Year 11 2020-2021

Half Term 2 (Autumn 2)

(Students will sit AP1 at the end of this term)

GCSE Chemistry C5 Chemical Changes			
What are we learning?	What knowledge, understanding and skills will we gain?	What does excellence look like?	What additional resources are available?
Reactions between acids and alkalis at an atomic level. How the reactivity series helps us predict reactions involving metals	**Knowledge** • Definitions of reactivity series, displacement reactions, neutralisation, salt, concentration, strength, soluble, insoluble, acids / alkalis and bases, oxidation and reduction • Rules of naming compounds • More reactive elements will take the place of lesser reactive ones • That reacting substances form new products containing the same number and type of elements - conservation of mass in reactions • Methods of making salts / measuring pH **Understanding** • The behaviour of a substance in reaction evidences the reactivity of it • Explanation of why displacement reactions cannot be used to extract all metals and appropriate choice of reactants for those that can • Successfully predicting the products for displacement and neutralisation reactions • Explanation of the method chosen to make a specific salt including selection of reactants • Comparing strength and concentration of acids and alkalis • Evaluating the methods of measuring acidity or alkalinity **Skills** • Make predictions based on scientific knowledge • Risk assess practical • Write detailed observations of chemical reactions / practical investigation • Take steps in practical to be able to determine repeatability and reproducibility of results • Constructing word and symbol equations using symbols to represent elements and compounds • Balance symbol equations	Linking to atomic structure to explain the order of elements in the reactivity series. Linking to atomic structure and structure and bonding topics to explain how news bonds in the products would have been formed (formation of ions) Confidently construct half equations for displacement reactions Understanding of the term redox reaction and independently investigate examples Selection of the correct reactants and process to make salts and an detailed scientific explanation of this or evidence or practical performed.	BBC Bitesize Doddle – power points and quick quizzes You tube: 'Free science lessons' Seneca learning platform

Scheme of Work 2020-2021

Subject: GCSE Science：C5 Chemical changes (Reactions in our Daily Lives)

Year Group: 10 /11

Specification: AQA Combined Science Trilogy

Skill focus: 3, 7,9,11, 18

Lesson No	Topic & Objectives	Big Question – What will students learn?	Key Activities & Specialist Terminology (Do Now Task / Starter/Tasks/Plenary	Planned Assessment	Homework or flipped learning resources DODDLE resources	Lit Num SMSC Codes
C5.1 The reactivity series	**Aiming for Grade 4 LOs:** • List the order of common metals in the reactivity series. • Use general equations to write specific word equations for metals listed in the reactivity series reacting with oxygen, water, and acid. • Safely make and record observations. **Aiming for Grade 6 LOs:** • Describe oxidation and reduction in terms of gain or loss of oxygen. • Write word equations for the metals listed in the reactivity series reacting with oxygen, water, and acid, and balance given symbol equations. • Predict observations for the metals listed in the reactivity series	Iron is one of the most commonly used metals in the world – where does metal come from? How could the weather (inc. acid rain) effect air transport? (or not?)	**Starters** **Metals and water** (10 minutes) Explain to students that when lithium is put in water it reacts vigorously but when magnesium is put in water there is no observable reaction. Then explain that calcium's reactivity is between these two metals. Ask students to predict what observations they would therefore expect to see. **Main** **Metals and acids** (40 minutes) Ask students to plan an investigation to determine the order of reactivity between copper, aluminium, zinc, iron, and magnesium when reacted with acid. Encourage students to write word and balanced symbol equations for all of the metals that react. They should also write a list of the metals from most to least reactive. If there is time, students could carry out part of their investigation. **Plenaries**	C1: Preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate, using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution = 8.2.1, 4.4.2.3, C4.8 QnA between teachers and students	Doddle: AQA Reactivity of metals mini quiz Reactivity series worksheet	So3 C3 Sp2 C8 Sp9 C5 So7

	reacting with oxygen, water, and acid. • **Aiming for Grade 8 LOs:** • Justify uses of metals in the reactivity series based on their chemical reactivity. • Write balanced symbol equations, with state symbols, for the metals listed in the reactivity series reacting with oxygen, water, and acid. • Evaluate in detail the investigation of metals plus acid, assessing the control of variables and the validity of conclusions drawn from the data collected.		**Bridges** (10 minutes) Show students a picture of a steel bridge and an iron bridge. Ask students to justify the use of each material for the purpose (strong, malleable). Then ask students to suggest why the maintenance of the iron bridge is greater than the steel bridge (iron reacts with the environment to form rust, steels are an alloy of iron and other elements and some types can resist rusting). Keywords: Reactivity Series Ores Oxidised Reduced Reaction Metals Group 1 Dilute	Written responses to questions Class discussion		
C5.2 Displace ment reactions	**Aiming for Grade 4 LOs:** • Recall a definition of a displacement reaction. • Use the reactivity series to determine whether a reaction between a metal and a different metal salt will occur. • Safely make and record observations. **Aiming for Grade 6 LOs:** • Explain why a displacement reaction occurs. • Write word equations and straightforward balanced symbol equations for displacement reactions. • Predict observations for the metals listed in the reactivity series reacting with a different metal salt. **Aiming for Grade 8 LOs:** • **Describe displacement reactions using an ionic equation.**	How do these reactions build our public transport links? (thermite welding of rail tracks) How can iron help us produce copper?	**Starters** **Classify** (5 minutes) Students use the student book to classify the statements to define oxidation and reduction: • Gain of oxygen (oxidation) • Loss of oxygen (reduction) • Gain of electrons (reduction) • Loss of electrons (oxidation) **Displacing a metal from solution** (10 minutes) Set up the practical to displace lead from lead nitrate solution with zinc. Encourage students to predict what will happen by writing word and balanced symbol equations with state symbols. Higher-tier students should write ionic equations for this reaction. **Mains** **Predicting reactions** (40 minutes) Students complete the displacement reactions of metals investigation. Encourage	QnA between teachers and students Written responses to questions Class discussion Ionic equations from practical task	Doddle: Displacement reactions of halogens interactive	So3 C3 C2 Sp2 Sp9 C5 So7

