C8 – Rates of Reaction

Lessons TBAT	Key Knowledge	Practical	Assessment
TBAT: Calculate the rate of reaction. TBAT: Explain the collision theory and factors affecting the rate of reaction. TBAT: Explain how surface area affects the rate of reaction. TBAT: Explain how temperature	5.6.1.1 Calculating rates of reactions The rate of a chemical reaction can be found by measuring the quantity of a reactant used or the quantity of product formed over time. The quantity of reactant or product can be measured by the mass in grams or by a volume in cm3 . The units of rate of reaction may be given as g/s or cm3 /s. For the Higher Tier, students are also required to use quantity of reactants in terms of moles and units for rate of reaction in mol/s. Students should be able to: • 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 • draw tangents to the curves on these graphs and use the slope of the tangent as a measure of the rate of reaction	Required practical activity 11: 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.	End of unit assessment Maths focus Graph work

affects the rate of reaction. TBAT: Explain how concentration and pressure affect the rate of reaction. TBAT: Explain the effects of catalysts on reactions. TBAT: Explain how reactions can be reversible and the energy changes that are involved. TBAT: Explain the term dynamic equilibrium. TBAT: Explain what happens in a reversible reaction if we	• (HT only) calculate the gradient of a tangent to the curve on these graphs as a measure of rate of reaction at a specific time. 5.6.1.2 Factors which affect the rates of chemical reactions 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. Students should be able to recall how changing these factors affects the rate of chemical reactions. 5.6.1.3 Collision theory and activation energy Collision theory explains how various factors affect rates of reactions. According to this theory, chemical reactions can occur only when reacting particles collide with each other and with sufficient energy. The minimum amount of energy that particles must have to react is called the activation energy. 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. Increasing the temperature increases the frequency of collisions and makes the collisions more energetic, and so increases the rate of reaction. Students should be able to : • 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	Key stage 3 • chemical reactions as the rearrangement of atoms • representing chemical reactions using formulae and using equations

change the conditions.	• use simple ideas about proportionality when using collision theory to explain the effect of a factor on the rate of a reaction. 5.6.1.4 Catalysts Catalysts change the rate of chemical reactions but are not used up during the reaction. Different reactions need different catalysts. Enzymes act as catalysts in biological systems. Catalysts increase the rate of reaction by providing a different pathway for the reaction that has a lower activation energy. A reaction profile for a catalysed reaction can be drawn. Students should be able to 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. Students should be able to explain catalytic action in terms of activation energy. Students do not need to know the names of catalysts other than those specified in the subject content. 5.6.2.1 Reversible reactions In some chemical reactions, the products of the reaction can react to produce the original reactants. Such reactions are called reversible reactions. The direction of reversible reactions can be changed by changing the conditions. 5.6.2.2 Energy changes and reversible reactions 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. 5.6.2.3 Equilibrium	

	When 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. 5.6.2.4 The effect of changing conditions on equilibrium (HT only) The relative amounts of all the reactants and products at equilibrium depend on the conditions of the reaction. If a system is at equilibrium and a change is made to any of the conditions, then the system responds to counteract the change. The effects of changing conditions on a system at equilibrium can be predicted using Le Chatelier's Principle. Students should be able to make qualitative predictions about the effect of changes on systems at equilibrium when given appropriate information. 5.6.2.5 The effect of changing concentration (HT only) If the concentration of one of the reactants or products is changed, the system is no longer at equilibrium and the concentrations of all the substances will change until equilibrium is reached again. If the concentration of a reactant is increased, more products will be formed until equilibrium is reached again. If the concentration of a product is decreased, more reactants will react until equilibrium is reached again. Students should 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. 5.6.2.6 The effect of temperature changes on equilibrium (HT only) 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. Students should be able to interpret appropriate given data to predict the effect of a change in temperature on given reactions at equilibrium. 5.6.2.7 The effect of pressure changes on equilibrium (HT only) For gaseous reactions at equilibrium: • an increase in pressure causes the equilibrium position to shift towards the side with the smaller number of molecules as shown by the symbol equation for that reaction • a decrease in pressure causes the equilibrium position to shift towards the side with the larger number of molecules as shown by the symbol equation for that reaction. Students should be able to interpret appropriate given data to predict the effect of pressure changes on given reactions at equilibrium.	

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