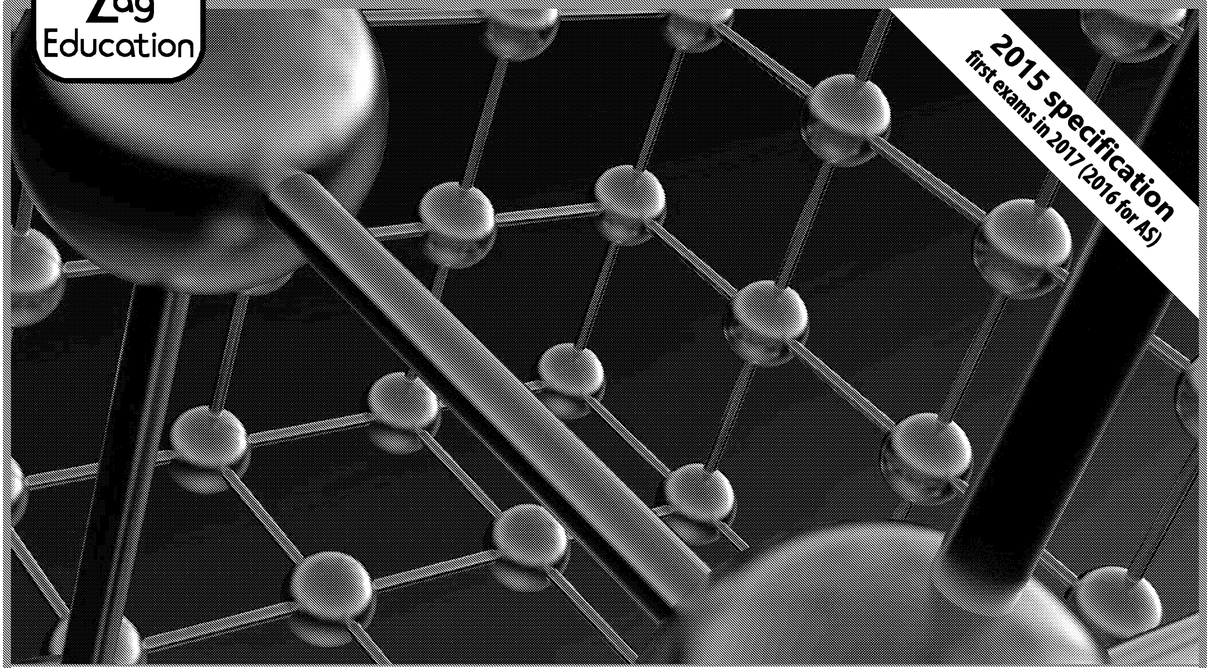
Chemistry AS and A Level | Edexcel | 8CH0/9CH0



Starters and Plenaries

for AS and A Level Edexcel Chemistry Year 1

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POD 12404

Contents

Teacher's Introduction

This resource follows the 2015 AS / A Level Edexcel specification for Chemistry, providing activities for all major topics under the first year of the course. While most activities cover ideas from one topic only, occasionally two or three related topics may be grouped into one activity. Each activity is designed to be used as either a starter or a plenary, but many are suitable for use in either situation. Additional notes and guidance often provide suggestions on how to use the activity differently in a starter or plenary situation, and may also provide extension ideas.

Remember!
Always check the exam board website for new information, including changes to the specification and sample assessment material.

On the next page you will find an overview table, providing the name and contents of each activity. This table also provides a syllabus reference for each activity and highlights how the activities are distributed across the AS / A Level Year 1 specification.

For each activity, there is a page of teacher's notes and a photocopiable student sheet.* Teacher's notes provide instructions, suggestions and answers for each activity, as well as additional notes, timings and other information. Many of the activities are not specific to any one topic and therefore can be adapted to other topics. You should also bear in mind that some types of activities will work better with certain student groups than with others, and therefore some experimentation will be needed to find the most effective starter and plenary strategies.

* There is no student sheet for Activity 22: What did others learn?

May 2024

Overview Table

Activity number	Topic	Activity title	Intended use	Time (minutes)	Edexcel specification reference	
1	Atomic structure	Atomic agreement line	S	5+	Topic 1, sub-topics 1–6	Atomic structure and the periodic table
2	Atomic structure	Word links	S / P	5	Topic 1, sub-topics 1–6	Atomic structure and the periodic table
3	Ionisation energy	True/false flash cards	P	5	Topic 1, subtopics 11–15	Atomic structure and the periodic table
4	Bonding	Microteaching	P	15+	Topic 2	Bonding and structure
5	Ionic bonding	Conception or misconception	P	15	Topic 2A, subtopics 1–7	Bonding
6	Redox	Spot the changes	S	5	Topic 3, subtopics 1–4	Redox I
7	Oxidation number	Questions for answers	P	10	Topic 3	Redox I
8	Redox	Interview with the scientist	P	15	Topic 3, subtopics 1–4	Redox I
9	Periodicity	Tarsia puzzle	P	5	Topic 1 (and possibly Topic 4)	Atomic structure and the periodic table (Inorganic chemistry and the periodic table)
10	Periodicity	Story chain	S/P	10	Topic 1 (and possibly Topic 4)	Atomic structure and the periodic table (Inorganic chemistry and the periodic table)
11	Periodicity, Group 2 and 7	Football	P	15	Topic 1 Topic 4A Topic 4B	Atomic structure and the periodic table The elements of Groups 1 and 2 The element of Group 7 (halogens)
12	Amount of substance	You are the examiner	P	10+	Topic 1, sub-topics 1–4	Atomic structure and the periodic table
13	Amount of substance	Word grid	S	5	Topic 1, sub-topics 1–4	Atomic structure and the periodic table

Table continued overleaf

Activity number	Topic	Activity title	Intended use	Time (minutes)	Edexcel specification reference	
14	Introduction to organic chemistry	Questions for answers	S	10	Topic 6A Topic 6B	Introduction to organic chemistry Alkanes
15	Structural isomerism	Molecule jigsaw	S	5	Topic 6A, subtopic 6	Introduction to organic chemistry
16	Alkanes	60-second hot seat	P	5	Topic 6B	Alkanes
17	Halogenoalkanes	Comparing bonds	S	10	Topic 6D	Halogenoalkanes
18	Organic chemistry	Making a revision map	p	15	Topics 6A–6E	Organic chemistry I
19	Organic analysis	Advice for next year's class	P	15	Topic 6, subtopics 25 & 38, Practical technique 4	Organic chemistry I
20	Mass spectrometer	A simple visual model	S	15	Topic 7A	Mass spectrometry
21	Infrared spectrometry	A model for molecular resonance	S	15	Topic 7B	Infrared (IR) spectroscopy
22	Energetics	What did others learn?	P	10	Topic 8	Energetics I
23	Energetics	Enthalpy anagrams	P	5	Topic 8	Energetics I
24	Kinetics	Sketch the graph	P	5	Topic 9	Kinetics I
25	Chemical equilibrium	Fill the bowl game	S	5	Topic 6A, subtopic 6	Introduction to organic chemistry
26	Chemical equilibrium	Two truths and a lie	P	10 – 15	Topic 6A, subtopic 6	Introduction to organic chemistry

Notes:
S/P = intended for use as either a starter or a plenary
S (P) = intended for use as a starter but possible to adapt for use as a plenary with a suggestion provided

Activity 1: Atomic structure

Activity name	Atomic agreement line
Aim	To assess existing understanding of atomic structure.
Instructions	• Allocate a space in the room where students can form a lin of the room. Explain that one end represents 'strongly agr 'strongly disagree' and the middle is 'do not know'. • Initially, and before each statement, students assemble in t • Give out copies of the accompanying sheet, which contains some hints. • Explain that you will make statements about atomic struct must listen and decide whether they agree, disagree or don themselves along the line accordingly. • Emphasise that staying in the 'do not know' position is per that you could ask any student to explain why they have c
Timings	10 minutes
Required prior learning	GCSE or equivalent understanding of the structure of the atom
Intended use	Starter
Specification reference	Topic 1, sub-topics 1–6: Atomic structure and the periodic table
Additional notes and guidance	Statements should be true/false and of varying challenge and in marked with *). Suggestions are: 1. a sodium atom has 11 electrons 2. a chlorine atom has 18.5 neutrons* 3. electrons are organised into shells or orbitals 4. when an atom forms a positive ion, it gains electrons* 5. two different elements could have the same number of pro 6. two different elements could have the same number of neu 7. the electron configuration of fluorine is 2, 9 8. the electron configuration of a Cl^- ion is 2, 8, 8
Answers	1. True – the number of electrons in a neutral atom is the sam which is the atomic number) 2. False – the number of any particle in an atom or ion must b made from a mixture of atoms with different numbers of n relative atomic mass of these 3. True 4. False – electrons are negatively charged, so to form a positi 5. False – the number of protons is the atomic number and th 6. True – the number of neutrons has no effect on the chemica 7. False – fluorine has nine electrons, so its configuration is 2, 7 8. True – a chlorine atom has the electron configuration 2, 8, 7, become an ion, so this becomes 2, 8, 8

