Year 10: Curriculum Intent

The intent of the Year 10 curriculum is to build on knowledge acquired in Key Stage 3 and prepare pupils for their GCSEs in science. They will continue to increase the depth and breadth of their knowledge and build strong links in learning to consolidate prior learning and secure the knowledge and skills required to excel in GCSE Science.. Pupils will continue to study the different areas of science:

- in Biology - Organisation, Infection & Response and Ecology..
- in Chemistry - Chemical Bonding & Structures, Quantitative Chemistry, Chemical Change and Energy Changes.
- in Physics - Particle Model of Matter, Atomic Structure & Radioactivity, Electricity and Waves.
- and across all three sciences - how to Work Scientifically.

Pupils will be taught key knowledge and skills in both theory and practical science. They will learn about the scientific method, how to keep safe and how to draw valid conclusions from data.

Year 10 Biology Essential Knowledge Summary

Schemata 1: B2 Organisation

Composite Knowledge: Pupils will gain an understanding of the organisation of the human digestive system and circulatory system. Students will gain an understanding of the structure of a plant and the movement of water gases and minerals.

Component Knowledge:
Foundational Knowledge:
Declarative Knowledge:

Recall the terms definition of cell, tissue, organ, organ system and organism, and be able to give examples of each.

State the order of size and scale of cells, tissues, organs, organ systems and organisms..

Describe the functions of the digestive system.

Identify the positions of the main organs on a diagram of the digestive system.

Recall that food molecules must be small and soluble in order to be absorbed into the blood.

Describe the functions of the organs in the system.

Define the terms ‘catalyst’ and ‘enzyme’.

Describe the properties of enzymes.

Explain why foods need to be digested into small, soluble molecules.

Describe the three types of enzymes involved in digestion, including the names of the substrates, products and where the enzymes are produced.

Describe the functions of the heart and circulatory system.

Describe and label a diagram of the heart showing four chambers, vena cava, pulmonary artery, pulmonary vein and aorta.

Describe the flow of blood from the body, through the heart and lungs and back to the body.

Explain how the heart is adapted for its function.

Describe the heart as a double pump and explain why this is efficient.

Label the main structures in the gas exchange system – trachea, bronchi, alveoli and capillary network around alveoli.

Recall the three blood vessels.

Recall the four main components of blood.

Identify pictures of the different blood cells.

Recall examples of communicable and non-communicable diseases.

Give risk factors associated with cardiovascular disease, Type 2 diabetes, lung diseases and cancers.

Describe some causes of cancer, eg viruses, smoking, alcohol, carcinogens and ionising radiation.

Recall the definition of cancer.

Schemata 2: B3: Infection and Response

Composite Knowledge: Pupils will gain an understanding of how we protect ourselves from pathogens that attack us. How we can treat symptoms of disease if these first line defences do not work.

Component Knowledge:
Foundational Knowledge:
Declarative Knowledge:

- Recall the term pathogen and state the four main groups of pathogen.
- Recall how pathogens can be spread to plants or animals and cause infection.
- Recall how the spread of disease can be reduced or prevented.
- Recall the safety precautions you must take when growing microorganisms.
- Recall safety precautions for microbial investigations.
- Recall the optimum conditions for bacterial growth.
- Recall the symptoms, mode of transmission, prevention and treatment for measles, HIV and AIDS, salmonella and gonorrhoea.
- Describe colds and flu as viral diseases.
- Describe athlete’s foot as a fungal disease.
- Describe the body’s first line defences.
- Describe what white blood cells do.
- Describe what a vaccine contains.
- Give examples of painkillers and other medicines used to treat symptoms.
- Explain why drugs need to be tested before they can be prescribed.
- Recall which drugs come from plants and microorganisms.
- Explain the terms placebo and double-blind trial.

Biology Only:

- Recall what MABs are.
- Recall the the uses of MABs.
- Explain why MABs are not yet widely used in the body.
- Recall the symptoms and effects of Tobacco mosaic virus and its effects.
- Recall the symptoms and effects of Rose black spot fungal infection
- Recall methods that gardeners and scientists can use to identify the disease causing pathogen.
- Recall the physical and chemical ways plants can resist microorganisms.
- Recall mechanical adaptations to deter animals.

Procedural Knowledge:

Schemata 3: B7 Ecology

Composite Knowledge: Pupils will gain an understanding of the relationship of organisms between living and the non-living environment. Pupils will gain an understanding of how the balance of nature maintains the health of the earth.

Component Knowledge:
Foundational Knowledge:
Declarative Knowledge:

Define the terms ecosystem, community, competition, habitat, interdependence.

Describe factors that affect the survival of organisms in their habitat.

Define a stable community.

Recall an example of a stable community.

Recall resources that plants and animals compete for in a given habitat.

Recall structural, behavioural and functional adaptations, in a range of organisms.

Define the term extremophile and give general examples.

Identify producers, primary, secondary and tertiary consumers in a food chain.

Classify organisms based on their similarities.

Recall the Linnaean classification system.

Use the binomial system to name organisms.

Explain how modern technologies have affected how organisms are classified today.

Recall Carl Woese’s system of classification and classify organisms into the three domains.

Recall biotic factors in a habitat.

Recall abiotic factors in a habitat.

Explain how a change in a biotic factor might affect a community.

Recall how to carry out random sampling of organisms using a quadrat.

Recall when and how a transect should be used.

Recall the parts of the carbon, water and decay cycle.

Define biodiversity

Recall examples of the reduction in biodiversity.

Recall the types of water pollution.

Recall examples of air pollutants and where they come from.

Recall the effects of smoke on buildings, humans and plant photosynthesis.

Recall how acid rain is formed and the effects of acid rain on living organisms.

Recall what herbicides and pesticides are used for.

Label the main organs of a plant and describe their functions.

Identify the tissues in a leaf and describe their functions.

Recall the organs that make up the plant transport system.

Recall the role of xylem; phloem and root hair cells.

Define the terms 'transpiration' and 'translocation'.

Define the term 'active transport'.

Procedural Knowledge:
Explain how the small intestine is adapted for its function.

Explain why enzymes are specific and are denatured by high temperatures and extremes of pH.

Explain how bile helps in the digestion of fats.

Describe the function of the pacemaker cells and coronary arteries.

Explain how the alveoli are adapted for efficient gas exchange.

Describe problems associated with the heart and explain how they can be treated.

Evaluate the use of drugs, mechanical devices and transplants to treat heart problems, including religious and ethical issues.

Explain how the blood vessels are adapted for their function.

Explain how each component is adapted for its function.

Explain how diet, stress and life situations can affect physical and mental health.

Describe examples of how diseases may interact.

Describe the effects of diet, smoking, alcohol and exercise on health.

Explain how and why the Government encourages people to lead a healthy lifestyle.

Describe the difference between benign and malignant tumours.

Explain why there are more stomata on the lower surface of a leaf.

Describe the role of stomata and guard cells to control water loss and gas exchange.

Relate the structure of each tissue in a plant to its function in photosynthesis.

Describe the role of xylem, phloem and root hair cells and explain how they are adapted for their functions.

Describe where active transport occurs in humans and plants and what is transported.

Explain why active transport requires energy.

Upper Hierarchical Knowledge

- Use the lock and key theory and collision theory to explain enzyme action.
- Explain how cancer may spread from one site in the body to form a secondary tumour in another part of the body.
- Calculate stomatal density.
- Explain how active transport enables cells to absorb ions from very dilute solutions.

- Recognise bacterial and fungal colonies growing on agar plates.
- Describe the main differences between bacteria and viruses.
- Explain why cultures are incubated at a maximum temperature of 25ºC in schools.
- Describe the life cycle of the malarial protist
- Describe the symptoms, mode of transmission, prevention and treatment for malaria.
- Explain how microbes make us feel ill and how viruses damage cells.
- Explain why antibodies are specific for one pathogen/ antigen.
- Explain how vaccines prevent disease.
- Describe the problems associated with antibiotic resistance.
- Describe Fleming's discovery and explain its importance.
- Explain how antibiotics treat only bacterial diseases and how this has saved lives.
- Explain the difficulty in developing drugs that kill viruses without damaging body tissues.
- Describe the main steps in the development and testing of a new drug.
- Give reasons for the different stages in drug testing.

Biology only:

- Describe how MABs are produced.
- Describe how the uses of MABs work with given information.
- Evaluate the advantages and disadvantages of MABs.
- Explain how aphids affect plant growth.
- Describe visual indications of plant disease, as described in the specification.

Upper Hierarchical Knowledge

- Explain the idea of 'herd immunity'.
- Calculate the cross-sectional areas of clear zones around disinfectant/ antibiotic discs using .
- Explain the difference between Tobacco Mosaic Virus in plants and Measles in animals.