	• Write balanced symbol equations, with state symbols, for displacement reactions. • **Determine and explain which species is oxidised and which species (metal atom or ion) is reduced in a displacement reaction in terms of electron transfer.**		students to write the equations for the reactions that occur. **Plenaries** **Displacing a metal from solution revisited** (5 minutes) Revisit the displacement of lead from lead nitrate solution by zinc. Discuss what has happened. Have students determine and explain which species has been oxidised and which has been reduced in terms of electron transfer. **Displacement reactions** (10 minutes) Students use the interactive to complete a series of word equations describing displacement reactions. Students then choose the correct chemical formula symbols to complete some balanced symbol equations for displacement reactions Keywords: Extracting Metals Ores Concentrated Purified Reduced Electrolysis Molten Reduction Oxidation Reactive			
C5.4 Salts from metals	**Aiming for Grade 4 LOs:** • Recall a definition of a salt. • Name a salt formed between a metal and sulfuric acid or hydrochloric acid. • Recall a general equation for a metal reacting with an acid and use it to write specific word equations. **Aiming for Grade 6 LOs:** • Describe how to make a salt by reacting a metal with an acid. • Write a balanced symbol equation to describe a reaction between a metal and sulfuric acid or hydrochloric acid.	What could be the consequences of a life without salt? 7% of salt production in Europe is food grade – what happens to the rest?	**Starters** **Diagram** (5 minutes) Draw a labelled diagram to show how to separate a sample of dry salt that has been dissolved in water to form a solution. **Salts from metals** (10 minutes) Interactive where students complete the general word equation for the reaction of an acid and a metal to form a salt and hydrogen. They then order sentences to explain how salts are made. **Mains** **Planning to make a salt** (30 minutes) Students plan a method for making a zinc salt from reacting zinc with an acid. Ensure that the plan is checked then allow students to make a sample of the dry zinc salt. The final drying and	QnA between teachers and students Written responses to questions Class discussion	Doddle: Salt production mini quiz	So3 C3 Sp2 Sp9 Sp1 C5 So7

	• Identify the chemical formula of the salt produced from the reaction between an acid and a metal. **Aiming for Grade 8 LOs:** • **Explain the reaction between a metal and an acid.** • **Write ionic and half equations, including state symbols, to describe a reaction between a metal and sulfuric acid or hydrochloric acid.** • **Identify and explain in detail which species is oxidised and which is reduced.**	Are all salts the same?	collection of the crystals can take place next lesson or plans can be collected and checked this lesson before the practical is tackled next lesson. Students should write the word equation and balanced symbol equation for the reaction they investigate. This practical could be used for Required practical 1, however differentiated Required practical resources are not available on Kerboodle. **Explaining** (20 minutes) This activity can be done whilst students' crystals are drying. Wearing eye protection, demonstrate magnesium (highly flammable) reacting with sulfuric acid (irritant) by putting 5 cm length of ribbon into half a test tube of dilute sulfuric acid. Put a boiling tube over the end to collect the gas and perform the squeaky pop test for hydrogen. Then discuss the explanation of the reaction between magnesium and sulfuric acid, given in the student book. Students then predict what would happen when calcium (highly flammable) is put into hydrochloric acid. Demonstrate this reaction. Ask students to explain the reaction in terms of oxidation and reduction illustrating their answer using word, balanced symbol equations with state symbols, ionic equations, and half equations. **Plenaries** **Finish the sentence** (5 minutes) Ask students to complete the following sentences: • A salt is ... • When sulfuric acid reacts with a metal ... • A spectator ion is ... Keywords: Spectator ion Salts Metals Redox Oxidation Reduction Equations Electron transfer Acid Chlorides	Completing the method for making salt practical		

			Sulphates Nitrates			
C5.5 Salts from insoluble bases	**Aiming for Grade 4 LOs:** • Safely prepare a pure, dry sample of a soluble salt from an insoluble base and a dilute acid. • Name a salt formed between a metal hydroxide or metal oxide and sulfuric acid or hydrochloric acid. • Recall a general equation for a base reacting with an acid and use it to write specific word equations. **Aiming for Grade 6 LOs:** • Describe a method to prepare a pure, dry sample of a soluble salt from an insoluble substance and a dilute acid. • Write a balanced symbol equation to describe a reaction between a metal hydroxide or oxide and sulfuric acid or hydrochloric acid. • Explain why the reaction between a base and a dilute acid is a neutralisation reaction. **Aiming for Grade 8 LOs:** • **Explain the reaction between a metal oxide or metal hydroxide and an acid, including an ionic equation.** • Generate the formulae of salts given the names of the metal or base and the acid • Explain how alkalis are a subgroup of bases.	How do copper sulphate crystals link to swimming pools? (used in swimming pools as an algicide) Copper sulphate – fish friend or foe?	**Starters** **Salts from insoluble bases** (5 minutes) Provide students with a list of acid and metal oxide reactions. Students identify the name and formula of the salt that will be formed. **Alkalis and bases** (10 minutes) Draw a table with three headings – bases, alkalis, both bases and alkalis. Students sort the following into the appropriate column of the table. • Dissolve in water (alkali) • React with acids (both bases and alkalis) • NaOH (alkalis) • Metal hydroxides (both bases and alkalis) • Copper oxide (bases) • Have a pH greater than 7 (both bases and alkalis) **Main** **Making a copper salt** (40 minutes) Give students the method for making copper sulfate crystals. Students write their own risk assessment and then complete the practical to make a sample of the dry copper salt. This practical could be used for Required practical 1, however, differentiated **Plenaries** **Equations** (5 minutes) Ask students to write word equations and balanced symbol equations for all the reactions met in the lesson. Students then use their equations to explain why the reaction of a base and a dilute acid is a neutralisation reaction. High-tier students should also write ionic equations.	QnA between teachers and students Written responses to questions Class discussion Completed practical	Doddle: Preparation of salts mini quiz	So3 C3 Sp2 Sp9 C5 Sp5 So7