Activity 1: Atomic structure – Atomic a

The Periodic Table of Elements (AS an

Key

relative atomic mass **atomic symbol** name atomic (proton) number

1 (1)	2 (2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
							1.0 **H** hydrogen 1			
6.9 **Li** lithium 3	9.0 **Be** beryllium 4									
23.0 **Na** sodium 11	24.3 **Mg** magnesium 12									
39.1 **K** potassium 19	40.1 **Ca** calcium 20	45.0 **Sc** scandium 21	47.9 **Ti** titanium 22	50.9 **V** vanadium 23	52.0 **Cr** chromium 24	54.9 **Mn** manganese 25	55.8 **Fe** iron 26	58.9 **Co** cobalt 27	58.7 **Ni** nickel 28	63.5 **Cu** copper 29
85.5 **Rb** rubidium 37	87.6 **Sr** strontium 38	88.9 **Y** yttrium 39	91.2 **Zr** zirconium 40	92.9 **Nb** niobium 41	96.0 **Mo** molybdenum 42	[98] **Tc** technetium 43	101.1 **Ru** ruthenium 44	102.9 **Rh** rhodium 45	106.4 **Pd** palladium 46	107.9 **Ag** silver 47
132.9 **Cs** caesium 55	137.3 **Ba** barium 56	138.9 **La**** lanthanum 57	178.5 **Hf** hafnium 72	180.9 **Ta** tantalum 73	183.8 **W** tungsten 74	186.2 **Re** rhenium 75	190.2 **Os** osmium 76	192.2 **Ir** iridium 77	195.1 **Pt** platinum 78	197.0 **Au** gold 79
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac***** actinium 89	[267] **Rf** rutherfordium 104	[268] **Db** dubnium 105	[271] **Sg** seaborgium 106	[272] **Bh** bohrium 107	[270] **Hs** hassium 108	[276] **Mt** meitnerium 109	[281] **Ds** darmstadtium 110	[280] **Rg** roentgenium 111

*Temporary name/symbol

Cu and Cl have not been rounded to the nearest whole number

A mass number in square brackets is the mass of the isotope with the longest half-life, where no stable isotopes exist.

Lanthanides**	140.1 **Ce** cerium 58	140.9 **Pr** praseodymium 59	144.2 **Nd** neodymium 60	[145] **Pm** prometheum 61	150.4 **Sm** samarium 62	152.0 **Eu** europium 63	157.3 **Gd** gadolinium 64
Actinides***	232.0 **Th** thorium 90	231.0 **Pa** protactinium 91	238.0 **U** uranium 92	[237] **Np** neptunium 93	[244] **Pu** plutonium 94	[243] **Am** americium 95	[247] **Cm** curium 96

Hints:

- The number of protons is equal to the number of electrons in a neutral atom.
- The groups are organised according to the number of electrons in the outer shells of the atoms.
- The periods are organised according to the number of electron shells of the atoms.
- Many elements have naturally occurring isotopes.

Activity 2: Atomic structure

Activity name	Word links
Aim	To revise the key concepts of atomic structure.
Instructions	• Ask students to raise their hands to offer words associated Write these on the board as they are offered. Take 2–3 mi the activity. • When there are sufficient words, ask students to work ind together in sentences about atomic structure. • Students can record the keywords on the accompanying sh construct their sentences. • Students then swap what they have written and compare a
Timings	5–10 minutes
Required prior learning	If used as a starter – understanding of atomic structure from GC If used as a plenary – coverage of the atomic structure topic.
Intended use	Starter or plenary
Specification reference	Topic 1, sub-topics 1–6: Atomic structure and the periodic table
Additional notes and guidance	If a student offers a keyword that does not appear to be obviousl then ask for an explanation.
Answers	Responses will vary, but an example could include: • Keywords – nucleus, electrons, shells • Sentence – Electrons are arranged in shells around the nucle in shells.

Use this space to record the keywords in the order that they are given.

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Now connect the keywords in sentences that describe atomic structure.

If you think of another keyword while constructing your sentences, then ask the t with the others.

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Activity 3: Ionisation energy

Activity name	True/false flash cards
Aim	To assess understanding of ionisation energy, including miscon
Instructions	• Students work individually. • They start by cutting out the three flash cards – T, F and ? – The question mark is used to show that a student isn't sure this option is better than guessing. • Draw a simple 2, 8, 1 electron configuration diagram of a s tell students that they can refer to this. • Read out the eight statements from the 'answers' section b misconceptions. • During the activity, students who voted T or F can be chos their choice.
Timings	10 minutes, to include preparing the cards
Required prior learning	Ionisation energy and periodicity.
Intended use	Plenary
Specification reference	Topic 1, subtopics 11–15: Atomic structure and the periodic table
Additional notes and guidance	Students could colour the borders (and possibly the reverse) of t for false, white for don't know and green for true. Colouring the seated behind them to see how they have voted.
Answers	**Statements:** 1. Energy must be supplied to the atom to lose the outer electr 2. Once this electron is removed, it can never return to the ato attracted to another ion or atom, it will be attracted back to by leaving) 3. The next electron will be easier to remove because it is close closer to the nucleus, the attraction will be stronger, less shi needed to remove it) 4. Electrons are attracted to the nucleus but the nucleus is not because electrostatic forces act with equal magnitude on bo 5. After the first electron is removed, the second one is harder less shielding from the nucleus (T) 6. This atom will spontaneously lose its outer electron to beco supplied to remove the electron) 7. The second electron to be removed is in a higher energy lev in a 3s level whereas the second is in a 2p level, closer to the lower energy level) 8. When the first electron is removed, both it and the ion that i the atom (F, they require energy to be separated and so mu before separation)

Activity 3: Ionisation energy – True/false f

Cut out the three cards from this sheet and use them to give your responses to th
your teacher.

You can colour the border and reverse of the T card green and the F card red to m
to see.

T	F

?

Activity 4: Bonding

Activity name	Microteaching
Aim	To allow students to plan and deliver part of a lesson on an asp
Instructions	• Students work in groups of three. • To save time during the lesson, students can be asked to pl aspect of the bonding topic and to prepare any resources th homework in advance. They must plan individual lessons. be delivered to two others in the group of three and not to t • Topics and outline lesson planning outlines are given in th • For the plenary activity, students are grouped and then eac lesson to the other two students. • The teacher starts the activity and times each teaching slot During this time, if there are say five groups, then five stud simultaneously. You should circulate and observe as many • Allow 1 minute for questions and feedback within the grou • Then start the next 4-minute slot and the next student in ea
Timings	15 minutes for groups of three
Required prior learning	Students should have covered all aspects of the microteaching t this activity.
Intended use	Plenary
Specification reference	Topic 2: Bonding and structure
Additional notes and guidance	• It does not matter if two students in the same group have c topic, because they will use different methods and approac • If appropriate and if time permits, you could choose one or be delivered again but to the whole class.
Answers	Students should be seen to do as many of these as possible: • encourage their 'class' to participate and interact • carry out an appropriate activity • ask questions of their students • respond to their students' needs • provide appropriate resources for their lessons

Activity 4: Bonding – Microteachin

On your own, plan a 3–4-minute lesson on **one** of these topics:

- formation of an ionic bond
- formation of a covalent bond
- formation of ions

Remember to make your lesson as active for your students as possible. Do not ju

Use the prompts below to help plan your lesson:

Topic: ....

Main thing I want them to learn: ....

....

Lesson starter activity and timing: ....

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Main lesson activity and timing: ....

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Questions I will ask: ....

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Lesson plenary (summary) and timing: ....

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How I will assess their learning: ....

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Resources required: ....

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Activity 5: Ionic bonding

Activity name	Conception or misconception
Aim	For students to think about ionic bonding, including some com
Instructions	• Provide students with the accompanying sheet of stateme Present these as if they are statements that students have m • Allow them to work in pairs (or small groups, if more app each statement is a conception or a misconception. • After deciding, they should write a short explanation to ju
Timings	15 minutes
Required prior learning	The topic of ionic bonding.
Intended use	Plenary
Specification reference	Topic 2A, subtopics 1–7: Bonding
Additional notes and guidance	Some of the statements that are misconceptions will be quite dif students who need more support. If necessary, the whole class c
Answers	1. **Misconception**. An ion can be surrounded by as many oth pack closely around it. 2. **Conception**. Opposite charges always attract. 3. **Misconception**. Molecules only form in covalent compoun carbon dioxide. Ionic compounds have giant lattices and n 4. **Misconception**. While it may look that way in two-dimens pattern is three-dimensional. Hence, there will be addition usually making a total of six ions surrounding any one oth 5. **Conception**. It is the attraction between positive and nega the ions together, or bonds them. 6. **Misconception**. It could result in the formation of a covale

Activity 5: Ionic bonding – Conception or mis

Below are some statements made by students about ionic bonding. You have to d is a conception (true statement) or a misconception (the student has the wrong ic explanation of your decision in each case.

