Stewards Academy

Science KS4: Blended Learning Booklet

C6 The rate of chemical change

Name:

Form:

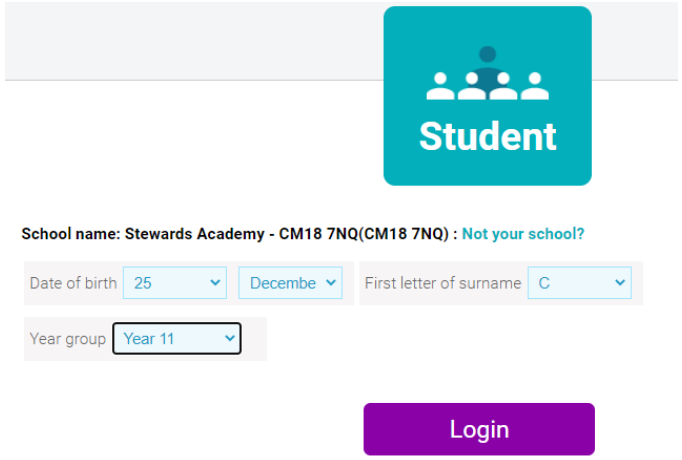
Aim to complete four lessons each week. Watch the videos and follow the four part lesson plan

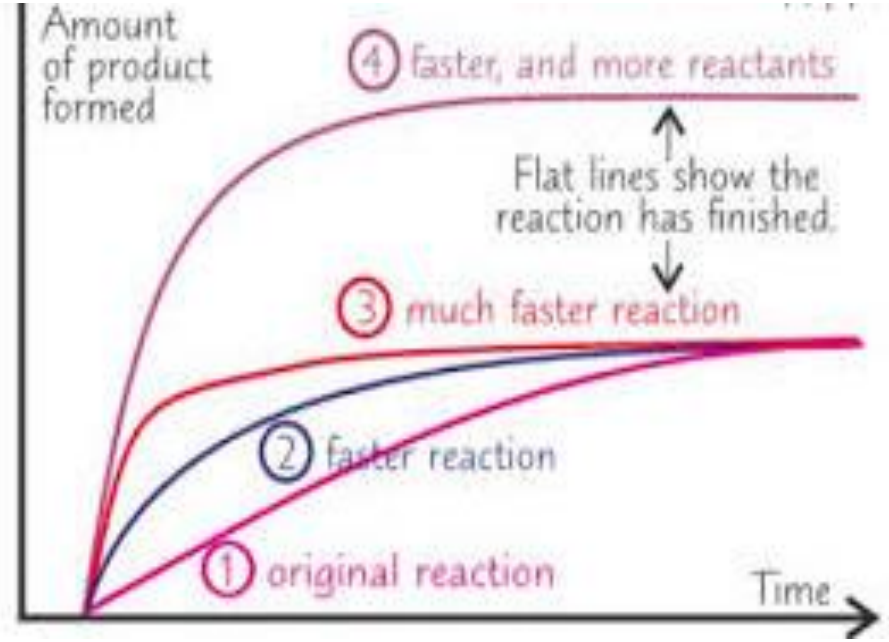
All video clips are online using the ClassCharts link. Upload all work onto ClassCharts for feedback.

The online textbook has all the key information and vocabulary to help you with this unit

To log on to the online textbook:

- https://connect.collins.co.uk/school/portal.aspx
- Type in “stewards” and select Stewards Academy
- Login using your date of birth, initial of your surname and your academic year





Contents

Contents

(T) = Triple scientists only

Big Picture – Year 10 Overview

Science

Unit Test

End of Year Exams

Nest Year

IR emission and absorption (T)

Colour, lenses, images and magnification (T)

The electro-magnetic spectrum

Sound waves and seismic waves (T)

Properties of waves

UNIT P6

Unit Test

Spectroscopy and other instrumental methods (T)

Tests for gases, metals, hydroxides and anions (T)

Pure substances and chroma-tography

Polymers and poly-merisation (T)

Waves

I will be able to describe characteristics of waves that can be measured. **I will** be able to measure reflection and refraction of waves and explain why they occur. **I will** be able to place visible light withing the electromagnetic spectrum. ***I will** be able to sound waves can reveal structures (T). **I will** be able to explain how lenses work (T)*

Hydrocarbons & Chemical analysis

I will be able to describe the properties of hydrocarbons. ***I will** be able to describe the properties of alkenes, alcohols, carboxylic acids and polymers (T).* **I will** be able to use techniques to produce and identify a pure substance. ***I will** be able to identify positive and negative ions and evaluate different analysis techniques (T).*

Meiosis and reproduction

Genetics and gene disorders

The work of Gregor Mendel (T)

Unit Test

UNIT C7 & C8

Crude oil, hydrocarbons and fractional distillation

Combustion and cracking of alkanes

Alkenes, alcohols and carboxylic acids (T)

DNA structure and protein production (T)

Genetics

I will be able to explain how we inherit our characteristics as a result of our genes which are made of DNA. **I will** be able to explain how the DNA is replicated and packaged in a specialised way to form the sex cells. ***I will** be able to describe the work by Gregor Mendel around plant genetics*

I will be able to explain how forces affect motion and how an understanding of these forces can make driving safer. ***I will** be able to explain the effects of forces on levers and in creating pressure (T).* I will be able to explain the effects of forces applied to springs.