Working Scientifically

Calculate the number of bacteria in a population after a given time, when given the mean division time:

- **WSME 1** apply mathematical concepts to use and rearrange equations in order to calculate results, using appropriate SI unit

Describe how microorganisms can be safely grown on agar plates:

- **WSAT 2** identify hazards and risks and suggest appropriate ways to reduce the risks

Required Practical: The effect of disinfectants or antibiotics on bacterial growth:

- **WSSK 2** identify independent, dependent and control variables and use these to plan and carry out a range of investigations to test a prediction, considering repeatability and reproducibility within their plan

Calculate the cross-sectional areas of clear zones around disinfectant/ antibiotic discs using .

- **WSME 1** apply mathematical concepts to use and rearrange equations in order to calculate results, using appropriate SI units

Interpret data about painkillers and other medicines.

Recall what peat is and why it is important to preserve areas of peat.

Recall why peat should not be burnt.

Recall the term deforestation.

Recall the terms greenhouse effect and global warming.

Recall the possible effects of global warming.

Recall measures to maintain biodiversity.

Biology Only

Define the term biogas.

Recall the term factory farming and give examples of animals farmed in this way.

Recall why some fish stocks are declining and why this is a problem.

Recall ways that fish stocks can be conserved.

Recall how the fungus Fusarium can be grown to produce mycoprotein that can be eaten.

Procedural Knowledge:

Explain how structural, behavioural and functional adaptations help an organism survive.

Explain what a food chain shows.

Explain that photosynthetic organisms are the producers of biomass for life on Earth.

Calculate area, mean, median, mode and range.

Explain why sample size is important to obtain valid results.

Interpret and explain population curves.

Explain the carbon cycle
Explain the water cycle

Interpret graphs showing human population.

Analyse and interpret data about water pollution.

Analyse and interpret data about air pollution.

Evaluate the use of fertiliser on plant growth and oxygen levels.

Explain why vast tropical areas have been cleared of trees.

Explain how deforestation increases the amount of carbon dioxide in the atmosphere and leads to a reduction in biodiversity.

Biology only

Recall the factors which affect the rate of decay.

Interpret data showing how factors affect the rate of decay.

Describe how gardeners and farmers try to provide optimum conditions for rapid decay of wastes.

Explain the difference between aerobic and anaerobic decay.

Evaluate the use of biogas generators.

Evaluate the necessity and effectiveness of recycling organic kitchen or garden wastes.

Explain why the output from a biogas generator is affected by climatic conditions.

Explain how factors affect food production and food security locally and globally.

Interpret population and food production statistics to evaluate food security.

Evaluate modern farming techniques.

● Explain the relationship between active transport and oxygen supply and numbers of mitochondria in cells. **<u>Working Scientifically</u>** Recap KS3- Modelling the path of digestion from gum to bum: - **WS5** make predictions using scientific knowledge and understanding Recap KS3- Modelling the small intestine using visking tubing: - **WS5** make predictions using scientific knowledge and understanding Required practical: Food tests: ● WS7 use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety Investigate the rate of reaction by measuring the volume of gas given off from the catalase reactions from boiled, liver, celery, potato and hydrogen peroxide: ● **WSSK 2** identify independent, dependent and control variables and use these to plan and carry out a range of investigations to test a prediction, considering repeatability and reproducibility within their plan Calculate rate, using gas given off over time. ● **WSME 1** apply mathematical concepts to use and rearrange equations in order to calculate results, using appropriate SI units Investigate the effect of temperature on amylase activity – measure time taken for starch to disappear: ● **WSAN 2** use basic data analysis to calculate means, plot graphs with line of best fit and use this data to draw conclusions Calculate the rate of enzyme controlled reactions: ● **WSME 1** apply mathematical concepts to use and rearrange equations Prepared slides: of xylem, phloem and root hair cells, microscopes, in order to calculate results, using appropriate SI units Dissection of a heart. Observe prepared slides of the different vessels, or use bio-viewers. Compare their size and structure: ● **WSAN 1** make and record observations and measurements and present data using appropriate methods including tables with repeat measurements. Measure pulse rate and blood pressure – lying down, sitting and standing. ● **WSAN 1** make and record observations and measurements and present data using appropriate methods including tables with repeat measurements. Demo: Model of blood vessels. Calculate the rate of water flow through different widths of tubing. ● WS10 apply mathematical concepts and calculate results. Observe prepared blood smears under the microscope: ● **WSAN 1** make and record observations and measurements and present data using	● **WS12** interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions.	Describe how microorganisms can be grown in large vats to produce useful products. Explain how the conditions in the vat are monitored and controlled for optimal growth. Evaluate the use of mycoprotein as a food. Describe the process of genetic engineering to produce better crops. Describe what Golden rice is and how it was produced. Interpret information about genetic engineering techniques. Make informed judgements about the economic, social and ethical issues concerning genetic engineering. **Upper Hierarchical Knowledge** Consider how mathematical models will help predict changes in carbon dioxide levels over time. Explain and evaluate conflicting pressures on maintaining biodiversity. Explain the possible impact of each environmental change on the distribution of species in an ecosystem. Calculate the rate of decay **<u>Working Scientifically</u>** Required Practical- Measure abundance and distribution of a plant species. ● **WSSK 4** select and use appropriate apparatus and sampling techniques for field and laboratory work Required Practical- Measure the rate of the decay of milf at different pH levels. ● **WSSK 2** identify independent, dependent and control variables and use these to plan and carry out a range of investigations to test a prediction, considering repeatability and reproducibility within their plan. Calculate the efficiency of biomass. ● WS12 interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions

appropriate methods including tables with repeat measurements. Calculate BMI and evaluate the use of this type of measurement. ● WS10 apply mathematical concepts and calculate results Observing stomata under the microscope: ● **WSAN 1** make and record observations and measurements and present data using appropriate methods including tables with repeat measurements. Measuring stomatal density (HT):: ● WS10 apply mathematical concepts and calculate results Plant stalks: celery of plant stalk in beaker of coloured water. ● **WSAN 1** make and record observations and measurements and present data using appropriate methods including tables with repeat measurements. Observing prepared slides under a microscope- xylem, phloem and root hair cells. ● **WSAN 1** make and record observations and measurements and present data using appropriate methods including tables with repeat measurements.		

Year 10 (biology) Final Composite Knowledge End Point

Schemata 1 B2 Organisation

- Recall the order of size and scale of cells, tissues, organs, organ systems and organisms
- Name the parts of the human digestive system, what does each part do?
- Describe the role of enzymes in the break down of food.
- Describe the structure of the heart.
- Recall the parts of the gas exchange and explain what each part does.
- Recall the three blood vessels and what they do.
- Recall the parts of the blood and what they do.
- Explain the difference between benign and malignant tumours.
- Describe the role of the stomata in a leaf.
- Recall xylem, phloem and root hair cells and what they do.
- Explain the process of active transport.

Schemata 2 Infection and Response

- Recall the definition of a pathogen.
- Recall how pathogens are spread.
- Recall the
- Describe the optimum conditions for bacterial growth.
- Describe how bacteria make you ill.
- Describe how virus's make you ill.
- Describe what antibiotics treat and how they should be used.
- Recall the lifecycle of Malaria and how Malaria can be prevented.
- Recall what a vaccine is.
- Describe how a vaccine works.
- Recall the symptoms, mode of transmission, prevention and treatment for measles, HIV and AIDS, salmonella and gonorrhoea.
- Recall why drugs are tested.
- Recall each stage of drug testing
- Explain what happens of each stage of drug testing.

Biology only:

- Recall what a MAB is and how it is produced.
- Recall the symptoms and effects of Rose Black Spot and Tobacco Mosiac Virus.

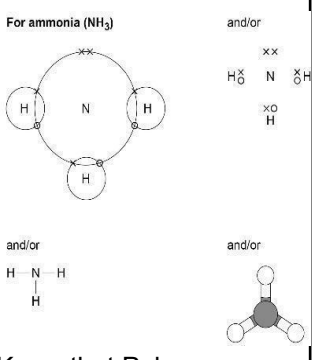
Schemata 3 B7 Ecology

- Recall the terms ecosystem, community, competition, habitat, interdependence.
- Recall the definition of a stable community.
- Recall the resources that plants and animals compete for in a given habitat.
- Recall structural, behavioural and functional adaptations, in a range of organisms.
- Recall the Linnaean classification system.
- Recall Carl Woese's system of classification and classify organisms into the three domains.
- Recall biotic factors in a habitat.
- Recall abiotic factors in a habitat.
- Define biodiversity
- Recall the types of water pollution.
- Recall examples of air pollutants and where they come from.
- Recall what global warming is
- Recall the gases responsible for global warming.

