KESTEVEN AND SLEAFORD HIGH SCHOOL

Chemistry Scheme of Learning

Year 10 – Term 3 Topic 6

Intent – Rationale

Pupils will investigate through a series of experiments how various factors affect the rate of a chemical reaction, and be able to explain these observations using collision theory. Pupils process data collected in these practicals and use this information to calculate rates of reaction, using tangents and gradients. Pupils then will investigate how the yield of a reaction can be changed by altering reaction conditions, using Le Chatliers principle to explain this. Applying both of these concepts will result in pupils being able to determine appropriate conditions for a specific reaction that maximises both rate and yield, without compromising on cost and safety

Sequencing – what prior learning does this topic build upon?	Sequencing – what subsequent learning does this topic feed into?
• Year 7 – Topic 1 Particles, Topic 3 Acids and Alkalis, Topic 4 Solutions, Topic 5 Simple Chemical Reactions • Year 8 – Topic 9 Reactions of Acids, Topic 10 Describing Chemical Reactions • Year 9 GCSE Topic 2 Bonding, Topic 3 Quantitative Chemistry, Topic 4 Chemical Changes • Year 10 GCSE Topic 5 Energy Changes	• GCSE Topic 7 Organic Chemistry, Topic 10 Using Resources, • A level Topic 5 and 9 Kinetics, Topic 6 and 10 Equilibria
What are the links with other subjects in the curriculum?	**What are the links to SMSC, British Values and Careers?**
• Base the content here on what you already know but there will be time in future to liaise further as part of our collaborative work	• SP – Pupil's enjoyment of learning about the world around them, M- considering ethics with regards to Fritz Haber, C – application of chemistry in everyday life and industry • GB4 b,c,d,e,f,g,i
What are the opportunities for developing literacy skills and developing learner confidence and enjoyment in reading?	**What are the opportunities for developing mathematical skills?**
FROM THE LIBRARY *Elements Compounds and Mixtures-541* *Acids Bases and Salts-546* *Air and Water-546* *Chemicals in Action-546* *Periodic Kingdom-546.8*	• Processing data and plotting graphs • Drawing tangents and calculating gradients • Calculating mean rates

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Chemistry Scheme of Learning

Year 10 – Term 3 Topic 6

Intent – Concepts

What knowledge will students gain and what skills will they develop as a consequence of this topic?
Know • I know that the factors which affect the rates of chemical reactions include: the concentrations of reactants in solution, the pressure of reacting gases, the surface area of solid reactants, the temperature and the presence of catalysts. • I know how changing the surface area affects the rate of a reaction • I know how changing the concentration or pressure affects the rate of a reaction • I know how the presence of a catalysis affects the rate of a reaction • I know how changing the temperature affects the rate of a reaction • I can 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. • I know that in some chemical reactions, the products of the reaction can react to produce the original reactants. Such reactions are called reversible reactions. • I know that if a reversible reaction occurs in apparatus which prevents the escape of reactants and products, equilibrium is reached when the forward and reverse reactions occur at exactly the same rate. • I know that if a system is at equilibrium and a change is made to any of the conditions, then the system responds to counteract the change. • I know the effects of changing conditions on a system at equilibrium can be predicted using Le Chatelier's Principle. • I know the raw materials for the Haber process • I know the conditions for the Haber process **Apply** • I can 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 • I can predict and explain the effects of changes in the size of pieces of a reacting solid in terms of surface area to volume ratio • I can draw, and interpret, graphs showing the quantity of product formed or quantity of reactant used up against time • I can explain catalytic action in terms of activation energy. • I know that if a reversible reaction is exothermic in one direction, it is endothermic in the opposite direction. The same amount of energy is transferred in each case. • I know that the relative amounts of all the reactants and products at equilibrium depend on the conditions of the reaction. • I know how concentration and temperature affect the position of equilibrium • I know how gas pressure affects the position of equilibrium • I can apply the principles of dynamic equilibrium in reversible reactions and dynamic equilibrium to the Haber process **Extend** • I can predict and explain using collision theory the effects of changing conditions of concentration, pressure and temperature on the rate of a reaction • I can explain practical observations using collision theory • I can draw tangents to the curves on these graphs and use the slope of • the tangent as a measure of the rate of reaction • I can calculate the gradient of a tangent to the curve on these graphs as a measure of rate of reaction at a specific time • I can make qualitative predictions about the effect of changes on systems at equilibrium when given appropriate information. • I can interpret appropriate given data to predict the effect of a change in concentration of a reactant or product on given reactions at equilibrium • I can interpret appropriate given data to predict the effect of a change in temperature on given reactions at equilibrium. • I can interpret appropriate given data to predict the effect of pressure changes on given reactions at equilibrium. • I can interpret graphs of reaction conditions versus rate