Statement 1: A potassium ion has a charge of +1, so it can only form one ionic bo
Explanation:

Statement 2: An ion with a negative charge is capable of attracting any ion with a positive charge.
Explanation:

Statement 3: Sodium chloride has ionic bonds so is a type of molecule.
Explanation:

Statement 4: In a lattice structure, the maximum number of negative ions that ca surround a positive one is four.
Explanation:

Statement 5: An ionic bond is simply the electrostatic attraction between ions of different charge.
Explanation:

Statement 6: When one atom donates an electron to another atom, an ionic bon always formed.
Explanation:

Finished? Devise your own for another student.

Statement 7:
Explanation:

Activity 6: Redox

Activity name	Spot the changes
Aim	To allow students to compare numbers of electrons in reactant a same element.
Instructions	• Students work in pairs. • Use only ionic substances at this stage because the concept yet be familiar for use with covalent substances. • Some of the equations appearing later that have compound redox reactions. • Explain the worked example first and ensure students kno • Ask students to compare the numbers of electrons in each u equation and use this activity to introduce the concept of re that not all reactions are redox.
Timings	5 minutes
Required prior learning	GCSE or equivalent understanding of the atom.
Intended use	Starter
Specification reference	Topic 3, subtopics 1–4: Redox I
Additional notes and guidance	• Students should have access to a periodic table. • Students needing more support may need reminding of the such as hydroxide, sulfate, etc. • Question 8 is challenging.
Answers	1. K has lost 1 electron 2. Mg has lost 2 electrons 3. Al has lost 3 electrons 4. Cu has gained 2 electrons 5. Na has neither gained nor lost electrons 6. Ag has gained 1 electron 7. Cu has lost 2 electrons 8. Mn has gained 5 electrons

Activity 6: Redox – Spot the chang

Worked example
Look at the reaction:

$$2\underline{Na} + 2H_2O \rightarrow 2\underline{Na}OH + H_2$$

We are going to compare the numbers of electrons in Na before and after the re

- Here, we can ignore the balancing numbers because they do not apply to th
- Na on the left is an element, so has 11 electrons as shown on the periodic ta
- Na on the right has formed an ionic bond, so will have lost an electron to for 10 electrons.

So we say that Na has lost 1 electron in this reaction.

Now write down whether the underlined substance has gained, lost or had no ch these. If there has been a change in number of electrons, write the number that

1. $\underline{K} + Cl_2 \rightarrow \underline{K}Cl$

   ……………………………………………………………………………………………………

2. $2\underline{Mg} + O_2 \rightarrow \underline{Mg}O$
   Remember to ignore the balancing numbers

   ……………………………………………………………………………………………………

3. $2\underline{Al} + 3Cl_2 \rightarrow 2\underline{Al}Cl_3$

   ……………………………………………………………………………………………………

4. $Mg + \underline{Cu}SO_4 \rightarrow MgSO_4 + \underline{Cu}$

   ……………………………………………………………………………………………………

5. $\underline{Na}OH + HCl \rightarrow \underline{Na}Cl + H_2O$

   ……………………………………………………………………………………………………

6. $Cu + 2\underline{Ag}NO_3 \rightarrow Cu(NO_3)_2 + 2\underline{Ag}$

   ……………………………………………………………………………………………………

7. $\underline{Cu} + 2AgNO_3 \rightarrow \underline{Cu}(NO_3)_2 + 2Ag$

   ……………………………………………………………………………………………………

8. *Challenge*: $2K\underline{Mn}O_4 + 3H_2SO_4 + 5H_2O_2 \rightarrow K_2SO_4 + 2\underline{Mn}SO_4 + 8H_2O + 5O_2$

   ……………………………………………………………………………………………………

Activity 7: Oxidation number

Activity name	Questions for answers
Aim	To allow students to create questions on the topic of oxidation s provided with answers.
Instructions	• Students work in pairs. • The accompanying sheet contains answers to questions on • Each pair of students then writes questions that would elici • The questions and answers are then swapped with another
Timings	10 minutes, to include discussion
Required prior learning	Oxidation numbers
Intended use	Plenary
Specification reference	Topic 3: Redox I
Additional notes and guidance	Encourage students to use commands rather than actual questio than 'What is…'
Answers	Example questions are: 1. Give the oxidation number of magnesium in $MgCl_2$. 2. State the rule for oxidation numbers of substances existing a 3. $2Fe^{2+} + ½O_2 \rightarrow 2Fe^{3+} + O + e^-$ 4. $2CuO + C \rightarrow 2Cu + CO_2$ 5. Define disproportionation. 6. H_2O_2 7. $Cl_2 + H_2O \rightarrow HCl + HClO$ 8. $NaOH + HCl \rightarrow NaCl + H_2O$

Activity 7: Oxidation number – Questions fo

Below are answers to questions on the topic of oxidation states, or oxidation num

Work with a partner to consider questions that would elicit each of these answers more than one correct question in each case.

Try to use command words rather than question words, as in the style of exam qu

1. **Answer:** +2

   Question: ....

   ....

2. **Answer:** It is always zero.

   Question: ....

   ....

3. **Answer:** In this half-equation, iron increases in oxidation number by 1.

   Question: ....

   ....

4. **Answer:** In this reaction, copper is reduced.

   Question: ....

   ....

5. **Answer:** The oxidation number of one element increases and decreases in th

   Question: ....

   ....

6. **Answer:** Hydrogen has oxidation number +1 and oxygen has oxidation numb

   Question: ....

   ....

7. **Answer:** In this reaction, chlorine undergoes disproportionation.

   Question: ....

   ....

8. **Answer:** This is not a redox reaction because no substance changes in oxidati

   Question: ....

   ....

Activity 8: Redox

Activity name	Interview with the scientist
Aim	To allow students to research the history of the discovery of re
Instructions	• Assign students to three groups and ask each group to res Joseph Priestly or Antoine Lavoisier on redox reactions. T homework to save time in the lesson. They should also lo scientists did in this respect. • When the activity starts, each student individually should sheet to prepare for the interview, should they be chosen. • Then, two students from different groups volunteer to com role of the scientist whom they researched and the other is • Some general, non-scientific questions can be asked to set must be about the relevant science. • The interview should last about 3 minutes. • This is then repeated twice more until each of the three 'sc
Timings	15 minutes, excluding research time
Required prior learning	The topic of redox reactions.
Intended use	Plenary
Specification reference	Topic 3, subtopics 1–4: Redox I
Additional notes and guidance	Interviewers can ask one or two general questions to each 'scien interested in oxidation in the first place?' to which the answer ca
Answers	**Some key facts on the scientists are:** **Stahl** (1659–1734) was a medic who also worked on chemistry a which was thought to be the principle of fire. Anything that bu phlogiston. When removed by burning, what was left was ash. explain rusting of iron. We now know that burning and rusting **Priestly** (1733–1804) was a chemist and theologian. He famous releasing a colourless gas in which a candle would burn and a m know this to be oxygen, but he called it 'dephlogisticated air'. D contemporary of Priestly) discovering oxygen, Priestly did not a phlogiston theory. **Lavoisier** (1743–1794) was a chemist. He showed that both pho after burning. Previously people assumed that substances lost m of phlogiston. He discovered the 'active' part of air (that we no experiments on combustion. Lavoisier was part of the 'chemical helped the abandonment of the phlogiston theory.

Activity 8: Redox – Interview with the s

Use this sheet to prepare for the activity.

Name of scientist whom you are researching:

....

Years when the scientist lived: ....

Key facts about this scientist's work on oxidation:

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Now think about questions you would like to ask the other scientists, if you were

Name of first scientist whom you might interview: ....

Years when that scientist lived: ....

Questions you would like to ask:..

....

....

....

Name of second scientist whom you might interview: ....

Years when that scientist lived: ....

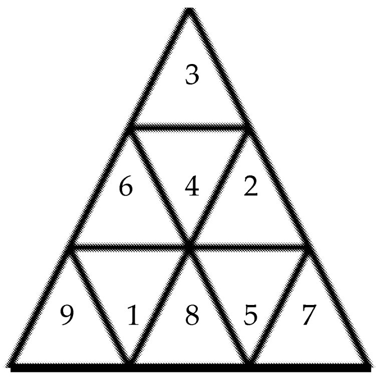
Questions you would like to ask:..

....

....

....