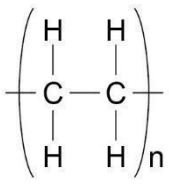
Year 10 Chemistry Essential Knowledge Summary

Schemata 1: C2 Bonding, Structure and Properties of matter	**Schemata 2: C3 Quantitative Chemistry**	**Schemata 3: C4 Chemical Changes**	**Schemata 4: The Rate and extent of Chemical Change**
Composite Knowledge: Students will gain a fundamental understanding of the range of different types of chemical bonding and how structure links to properties. Students will build on from knowledge of atomic structure to explain why bonding takes place between atoms. **Component Knowledge:** **Foundational Knowledge:** Declarative Knowledge: ● State there are three types of strong chemical bonds: ● Define Ionic bonding ● Define Covalent bonding ● Define Metallic bonding ● Recognise for ionic bonding the particles are oppositely charged ions. ● Recognise for covalent bonding the particles are atoms which share pairs of electrons. ● Recognise in metallic bonding the particles are atoms which share delocalised electrons. ● State that bIonic bonding occurs in compounds formed from metals combined with non-metals. ● State that Covalent bonding occurs in non-metallic elements and in compounds of non-metals. ● State that Metallic bonding occurs in metallic elements and alloys ● Identify chemical bonding in terms of electrostatic forces and	**Composite Knowledge:** Students will gain a fundamental understanding of quantitative chemistry and how chemists work with amounts of substances. They will use a variety of different chemical equations to complete a variety of 'amount of substance' questions. **Component Knowledge:** **Foundational Knowledge:** Declarative Knowledge: ● Explain the meaning of the law of conservation. ● Write simple word equations. ● Write simple symbol equations. ● Balance symbol equations. ● Describe the equations given in terms of number of moles, reactants and products ● .Review the definition of relative atomic mass. ● Recall how to find the relative atomic mass from the Periodic Table. ● Define the relative molecular mass. ● Be able to calculate the relative formula mass (M_r) of a compound from its formula, given the relative atomic masses ● Explain any observed changes in mass in non-enclosed systems during a chemical reaction. ● Use the balanced symbol equation for a reaction to recognise changes in terms of the particle model ● use measurements of mass before and after an experiment to explain what has happened to the mass during the experiment and why it has happened. ● Know that whenever a measurement is made there is	**Composite Knowledge:** Students will gain a fundamental understanding of the range of different types of chemical changes involving metals and non metals. They will use reactivity of metals to explain and develop different ideas including extraction of metals and electrolysis. **Component Knowledge:** **Foundational Knowledge:** Declarative Knowledge: ● Define the following terms: oxidation reduction. ● Write word and balanced symbol equations for the reactions of metals with oxygen to produce metal oxides. ● identify where reduction and oxidation has taken place. ● Recall and describe the reactions, if any, of potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper with water or dilute acids, where appropriate, to place these metals in order of reactivity. ● State why metals such as gold are found in the Earth as the metal itself but most metals are found as compounds that require chemical reactions to extract the metal. ● know why Metals less reactive than carbon can be extracted from their oxides by reduction with carbon. ● Know Reduction involves the loss of oxygen ● Identify the substances which are oxidised or reduced in terms of gain or loss of oxygen ● Know that Oxidation is the loss of electrons and reduction is the gain of electrons. ● Know that acids react with some metals to produce salts and hydrogen. ● Define the term neutralisation. ● Know that acids are neutralised by alkalis. ● Know that acids and bases (metal oxides) produce salts and water	**Composite Knowledge:** Students will gain a fundamental understanding of how external conditions and factors can affect both rate of reaction and position of equilibrium. Students will analyse graphs to show how rates proceed and will evaluate conditions to maximise rate and equilibrium. **Component Knowledge:** **Foundational Knowledge:** Declarative Knowledge: ● Calculate the mean rate of a reaction from given information about the quantity of a reactant used or the quantity of a product formed and the time taken. ● Draw and interpret graphs showing the quantity of product formed or quantity of reactant used up against time. ● Use graphical data to explain each part of the graph ie: initially rate is fast slows down reaction completes. ● Explain what is meant by the units: g/s cm^3/s mol/s. ● Know the Factors which affect the rates of chemical reactions including The concentrations of reactants in solution The pressure of reacting gases, The surface area of solid reactants The temperature of reactants The presence of a catalyst. ● recall how changing these factors affects the rate of chemical reactions. ● Predict and explain using collision theory the effects of changing conditions of concentration, pressure and temperature on the rate of a reaction. ● Predict and explain the effects of changes in the size of pieces of a reacting solid in terms of surface area to volume ratio. ● Use simple ideas about proportionality when using collision theory to explain the effect of a factor on the rate of a reaction. ● Know what Collision theory is ● Know how According to collision theory, chemical reactions can occur.

- the transfer or sharing of electrons.
- Identify when a metal atom reacts with a non-metal atom, electrons in the outer shell of the metal atom are transferred.
- state metal atoms lose electrons to become positively charged ions.
- State Non-metal atoms gain electrons to become negatively charged ions
- Recall the ions produced by metals in Groups 1 and 2
- Recall the ions produced by Groups 6 and 7.
- Draw dot and cross diagrams for ionic compounds formed by metals in Groups 1 and 2 with non-metals in Groups 6 and 7
- State how electrons transfer during the formation of an ionic compound.
- State how ionic compounds are held together by strong electrostatic forces of attraction between oppositely charged ions.
- Know that forces act in all directions
- Know that an ionic compound is a giant structure in the lattice.
- Know when atoms share pairs of electrons, they form covalent bonds.
- State these bonds between atoms are strong.
- Know that covalently bonded substances may consist of small molecules.
- Know that some covalently bonded substances have very large molecules, such as polymers.
- Know that some covalently bonded substances have giant covalent structures,
- State that diamond, graphite and silicon dioxide are giant structures
- Know that the covalent bonds in molecules and giant structures can be represented in the following forms:



- Know that Polymers can be represented in the form:



- poly(ethene)
- State that n is a large number.

always some uncertainty about the result obtained.

- Represent the distribution of results and make estimations of uncertainty.
- Use the range of a set of measurements about the mean as a measure of uncertainty
- Understand that the measurement of amounts in moles can apply to atoms, molecules, ions, electrons, formulae and equations.
- Know for example that in one mole of carbon (C) the number of atoms is the same as the number of molecules in one mole of carbon dioxide (CO_2).
- Understand that the number of atoms, molecules or ions in a mole of a given substance is the Avogadro constant. The value of the Avogadro constant is 6.02×10^{23} per mole.
- Define one mole in terms of M_r and A_r
- Calculate the number of moles in a substance using the relative formula mass.
- Define the term limiting reactant.
- Link the limiting reactant to the number of moles.
- Link the limiting reactant to the masses in grams.
- Calculate the mass of solute in a given volume of solution of known concentration in terms of mass per given volume of solution.
- convert cm^3 into dm^3.
- Use the equation:
  $C = m / v$
  to calculate the concentration of a solution.

- Calculate the percentage yield of a product from the actual yield of a reaction.
- Describe how atoms are lost or gained in a chemical reaction.
- Explain why atoms can be lost or gained in a chemical reaction.
- Calculate the theoretical yield for simple examples
- Calculate the atom economy for simple examples.
- Explain the meaning of concentration and the unit mol per dm^3.
- Be able to convert cm^3 into dm^3.
- Use the equation
  $C = n / v$
  to calculate the concentration of a solution.
-
- Including reasons for using a burette instead of other measuring equipment.
- Recall the equation:
  $$number\ of\ moles = \frac{mass}{relative\ formula\ mass}$$
- Use the equation:
  volume of gas at rtp = number of moles x molar gas volume (24 dm^3)
  for simple examples.
- Calculate the volume of a gas at room temperature and pressure from its mass and relative formula mass
- Calculate volumes of gaseous reactants and products from a balanced equation and a given volume of a gaseous reactant or product.
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Procedural Knowledge:

- Know that metal carbonates and acid produce salts, water and carbon dioxide.
- Know that metals reacting with acid produce hydrogen and salts
- Know that the salt produced in any reaction between an acid and a base or alkali depends on:the acid used
- Know that hydrochloric acid produces chlorides
- Know that Nitric acid produces nitrates
- Know that sulfuric acid produces sulfates
- Define the terms:
  soluble
  insoluble.
- Explain what is meant by a soluble salt.
- Explain why reactants are often used in excess.
- Know that salt solutions can be crystallised to produce solid salts.
- Define the following terms:
  acid
  base
  alkali
  neutral.

- Recall the pH numbers for the following solutions:
  acidic
  alkaline
  neutral.

- Describe the use of universal indicator or a wide range indicator to measure the approximate pH of a solution.
- Use the pH scale to identify acidic or alkaline solutions.
- State that Acids produce hydrogen ions (H^+) in aqueous solutions.
- State aqueous solutions of alkalis contain hydroxide ions (OH^-).
- Know that In neutralisation reactions between an acid and an alkali, hydrogen ions react with hydroxide ions to produce water.