			Explaining procedure (10 minutes) Ask students to review the method to make a copper salt and explain the following: • Copper oxide was in excess (the black reactant left over in a suspension, as all the acid needed to be neutralised). • The residue is discarded (this is the unreacted copper oxide and as such is an impurity in the preparation). • The filtrate is heated and volume reduced by half (to create a hot saturated solution, which on cooling will crystallise out into larger, well-formed crystals of the hydrated salt). Keywords: Soluble Insoluble Neutralisation Salt water Base Salt Ions Crystallised Filter paper			
C5.6 Making more salts	**Aiming for Grade 4 LOs:** • Safely make a salt by reacting a metal carbonate with a dilute acid. • Write a general word equation for metal carbonates and alkalis reacting with dilute acids and use this to make specific word equations. **Aiming for Grade 6 LOs:** • Describe how to make a dry sample of a salt from reacting a metal carbonate or an alkali with a dilute acid. • Write balanced symbol equations for neutralisation reactions.	How can we use this information to undo damage caused by acid rain? (powdered limestone heli dump into rivers and lakes) The global fertiliser market is expected to be worth r $245 billion in 2020 – what's all the fuss about?	**Starters** **General equations** (10 minutes) Ask students to use the following equations to generate a general word equation for the reaction. a) sodium hydroxide + hydrochloric acid → sodium chloride + water $KOH + HNO_3 \rightarrow KNO_3 + H_2O$ $OH_{-} + H^+ \rightarrow H_2O$ (acid + alkali → salt + water) b) calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide $CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + H_2O + CO_2$ (metal carbonate + acid → salt + carbon dioxide + water)	QnA between teachers and students Written responses to questions Class discussion Completed method, observations and equations for salt practical	Doddle: How is salt obtained from copper oxide powder animation	So3 C3 Sp2 Sp5 Sp9 C5 So7

	Aiming for Grade 8 LOs: • Explain the reaction between ammonia and dilute acids to produce salts and the agricultural importance of the salts. • Describe neutralisation using ionic equations, including the ionic equation for a carbonate plus an acid.		**Mains** **Making a salt from a metal carbonate** (40 minutes) Demonstrate a metal carbonate reacting with an acid in a boiling tube. Ask students to make their observations. Then ask them to write a method for making a salt from a metal carbonate reacting with a dilute acid. Students should illustrate the reaction with an equation. Encourage students to explain the observations that they could make which shows all of the acid has reacted. They then carry out the practical, collecting the pure, dry crystals next lesson. **Plenaries** **Explain** (5 minutes) Ask students to explain neutralisation by annotating a balanced symbol equation. They should highlight the 'acid particle' in red, the 'alkali particle' in blue, and water molecule in green. **Justify** (10 minutes) Ammonium sulfate ($(NH_4)2SO_4$) and ammonium nitrate (NH_4NO_3) can both be used as fertilisers. Ask students to justify which fertiliser they would choose. Keywords: Indicator Acids Alkalis Ammonia Salt Titration Carbonate Volume Crystallise			
C5.7 Neutralisation and the pH scale	**Aiming for Grade 4 LOs:** • Safely use universal indicator to classify a solution as acidic or alkaline. • Describe the pH scale. • Recall an example of an alkaline, neutral, basic, and acidic chemical. **Aiming for Grade 6 LOs:**	How can we use this information to undo damage caused by acid rain? (powdered limestone heli dump into rivers and lakes)	**Starters** **Guess the pH** (5 minutes) Ask students to write the word equation for the reaction of hydrochloric acid with sodium hydroxide. They should then annotate their predictions of the pH for each chemical–hydrochloric acid (pH 1), sodium hydroxide (pH 14), and sodium chloride solution/water (pH 7).	QnA between teachers and students Written respones to questions	Doddle: PH change during neutralization animation Neutralisation worksheet	So3 C3 C5 Sp2 Sp9