Activity 9: Periodicity

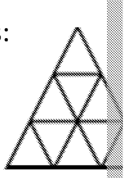
Activity name	Tarsia puzzle
Aim	To allow students to create their own Tarsia puzzle based on th
Instructions	• Students work in groups of two or three. • If necessary, explain what is meant by a Tarsia puzzle. Wri triangle is either a question, an answer or a statement. No another statement or question, as some of the small triangl the large one. • The small triangles are to be matched by pairing up correct triangle, as shown in the accompanying sheet. Set a time li to complete the puzzle after cutting out. • Students can then spend the remaining time looking at the completed, puzzles of other groups. Feedback can be give
Timings	15 minutes approximately
Required prior learning	The topics of periodicity and atomic structure.
Intended use	Plenary
Specification reference	Topic 1: Atomic structure and the periodic table (and possibly Topic 4: Inorganic chemistry and the periodic table)
Additional notes and guidance	• Students should have access to a periodic table. • As a stretch and challenge activity, students could work in g their own Tarsia puzzles, possibly with 16 small triangles, a groups.
Answers	The small triangle numbers fit together as shown: 

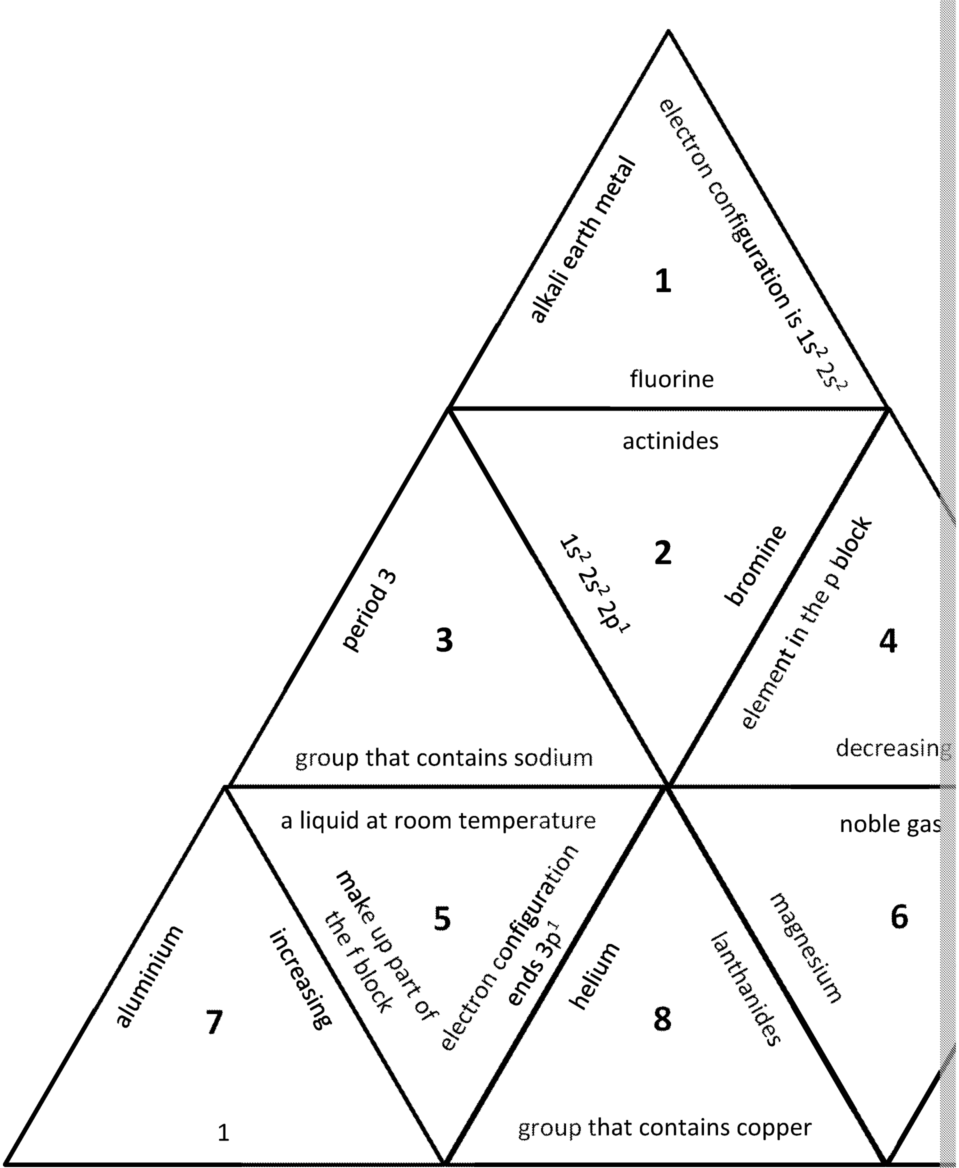
Activity 9: Periodicity – Tarsia puz

Cut out each of the nine small triangles below and assemble them to make one la

Where the side of a small triangle borders with another, then the statements mus

The small triangles should be assembled like this:





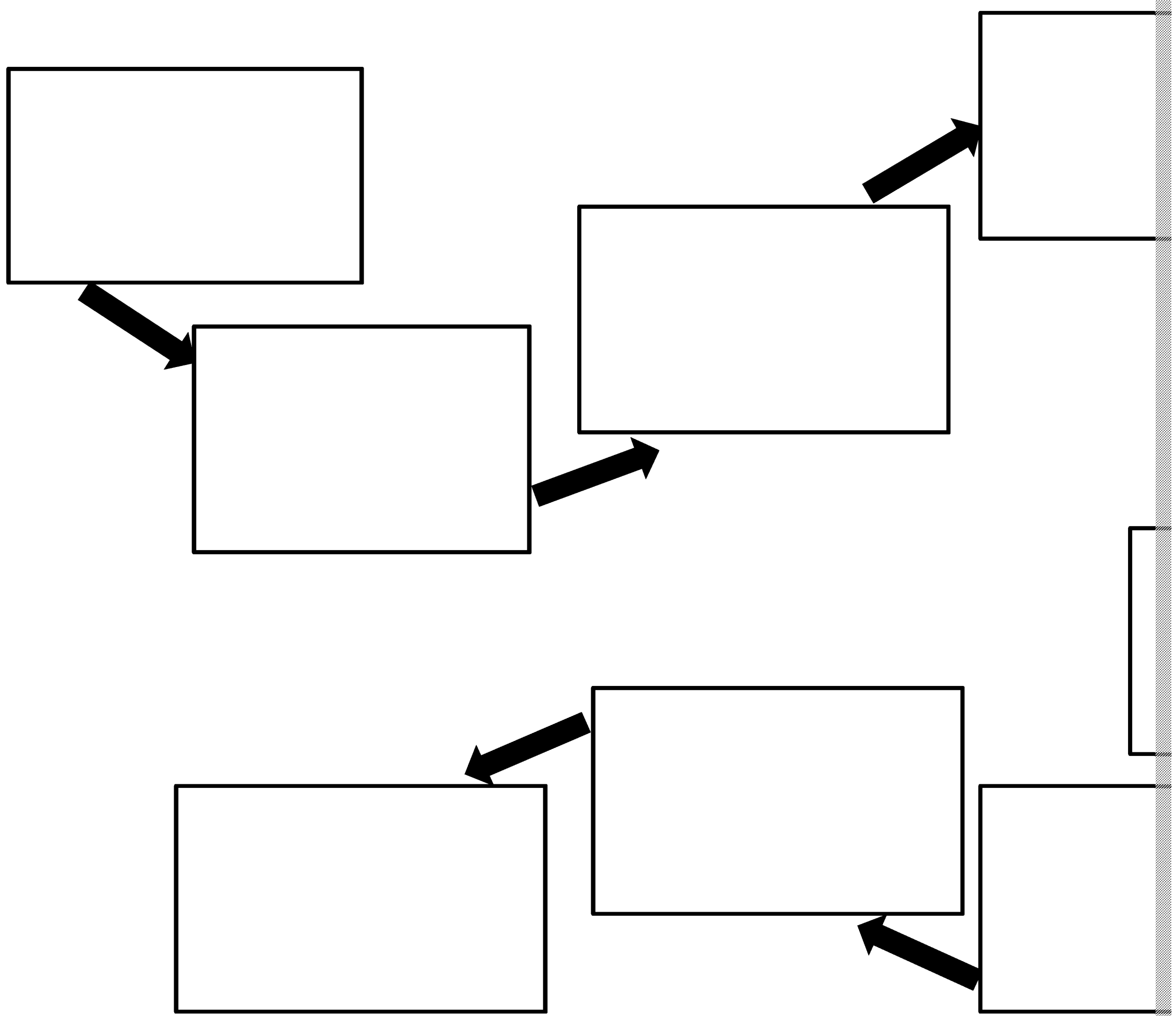
Activity 10: Periodicity

Activity name	Story chain
Aim	To recall information about the periodic table and what it show
Instructions	• Tell students that they will take it in turns to add sentence table and the information within it. They can include tren list element names. • You start the story with a sentence, such as 'Our present-d from one that was devised by Dimitri Mendeleev in the 19 • Then go around the class asking each student to voluntee • Leave sufficient time between sentences for: a) students to write down the sentence so they have a co b) time for them to compose the next sentence
Timings	5 minutes
Required prior learning	The periodic table from previous courses, such as GCSE.
Intended use	Starter/Plenary
Specification reference	Topic 1: Atomic structure and the periodic table (and possibly Topic 4: Inorganic chemistry and the periodic table)
Additional notes and guidance	• Students should have access to a periodic table. • You can set rules; for example, a maximum of one element limits on the number of non-scientific sentences. • The name Mendeleev is often wrongly pronounced as Men- pronunciation is Men-del-ay-eff.
Answers	Answers will vary, but the next two sentences could be: 'The periodic table is organised into groups and periods.' and 'T the periods are the rows.'

Activity 10: Periodicity — Story

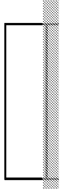
Make a copy of the story as it goes along.

This will help you compose your sentence when it is your turn.