- Know this reaction can be represented by the equation:
  $H^+ (aq) + OH^- (aq) \rightarrow H_2O (l)$
- Use and explain the terms dilute and concentrated (in terms of amount of substance), and
- Use the terms weak and strong (in terms of the degree of ionisation) in relation to acids.
- Explain the meaning of the following terms:
  dilute
  concentrated
  weak
  strong.
- Recall examples of strong and weak acids.
- Describe neutrality in terms on hydrogen ion concentration.
- Describe relative acidity in terms of hydrogen ion concentration.
- Define the term electrolyte.
- Describe how an electric current can pass through an ionic compound.
- Know why solid ionic compounds cannot conduct electricity.
- Know why ionic compounds can conduct electricity when melted or dissolved in water.
- Predict the products of the electrolysis of binary ionic compounds in the molten state
- Recall the reactivity series.
- Give reasons why some metals have to be extracted by electrolysis.
- Know Aluminium is manufactured by the electrolysis of a molten mixture of aluminium oxide and cryolite
- Know that carbon is used for positive electrode (anode).
- Know how aluminium is extracted from its ore.
- Write balanced half equations for the reactions that occur at both electrodes for aluminium extraction

- Recognise when reacting particles collide with each other and with sufficient energy a reaction is possible.
- Know that the minimum amount of energy that particles must have to react is called the activation energy.
- Recognise that increasing the concentration of reactants in solution, the pressure of reacting gases, and the surface area of solid reactants increases the frequency of collisions and so increases the rate of reaction.
- Know that increasing the temperature increases the frequency of collisions and makes the collisions more energetic, and so increases the rate of reaction.
- identify catalysts in reactions from their effect on the rate of reaction and because they are not included in the chemical equation for the reaction.
- Explain catalytic action in terms of activation energy.
- Define the term activation energy.
- Identify advantages of using catalysts in industrial reactions eg reducing costs.
- Know that enzymes act as catalysts in biological systems.
- Know that catalysts increase the rate of reaction by providing a different pathway for the reaction that has lower activation energy.
- Know that In some chemical reactions, the products of the reaction can react to produce the original reactants.
- Know that reversible reactions are represented in the following way:

  $A + B \rightleftharpoons C + D$

- Know that the direction of reversible reactions can be changed by changing the reaction conditions.
- Know this type of arrow represents reversible reactions $\rightleftharpoons$
- Recall definition of:
  exothermic
  endothermic.
- Know that If a reversible reaction is exothermic in one direction, it is endothermic in the opposite direction.
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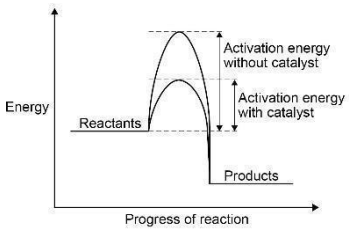
Procedural Knowledge:

- Draw tangents to the curves on graphs and use the slope of the tangent as a measure of the rate of reaction.
- Calculate the gradient of a tangent to the curve on these graphs as a measure of rate of reaction at a specific time.
- Explain the effect on the rate of reaction of the following factors:
  concentration
  pressure
  surface area
  temperature
  catalyst.
- A reaction profile for a catalysed reaction can be drawn in the following form:



- Explain what is meant by a reversible reaction.
- Explain the difference between:
  $\rightleftharpoons$ reactions and □ reactions.
- Explain the term equilibrium
- Know how equilibrium is reached when the forward and reverse reactions occur at exactly the same rate
- Describe the effects of temperature on a reversible reaction
- Be able to interpret appropriate given data to predict the effect of a change in concentration of a reactant or product on given reactions at equilibrium.

- Recognise substances as small molecules, polymers or giant structures from diagrams showing their bonding.
- recognise common substances that consist of small molecules from their chemical formula.
- Draw dot and cross diagrams for the molecules of hydrogen, chlorine, oxygen, nitrogen, hydrogen chloride, water, ammonia and methane
- Represent the covalent bonds in small molecules, in the repeating units of polymers and in part of giant covalent structures, using a line to represent a single bond
- State that metals consist of giant structures of atoms arranged in a regular pattern.
- know that the electrons in the outer shell of metal atoms are delocalised and so are free to move through the whole structure.
- Know that the sharing of delocalised electrons gives rise to strong metallic bonds.
- State the three states of matter are solid, liquid and gas.
- Know that Melting and freezing take place at the melting point, boiling
- Know that condensing takes place at the boiling point.
- State that the three states of matter can be represented by a simple model.
- Know in this model, particles are represented by small solid spheres.
- Know that Particle theory can help to explain melting, boiling, freezing and condensing.
- Know that the amount of energy needed to change state from solid to liquid and from liquid to gas depends on the strength of the forces between the particles of the substance.
- Know that the stronger the forces between the particles, the higher the melting point and boiling point of the substance.
- State in chemical equations, the three states of matter are shown as (s) solid
- know that Liquid (l) and (g) gas are state symbols
- Know that Aqueous solutions have the symbol (aq) .
- Know that Ionic compounds have regular structures (giant ionic lattices) in which there are strong electrostatic forces of attraction in all directions between oppositely charged ions.
- State that compounds have high melting points and high boiling points
- Know that Large amounts of energy are needed to break the many strong bonds.

- Use the relative formula mass of a substance to calculate the number of moles in a given mass of that substance and vice versa.
- Calculate the masses of substances shown in a balanced symbol equation.
- Calculate the masses of reactants and products from the balanced symbol equation and the mass of a given reactant or product
- Rearrange the equation
  $C = m / v$
  to make number of moles the subject.
- Know the method on how to carry out a titration.
- Use the masses of substances present in a reaction to write a balanced equation.
- Explain how the mass of a solute and the volume of a solution is related to the concentration of the solution.
- Explain the meaning of concentration and the unit grams per dm^3
- Explain how the concentration of a solution in mol/dm^3 is related to the mass of the solute and the volume of the solution.
- Rearrange the equation:
  $C = m / v$
  to make mass the subject.
- explain why indicators eg methyl orange and phenolphthalein are used instead of Universal indicator.
- Change the subject of a mathematical equation.

Upper Hierarchical Knowledge

- Balance complex equations and add state symbols.
- Balance chemical equations and use these to calculate the masses of substances present.
- Be able to balance an equation given the masses of reactants and products.
- Change the subject of a mathematical equation.
- Explain the effect of a limiting quantity of a reactant on the amount of products it is possible to obtain in terms of amounts in moles or masses in grams.
- Calculate the theoretical amount of a product from a given amount of reactant and the balanced equation for the reaction.
- Calculate the atom economy of a reaction to form a desired product from the balanced equation.
- Explain why a particular reaction pathway is chosen to produce a specified product given appropriate data such as atom economy (if not calculated), yield, rate, equilibrium position and usefulness of by-products.
- Use balanced equations and known volume of reactant/product to calculate the volumes of gaseous reactants/ products.

Working Scientifically

Teacher Demo

- Model the law of conservation using molecular model kits. Lego or Duplo bricks can be used to good effect.

- Teacher demonstration.
  The precipitation reaction:

- State why a mixture is used as the electrolyte.
- State why the positive electrode must be continually replaced.
- Define the term aqueous.

- Know how an aqueous solution is electrolysed.

- Predict the products of the electrolysis of aqueous solutions containing a single ionic compound
- Know that at the negative electrode (cathode), hydrogen is produced if the metal is more reactive than hydrogen
- Know that at the positive electrode (anode), oxygen is produced unless the solution contains halide ions when the halogen is produced.
- Know that in the aqueous solution water molecules break down.
- Know that hydrogen ions and hydroxide ions are discharged from this breakdown
- Know that the cathode is the negative electrode
- Know that positively charged ions gain electrons at the cathode.
- Know that reduction takes place at the cathode
- Know the anode is the positive electrode
- Know that negatively charged ions lose electrons at the anode.
- Know that oxidation takes place at the anode
- Know that oxidation is loss of electrons
- Know that reduction is gain of electrons.