	• Describe how universal indicator can be used to classify a chemical as acidic or alkaline. • Describe how solutions can be acidic or alkaline. • Describe the relationship between alkalis and bases. **Aiming for Grade 8 LOs:** • Evaluate how universal indicator or a data logger can be used to determine the approximate pH of a solution. • Use ionic equations to explain how solutions can be acidic or alkaline. • Explain how the pH of a solution changes as acid or alkali is added.	The global fertiliser market is expected to be worth r $245 billion in 2020 – what's all the fuss about?	**pH scale** (10 minutes) The pH scale is a logarithmic scale. Choose students to aid with demonstrating the pH scale practical to illustrate the difference in concentration of each number on the pH scale. **Main** **Obtaining a pH curve** (40 minutes) Explain to students that they are going to add hydrochloric acid to sodium hydroxide. They should predict how the pH changes as the 1 cm3 increments are added. Then allow students to complete the practical outlined. Students should draw a line graph with a line of best fit to display their results. **Plenaries** **The pH scale** (5 minutes) Call out pH values, colours of universal indicator, and other statements that describe acids and alkalis. Students have to classify whether each statement or value is describing an acid or an alkali. **Justify** (10 minutes) Ask students to work in small groups to evaluate the method for generating a pH curve and suggest improvements. Then ask each group to feed back one of their ideas. Keywords: Neutralisation pH acid alkali solution solute solvent base aqueous neutral alkalinity probe indicator	Class discussion Completing PH curve from practical	AQA The PH scale mini quiz	C5 So7
C5.8 Strong and weak acids	**Aiming for Grade 6 LOs:** • Recall examples of strong and weak acids. • Describe how an acid or alkali can be concentrated or dilute.	Will this acid 'burn' through my hand?	**Starters** **Strong and weak acids** (5 minutes) Students complete the paragraph to describe the difference between strong and weak acids, and how the pH of an acid is affected by acid	QnA between teachers and students	Doddle: Magnesium and hydrochloric acid animation	So3 C3 Sp2

(higher only)	• Describe how an acid or alkali can be weak or strong. **Aiming for Grade 8 LOs:** Explain the difference between concentration and strong or weak in • terms of acids and alkalis. • Use ionic equations to explain how acids can be strong or weak. Quantatively explain how the concentration of hydrogen ions relates • to the pH number.	Is it actually possible to dispose of a body with acid? How can sulphuric acid be safe enough to use in school laboratories?	strength and concentration. Then give students a list of acids to classify as strong or weak acids. For example: • Hydrochloric acid (strong) • Citric acid (weak) • Ethanoic acid (weak) • Sulfuric acid (strong) • Nitric acid (strong) **Acids: formulae and equations** (10 minutes) Ask students to write an equation to show the ionisation in water of ethanoic acid and hydrochloric acid. **Mains** **Comparing acids** (30 minutes) Ask students to design a results table to record their observations. Allow students to investigate the two acids and then ask them to conclude which is the stronger acid and to explain how they know. **pH and H^+ concentration** (10 minutes) Students use the calculation sheet to work through some calculations on H+ concentration and pH values. **Plenaries** **Concentrated and dilute** (5 minutes) Wearing eye protection put 10 cm^3 of 0.1 mol/dm^3 hydrochloric acid into a 250 cm^3 beaker. Then add water to dilute the acid, using a pH probe to monitor the pH. Ask students to explain this observation. **Diagram** (10 minutes) Ask students to use the particle model to depict the following situations: • Dilute weak acid • Concentrated weak acid • Dilute strong acid • Concentrated strong acid Water particles could be shown as blue circles, the acid as a red particle labelled HA, the H^+ as a red particle, and the negative ion as a white particle labelled A^-. Keywords: Solutions	Written responses to questions Class discussion Completed results table	Reactions of acids mini quiz	Sp9 C5 So7

			Weak Strong Acid Alkali Concentrated Equilibrium pH Carboxylic Order of magnitude			

GCSE Physics P7 Radioactivity			
What are we learning?	What knowledge, understanding and skills will we gain?	What does excellence look like?	What additional resources are available?
The type of radiation, the dangers and the uses of these.	**Knowledge** • Describe types of radiation, alpha, beta and gamma • Be able to list properties of different types of radiation • Define half life • Give some uses of radiative substances • List the safety precaution that should be taken when dealing with radioactive substances **Understanding** • Link the structure of the radiation to its properties and uses • Evaluate whether the benefits of radioactive substances outweigh the associated risks (e.g. use of nuclear power stations and medicine) • Link properties of radiation and half-life to evaluate the danger of a given radioactive substance • Explain how the Rutherford scattering experiment led to the development of the atomic structure **Skills** • Use of symbols in chemical equations to predict reactants/products • Compare: describe the similarities and/or differences between things • Suggest: apply knowledge and understanding to a new situation.	Being able to link and relate several ideas together in order to determine the appropriate hazard of a given radioactive material. Own research project on the use of radioactive substances (such as Chenobyl) and considering the social, economic and environment impact of its use before and after a meltdown Detail timeline and description of how scientific experiments have changed our understanding of atomic structure over time including consideration of how these ideas came to accepted as scientific truths.	BBC Bitesize Doddle – power points and quick quizzes You tube: 'Free science lessons' Seneca learning platform

Scheme of Work 2020-2021

Subject: GCSE Science: P7: Radioactivity

Year Group: 10 /11

Specification: AQA Combined Science Trilogy

Skill focus: 18, 20d and e

Lesson No	Topic & Objectives	Big Question – What will students learn?	Key Activities & Specialist Terminology (Do Now Task / Starter/Tasks/Plenary	Planned Assessment	Homework or flipped learning resources DODDLE resources	Lit Num SMSC Codes
P7.1 Atoms and Radiation	**Aiming for Grade 4 LOs:** • Name the three types of nuclear radiation. • Name the three sub-atomic particles found in an atom (proton, neutron, and electron). • Identify some sources of background radiation. **Aiming for Grade 6 LOs:** • Describe some safety precautions used when dealing with radioactive materials. • Describe how a Geiger counter can be used to detect radiation. • Identify natural and man-made sources of background radiation. **Aiming for Grade 8 LOs:** • Describe in detail the decay of an unstable nucleus.	How likely are you to find a radioactive rock? Should experiments with radioactive substances be conducted? What happened when atoms become unstable?	**Lesson Overview** **Starters** **Look alike** (5 min) Ask students to draw and label an atom and discuss whether it is a realistic model. Show the students some caricatures of famous people to see whether these capture the essence of each person. **Atom models** (10 min) Ask students to draw some simple atomic models. Ask them to note any of the properties of the sub-atomic particles that they already know, for example, from studying electricity or from atomic structure in chemistry. **Main** **Investigating radioactivity** (40 min) Discuss the discovery of nuclear radiation, outlining the initial evidence and the efforts made to explain it. Show how the Geiger counter can be used to detect nuclear radiation, starting with a background count. Some sample rocks or salts can be used to show that natural substances are radioactive.	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** What are the sources of background radiation? Why do they change depending on location? **Doddle task:** How was radioactivity discovered? (animation)	C3 C3