Activity 11: Periodicity, group 2 and group 7

<table>
<tr><th>Activity name</th><td>Football</td></tr>
<tr><th>Aim</th><td>To assess understanding of these topics when they have all bee</td></tr>
<tr><th>Instructions</th><td>

Divide the class into two teams; each team nominates a captain. You, or a student, can be the referee. Tell students the duration of play is 10 minutes.
Draw the ‘pitch’ on the board. This consists of a rectangle with a centre line (0) and three additional numbered lines each side, between the centre line and the goal line, as shown.


Use an X for the ball and draw this on the centre line. Eac to the right.
The ball moves according to correct answers from a team. 3 points according to level of challenge. A team can confe can only be given through the captain.
For example, if team A wins the kick-off, they can elect to t This is chosen by the team and communicated to you via t point question and answer this correctly, then the ball mo towards the opponent’s goal line. If they get the question other team. If the other team gets it correct, then the ball m team A’s goal line. After a goal is scored, the ball returns t
Tell the students when full time has been reached.
Some questions are given on the accompanying sheet, whi students until after the game.
You should use one copy of the sheet to read the questions,

</td></tr>
<tr><th>Timings</th><td>15 minutes in total for 10 minutes of play.</td></tr>
<tr><th>Required prior learning</th><td>Coverage of periodicity, group 2 and group 7.</td></tr>
<tr><th>Intended use</th><td>Plenary</td></tr>
<tr><th>Specification reference</th><td>Topic 1: Atomic structure and the periodic table
Topic 4A: The elements of Groups 1 and 2
Topic 4B: The element of Group 7 (halogens)</td></tr>
<tr><th>Additional notes and guidance</th><td>The game could be played as hockey, netball, basketball, etc. if p
Additional aspects such as penalties, yellow cards, etc. could be i</td></tr>
<tr><th>Answers</th><td>
<table>
<tr><td>1.1 2, 8, 8, 2</td><td>2.1 two from: mercury, bromine, francium, rubidium, gallium</td><td>3.1 OC</td></tr>
<tr><td>1.2 increases</td><td>2.2 decreases</td><td>3.2 +1</td></tr>
<tr><td>1.3 increases</td><td>2.3 decreases</td><td>3.3 add silv for c bro chl am bro am</td></tr>
<tr><td>1.4 increases</td><td>2.4 increases from Na to Mg then decreases to Al and increases again to Ar (with a slight decrease at S)</td><td>3.4 les an e fro is p is u</td></tr>
</table>
</td></tr>
</table>

Answers continued	1.5 +2	2.5 reaction with water / reaction with alkali	3.5 ad of chl
	1.6 -1	2.6 where one species undergoes simultaneous oxidation and reduction	3.6 ph
	1.7 ionic	2.7 $MgSO_4$ is soluble whereas $BaSO_4$ is not	3.7 rad has thi she and
	1.8 p block	2.8 decreases because metallic bonding becomes weaker – atomic radius increases but number of delocalised electrons remains the same	3.8 the
	1.9 d block	2.9 decreases because electron affinity decreases – outer shell gets further from pull of positive nucleus	3.9 bot pro Ba dis fro

Activity 11: Periodicity, group 2 and group 7

You should receive this sheet of questions **after** the game for your reference.

Level 1 questions

1.1 Give the electron configuration in 2, 8, 8 format of calcium.
1.2 What is the trend in atomic radius going down a group?
1.3 What is the trend in reactivity going down group 2?
1.4 What is the trend in boiling point going down group 7?
1.5 What charge of ions do group 2 atoms most likely form?
1.6 What charge of ions do group 7 atoms most likely form?
1.7 What type of bonding will occur between a group 2 element and a group 7 el
1.8 Name the block of the periodic table that contains selenium.
1.9 Name the block of the periodic table that contains zinc.

Level 2 questions

2.1 Name two elements that are liquids at room temperature.
2.2 What is the trend in first ionisation energy going down group 2?
2.3 What is the trend in electron affinity going down group 7?
2.4 Describe the trend in first ionisation energy going across period 3.
2.5 Chlorine undergoes disproportionation in some reactions – give an example this happens.
2.6 What does *disproportionation* mean?
2.7 Compare the solubility of $MgSO_4$ and $BaSO_4$ in water.
2.8 Explain the trend in melting point going down group 2.
2.9 Explain the trend in oxidising ability of the halogens going down the group.

Level 3 questions

3.1 What is the formula for the hypochlorite ion?
3.2 What is the oxidation number of chlorine in hypochlorite?
3.3 Explain how to show whether a solution contains chloride or bromide ions.
3.4 Why does first ionisation energy decrease between Mg and Al?
3.5 Describe how to compare the solubility of group 2 hydroxides, starting with g soluble (no results are needed).
3.6 Name the elements in period 3 that exist as molecules.
3.7 Explain how the ionic radius of Na^+ compares with that of Cl^-.
3.8 How is CaO produced from $CaCO_3$ in industry?
3.9 When testing for sulfates, why must $BaCl_2$ be acidified?

Activity 12: Amount of substance

Activity name	You are the examiner
Aim	To assess understanding gained in the amount of substance topi
Instructions	• Students work in pairs. Provide students with the exempla mark schemes on the accompanying sheet. Students shoul sheet that accompanies the examination. If this is not avail periodic table and values of the Avogadro constant, molar • Students then devise their own question part and write a m separate piece of paper. Students should be encouraged to and not to just copy the examples and change the numbers. • Questions are then swapped between students and they att other's questions. • Answers are then given back to the setter for marking and
Timings	15 minutes
Required prior learning	Students must only set questions for each other based on the lea lessons on the same topic.
Intended use	Plenary
Specification reference	Topic 1, sub-topics 1–4: Atomic structure and the periodic table
Additional notes and guidance	• Students could also be given, or asked to select, real past ex from your centre's specification. • Students should not set multiple-choice questions for this ac involves understanding mark allocations in a calculation. • As an alternative to numerical scores based on marking poi comment-only marking. For example, 'You have gained a r 'You would have been awarded an additional mark if you h
Answers	Students' questions and mark schemes will vary, but they shoul exemplars shown here or actual past papers and mark schemes. material that is on the specification and be at an appropriate leve

Activity 12: Amount of substance – You are t

Study these exam-style question parts and mark schemes.

Use these to set your own questions and develop your own mark schemes. Mark separate sheet.

Try not to just copy the questions from here and change the numbers or substanc

Exam-style question 1

Pencil 'lead' is not actually lead but is graphite, which is a form of carbon. 'lead' and records the mass as 0.325 g.

Assuming the 'lead' is pure carbon, calculate the number of carbon atoms i

Mark scheme for exam-style question 1

number of moles of carbon seen as $\frac{0.325}{12}$ = 0.02708 / 0.027 / 0.0271 [1]
'0.02708' × 6.022×10^{23} answer in range 1.625×10^{22} to 1.632×10^{22} dependin of moles [1]

Exam-style question 2

A student makes two solutions:

- solution A which is 1.5 g of NaOH dissolved in water and made up to
- solution B which is 1.4 g of HCl dissolved in water and made up to 10

The student then mixes the two solutions for the reaction

$$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$$

to occur.

Show by calculation which reactant is in excess.

Mark scheme for exam-style question 2

relative formula masses 40 for NaOH and 36.5 for HCl [1]
number of moles of each 0.0375 for NaOH and 0.0384 for HCl [1] *accept corr*
HCl is in excess [1] *accept solution B*

Activity 13: Amount of substance

Activity name	Word grid
Aim	To allow students to recall keywords related to amount of subst
Instructions	• A student volunteers to come to the board and write a key of substance. • They write this across the centre of the board in capital lett • Another student then volunteers to come to the board and vertically across the first word, intersecting at a common le • This continues for the duration of the activity or until stud • All students, whether they get up to write a word or not, sh and write their meanings on the accompanying sheet.
Timings	5 minutes
Required prior learning	Amount of substance from GCSE or equivalent.
Intended use	Starter
Specification reference	Topic 1, sub-topics 1–4: Atomic structure and the periodic table
Additional notes and guidance	• Students should do the task from memory and not look up • If necessary, they can work in groups of two or three to de • To add significant challenge, a squared grid can be drawn be equally spaced in all rows and columns. This means tha be compressed to avoid crossing another if there are no co cannot be made to bend to seek out common letters in exist
Answers	Students will choose different words, but some common ones in • moles • concentration • mass • grams • volume • relative atomic mass • relative formula mass • moles per decimetre cubed

Activity 13: Amount of substance – Wo

For each of the keywords written in the word grid:

- write the word on this sheet
- write your own understanding of the meaning of this word (do not look up a

Keyword: ....

Meaning:..

....

Keyword: ....

Meaning:..

....

Keyword: ....

Meaning:..

....

Keyword: ....

Meaning:..

....

Keyword: ....

Meaning:..

....

Keyword: ....

Meaning:..

....

Keyword: ....

Meaning:..

....