What subject specific language will be used and developed in this topic?	What opportunities are available for assessing the progress of students?
(see glossary below)	• **Assessed homeworks after lesson 5, 10 and 11** • **End of topic test** • **Required practical 5**

Le Chatelier's Principle	When a change in conditions is introduced to a system at equilibrium, the position of equilibrium shifts to oppose the change
Rate of Reaction	The time taken for reactants to be converted into products in a chemical reaction
Collision theory	Particles must collide with enough energy for a reaction to take place
Activation Energy	The minimum energy required for a reaction to take place. Particles must collide with at least this energy for a successful collision
Catalyst	A substance which provides an alternative route for a chemical reaction with lower activation energy. It remains unchanged at the end of the reaction
Surface area	Small pieces of solid in a reaction have larger surface areas. There are more reacting surfaces as more particles are exposed
Concentration	A higher concentration of a solution has more particles of reactants in the same volume. This concept also applies to gases and pressure
Frequency	How often something occurs e.g. a higher frequency of collisions mean particles are colliding more often
Reversible	A reaction in which the products can react together to make the original reactants again
Hydrated	Ionic crystals contain water as part of the ionic lattice. This water is called water of crystallisation

Anhydrous	Ionic crystals DO NOT contain water as part of the ionic lattice ('without water')	
Dynamic Equilibrium	When the rate of the forward reaction is the same as the rate of the backward reaction. This happens in a closed system and there is no change in the amount of reactants or products	

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Intent – Concepts

Lesson title	Learning challenge	Higher level challenge	Suggested activities and resources
Lesson 1 Collision Theory	• I can 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 • I know that the factors which affect the rates of chemical reactions include: the concentrations of reactants in solution, the pressure of reacting gases, the surface area of solid reactants, the temperature and the presence of catalysts.	• I can predict and explain using collision theory the effects of changing conditions of concentration, pressure and temperature on the rate of a reaction	https://robertcarretrust.sharepoint.com/sites/rct-files-staff/shared%20documents/KSHS/Departments/Curriculum/Science/KS4/CHEMISTRY%20KS4/AQA%20CHEMISTRY%20GCSE/Topic%206%20Rates%20and%20Extent%20of%20Reactions/Lesson%201%20Collision%20Theory
Lesson 2 Surface Area and Rates of Reaction	• I know how changing the surface area affects the rate of a reaction • I can predict and explain the effects of changes in the size of pieces of a reacting solid in terms of surface area to volume ratio	• I can explain this effect using collision theory	https://robertcarretrust.sharepoint.com/sites/rct-files-staff/shared%20documents/KSHS/Departments/Curriculum/Science/KS4/CHEMISTRY%20KS4/AQA%20CHEMISTRY%20GCSE/Topic%206%20Rates%20and%20Extent%20of%20Reactions/Lesson%202%20Surface%20Area%20and%20Rates
Lesson 3 Concentration and Rates	• I know how changing the concentration or pressure affects the rate of a reaction • I can draw, and interpret, graphs showing the quantity of product formed • or quantity of reactant used up against time	• I can explain this effect using collision theory • I can draw tangents to the curves on these graphs and use the slope of • the tangent as a measure of the rate of reaction • I can calculate the gradient of a tangent to the curve on these graphs as a measure of rate of reaction at a specific time	https://robertcarretrust.sharepoint.com/sites/rct-files-staff/shared%20documents/KSHS/Departments/Curriculum/Science/KS4/CHEMISTRY%20KS4/AQA%20CHEMISTRY%20GCSE/Topic%206%20Rates%20and%20Extent%20of%20Reactions/Lesson%203%20Conc%20and%20Rates%20(req%20prac%205)
Lesson 4 Temperature and Rates	• I know how changing the temperature affects the rate of a reaction • I can draw, and interpret, graphs showing the quantity of product formed • or quantity of reactant used up against time	• I can explain this effect using collision theory • I can draw tangents to the curves on these graphs and use the slope of • the tangent as a measure of the rate of reaction • I can calculate the gradient of a tangent to the curve on these graphs as a measure of rate of reaction at a specific time	https://robertcarretrust.sharepoint.com/sites/rct-files-staff/shared%20documents/KSHS/Departments/Curriculum/Science/KS4/CHEMISTRY%20KS4/AQA%20CHEMISTRY%20GCSE/Topic%206%20Rates%20and%20Extent%20of%20Reactions/Lesson%204%20Temperature%20and%20Rates
Lesson 5 Catalysts and Rates	• I know how the presence of a catalysis affects the rate of a reaction • I can 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. • I can explain catalytic action in terms of activation energy.	• I can explain this effect using collision theory	https://robertcarretrust.sharepoint.com/sites/rct-files-staff/shared%20documents/KSHS/Departments/Curriculum/Science/KS4/CHEMISTRY%20KS4/AQA%20CHEMISTRY%20GCSE/Topic%206%20Rates%20and%20Extent%20of%20Reactions/Lesson%205%20Catalysts%20and%20Rates
Lesson 6 Calculating Rates (optional)	• I can draw, and interpret, graphs showing the quantity of product formed or quantity of reactant used up against time • I can draw tangents to the curves on these graphs and use the slope of the tangent as a measure of the rate of reaction	• I can calculate the gradient of a tangent to the curve on these graphs as a measure of rate of reaction at a specific time.	https://robertcarretrust.sharepoint.com/sites/rct-files-staff/shared%20documents/KSHS/Departments/Curriculum/Science/KS4/CHEMISTRY%20KS4/AQA%20CHEMISTRY%20GCSE/Topic%206%20Rates%20and%20Extent%20of%20Reactions/Lesson%206%20Calculating%20Rates%20(optional)