	• Explain the similarities and differences between nuclear radiation and visible light. • Describe the relative penetrating powers of the three types of nuclear radiation.		Introduce the explanation of the source of the radiation – radioactive decay. Outline that there must be changes to the nucleus itself to produce these particles. Discuss some of the sources of background radiation, differentiating between natural sources and some man-made ones, particularly medical sources. **Plenaries** **Murder mystery** (5 min) The body of a press photographer has been found in a sealed room, and all of the film in her camera has gone black even though it hasn't been used. Students explain what they think happened and how they know. **Comparing locations** (10 min) Interactive where students are provided with some data about the sources of background radiation in different locations in a pie chart. They use the pie chart to answer questions that compare the risks in each of the locations.			
P7.2 Discovery of the Nucleus	**Aiming for Grade 4 LOs:** • Identify the Rutherford (nuclear) model of an atom. • Identify the locations of protons, neutrons, and electrons in the nuclear model. • State that electrons can move between fixed energy levels within an atom. **Aiming for Grade 6 LOs:** • Describe the plum pudding model of the atom. • Describe the evidence provided by the Rutherford scattering experiment. • Describe the properties of protons, neutrons, and electrons. **Aiming for Grade 8 LOs:** • Compare the plum pudding model, Rutherford model, and Bohr model of the atom in terms of the evidence for each model.	How do we know about the structure of an atom when we can't see it? Should we investigate with radioactive sources? Who was responsible for the discovery of the atom? Is it fair to credit one person with a discovery?	**Lesson Overview** **Starters** **What's in the tin?** (5 min) Peel the label off a tin of sponge pudding. Show the unmarked tin to the students and ask them to describe ways they could find out what's inside without opening it. **Believe it or not?** (10 min) What does it take to change the students' minds about something? How much evidence would be needed to convince them that NASA has sent men to the Moon? Discuss how difficult it is to change people's strongly held beliefs, and point out that scientists also find it difficult to change ideas that they may have been working with for many years. **Main** **The Rutherford model of the atom** (25 min) Discuss the atomic model that students will have used in KS3 and ask them what evidence there is for it. Outline Rutherford's work and allow the students to discuss the idea of discovery by firing particles.	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** Why do models need to change? **Doddle task:** The story of Ernst Rutherford (animation)	C3 C3

	• Explain how Rutherford and Marsden's experiment caused a rejection of the plum pudding model. • Describe how the initial evidence for the nuclear model was processed and how the model came to be accepted.		Emphasise Rutherford's mathematical analysis of the Geiger and Marsden experiment that confirmed the model and how the model matched the behaviour observed during nuclear decay. Compare the Rutherford model briefly with the plum pudding model. **Further changes to the model of the atom** (15 min) Show the students the typical electron arrangement diagram used in Chemistry lessons, and discuss the nature of energy levels using the Bohr model. Ensure the students know that electrons can move between these levels when the electron's energy changes. Explain the need for a neutron as a component of most nuclei, and outline its discovery. The students should now know the key properties of all three sub-atomic particles. **Plenaries** **Not like a solar system** (5 min) The students should make a list of similarities and particularly differences between atomic models and solar systems. **I don't believe it** (10 min) Interactive where students choose the missing words to complete a paragraph summarising the evidence that led to the plum pudding model being replaced. Students then use this summary to write a letter to an unconvinced scientist who wants to hold on to the plum pudding model.			
P7.3 Changes at the Nucleus	**Aiming for Grade 4 LOs:** • Identify the mass and atomic number by using nuclear notation. • Identify the type of decay taking place from a nuclear equation. • Describe how isotopes are atoms of the same element with different mass numbers. **Aiming for Grade 6 LOs:** • Calculate the number of neutrons in an isotope by using nuclear notation. • Describe the differences between isotopes.	What happens when an atom becomes unstable? Why isn't chlorine's mass number a whole number? How can we recognise the type of decay through nuclear equations?	**Lesson Overview** **Starter** **Fact or fiction** (5 min) The students use red, amber, and green cards to decide whether a series of statements about radioactivity and atoms are false, they don't know, or are true. **Chemical change** (10 min) Give the students a demonstration of a chemical reaction (magnesium + oxygen → magnesium oxide). Ask the students to describe what is happening in terms of particles and see if they understand basic conservation of particles in chemical reactions.	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** What causes an element to have isotopes? **Doddle task:** Radioactive decay (presentation)	C3 C3