Activity 14: Introduction to organic chemistry

Activity name	Questions for answers
Aim	To assess students' understanding of organic chemistry from pr
Instructions	• The accompanying sheet contains a series of answers. • Students work in pairs to write questions that would elicit • Once complete, then students swap their questions and ans for discussion. • The point here is that there could be more than one questio answer correctly.
Timings	10 minutes, to include discussion
Required prior learning	An understanding of organic chemistry from GCSE or equivaler
Intended use	Starter. The activity should assess prior understanding and pos
Specification reference	Topic 6A: Introduction to organic chemistry Topic 6B: Alkanes
Additional notes and guidance	Students should be encouraged to use appropriate command w grammatical questions. For example, if the answer was a displa the question could be 'Draw the displayed formula of methane.' displayed formula of methane?'
Answers	There are different questions that can elicit many of these answer these are: 1. Name the elements contained in a hydrocarbon. 2. State the general formula for an alkane. 3. Give the process that produces only carbon dioxide and wat 4. Name the compound with molecular formula C_3H_8. 5. Name the compound that can be produced by fermentation 6. Name the method used to separate the substances in crude 7. Write the molecular formula of propene. 8. Describe what makes carboxylic acids different from other

Activity 14: Introduction to organic chemistry – Qu

Each of these is an answer to a question.

Your job is to write the question that would correctly give the answer in each cas

1. **Answer:** carbon and hydrogen only

   Question: ....

   ....

2. **Answer:** $C_n H_{2n+2}$

   Question: ....

   ....

3. **Answer:** complete combustion

   Question: ....

   ....

4. **Answer:** propane

   Question: ....

   ....

5. **Answer:** ethanol

   Question: ....

   ....

6. **Answer:** fractional distillation

   Question: ....

   ....

7. **Answer:** C_3H_6

   Question: ....

   ....

8. **Answer:** they contain the –COOH group

   Question: ....

   ....

Activity 15: Introduction to organic chemistry

Activity name	Molecule jigsaw
Aim	To introduce structural isomerism in alkanes.
Instructions	• Remind students that a carbon atom forms four covalent b electrons in its outer shell. • In a hydrocarbon, the bonds can be either to hydrogen ato • The accompanying sheet contains drawings of six carbon a representing these covalent bonds. • Explain to students that sometimes the H symbol is omitte a hydrocarbon, and that will be the case in this activity. • Students work in pairs. They cut out the six 'jigsaw pieces' that an alkane containing 1, 2, 3, 4, 5 and 6 carbon atoms ca and be different. They do this by moving the pieces aroun
Timings	5 minutes
Required prior learning	An understanding of organic chemistry from GCSE or equivale
Intended use	Starter. The activity should introduce branch isomers in alkane
Specification reference	Topic 6A, subtopic 6: Introduction to organic chemistry
Additional notes and guidance	• Students may need reminding that they are representing s space, so a methyl group on the second or fourth carbon o the same molecule. • If students have already covered nomenclature, then they c they make.
Answers	The number of branch isomers for each total number of carbon a • 1 carbon – 1 isomer (methane) • 2 carbons – 1 isomer (ethane) • 3 carbons – 1 isomer (propane) • 4 carbons – 2 isomers (butane and methyl propane) • 5 carbons – 3 isomers (pentane, methyl butane and dimeth • 6 carbons – 5 isomers (hexane, 2-methyl pentane, 3 methyl and 2,2-dimethyl butane)

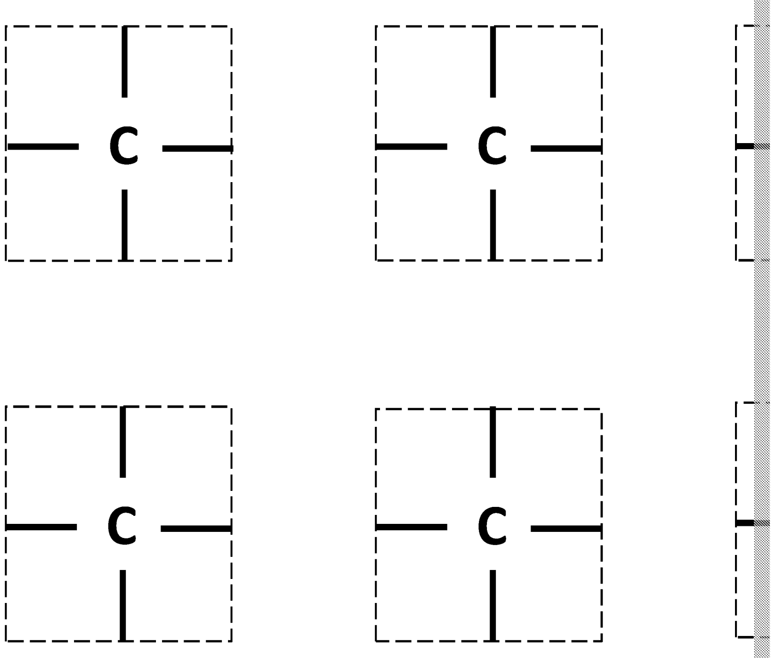
Activity 15: Introduction to organic chemistry – M

Cut out each of the jigsaw pieces along, or just inside, the dashed lines.

Each carbon atom can connect to one other if the two bonds (straight lines) join e

Move the pieces around to work out the number of ways of connecting them tog

- 1 carbon atom alone
- 2 carbon atoms
- 3 carbon atoms
- 4 carbon atoms
- 5 carbon atoms
- 6 carbon atoms



Activity 16: Alkanes

Activity name	60-second hot seat
Aim	To assess students' understanding of alkanes.
Instructions	• This game is a variation of 'hot seat' and the rules are base *Just a Minute*. • Students should be given 2–3 minutes to make some notes accompanying sheet. • One student volunteers to come to the front and sit in the ' the class for 60 seconds on the topic of alkanes, without ref o no repetition (except for words like 'the', 'a', 'an', etc. o no deviation from the topic o no hesitation or pauses o no scientific errors • The clock starts as soon as the student starts to speak. • Any other member of the class can challenge by clapping o above things have happened. The clock then stops. • If the challenge is incorrect (judged by you) then the stude 60 seconds to continue speaking. • If the challenge is correct (judged by you), then the challen 'hot seat' and continues to speak. In this case, the repetitio can repeat any of the words the previous student has used. • The winner is the student speaking in the hot seat when th
Timings	10 minutes, including explaining the rules
Required prior learning	The alkanes topic.
Intended use	Plenary
Specification reference	Topic 6B: Alkanes
Additional notes and guidance	Students can be allowed to discuss or decide whether a challeng than the teacher making a ruling.
Answers	Students will obviously speak about different aspects of the alka given should be correct.

Activity 16: Alkanes – 60-second hot s

Use this sheet to make some preparation notes on alkanes.

List things that you would speak about if you were in the 'hot seat'. Remember, y
you to the 'hot seat'.

Possibly include information about:

- the general formula

 ....

- the class of organic molecules to which alkanes belong

 ....

- the trend in boiling points

 ....

 ....

- uses of alkanes

 ....

 ....

- where alkanes come from

 ....

 ....

- reactions of alkanes

 ....

 ....

 ....

 ....

- anything else you consider relevant

 ....

 ....

 ....

 ....

Activity 17: Halogenoalkanes

Activity name	Comparing bonds
Aim	To introduce the properties of halogenoalkanes compared to alk
Instructions	• This is a think–pair–share activity. • Provide each student with the questions on the accompany to *think* about these but **not** write any answers yet. • Students then *pair* up and *share* ideas with each other. • They can then write the collaborated answers.
Timings	10 minutes
Required prior learning	Coverage of bond polarity from a previous AS topic (Topic 2A:
Intended use	Starter. The activity should get students thinking about why th properties of halogenoalkanes differ from alkanes.
Specification reference	Topic 6D: Halogenoalkanes
Additional notes and guidance	• This is an example of collaborative learning where the stude ideas of others on the same question. • As part of your formative assessment, you should listen to s
Answers	1. sharing of a pair of electrons 2. the tendency of an element to attract shared electrons in a co 3. fluorine 4. carbon, hydrogen 5. polar 6. a) oxygen is more electronegative than hydrogen so the b attracts the shared electrons closer to it b) chlorine is more electronegative than carbon so the bo attracts the shared electrons closer to it

Activity 17: Halogenoalkanes – Comparin

This is a ***think–pair–share*** activity.

- ***Think*** about each of these questions, but don't write any answers just yet.
- ***Pair*** up with one of your classmates.
- ***Share*** your ideas on each of the questions.

You can then write the answers that you have both agreed.

1. Describe **one** thing that is common to all covalent bonds.

   ....

   ....

2. Write a definition of *electronegativity* in your own words.

   ....

   ....

3. What is the most electronegative element?

   ....

4. Name **two** of the least electronegative elements that occur in organic compo

   1. ....

   2. ....

5. In one word, what is the property that describes a covalent bond between, fo
   - chlorine and hydrogen?
   - oxygen and carbon?

   ....

6. Describe how each of the elements in these bonds affects the bond between
   a) O–H

   ....

   ....

   ....

   b) C–Cl

   ....

   ....

   ....