Forces

DNA, genes and the human genome

UNIT B6

Unit Test

Forces and energy in springs

Moments, levers and pressure (T)

Momentum and road safety

Mass and Weight

Forces, speed and acceleration

UNIT P5

Energy Changes & Reaction Rates

I will be able to describe, explain and represent energy changes in chemical reactions and link them to bond energies and the particle theory. ***I will** be able to explain how dells produce a voltage and how fuel cells work (T).* **I will** be able to measure and calculate the rate of a reaction and describe factors that can affect rate. ***I will** be able to apply Le Chatelier's principle to reactions in equilibrium (T).*

Unit Test

Exo and endo thermic reactions

Reaction profiles

Cells, batteries and fuels cells (T)

Measuring rates of reaction

Factors affecting rates of reaction

Catalysts and collision theory

Reversible reactions and energy changes

Factors affecting equilibrium

UNIT C5 & C6

I will be able to explain how conditions in the body, processes and organ systems are coordinated and controlled. **I will** be able to describe how hormones control sexual development and human reproduction, *as well as how hormones enable plants to respond to stimuli (T)*

Homeostasis

Unit Test

Plant hormones (T)

Human reproduction and IVF

The endocrine system and the kidneys (T)

The nervous system *and the eye (T)*

Homeostasis

UNIT B5

Unit Test

Nuclear fission and fusion (T)

Hazards and uses of radiation

I will be able to reconise an atomic isotope and explain how one isotope can turn into another through three different forms of radioactive decay. **I will** be able to represent radioactive decay using a nuclear equation.

Atomic structure

Titration (T)

Electrolysis

Oxidation and reduction)

Unit Test

UNIT P4

Atomic structure

Radioactive decay

Nuclear equations

Neutralisation

Chemical changes

I will be able to describe why some metals are more reactive than others, **I will** be able to describe how neutralization occurs and how salts are formed. **I will** be able to explain how some metals are extracted by electrolysis rather than oxidation

I will be able to describe how lifestyle choices can affect the risk of catching a non-communicable disease. **I will** be able to explain how communicable diseases are spread and how we can control their spread. ***I will** be able to describe how plants are affected by and protected from disease causing organisms (T).*

Health

Metal reactivity

UNIT C4

Unit Test

Plant diseases & defenses (T)

Protecting the body

Malaria

Pathogens

Health and disease

UNIT B4

Year 10

ZOOM IN...

MY LEARNING JOURNEY:

Subject: Rate of reaction Year: 10 Unit: C6

AIMS

Students will build on ideas about measuring mass and volume, how a quantity of reactants forms a quantity of new products, that some reactions are faster than other and that some can be reversible.
Students will use a range of methods to measure reaction rates; identify ways of speeding up reactions, and use collision theory and ideas about activation energy to make predictions. They will explore reversible reactions and use Le Chatelier's principle to predict the effects of changing temperatures, pressures and concentrations on equilibrium systems.

DEVELOPING COURAGE

- **C** The rate of a chemical reaction can be controlled
- **O** Understand how chemical reactions work
- **U** Work together to carry out rate of reaction practicals
- **R** Usng data/graphs to calculate reaction rate
- **A** The importance of catalysts
- **G** Share our scientific knowledge
- **E** Linking different factors to how they affect rates of reaction

UP NEXT

Hydrocarbons

- Crude oil
- Properties of hydrocarbons
- Combustion
- Cracking
- Alkenes, Alcohols & Carboxylic acids
- Polymerisation

CAREERS

- Chemical Engineer
- Medical technician
- Cleaner

PREVIOUS LEARNING

Pupils will have some knowledge about measuring amounts and carrying out chemical reactions. They will understand that chemicals are used up during a reaction. They will appreciate that some reactions are fast and that some are slow. They will have some idea that surface area affects reaction rate.

WHAT WE KNOW/ REMEMBER

- .....
- .....
- .....
- .....
- .....

RECOMMENDED READING

1. :Thermodynamics Kept Simple - A Molecular Approach: by Roland Kjellander,
2. Reactions: The private life of atoms by Peter Atkins,
3. The Chemistry Book: From Gunpowder to Graphene, 250 Milestones in the History of Chemistry by Derek Lowe.

PERSONAL OBJECTIVES

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Lesson 1: C6.1 – Measuring rates

Connection

Have a look at the topic overview and the C6 zoom in.

Populate what you know and your personal objectives.