	• Complete decay equations for alpha and beta decay. **Aiming for Grade 8 LOs:** • Explain why particles are ejected from the nucleus during nuclear decay. • Describe the changes in the nucleus that occur during nuclear decay. • Write full decay equations, for example, nuclear decays.		**Main** **Nuclear notation** (10 min) Show some examples of nuclear notation, ensuring the students can identify the atomic number (proton number) and mass number (nucleon number). Students should calculate the number of neutrons in some examples. Discuss isotopes, showing some in nuclear notation and noting the difference in mass numbers. **Alpha, beta, and gamma emission** (30 min) Describe an alpha decay and the changes it causes in a nucleus. The students should look at an example and then try to construct a few additional equations by using a periodic table. Move on to beta emission, focusing on the change of a neutron to a proton and how this affects the decay equation. Show a few examples and ask the students to complete a few more. Discuss gamma emission, pointing out that there is no change in the particle structure of the nucleus and so no decay equations are needed. Students then calculate changes in atomic number and mass number of an atom after it emits alpha and beta radiation. **Plenaries** **Name that isotope** (5 min) Students use the interactive to complete a table describing various isotopes. They need to fill in missing details such as element name, proton number, mass number, and number of electrons. **Definitions** (10 min) The students must give accurate definitions of the terms ‘proton’, ‘neutron’, ‘electron’, ‘ion’, ‘mass number’, ‘atomic number’, ‘alpha particle’, ‘beta particle’, and ‘gamma ray’.			
P7.4 More about alpha, beta and	**Aiming for Grade 4 LOs:** • Rank the three types of nuclear radiation in order of their penetrating power. • Rank the three types of nuclear radiation in order of their range through air.	Why type of radiation is the most dangerous?	**Lesson Overview** **Starters** **Too many symbols?** (10 min) Scientists use a lot of symbols in their work. Students use the interactive to match some symbols they have met so far with what they	Question & Answer, Mini white boards,	**Rich question to research:** What are the effects of ionising radiation on the body?	C3

gamma radiation	• State that all three types of nuclear radiation are ionising. **Aiming for Grade 6 LOs:** • Describe how the penetrating powers of radiation can be measured. • Describe the path of radiation types through a magnetic field. • Describe the process of ionisation. **Aiming for Grade 8 LOs:** • Describe in detail how the thickness of a material being manufactured can be monitored by using a beta source. • Compare the ionisation caused by the different types of nuclear radiation. • Evaluate in some detail the risks caused by alpha radiation inside and outside the human body.	Should we investigate with radioactive sources? Should nuclear energy be banned?	represent (e.g., elements, equations, the names of things, etc.). Discuss the reasons that scientists use symbols. **X-ray flashback** (5 min) The students should explain why X-rays can be harmful and the precautions used to reduce exposure. **Main** **Radiation in action** (40 min) Describe how the penetrating power of radiation can be measured by using a Geiger counter. Discuss the safety measures that must be used when measuring radiation. Introduce the different penetrating powers of the three types of radiation – alpha, beta, and gamma. Students suggest how the penetrating power could be used to measure the thickness of a material and how this can be applied to controlling thickness. Students complete the Working scientifically sheet to examine the results from an investigation on beta radiation through cardboard and link it to the measurement and control of cardboard manufacture. Discuss the damage caused by ionisation and some of the precautions that can reduce exposure, emphasising that keeping the sources at a distance is one of the most effective methods. The concept of sharing data about radiation effects should be covered here. **Plenaries** **Local rules** (10 min) The students should make a plan for a poster or booklet explaining how the radioactive sources should be stored and handled and explaining how these precautionary rules reduce harm. They can then produce this booklet as homework. **Protect and survive** (5 min) Ask students to suggest what would need to be done if one of the radioactive sources was dropped and lost.	Exam style question	**Doddle task:** Dangers of ionising radiation (animation)	C3

P7.5 Activity and Half Life	**Aiming for Grade 4 LOs:** • Define half life • Be able to plot half-life data and determine the half-life from the graph **Aiming for Grade 6 LOs:** • Be able to use the half-life to calculate the count over a set period of time **Aiming for Grade 8 LOs:** • Use information on half-life to compare and determine the relative danger of radioactive materials	How dangerous are radioactive atoms? Are radioactivity substances always dangerous?	**Lesson Overview** **Starters** Ask students what they can remember about the type of radioactive decay. Challenge the students to consider whether it is now safe to return to the area of Chernobyl. Challenge students to consider when a material is no longer radioactive – watch out for the misconception that students believe it is when all the protons and neutrons have been expelled from the nucleus. **Main** MnM/ Dice decay. Separate students into small groups and give them a set of 20 dice each. Ask them to roll all the dice and then record all of those which have landed with an even number and record this in a table – these dice represent the remaining radioactive material – all those that have landed with an odd number should be removed at these represent atoms which have now decayed. Continue until there aren't any dice left and plot the results on a line graph – they can now use the graph to find the half- life of the dice. Provide students with a variety of graph and calculation questions which ask them to work out the half-life or a radioactive substance or the time needed to pass until the substance is safe to handle **Plenaries** Real world applications – give students examples of when radioactive tracers and trackers are used in medicine, ask them to think about why the half-lives of these materials is so short.	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** Are irradiated objects radioactive? **Doddle task:** Investigating the rate of decay (animation) AQA Radioactivity and half-life (mini quiz)	C3 C3 C3

GCSE Chemistry C6 Electrolysis			
What are we learning?	What knowledge, understanding and skills will we gain?	What does excellence look like?	What additional resources are available?
How to separate compounds using a process called electrolysis	**Knowledge** • Key definitions including electrolysis, anode, cathode, electrolyte and ion • Equipment used in electrolysis and how it is arranged • Metals form positive ions and non-metals negative ions • Charges are oppositely attracted to each other • Advantages and disadvantage of the process **Understanding** • Explaining why each substances is formed at that electrode • Evaluating the use of electrolysis in real world applications including metal extraction with links to previous topics on formation of ions **Skills** • Making predictions based on scientific knowledge and understanding • Use detailed observation for conclusions or future predictions • Using scientific terminology to describe and explain •	Linking to displacement reactions to explain why electrolysis is needed Constructing half equations for the changes at each electrode Suggesting further applications of the technology Application of understanding to methods of electrolysis on an industrial scale	BBC Bitesize Doddle – power points and quick quizzes You tube: ‘Free science lessons’ Seneca learning platform