Procedural Knowledge:

- Draw the atomic structure of metals and the ion formed. Use these to describe how the ion has been formed.
- Explain reduction and oxidation in terms of loss or gain of oxygen
- Make links between the ability to form ions and the reactivity with water and acid.
- Explain the trends in reactivity of Group 1 in terms of atomic structure.
- Describe what occurs in a displacement reaction, using suitable examples.
- Deduce an order of reactivity of metals based on experimental results.
- Write ionic equations for displacement reactions.
- Identify in a given reaction, symbol equation or half equation which species are oxidised and which are reduced.
- Explain in terms of gain or loss of electrons, that these are redox reactions.
- Identify which species are oxidised and which are reduced in given chemical equations.
- Predict products from given reactants.
- Use the formulae of common ions to deduce the formulae of salts.
- Describe how to make pure, dry samples of named soluble salts from information provided.
- Describe how to carry out titrations using strong acids and strong alkalis only (sulfuric, hydrochloric and nitric acids only) to find the reacting volumes accurately.
- Calculate the chemical quantities in titrations involving concentrations in mol/dm^3 and in g/dm^3.
- Explain why strong acids are completely ionised in aqueous solutions but a weak acid is only partially ionised.
- Explain what happens to positive and negative ions during electrolysis

- Use data to predict the effect of concentration on equilibrium.
- Interpret appropriate given data to predict the effect of a change in temperature on given reactions at equilibrium.
- Use data to predict the effect of temperature on equilibrium
- interpret appropriate given data to predict the effect of pressure changes on given reactions at equilibrium.
- Use data to predict the effect of pressure on equilibrium

Upper Hierarchical Knowledge

- Use graphs of data obtained from concentration reactions to explain what occurs as the reaction proceeds
- Be able to make qualitative predictions about the effect of changes on systems at equilibrium when given appropriate information
- Describe Le Chatelier's principle.
- Explain the effects on equilibrium of changing conditions using suitable examples.
- Explain how the effects of changing conditions on a system at equilibrium can be predicted using Le Chatelier's Principle.
- Explain if the temperature of a system at equilibrium is increased:

  the relative amount of products at equilibrium increases for an endothermic reaction
  the relative amount of products at equilibrium decreases for an exothermic reaction.

- If the temperature of a system at equilibrium is decreased:

  the relative amount of products at equilibrium decreases for an endothermic reaction
  the relative amount of products at equilibrium increases for an exothermic reaction.
- For gaseous reactions at equilibrium:

  Explain how an increase in pressure causes the equilibrium position to shift towards the side with the smaller number of molecules
  Explain how a decrease in pressure causes the equilibrium position to shift towards the side with the larger number of molecules.

Working Scientifically

- React $CaCO_3$ with dilute HCl and measure the volume of CO_2 evolved against time.
- **Required practical 5:** investigate how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produced **and** a method involving a change in colour or turbidity.

- Investigate changing temperature and surface area of reactants and use of catalysts.
- Investigate the catalytic effect of adding different metal salts to a reaction such as the decomposition of hydrogen peroxide.
- Practical: hydrate or dehydrate copper sulfate.
- Heat ammonium chloride in a test tube. Use mineral wool to support a piece of damp pH paper half way up the tube and observe the colour change.
- Investigate the temperature changes for:

$$hydrated\ copper\ sulfate\ (\text{Blue}) \rightleftharpoons anhydrous\ copper\ sulfate\ (White) + water$$

- Know that when melted or dissolved in water, ionic compounds conduct electricity.
- Recognise that ions are free to move and so charge can flow.
- Know that substances that consist of small molecules are usually gases or liquids.
- Recognise that small molecules have low melting points and boiling points.
- Know that these substances have only weak forces between the molecules (intermolecular forces).
- Recognise that intermolecular forces are overcome, not the covalent bonds, when the substance melts or boils.
- Know that intermolecular forces increase with the size of the molecules,
- Identify larger molecules as having higher melting and boiling points.
- Know that these substances do not conduct electricity because the molecules do not have an overall electric charge.
- Identify polymers as very large molecules.
- know that atoms in the polymer molecules are linked to other atoms by strong covalent bonds.
- Know that the intermolecular forces between polymer molecules are relatively strong and so these substances are solids at room temperature.
- Know that substances that consist of giant covalent structures are solids with very high melting points.
- Know that all of the atoms in these structures are linked to other atoms by strong covalent bonds.
- Recognise that these bonds must be overcome to melt or boil these substances.
- Identify that Diamond and graphite (forms of carbon) and silicon dioxide (silica) are examples of giant covalent structures.
- Know that metals have giant structures of atoms. with strong metallic bonding.
- Identify that most metals have high melting and boiling points.
- Know that in pure metals, atoms are arranged in layers.
- Know that metals can be bent and shaped.
- Know that Pure metals are too soft for many uses and so are mixed with other metals to make alloys which are harder.
- State that Metals are good conductors of electricity
- Know that the delocalised electrons in

$lead\ nitrate\ +\ potassium\ iodide$

- Model compounds with different sized and coloured lego bricks pre-marked with symbol and A_r of different elements. Sum the A_rs marked on the bricks to obtain the M_r
- Use magnesium ribbon to produce magnesium oxide. Measure the mass of the ribbon at the start of the experiment, burn the ribbon in a strong Bunsen flame (SAFETY required) and measure the mass of the ribbon at the end of the experiment.
- Use HCl acid in a conical flask with $CaCO_3$. Measure the mass of the reaction on a top pan balance as the reaction proceeds over two minutes.
- Demonstrate combustion of paper in a large beaker to show mass may decrease because products are released to the air as gases.
- Try balancing iron wool on a pair of scales (a makeshift one can be set up using a carefully balanced metre rule). Heat the iron wool strongly to observe the increase in mass of the oxide.
- Class thiosulfate 'disappearing cross' experiment at a single fixed concentration using (a) pre-printed computer generated crosses (b) hand drawn crosses using different pens/pencils
- Measure out and compare 1 mole of elements like iron, sulfur, magnesium, copper, aluminium and so on.
- Use a small strip of magnesium ribbon in 20 ml HCl acid. Identify which reactant is the limiting reactant and state the reason for this choice.
- Measure out and compare one mole of common compounds, water, sodium chloride, calcium carbonate and so on.
- To demonstrate the idea of concentration students could make different concentrations of tea, coffee or a dark squash like blackcurrant.
-
- Identify a chemical reaction that has a high atom economy and research the positives to industry of producing a high yield of useful product.
- Identify a chemical reaction that has a low atom economy and research the negatives to industry of producing a low yield of useful product and ways the reactions has been improved to increase the yield of useful product

RP Titration

- Titrate HCl with NaOH using an indicator of methyl orange. Use the titre results and know volumes of NaOH and concentration, to calculate the concentration of the HCl.

and how elements form from their ions.

- Explain why the following atoms could be produced:
  hydrogen
  oxygen.

- Reactions at electrodes can be represented by half equations, for example:

$2H^+ + 2e^- \rightarrow H_2$
and
$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$
or
$4OH^- - 4e^- \rightarrow O_2 + 2H_2O$

<u>Upper Hierarchical Knowledge</u>

- Explain how the reactivity of metals with water or dilute acids is related to the tendency of the metal to form its positive ion.
- Explain why displacement occurs.
- Describe how carbon is used to reduce metal oxides. Explain how this takes place in terms of movement of electrons.
- Identify which products have been oxidised in extraction examples. Explain how this takes place in terms of movement of electrons
- Write balanced symbol equations/half equations for the displacement of metal oxides. Use these to identify which species has been oxidised or reduced. Give reasons for your answers.
- Write the symbol equation for the neutralisation of an acid and an alkali.
- Describe neutrality and relative acidity in terms of the effect on hydrogen ion concentration and the numerical value of pH
- Write half equations for the reactions occurring at the electrodes during electrolysis.
- Balance supplied half equations.
- Explain thoroughly what happens at the following electrodes using suitable examples and half equations:
  cathode
  anode

<u>Working Scientifically</u>

- Demo, and where appropriate practically investigate, the reactivity of some of the metals with water and acid.
- Carry out displacement reactions
- Reduce iron oxide using carbon:
- Research different methods for extraction metals from their oxides.
- Investigate the reactions of the following metals with sulfuric acid:
  magnesium
  zinc
  iron.

- Investigate the following reactions:

acids + soluble metal hydroxide
acid + insoluble metal hydroxide
acids + metal carbonates.

Required practical 1:

- 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.

- Measure the pH of a variety of the following solutions:
  acidic
  alkaline
  neutral.

- Practical: measure the pH change when a strong acid neutralises a strong alkali.