Lesson 7 Reversible Reactions	• I know that in some chemical reactions, the products of the reaction can react to produce the original reactants. Such reactions are called reversible reactions.	• I know that if a reversible reaction is exothermic in one direction, it is endothermic in the opposite direction. The same amount of energy is transferred in each case.	https://robertcarretrust.sharepoint.com/sites/rct-files-staff/shared%20documents/KSHS/Departments/Curriculum/Science/KS4/CHEMISTRY%20KS4/AQA%20CHEMISTRY%20GCSE/Topic%206%20Rates%20and%20Extent%20of%20Reactions/Lesson%207%20Reversible%20Reactions
Lesson 8 Dynamic Equilibrium	• I know that if a reversible reaction occurs in apparatus which prevents the escape of reactants and products, equilibrium is reached when the forward and reverse reactions occur at exactly the same rate.	• I know that the relative amounts of all the reactants and products at equilibrium depend on the conditions of the reaction.	https://robertcarretrust.sharepoint.com/sites/rct-files-staff/shared%20documents/KSHS/Departments/Curriculum/Science/KS4/CHEMISTRY%20KS4/AQA%20CHEMISTRY%20GCSE/Topic%206%20Rates%20and%20Extent%20of%20Reactions/Lesson%208%20Equilibria
Lesson 9 Position of Equilibria	• I know that if a system is at equilibrium and a change is made to any of the conditions, then the system responds to counteract the change. • I know the effects of changing conditions on a system at equilibrium can be predicted using Le Chatelier's Principle. • I know how concentration and temperature affect the position of equilibrium	• I can make qualitative predictions about the effect of changes on systems at equilibrium when given appropriate information. • I can interpret appropriate given data to predict the effect of a change in concentration of a reactant or product on given reactions at equilibrium • I can interpret appropriate given data to predict the effect of a change in temperature on given reactions at equilibrium.	https://robertcarretrust.sharepoint.com/sites/rct-files-staff/shared%20documents/KSHS/Departments/Curriculum/Science/KS4/CHEMISTRY%20KS4/AQA%20CHEMISTRY%20GCSE/Topic%206%20Rates%20and%20Extent%20of%20Reactions/Lesson%209%20Position%20of%20Equilibrium
Lesson 10 Gases and Equilibria	• I know the effects of changing conditions on a system at equilibrium can be predicted using Le Chatelier's Principle. • I know how gas pressure affects the position of equilibrium	• I can interpret appropriate given data to predict the effect of pressure changes on given reactions at equilibrium.	https://robertcarretrust.sharepoint.com/sites/rct-files-staff/shared%20documents/KSHS/Departments/Curriculum/Science/KS4/CHEMISTRY%20KS4/AQA%20CHEMISTRY%20GCSE/Topic%206%20Rates%20and%20Extent%20of%20Reactions/Lesson%2010%20Gases%20and%20Equilibria
Lesson 11 The Haber Process (Chemistry only)	• I know the raw materials for the Haber process • I know the conditions for the Haber process	• I can apply the principles of dynamic equilibrium in reversible reactions and dynamic equilibrium to the Haber process • I can interpret graphs of reaction conditions versus rate	https://robertcarretrust.sharepoint.com/sites/rct-files-staff/shared%20documents/KSHS/Departments/Curriculum/Science/KS4/CHEMISTRY%20KS4/AQA%20CHEMISTRY%20GCSE/Topic%206%20Rates%20and%20Extent%20of%20Reactions/Lesson%2011%20Haber%20Process%20(Chemistry%20Only)
Test	All of the above	All of the above	https://robertcarretrust.sharepoint.com/sites/rct-files-staff/shared%20documents/KSHS/Departments/Curriculum/Science/KS4/CHEMISTRY%20KS4/AQA%20CHEMISTRY%20GCSE/Topic%206%20Rates%20and%20Extent%20of%20Reactions/Test