Scheme of Work 2020-2021

Subject: GCSE Science: C6 Electrolysis

Year Group: 10 /11

Specification: AQA Combined Science Trilogy

Skill focus: 3,9 and 20

Lesson No	Topic & Objectives	Big Question – What will students learn?	Key Activities & Specialist Terminology (Do Now Task / Starter/Tasks/Plenary	Planned Assessment	Homework or flipped learning resources DODDLE resources	Lit Num SMSC Codes
C6.1 Introducing Electrolysis	**Aiming for Grade 4 LOs:** • Define electrolysis. • Write a word equation to describe the electrolysis of a molten ionic compound. **Aiming for Grade 6 LOs:** • Describe electrolysis in terms of movement of ions. • Write a balanced symbol equation including state symbols for the overall electrolysis of a molten ionic compound. • Predict the products at each electrode for the electrolysis of a molten ionic compound. **Aiming for Grade 8 LOs:** • Explain why electrolysis can only occur when an ionic compound is molten or in aqueous solution.	Can we undo an ionic bond? How easy is it to undo an ionic bond?	**Starters** **Formula** (5 minutes) Explain to students that zinc forms 2+ ions. Ask them to determine the formula of zinc chloride and state the bonding present. **Electrolysis** (10 minutes) Set up a simple electrolysis circuit made of about 1 cm depth of sodium chloride in a 100 cm3 beaker, with two carbon electrodes connected in series to a low voltage lamp and a low voltage power supply. Demonstrate that the bulb does not light up when sodium chloride is a solid. Add water and the bulb will light up, showing there is a flow of current. Ask students to suggest which type of particles is carrying the charge between the electrodes in the beaker and why in a solid the ionic compound cannot conduct (ions are not free to move). **Main** **Electrolysis of zinc chloride** (40 minutes) Show students samples of zinc, zinc chloride, and chlorine. Encourage students to note the difference in appearance of the	QnA between teachers and students Written responses to questions Class discussion Drawn and labelled diagram of the practical set up	Doddle: AQA Electrolysis practical quiz	So3 C5 C3 Sp2 Sp9 C5 So7

	• **Describe electrolysis with half equations at the electrodes.** • Explain the classification of the reactions at each electrode as oxidation or reduction.		chemicals. Explain the process of electrolysis and encourage students to predict the products at each electrode. Demonstrate the electrolysis of zinc chloride as outlined. Use question and answer to ensure students make all the relevant observations. Students should draw a labelled diagram and then add information to explain how the ions move to each electrode and how they become the elements. **Plenaries** **Electrolysis** (5 minutes) Interactive where students complete a paragraph to explain how ionic compounds conduct electricity in solution and when molten. Students then label a diagram of an electrolysis experiment to identify the different species involved, the anode, and the cathode. **Personification of electrolysis** (10 minutes) Ask students to imagine that they are an electrolyte that is first melted and then electrolysed. They should write a brief story to describe what happens to them.			
C6.2 Changes at the Electrodes	**Aiming for Grade 4 LOs:** • State that oxygen can be produced at the anode when some solutions are electrolysed. • State that hydrogen can be produced at the cathode when some solutions are electrolysed. • Write a word equation to describe electrolysis of a solution. **Aiming for Grade 6 LOs:** • Describe electrolysis of solutions in terms of movement of ions. • Write a balanced symbol equation including state symbols for the overall electrolysis of a solution. • Predict the products at each electrode for the electrolysis of a molten ionic compound or its solution. **Aiming for Grade 8 LOs:**	Can we undo an ionic bond? Is electroplating worth it? (Chrome car parts, jewellery) Can oxidation exist without a reduction reaction?	**Lesson Overview** **Starters** **List your particles** (5 minutes) Ask students to list the particles present in a sample of lithium bromide solution and to give their symbols (Li^+, Br^-, H_2O, H^+, and OH^-). **Water** (10 minutes) Ask students to draw the dot and cross diagram of water. Then ask students to work in small groups to discuss how the electrons could be arranged to make a hydrogen ion and a hydroxide ion. Use question and answer to ensure that students recognise that a very small proportion of water molecules break up and form these ions. **Mains** **Electrolysis of potassium bromide** (20 minutes) Ask students to consider a solution of potassium bromide. Which ions would be attracted to each electrode? Students explain why hydrogen gas is made at the cathode rather than potassium metal (remind students of the reaction of potassium with water). Then ask students to	QnA between teachers and students Written responses to questions Class discussion Oxidation and reduction statements	Doddle: AQA Electrolysis mini quiz	So3 C3 Sp2 So8 Sp9 C5 So7