Required practical 2:

the metal carry electrical charge through the metal. ● State that metals are good conductors of thermal energy because energy is transferred by the delocalised electrons. ● Know that in diamond, each carbon atom forms four covalent bonds with other carbon atoms. ● Know that diamond exists in a giant covalent structure. ● State that diamond is very hard ● State that diamond has a very high melting point. ● State that diamond does not conduct electricity. ● Know that in graphite, each carbon atom forms three covalent bonds with three other carbon atoms, ● Recognize that graphite forms layers of hexagonal rings which have no covalent bonds between the layers. ● Know that in graphite, one electron from each carbon atom is delocalised. ● Identify that graphene is a single layer of graphite ● Know that Graphene has properties that make it useful in electronics and composites. ● Know that fullerenes are molecules of carbon atoms with hollow shapes. ● Recognise that the structure of fullerenes is based on hexagonal rings or tubes of carbon atoms ● State that the first fullerene to be discovered was Buckminsterfullerene (C_{60}) which has a spherical shape. ● Know that carbon nanotubes are cylindrical fullerenes ● Recognise the properties that nanotubes useful for nanotechnology, electronics and materials. **<u>Chemistry ONLY</u>** ● State that nanoscience refers to structures that are 1–100 nm in size ● State that Nanoparticles are smaller than fine particles ($PM_{2.5}$), which have diameters between 100 and 2500 nm ● Identify Coarse particles (PM_{10}) as having diameters between 1 x 10^{-5} m and 2.5 x 10^{-6} m. ● State that coarse particles are often referred to as dust. ● ● Know that nanoparticles may have properties different from those for the same materials in bulk. ● Identifying this is because of their high surface area to volume ratio. ● State that smaller quantities of		● Determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration. Determination of the concentration of one of the solutions in mol/dm^3 and g/dm^3 from the reacting volumes and the known concentration of the other solution. ● Use universal indicator or a pH probe to measure the pH of hydrochloric acid, ethanoic acid, sodium hydroxide and ammonium hydroxide ● Measure the pH of different acids at different concentrations. ● Compare the rate of reaction when magnesium is dipped in hydrochloric acid and ethanoic acid of the same concentration. ● Carry out the electrolysis of solutions ● Demo the electrolysis of lead bromide. A safer alternative for practical work is anhydrous zinc chloride. **Required practical 3:** ● Investigate what happens when aqueous solutions are electrolysed using inert electrodes. This should be an investigation involving developing a hypothesis	

nanoparticles are needed to be effective than for materials with normal particle sizes. ● Know that nanoparticles have many applications in medicine, in electronics, in cosmetics and sun creams, as deodorants, and as catalysts. ● Recognise that new applications for nanoparticulate materials are an important area of research. **Procedural Knowledge:** ● Work out the charge on the ions of metals and non-metals from the group number of the element ● Limited to the metals in Groups 1 and 2, and non-metals in Groups 6 and 7. ● Deduce that a compound is ionic from a diagram of its structure in one of the specified forms ● Describe the limitations of using dot and cross, ball and stick, two and three dimensional diagrams to represent molecules or giant structures ● Explain intermolecular forces are weak compared with covalent bonds to explain the bulk properties of molecular substances. ● Recognise graphene and fullerenes from diagrams and descriptions of their bonding and structure. ● Explain the properties of graphite in terms of its structure and bonding. ● Know that graphite is similar to metals in that it has delocalised electrons. ● Explain the properties of diamond in terms of its structure and bonding. ● Know that the side of the cube decreases by a factor of 10 the surface area to volume ratio increases by a factor of 10. **<u>Upper Hierarchical Knowledge</u>** ● Be able to translate data between diagrammatic and numeric forms. ● Describe the limitations of using dot and cross, ball and stick, two and three dimensional diagrams to represent a giant ionic structure ● State and describe limitations of the particle model ● Work out the empirical formula of an ionic compound from a given model or diagram that shows the ions in the structure. ● Deduce the molecular formula of a substance from a given model or diagram. ● Explain why alloys are harder than pure metals in terms of distortion of the layers of atoms in the structure of a pure metal. ● Compare ‘nano’ dimensions to typical dimensions of atoms and molecules. ● Evaluate the use of nanoparticles for a specified purpose.			

● **Working Scientifically** ● Demo the formation of sodium chloride in a fume cupboard. ● Use magnesium ribbon to produce magnesium oxide. Draw the dot and cross diagram for this reaction. ● Model the sodium chloride lattice using molecular model kits. ● Demo the formation of hydrogen chloride. Draw the dot and cross diagram for this reaction. ● Model simple covalent substance using molecular model kits. ● Demo giant covalent structures using molecular model kits. ● Use copper wire and silver nitrate solution to grow silver crystals. ● Practically test the conductivity of ionic compounds, eg sodium chloride and potassium chloride. ● Practically test the conductivity of simple covalent substances using ethanol and solid wax pieces. ● Model the structure of diamond using model kits ● Model the structure of graphite using model kits.			

Year 10 (Chemistry) Final Composite Knowledge End Point

Schemata 1 – Structure and Bonding

Students will learn about different types of bonding

- **Ionic Bonding:**
  - Transfer of electrons between metals and non-metals.
  - Formation of ions and ionic compounds.
  - Properties of ionic compounds: high melting points, conductivity when molten or dissolved.
- **Covalent Bonding:**
  - Sharing of electrons between non-metals.
  - Formation of molecules.
  - Properties of simple molecular substances: low melting and boiling points, poor conductivity.
- **Metallic Bonding:**
  - Sea of delocalized electrons.
  - Properties of metals: conductivity, malleability, ductility.

Students will learn about structure and properties

- **Giant Ionic Structures:**
  - Lattice structure of ionic compounds.
  - High melting and boiling points.
- **Simple Molecular Structures:**
  - Weak intermolecular forces.
  - Low melting and boiling points.
- **Giant Covalent Structures:**
  - Diamond, graphite, and silicon dioxide.
  - High melting points and unique properties (e.g., hardness of diamond, conductivity of graphite).
- **Metallic Structures:**
  - Layers of atoms and delocalized electrons.
  - Explanation of metal properties in terms of structure and bonding.

Students will about states of matter

- **Particle Model:**
  - Solid, liquid, gas: particle arrangement and movement.
  - Changes of state and energy transfer: melting, boiling, condensation, freezing.

Students will learn about Nanoscience

- **Nanoparticles:**
  - Definition and scale of nanoparticles.
  - Unique properties and applications.
  - Potential risks and benefits of nanotechnology.

Schemata 2 – Quantitative Chemistry

Students will learn about Atomic and Molecular Mass

- **Relative Atomic Mass (Ar):**
  - Definition and calculation based on isotopic abundance.
- **Relative Formula Mass (Mr):**
  - Calculation for compounds using relative atomic masses of constituent elements.

Students will learn about The Mole and Avogadro's Constant

- **The Mole:**
  - Definition of the mole as a unit of amount of substance.
  - Avogadro's constant: 6.022×10236.022 \times 10^{23}6.022×1023 particles per mole.
  - Use of the mole in converting between mass, particles, and moles.
- **Molar Mass:**
  - Definition and calculation from relative atomic and formula masses.
  - Use in converting between mass and moles.

Students will about Chemical Calculations

- **Balanced Equations:**
  - Interpretation of balanced chemical equations in terms of moles.
  - Use of stoichiometry to calculate reacting masses.
- **Reacting Masses:**
  - Calculations involving masses of reactants and products.
  - Limiting reactants: identification and calculations.

Students will learn about Concentrations of Solutions

- **Concentration:**
  - Definition and calculation in terms of mass per unit volume (g/dm³) and moles per unit volume (mol/dm³).

Chemistry Only

Students will learn Volumes of Gases

- **Gas Volumes:**
  - Molar volume of gases at room temperature and pressure (RTP): 24 dm³/mol.
  - Use of molar volume in calculations involving gaseous reactants and products.

Students will learn about Percentage Yield and Atom Economy

- **Percentage Yield:**
  - Calculation from actual yield and theoretical yield.
  - Factors affecting percentage yield in reactions.
- **Atom Economy:**
  - Definition and calculation.
  - Importance of atom economy in sustainable chemistry.

Students will learn about Titrations

- **Acid-Base Titrations:**
  - Procedure and calculations for determining concentrations.
  - Use of indicators and understanding of end-point.
- **Calculations:**
  - Using titration data to calculate unknown concentrations.

Students will learn about Uncertainties and Errors

- **Measurement Uncertainties:**
  - Understanding and calculating uncertainties in measurements.
  - Reporting and reducing uncertainties in experimental results.

Schemata 3 – Chemical Change

Students will learn about Chemical Reactions

- **Chemical Reactions:**
  - Definition and identification of chemical reactions.
  - Evidence of a chemical reaction: color change, gas production, precipitate formation, temperature change.
- **Chemical Equations:**
  - Writing word equations for common reactions.
  - Writing and balancing simple symbol equations.
  - Use of state symbols: (s), (l), (g), (aq).

Students will learn about Acids, Bases, and Neutralization

- **Acids and Bases:**
  - Definition and properties of acids and alkalis (bases).
  - The pH scale: understanding pH values and their significance.
  - Use of indicators (litmus, universal indicator) and pH meters.
- **Neutralization Reactions:**
  - General equation for acid-base neutralization: acid + base → salt + water.
  - Practical applications: everyday examples like antacids and soil treatment.

Students will about Reactions of Acids

- **With Metals:**
  - General reaction: acid + metal → salt + hydrogen gas.
  - Observations and simple tests for hydrogen gas (pop test).
- **With Bases:**
  - General reaction: acid + base → salt + water.
  - Formation and naming of salts based on the acid and base used.
- **With Carbonates:**
  - General reaction: acid + carbonate → salt + water + carbon dioxide.
  - Observations and tests for carbon dioxide gas (limewater test).