Activity 18: Organic chemistry

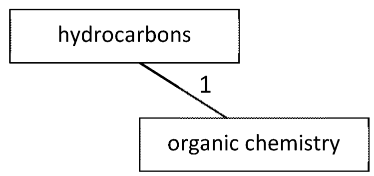
Activity name	Making a revision map.
Aim	For students to link all the concepts in organic chemistry, or a su
Instructions	• Allow students to work in groups of three or four. • Provide them with the accompanying sheet which has the s • Students work in their groups to complete the mind map. • Every line on the map should have a number; the first one i The next number should be 2, and so on. • After the mind map is complete, students write brief descri connect the concepts. This can be just a few words in each section below.
Timings	15 minutes
Required prior learning	Organic chemistry or any subtopics of it.
Intended use	Plenary
Specification reference	Topics 6A – 6E: Organic chemistry I
Additional notes and guidance	• Students could easily forget to include any aspect of organi They can look at a textbook or get a reminder from the teac the map. • Some students find the process of constructing a map like t learning than looking at it afterwards. If that is the case, th apply this activity to other topics.
Answers	Students will construct their maps in different ways, but a conce could be 'alkanes' and the line given a number 2. This could be hydrocarbons'. If the general formula for alkanes is not given its included in the description of the number 2. Otherwise, $C_n H_{2n+2}$ alkanes and the line given the number 3. This could be describe general formula'.

Activity 18: Organic chemistry – Making

Use this space to make a mind map of organic chemistry. Turn this into a revision map by:

- putting a number on each line connecting two concepts
- writing a short description of each number

The first one has been done for you.



1. This branch of organic chemistry deals with compounds that contain hydrogen and carbon only.
2. ....
3. ....
4. ....
5. ....
6. ....
7. ....
8. ....
9. ....
10. ....
11. ....
12. ....

continue on th

Activity 19: Organic analysis

Activity name	Advice for next year's class
Aim	For students to consolidate understanding and produce notes fo
Instructions	• Students work in pairs or in groups of three to produce gui the topic of testing for organic functional groups. • The guidance should include: o a list of the tests that are required o the method for each test with the positive result descri o labelled diagrams where appropriate o equations for reactions where appropriate o any other advice they think would be useful • Plans should be outlined on the accompanying sheet. • If time permits, some groups could show their finished pro the class.
Timings	15 minutes
Required prior learning	Theory and practical on the qualitative tests for functional grou acids, alkenes and aldehydes.
Intended use	Plenary
Specification reference	Topic 6, subtopics 25 & 38: Organic chemistry I Practical technique 4
Additional notes and guidance	• Encourage groups to be as creative as possible. The guidan For example, students could make a video of themselves ac podcast or produce a rap, or make a series of posts or social storyboard in cartoon form. • Ensure that students do not violate copyright (for example, or website and using it as if it were their own). • If students are going to make a video of themselves actually then this can be planned in written form only.
Answers	Students will choose different methods to present the informatio information from all five bullet points in the instructions above.

Activity 19: Organic analysis – Advice for next

Use this sheet to plan your advice for next year's class.

Step 1

Complete this table to help you plan what advice you need to give.

Functional group	Method for the test	C

Step 2:

Describe what extra advice you would like to give. Think about your own experience of this topic and anything you found challenging.

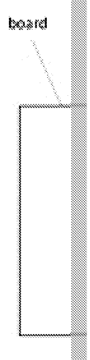
Step 3

Describe what form and style your guide will take. Be as creative as you can and make something that will appeal to next year's class.

Step 4

Outline your plan here. Remember to include how the class will access your guide

Activity 20: Mass spectrometer

Activity name	A simple visual model
Aim	To demonstrate how a mass spectrometer separator works.
Instructions	You will need: • large rigid board, such as 4 mm thick plywood – should be • magnet, which should be as strong as possible • thin wood blocks, ideally the same height as the magnet • small wood or plastic ramp • selection of steel ball bearings of different sizes • sandbox or something to catch the ball bearings and record 1. Set the board so it rests horizontally on the thin wood blocks. Place the magnet under the board and the ramp on top of the board as shown in this top-down diagram.  2. Before showing students, release the ball bearings, one at a time, from the ramp. Do this from the same height to ensure their speeds are approximately the same. 3. Use these trials to position the sandboxes. Their role is to record the position at which each ball bearing leaves the board. 4. Explain that the magnetic field from the magnet sorts the ball bearings according to their mass. 5. Use this as a starter for the mass spectrometer. 6. After the main lesson activity, return to the model and ask part of the model represents. This can be done on the acco
Timings	15 minutes
Required prior learning	None
Intended use	Starter
Specification reference	Topic 7A: Mass spectrometry
Additional notes and guidance	As an additional challenge, students could describe the strengths in representing mass spectrometry.
Answers	1. See diagram above 2. Ball bearings with a larger mass take a larger force to make 3. In this model: • the ball bearings represent ion fragments of varying m • the ramp represents the ion accelerator • the magnet represents the magnetic field that is used to • the sandbox represents the detector 4. a) Strengths of the model: • it is highly visual • movement is slow enough to see • the different motion of the different mass ball bea b) Limitations of the model: • does not show how the fragments are produced • the magnet bends the path of the ball bearings be not because they have charges that interact with it

Activity 20: Mass spectrometer – A simple vi

1. Draw a labelled diagram of the *model* of the mass spectrometer.

2. Explain what makes the path of the ball bearings different in this model.

   ....

   ....

   ....

   ....

3. List each part of the model and describe what it represents in a real mass spe

   ....

   ....

   ....

   ....

4. Explain
   a) the strengths of this model

      ....

      ....

      ....

      ....

   b) the limitations (weaknesses) of this model

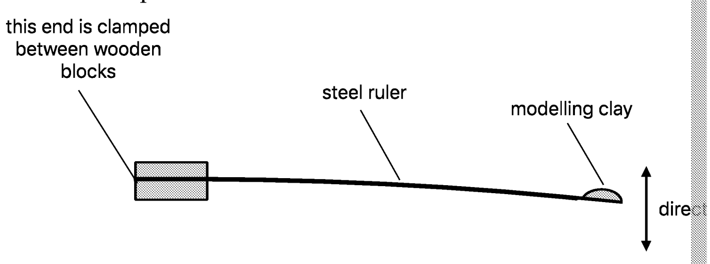
      ....

      ....

      ....

      ....

Activity 21: Infrared spectroscopy

Activity name	A model of molecular resonance.
Aim	To demonstrate what affects the differences in resonance in diff
Instructions	You will need: • a 30 cm steel ruler • 2 small wood blocks • a clamp stand • modelling clay • stopwatches 1. Use the wood blocks to clamp the steel ruler close to one en horizontal and with the measuring side top or bottom. 2. Attach the modelling clay to the end of the ruler, furthest fr 3. Displace this end vertically a little so that the end of the rul oscillates up and down.  4. Students time how many oscillations occur in 10 seconds. 5. Repeat this so that students can see the rate of oscillation is 6. Then ask what affects the rate of this oscillation: how could 7. Modify the set-up according to students' suggestions and te 8. Students can answer the questions on the accompanying sh infrared spectroscopy later in this lesson or in a subsequent
Timings	15 minutes
Required prior learning	None
Intended use	Starter
Specification reference	Topic 7B: Infrared (IR) spectroscopy
Additional notes and guidance	The activity can be revisited as a plenary after students have learn
Answers	1. See diagram in instructions 2. Variables affecting the rate of oscillation are: • mass of modelling clay used • length of the ruler extending beyond the clamp • distance from the clamp to the modelling clay • stiffness of the ruler 3. The parts represented are: • the ruler represents a covalent bond • the modelling clay represents a bonded atom or chemi • the displacement to start the oscillation represents the i 4. a) Strengths of the model are: • its simplicity • the ability to vary the key variables (listed above) b) Limitations include: • it is not possible to vary the frequency of the drivi the frequency of infrared would vary in a real infr • a covalent bond will behave in a different manner stretch as well as bend

Activity 21: Infrared spectroscopy – A model of mo

1. Draw a labelled diagram of the *model* that you saw earlier in the lesson.

2. Describe the variables that affect the rate of oscillation in the model and wha

   ....

   ....

   ....

   ....

3. List each part of the model and describe what it represents in a real molecule

   ....

   ....

   ....

   ....

4. Explain
   a) the strengths of this model

      ....

      ....

      ....

      ....

   b) the limitations (weaknesses) of this model

      ....

      ....

      ....

      ....

Activity 22: Energetics

Activity name	What did others learn?
Aim	To allow students to share learning and assess each other.
Instructions	• Ask students to move randomly around the room in differe possibly do this as getting them to model particle moveme • At some point say 'Stop' and the students stop moving. Th student closest to them. If there is an odd number, then all • The next part of the activity is timed by the teacher: o give 30 seconds for one of the pair to tell their partner about energetics o give a further 30 seconds for the partner to tell the first learned about energetics • Then, still in their positions, ask for volunteers to share wh Before responding, confirm with that partner that the infor • You can then either take more volunteers and allow class d each one, for a show of hands for whose partners also told • As this activity is an entirely spoken one, there is no accom
Timings	Approximately 10 minutes to allow instructions to be given and
Required prior learning	Students must be asked to relate the learning in that lesson or p same topic.
Intended use	Plenary
Specification reference	Topic 8: Energetics
Additional notes and guidance	• There is no student sheet for this activity. • It does not matter if one pair of students tell each other the s will further consolidate learning. • The number of learning outcomes to be stated and the timin as needed. • Students could also be asked whether they learned anything whether their partner told them something that they hadn't remembered themselves.
Answers	Each student will respond differently, based upon the informatio partner. There will be some common themes and the main learn identified in their answers.

