Its thin material to be produced which prevents air flow which would norm addition Thinsulate is water resistant so provides insulation even in traditional materials like wool. Thinsulate can be found in gloves, co cold weather.
6. Students should mention at least three concerns, for example:
   - Some people have put forward a number of concerns regarding the s raised environmental concern over their use.
   - Like any new material or technology the argument is that not enoug problems with the use of nanochemistry.
   - Nanoparticles, such as silicon oxide found in sun lotion, are small en cause unknown effects.
   - People are worried that they could also have an effect on the chemic biological cells.
   - Some nanoparticles' antibacterial properties could also cause havoc w live in our gut, should the nanoparticles enter our bodies, or with the environment.
   - Unknown effects on the human immune system, which could leave a any possible attack from a not previously encountered nanoparticle.
   - Environmental concerns about the use of nanoparticles include the g into the environment through their manufacture or through an indu
   - Fears are that they could build up in the soil and enter the food chai
   - Recycling has also been an issue for some people. They fear that we biodegradable products that we can't get rid of when we want to.

   Students should mention at least three benefits, which could include a lis nanoparticles, a list of problems solved by nanoparticles, the future uses come to a conclusion either way; conclusion is unimportant, so long a

The Periodic Table of Elem

1	2									
							1 [illegible] hydrogen 1			
				Key relative ato[illegible] [illegible] [illegible] [illegible]c (proton) number						
7 **Li** lithium 3	9 **Be** beryllium 4									
23 **Na** sodium 11	2[illegible] **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 [illegible]	192 **Ir** [illegible] 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** dubni[illegible] [illegible]	[266] [illegible] [illegible] [illegible]	[illegible] [illegible] bohrium 107	[illegible] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111

***** ***The lanthan[illegible]m[illegible]ers 58–71) and the actinoids (atomic numbers 90–103) have bee***

The relative a[illegible]sses of copper and chlorine have not been rounded to the nearest whole n