Students will learn about Electrolysis

- **Basic Principles:**
  - Definition of electrolysis and its purpose.
  - Key components: electrolyte, anode (positive electrode), cathode (negative electrode).
- **Electrolysis of Molten Compounds:**
  - Simple examples such as the electrolysis of molten lead bromide.
  - Understanding ion movement and products at each electrode.
- **Electrolysis of Aqueous Solutions:**
  - Differences when electrolyzing aqueous solutions.
  - Example: electrolysis of sodium chloride solution producing hydrogen and chlorine.

Students will learn about the Reactivity Series

- **Reactivity Series:**
  - Arrangement of metals in order of reactivity.
  - Comparison of reactivity based on reactions with water, acids, and oxygen.
  - Placement of carbon and hydrogen in the reactivity series for comparison.
- **Displacement Reactions:**
  - Explanation and examples of displacement reactions.
  - Use of displacement reactions to determine the reactivity of metals.

Students will learn about Extraction of Metals

- **Ores and Minerals:**
  - Definition of ores and their economic importance.
  - Common ores of metals like iron, aluminum, and copper.
- **Methods of Extraction:**
  - Extraction of metals below carbon in the reactivity series (e.g., iron) using reduction with carbon.
  - Extraction of metals above carbon (e.g., aluminum) using electrolysis.
- **Reduction with Carbon:**
  - Example: extraction of iron from iron ore in a blast furnace.
  - Chemical equations for the reduction process.

- **Electrolysis:**
  - Extraction of aluminum from bauxite using electrolysis.
  - Chemical equations for the electrolysis process.

Students will learn about Oxidation and Reduction

- **Definitions:**
  - Oxidation: loss of electrons, gain of oxygen.
  - Reduction: gain of electrons, loss of oxygen.
  - Redox reactions: simultaneous oxidation and reduction processes.
- **Examples of Redox Reactions:**
  - Reactions of metals with oxygen (e.g., rusting of iron).
  - Displacement reactions as redox reactions

Schemata 4 - The Rate and Extent of Chemical Change

Students will learn about Rate of Reaction

Students will learn about Rate of Reaction

- **Definition of Rate of Reaction:**
  - The speed at which reactants are converted to products.
  - Calculation of reaction rate: change in quantity of reactant/product over time.
- **Factors Affecting Rate of Reaction:**
  - Concentration: higher concentration increases rate.
  - Temperature: higher temperature increases rate.
  - Surface Area: greater surface area increases rate.
  - Catalysts: substances that increase rate without being consumed.
  - Pressure (for gases): higher pressure increases rate.
- **Collision Theory:**
  - Explanation of how reactions occur when particles collide with sufficient energy.
  - Activation energy: minimum energy needed for a reaction to occur.
- **Measuring Rates of Reaction:**
  - Monitoring changes in mass, volume of gas produced, or color change.
  - Practical methods such as gas syringe or precipitation methods.

Students will learn about Graphical Representation of Reaction Rates

- **Rate Graphs:**
  - Interpreting graphs of concentration vs. time.
  - Determining rate from the gradient of the graph.
  - Understanding different shapes of rate graphs for different reactions.

Students will learn about Catalysts

- **Function of Catalysts:**
  - Definition and role of catalysts in increasing reaction rate.

- How catalysts lower activation energy.
- Examples of catalysts in industry (e.g., enzymes in biological processes).

Students will learn about Reversible Reactions and Dynamic Equilibrium

- **Reversible Reactions:**
  - Definition and characteristics of reversible reactions.
  - Examples of reversible reactions (e.g., the Haber process).
- **Dynamic Equilibrium:**
  - Definition and conditions for dynamic equilibrium in a closed system.
  - Characteristics of dynamic equilibrium: rates of forward and reverse reactions are equal.
  - Understanding that concentration of reactants and products remain constant.

Students will learn about Le Chatelier's Principle

- **Le Chatelier's Principle:**
  - Explanation of how changes in concentration, temperature, and pressure affect the position of equilibrium.
  - Predicting the effect of changing conditions on the yield of products.
- **Applications of Le Chatelier's Principle:**
  - Industrial processes such as the Haber process for ammonia production.
  - Effect of pressure, temperature, and concentration changes on equilibrium position and product yield.

Students will learn about Calculations Involving Reaction Rates

- **Quantitative Aspects:**
  - Calculations involving rate of reaction (e.g., rate = amount of reactant used / time).
  - Interpretation and calculation of data from rate experiments.

Year 10 Physics Essential Knowledge Summary			
Schemata 1: P3 Particle Model of Matter	**Schemata 2: P4 Atomic Structure**	**Schemate 3: P2 Electricity**	**Schemata 4: P6 Waves**
Composite Knowledge: Pupils will be able to discuss the changes to particle arrangement, movement, energy and force in relation to states of matter and changes of state. Pupils will be able to calculate density with both their primary data and secondary data. Pupils will learn how changes to the internal energy of a substance affect the substance. Pupils will be able to define and distinguish between specific heat capacity and latent heat. Pupils will learn about Boyle's law and (Triple only) Charles's Law. **Component Knowledge:** **Foundational Knowledge:** Declarative Knowledge: • Recall the equation that links: density, mass, and volume • Recall the units for density, mass, volume, energy changes, specific heat capacity, temperature change, latent heat, pressure • Recall the three states of matter • Draw simple diagram to represent the three state of matter • Describe the particle arrangement and particle movement in each state of matter • Describe how density changes when changing state • State the law of conservation of mass in relation to changing state • Name the changes of state • Describe how the forces between particles and energy of particle changes during changes of state • Define internal energy • Apply the equation for specific heat capacity • Define specific heat capacity • Define latent heat, latent heat of fusion, and latent heat of vaporisation • Apply the latent heat equation	**Composite Knowledge:** Understand and describe the structure of the atom and use evidence to explain how this has changed over time. Understand the concept of the random nature of radioactive decay and the properties of the different types of nuclear radiation. Understand how the penetrating power and ionising ability differentiates the different types of nuclear radiation. Describe the applications and hazards of nuclear radiation. Complete, interpret and balance decay equations. Understand the concept and application of half-life. (Triple only) Understand and compare the processes of nuclear fission and nuclear fusion. Understand the effect of nuclear radiation on living things and how we take precaution to make ourselves and the environment safe. Understand the difference between contamination and irradiation. **Component Knowledge:** **Foundational Knowledge:** Declarative Knowledge: • State the approximate radius of an atom • State the approximate size of the nucleus compared to the size of an atom • Name the three subatomic particles • State the relative charge and relative mass of the three subatomic particles • Simply describe the location of the three subatomic particles. • State what is meant by mass number and atomic number • Define isotope • Name historic models of the atoms in chronological order • Describe different models of the atom	**Composite Knowledge:** Pupils will learn about the relationship between current, potential difference, and resistance. They will learn about circuit components, how to interpret circuit diagrams and how to apply the rules for current, potential difference, and resistance in both series and parallel circuits. Pupils will investigate resistance in various components and circuits. They will practise and become confident in using and manipulating many equations. Pupils will learn about our domestic supply, how it is transferred and how we keep ourselves safe when using it. **Component Knowledge:** **Foundational Knowledge:** Declarative Knowledge: • Recall the units for: current, charge, time, resistance, potential difference, power • Name and draw circuit symbols • Define electrical current • Recall the equation that links: charge, current and time • State Ohm's law • Recall the Ohm's law equation • Recognise the V-I graph for a fixed value resistor, filament lamp, diode, thermistor & LDR. • State how the resistance of thermistors and LDRs change with change in the environment • State the difference between a series and parallel circuit • State the rules for current, potential difference and resistance in both series and parallel circuits. • State the frequency and potential of the UK domestic supply • State what is meant by both direct and alternating potential differences.	**Composite Knowledge:** Pupils will understand the difference between longitudinal and transverse waves. Pupils will become familiar with the terms amplitude, wavelength, frequency, time period and wave speed. Pupils will learn and be able to use the wave speed equation. They will recognise the waves in the electromagnetic spectrum, their properties, uses and dangers. In triple science pupils will learn about sound waves and seismic waves, their properties and uses. Pupils will learn about light, how it is reflected and refracted. In triple science they will discuss wave fronts and also be able to understand how lenses work. **Component Knowledge:** **Foundational Knowledge:** Declarative Knowledge: • Recall the units of: wave speed, frequency, wavelength, period • Recognise, define and label transverse and longitudinal waves. • Define terms: 'frequency', 'wavelength' & 'amplitude'. • Recall and use the wave equation and period-frequency equations. • Describe how to measure the speed of sound in air • Recognise that waves can be reflected, transmitted and absorbed at the boundary of different materials (triple only) • Describe the effect of reflection, transmission or absorption of waves at a boundary (triple only) • Know how sound waves travel (triple only) • Describe how the structure of the ear restricts the human range of hearing (triple only) • State the range of human hearing (triple only) • Define ultrasound (triple only)

- State how particles in a gas move
- Relate the temperature, pressure and volume of a gas
- Apply the equation for gas pV=const (Triple only)
- State how work done on a gas affects pressure / temperature (Triple only)

Procedural Knowledge:

- Use an equation to find an unknown variable
- Write methods for experiments.
- Accurately plot axes & graphs
- Draw lines of best fit and use them to find tangents and gradients.