	• Explain how hydrogen ions and hydroxide ions can be present in solutions, including a balanced symbol equation with state symbols, for the reversible reaction in which water ionises. • **Describe electrolysis with half equations at the electrodes.** • Explain the classification of reactions at the electrodes as oxidation or reduction.		explain why bromine is made at the anode rather than oxygen. Students write a word and symbol equation for the reactions at the electrodes. **Explaining ions** (20 minutes) Ask students to make a table to compare and contrast each electrode. Each time they write anode, positive, or the symbol/name of a positive ion they should use a red pen. Each time they write cathode, negative, or the symbol/name of a negative ion they should use a blue pen. Any species that has no charge should be written in green pen. They should include information about reduction, oxidation, and which ions are attracted to each electrode and use appropriate vocabulary. **Plenaries** **Oxidation or reduction** (5 minutes) Ask students to classify the following statements as oxidation or reduction: • At the cathode (reduction) • At the anode (oxidation) • Metal ions becoming metal atoms (reduction) • Non-metal ions becoming atoms (oxidation) • Electrolysis (neither as it is actually an example of both, i.e., redox) **Predict** (10 minutes) Students predict the products if water was electrolysed and explain how they are produced			
C6.3 Extraction of Aluminium	**Aiming for Grade 4 LOs:** • State that aluminium can be extracted from aluminium oxide using electrolysis. • Write a word equation to describe the electrolysis of aluminium oxide. **Aiming for Grade 6 LOs:**	Is electrolysis of aluminium contributing to increases in global warming? Are we running out of cryolite and what might the	**Lesson Overview** **Starters** **Aluminium uses** (5 minutes) Give students a tray of aluminium items, for example, foil, drinks can, drinks cup, saucepan. Then ask students to suggest what they all have in common.	QnA between teachers and students Written responses to questions	Doddle: Extracting aluminium animation Extracting metals by reduction worksheet	So3 C3 Sp2 Sp9 C5

	• Describe the electrolysis of aluminium oxide. • Explain why electrolysis is an expensive metal extraction method and illustrate this with the extraction of aluminium. • Explain why cryolite is added to aluminium oxide in the industrial extraction of aluminium. **Aiming for Grade 8 LOs:** • Explain why electrolysis is used to extract aluminium from compounds. • **Describe electrolysis with half equations at the electrodes.** • **Explain the classification of the reactions at each electrode as oxidation or reduction.**	consequences of this be? What is the link between Greenland and the aviation industry? (Greenland had a large deposit of cryolite	**Dot and cross diagrams** (10 minutes) Ask students to draw the dot and ross diagram of an aluminium atom, oxygen molecule, and aluminium oxide compound. **Mains** **The extraction of aluminium** (30 minutes) Introduce the electrolytic cell. Show students an unlabelled diagram of the electrolytic cell for aluminium production. Ask students to annotate the diagram to: • describe electrolysis of aluminium oxide in terms of ions moving • write an equation to summarise the electrolysis • explain why cryolite is added • explain why carbon electrodes need to be replaced frequently. A labelled diagram of the electrolytic cell is available in the student book. **Writing half equations** (10 minutes) Students use the maths skills interactive for further practice on writing half equations for electrolysis reactions. **Plenaries** **Extraction of aluminium** (5 minutes) Students complete sentences to describe the process of aluminium extraction. They then identify whether the reactions at the anode and cathode are reduction reactions or oxidation reactions. **Flow chart** (10 minutes) Ask students to use the student book to make a flow chart to describe how aluminium is extracted from the Earth. The flow chart should include equations for the electrolysis of aluminium and classifications of each of the reactions as oxidation or reduction.	Class discussion Half equations complete		Sp1 So7
C6.4 Electrolys is of	**Aiming for Grade 4 LOs:** • State the products of the electrolysis of brine and a use for each.	Is the addition of water help of	**Lesson Overview** **Starters**	QnA between teachers and students	Doddle: Electrolysis of copper sulphate soulation animation	So3 C3

Aqueous Solutions	• Safely electrolyse a solution, with guidance provided. **Aiming for Grade 6 LOs:** • Describe how to electrolyse brine in terms of ions moving. • Predict the products of electrolysis of a solution. • Plan and carry out an electrolysis investigation. **Aiming for Grade 8 LOs:** • **Explain the electrolysis of brine using half equations, classifying reactions at the electrode as oxidation or reduction.** • Evaluate in detail an investigation they have planned and carried out, commenting on their methodology and quality of the data collected. • Compare and contrast the electrolysis of a compound in solution with its electrolysis as a molten compound.	hindrance to electrolysis ?	**Electrolysis of aqueous solutions** (10 minutes) Interactive where students complete a crossword to summarise what they have learnt so far about electrolysis. **Predict the products** (10 minutes) Ask students to predict the products at the electrodes for the following electrolyses: • Iron(II) sulfate solution (iron and oxygen) • Copper(II) nitrate solution (copper and oxygen) • Iron(III) chloride solution (iron and chlorine) • Sodium chloride solution (hydrogen and chlorine) Students should write a half equation for each product that demonstrates how it is made, classify each as oxidation or reduction, and state at which electrode the change occurs. **Mains** **Investigating the electrolysis of solutions** (40 minutes) Split the class into small groups. Introduce the investigation and ask students to write an outline plan, highlighting the dependent and control variables and predictions. If the plan is safe allow students to complete their investigation, recording their observations in a table. Encourage students to write a conclusion and evaluation. **Plenaries** **Copper chloride** (5 minutes) Ask students to predict the products of the electrolysis of copper chloride as a liquid and as a solution. Students should then explain the difference and similarities in the products. **Explaining observations** (10 minutes) Demonstrate the electrolysis of brine in a Petri-dish, adding Universal Indicator. Ask students to explain their observations. Bubbles demonstrate that a gas is made, universal indicator turns colourless around the anode as chlorine is produced, and universal indicator turns purple as sodium hydroxide, an alkali, is made.	Written responses to questions Class discussion Completed electrolysis practical and observations	AQA Electrolysis of solutions mini quiz	Sp2 Sp9 C5 So7