Activity 23: Energetics

Activity name	Enthalpy anagrams
Aim	To revise the key terms in the topic of energetics.
Instructions	• Students work in pairs. Each student chooses a keyword (c energetics and scrambles the letters, using only capitals. • They can use the accompanying sheet, which can be folded and any planning that they have done. • Where there is more than one keyword, then each one shou For example, Hess's law could become SEHSS AWL • The anagrams are swapped for their partner to solve. • This is done one anagram from each student at a time. • If a partner is struggling, then a clue can be given by the ot clue for Hess's law could be 'The basis for constructing an e • Once both partners have solved their anagrams, they each v process repeats.
Timings	5 minutes
Required prior learning	The topic of chemical energetics.
Intended use	Plenary
Specification reference	Topic 8: Energetics
Additional notes and guidance	• Emphasise to students the importance of having the correct otherwise it will be impossible to solve. They should check before scrambling it if unsure. • There are free-to-use websites that will create (and solve) an have access to these during the activity.
Answers	Students who are struggling could be given clues. For example, could have a clue such as 'The second word is LAW.' or 'This m for a reaction is independent of the route taken provided the in the same.'

Activity 23: Energetics – Enthalpy anag

Use this sheet to write your anagrams, *one at a time*. Then pass it to your partne
solve each one. They pass the sheet back to you, and you set another one.

Use keywords from the topic of energetics.

Anagram 1: ....

Solution:

....

Anagram 2: ....

Solution:

....

Anagram 3: ....

Solution:

....

Anagram 4: ....

Solution:

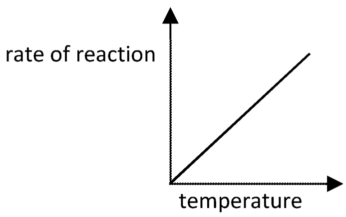
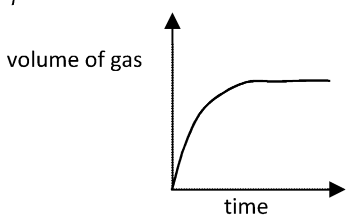
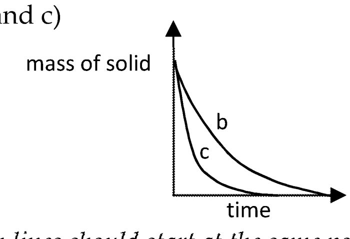
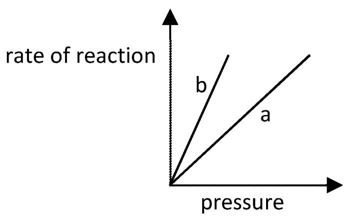
....

Anagram 5: ....

Solution:

....

Activity 24: Kinetics

Activity name	Sketch the graph
Aim	To assess students' understanding of rates of reaction through s
Instructions	• The accompanying sheet has a series of questions and blan answer these. Depending on the class, students can do thi in pairs. • Each answer should be a line, or lines, drawn on the axes to in the question. Where there are two lines, these should b be added.
Timings	5 minutes
Required prior learning	An understanding of the kinetics topic at a qualitative level onl
Intended use	Plenary
Specification reference	Topic 9: Kinetics I
Additional notes and guidance	• Students should be reminded that sketch graphs should ha numbers or units need to be added. • Students can find sketching and interpreting graphs to be c support with this. One way to do this is to provide the ans (incorrect) sketch graphs and allow the students to match t
Answers	1.  *accept a line that curves up slightly* *accept a line that starts above the origin, as the temperature coul* 2. a)  b) and c)  *both lines should start at the same position* *line c should reach the time axis before line b* 3. a) and b) *accept lines levelling off or decreasing in gradient* 

Activity 24: Kinetics – Sketch the gra

You may have heard the expression 'A picture is worth a thousand words.' In scie
same way.

For each of these questions, sketch a graph on the axes provided.

Remember:

- label the axes with quantities, but you do **not** have to add numbers or units
- where there is more than one line, label the lines or add a key

1. Show how the rate of reaction between two gases depends on temperature.

2. A reaction between a solid and a solution produces a gas.
   a) Show how the volume of gas produced varies with reaction time until the reaction is complete.

   b) Show how the mass of the solid varies with reaction time until completion.
   Assume the solid is in excess.

   c) Add another line to the graph in part b) to show how the mass of the same solid varies when its surface area is greater.

3. Show how the rate of reaction between two gases varies with pressure
   a) in the absence of a catalyst

   b) in the presence of a catalyst

Activity 25: Chemical equilibrium

Activity name	Fill the bowl game
Aim	To introduce the concept of dynamic equilibrium.
Instructions	• Place an equal volume of water in two large plastic bowls. large outdoor space. Bowls should be at least 4 m apart. • Give two student volunteers one identical plastic beaker ea beside one bowl of water. • The aim is for each student to fill their opponent's bowl usi simple rules: o the students cannot touch the bowls o neither the students nor their clothing should become o the students cannot throw water o only the beakers provided can be used, and water mus • Stop the activity before the level of water in the bowls beco • After the activity, pose the questions from the accompanyi **Risk assessment** – ensure that students are wearing suitable foo going to become slippery when wet; there should be no tripping plastic beakers and bowls should be used.
Timings	5 minutes
Required prior learning	Coverage of equilibrium or reversible reaction from GCSE or eq
Intended use	Starter. The activity should introduce branch isomers in alkanes
Specification reference	Topic 6A, subtopic 6: Introduction to organic chemistry
Additional notes and guidance	• This activity is designed to overcome the misconception tha situation where reactions stop. • Students can write their answers on the sheet or discuss the • Modelling concepts in science can help concrete thinkers to however, all models have limitations as well as strengths. S discuss this model after studying equilibrium and Le Chate
Answers	1. - the movement of the water is the chemical reaction - the water in the bowls is the reactants and products - the transfer of water in each direction is the forward an - the fact that the level doesn't change much shows the s - the fact that water keeps moving shows it is a dynamic 2. - transfer water faster than the other person (with the sa transfer water with another beaker - use a larger beaker than the other person 3. increase the rate of one of the reactions 4. - the substance in both bowls is the same, whereas the p different and can be in different states - substances are not transferred from one place to anoth - there would be no way to model changes in pressure / a catalyst - the model works on a macro (large) scale whereas react (small) scale

Activity 25: Chemical equilibrium – Fill the b

After doing the activity with the water in the bowls, think about these questions:

1. How does this activity model chemical equilibrium?

Hint – describe what each part of the model represents.

....

....

....

....

....

....

2. Give **two** ways that you could fill your opponent's bowl faster than they fill y of the rules.

   1. ....

      ....

   2. ....

      ....

3. Explain how the methods that you describe in question 2 are related to chem suggestions may have only one equivalent in chemistry.

....

....

4. You may recall the Haber process, which is an example of an equilibrium reac

$$3H_2 + N_2 \rightleftharpoons 2NH_3$$

Use this example to list the limitations of the water bowl model.

Hint – explain the ways in which the model does not properly represent a rea

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Activity 26: Chemical equilibrium

Activity name	Two truths and a lie
Aim	To revise the key concepts of chemical equilibrium.
Instructions	• Give students 2–3 minutes to write three statements about t two of which must be true. They can do this on the accomp folded over so that others cannot see what they are writing • After this, students can volunteer, one at a time, to come to statements. These should be read as 'Statement 1', 'Stateme copy these down. • After the three statements are read out, the student asks the hands for whether each statement in turn is true. The stude hand up why they voted that way. • The process is repeated as time permits.
Timings	10–15 minutes depending on class size
Required prior learning	The topic of chemical equilibrium.
Intended use	Plenary
Specification reference	Topic 6A, subtopic 6: Introduction to organic chemistry
Additional notes and guidance	Students should be reminded that, just as in multiple-choice ques always be true.
Answers	Statements will vary, but an example of one set could be: • Statement 1 – Le Chatelier's principle only applies to reactio solution, such as ester formation. (False, it also applies to rea the gas phase, such as the Haber process.) • Statement 2 – Increasing the pressure in a gas equilibrium w that produces the smaller number of moles. (True) • Statement 3 – Adding a catalyst to an equilibrium reaction v be formed. (True)

Activity 26: Chemical equilibrium – Two trut

Write three statements about the chemical equilibrium topic.
Two of them must be true and one of them should be false (in any order).
You can then volunteer to read these to the class.

Statement 1

....

....

Statement 2

....

....

Statement 3

....

....

You can use the space below to make notes on other students' statements.

Clue giver:	Statements	Truth or lie?