Upper Hierarchical Knowledge

- Describe how to experimentally find the density of a regular solid, irregular solid, and a liquid (RP5)
- Describe how to experimentally find the specific heat capacity of a substance (RP1)
- Manipulate and use the equations for:
  - Density
  - Specific heat capacity
  - Latent heat
- Explain how adding or removing heat from a substance changes the arrangement and movement of particles and the density of the substance.
- Use the concepts of specific heat capacity and latent heat to interpret heating and cooling curves
- Explain the relationship between gas pressure and volume
- Explain the relationship work on a gas and temperature

Working Scientifically

Density (RP5)

- WS 2.2 Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena.
  - Describe a practical procedure for a specified purpose.
- Describe a practical procedure for a specified purpose.
  - Assess whether sufficient, precise measurements have been taken in an experiment.

Specific Heat Capacity (w. joule metres) (RP1)

- WS 3.3 Carrying out and represent mathematical and statistical analysis.
  - use an appropriate number of significant figures
  - change the subject of an equation substitute numerical values into algebraic
  - equations using appropriate units for physical quantities
  - determine the slope and intercept of a linear graph

Air pressure / can crush demo

- WS 3.5 Interpreting observations, making inferences and drawing conclusions.
  - Draw conclusions from given observations.

- State the evidence used for changing between atomic models.
- Name the three types of nuclear radiation.
- State what the different types of nuclear decay are made of.
- Name the unit for radioactivity
- Define count-rate and activity
- Know that radioactive decay is random
- State the penetrating power & ionising power of the different types of nuclear decay
- Name the equipment used to detect radioactive decay
- Give uses of nuclear radiation
- Complete decay equation
- State what happens in the nucleus of an atom that undergoes radioactive decay
- Define half-life
- Define radioactive contamination
- Define irradiation
- Describe the precautions taken to stay safe in the presence of nuclear radiation
- Define background radiation (triple only)
- Give examples of background radiation (triple only)
- Define nuclear fission (triple only)
- Draw a diagram to represent a nuclear fission chain reaction (triple only)
- State the role of control rods in a chain reaction (triple only)
- Define nuclear fusion

Procedural Knowledge:

- Use mass number and atomic number to state the number of subatomic particles in an atom.
- Complete decay equations
- Determine the half-life of a radioactive source
- Calculate net decline as a ratio (higher tier only)

Upper Hierarchical Knowledge

- Describe how the absorption or emission of EM radiation affects electrons.
- Explain, in depth, the changes to the atomic model.

Working Scientifically

Radioactive source demo

- WS 3.5 Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions.
  - Draw conclusions from given observations.

None practical based:

Atomic structure / atoms

- WS 1.2 Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts.
  - Use models in explanations, or match

- State the colour of the insulation in a three pin plug
- State the names of the pins in a three pin plug
- State the role of each wire / component in a three pin plug.
- State the expected potential difference between the live and neutral wires in a three pin plug.
- Recall the equation that links: power, current, and potential difference
- Recall the equation that links: power, current, and resistance
- Recall the equation that links: power, energy, and time
- Recall the equation that links: charge, energy, and potential difference
- State the components of the National Grid
- State how step-up and step-down transformers affect potential difference and current.
- State that objects become charged because of the transfer of electrons (Triple only)
- State that electrons have a negative electrical charge (Triple only)
- Know that like charges repel and unlike charges attract (triple only)

Procedural Knowledge:

- Use an equation to find an unknown variable
- Write methods for experiments.
- Accurately plot axes & graphs
- Draw lines of best fit and use them to find tangents and gradients.

Upper Hierarchical Knowledge

- Describe how to experimentally find the resistance of an electrical component (RP3/4)
- Compare the resistance of electrical components and explain how this changes as potential difference and/or the environment changes
- Manipulate and use the equations for:
  - charge
  - Ohm's law
  - Potential difference
  - Power
  - Energy
  - Resistance
- Compare and evaluate different energy resources

Working Scientifically

Ohm's Law

- WS 3.2 Translating data from one form to another.
  - Translate data between graphical and numeric form.

Resistance of a wire (RP3)

- WS 3.3 Carrying out and represent mathematical and statistical analysis.
  - use an appropriate number of significant figures
  - find the arithmetic mean and range of a set of data
  - substitute numerical values into algebraic equations using

- State the properties of different seismic waves (triple only)
- Describe how echo-sounding is used to measure depth (triple only)
- Define 'electromagnetic wave'
- State the names of the wave in the electromagnetic spectrum in order (in terms of frequency and wavelength)
- Describe how EM waves can be produced by changes in an atom
- Define 'radiation dose'
- Recall uses of EM waves
- Recognise a concave and convex lens (triple only)
- Understand the terms: principal focus, focal length, real image and virtual image.
- Name the colours of the visible spectrum in order
- Understand the terms: specular reflection & diffuse scattering (triple only)
- Describe how colour filters work in terms of reflection & transmission (triple only)
- Understand the colour of opaque object in terms of reflection & absorption (triple only)
- Use the terms transparent, translucent and opaque appropriately (triple only)
- Understand the term 'black body' and how wavelength and frequency of emission depends on temperature (triple only)

Procedural Knowledge:

- Write methods for experiments
- Construct a ray diagram to show reflection (triple only)
- Construct a ray diagram to show refraction at a boundary
- Construct a ray diagram to show the images formed by concave and convex lenses (triple only)
- Calculate magnification (triple only)
- Write methods for experiments.
- Accurately plot axes & graphs
- Draw lines of best fit and use them to find tangents and gradients.

Upper Hierarchical Knowledge

- Describe how changes in wave speed, frequency & wavelength of sound waves are related as they move from one medium to another.
- Describe how the properties of waves are used for detection & exploration (triple only)
- Use the idea of wave front diagrams to explain refraction
- Describe how radio waves can be produced and transmitted.
- Draw conclusions about the risks of exposure to EM waves
- Explain why a particular EM wave is suitable for a specific application
- Explain temperature of Earth and other bodies in terms of absorption & emission of energy (triple only)

Working Scientifically

Ripple tank & Waves on a string (RP8)

- WS 2.3 Apply a knowledge of a range of techniques, instruments, apparatus, and

<table>
<tr>
<td>Boyle’s law demo
● WS 3.1 Presenting observations and other data using appropriate methods.
○ Plot two variables from experimental or other data.
Charles's Law / Hyman Fire Piston demo
● WS 3.5 Interpreting observations, making inferences and drawing conclusions.
○ Draw conclusions from given observations.</td>
<td>features of a model to the data from experiments or observations that the model describes or explains.
History of the atom
● WS 1.1 Understand how scientific methods and theories develop over time.
○ Give examples to show how scientific methods and theories have changed over time.
○ Explain, with an example, why new data from experiments or observations led to changes in models or theories.
●</td>
<td>appropriate units for physical quantities
Resistors in series & parallel (RP3)
● WS 3.5 Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions.
○ Use data to make predictions.
○ Recognise or describe patterns and trends in
○ data
○ Draw conclusions from given observations.
V-I characteristics of filament lamp, diode, and a resistor at constant temperature (RP4)
● WS 3.3 Carrying out and represent mathematical and statistical analysis.
○ draw and use the slope of a tangent to a curve as a measure of rate of change
Series and parallel circuits
● WS 2.1 Use scientific theories and explanations to develop hypotheses.
○ Suggest a hypothesis to explain given observations or data.</td>
<td>materials to select those appropriate to the experiment.
○ Describe/suggest/select the technique, instrument, apparatus or material that should be used for a particular purpose, and explain why.

Reflection & refraction of light (RP 9) (triple only)
● WS 2.2 – Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena.
○ Describe a practical procedure for a specified purpose.

Investigating the absorption & radiation of infrared radiation (RP 10)
● WS 3.5 Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions.
○ Use data to make predictions.
○ Recognise or describe patterns and trends in data presented in a variety of tabular, graphical and other forms.
○ Draw conclusions from given observations.</td>
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<tr>
<td colspan="4"><u>Year 10 (physics) Final Composite Knowledge End Point (May ½ term)</u></td>
</tr>
<tr>
<td colspan="4">● Learn about electrical circuits and explain the behaviour of components such as filament bulbs, thermistors and LDRs.
● Understand current, potential difference, resistance and their relationships.
● Understand how electricity is transmitted to consumers and the difference between ac/dc.
● Explore ideas of density and pressure, relating this to states of matter and changes of state.
● Understand both specific heat capacity and specific latent heat.
● Describe the structure of an atom and explain how our ideas about atoms have changed.
● Describe the random nature of radioactive decay and the properties of alpha, beta and gamma radiation.
● Understand radioactive decay in terms of isotopes, half-life and decay chains.</td>
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</table>