Activation

LI: Explain how to measure the rate of a reaction

1. https://www.youtube.com/watch?v=SPXanyy3-hU
2. Make a note of the title and the LI
3. Read pages 194-195
4. Define the key words on page 174
5. Draw and label figure 6.2 page 195

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C6 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers:C6.1 – Measuring rates

Connection

1 NA
2 NA
3 NA

Demonstration

1 1.6 – 1.7 g.

2 During the first minute. The concentration of hydrochloric acid is greatest at the start of the reaction.

3 18.4 cm3

4 58 seconds (curve becomes horizontal).

5 Keep the total volume of sodium thiosulfate and hydrochloric acid constant. Dilute the sodium thiosulfate. Run the experiment again and record the time taken for the cross to disappear. Repeat for different concentrations. Analyse the time data for trends.

6 1. Temperature affects rate and is not controlled (room temperature may vary and the reaction itself is exothermic). Place the conical flask in a temperature controlled water bath. 2. The end point when the cross disappears relies on eye sight judgment. Use colourimeter (measures change in intensity of light as it passes through the precipitate) or data logger. 3. Starting the stopwatch and mixing simultaneously is difficult. So at least two operators needed.

Lesson 2: C6.2 – Key concept: limiting reactants and molar masses

Connection

Q1. Describe two ways to measure the time taken for a chemical reaction

Q2. State an advantage of using a black X underneath a beaker to measure the rate of reaction of sodium thiosulphate and hydrochloric acid

Q3. Describe the trend in the graph on fig 6.1 page 194

Activation

LI: Explain the effect of a limiting quantity of a reactant on the amount of products

1. https://www.youtube.com/watch?v=TKDOyR7WKQQ
2. Make a note of the title and the LI
3. Read pages 196-197
4. Define the key words on page 196
5. Draw and label figure 6.6 page 197

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C6 DIP file

Demonstration

Attempt questions 1-8
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers:C6.2 – Key concept: limiting reactants and molar masses

Connection

1 Any two from:

- The loss in mass in reactants over time
- The volume of gas produced over time
- The time for a solution to become opaque

2 to allow you to compare the times for different concentrations
To allow you to see when the measurement was completed
So you know when to stop the timer

3 The reduction in mass decreases rapidly in the first minute. The rate at which the mass reduces then gradually decreases over the next four minutes

Demonstration

1 Rate = 50/23.5 = 2.13 cm3 /s

2 a 33 cm3 b 65 cm3 c As more reactant is used, more of the product is formed. The two are directly proportional. If the reactant is doubled, the amount of product produced will also double.

3 0.0125 g is half of 0.025 g. So half the volume of hydrogen will be collected - about 16.5 cm3 . Use Fig. 6.5. The line should be less steep than the 0,025 g curve and become horizontal at about 16.5 cm3 .

4 It is the reactant that limits the amount of product that can be formed. 5 The amount of product will quadruple.

6 3/24 = 0.125 moles Mg. Ratio Mg:$MgCl_2$ = 1:1. So mass $MgCl_2$ = 0.125 x 95 = 11.9 g

7 These are the formula masses of Mg and $MgCl_2$.

8 a 2 moles since the ratio of Mg:$MgCl_2$ = 1:1. b 4 moles since ratio of Mg:HCl = 1:2.

Lesson 3: C6.3 – Calculating rates

Connection

Q1. State what is meant when a substance is added in excess

Q2. Describe what is meant by a limiting reactant

Q3. Work out the mass of calcium chloride that would be made from 3g calcium

Activation

LI: Calculate the mean rate of a reaction

1. https://www.youtube.com/watch?v=GCR5xeduq2o
2. Make a note of the title and the LI
3. Read pages 198-199
4. Define the key words on page 198
5. Draw and label figure 6.8 and 6.9 page 198-199

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C6 DIP file

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers:C6.3 – Calculating rates

Connection

1 In excess refers to when enough of a substance is added so that all of the other reactant is used up

2 A limiting reactant is a chemical that is used up in the reaction that limits the rate of product formation

3 8.325g

Demonstration

1 a Slow rate. Long time taken (minutes to hours). b Fast rate. Very short time taken. c Very slow rate. Extremely long time taken.
2 30/50 = 0.6 cm3 /s
3 30/20 = 1.5 cm3 /s
4 Editor: Draw construction lines at 40 seconds (vertical) and use the x axis as the horizontal construction line. Gradient = 52/40 = 1.3 cm3 /s
5 The steeper / larger gradient for the blue line indicates a greater rate of reaction than for the red line i.e. greater volume collected per unit time.
6 a 20 seconds. Red = 26/20 = 1.3 cm3 /s. Blue = 28.5/10 = 2.85 cm3 /s.
b 40 seconds. Red = 52/40 = 1.3 cm3 /s. Blue = (70 – 24) / (30 – 0) = 1.53 cm3 /s.

Lesson 4: C6.4 – Factors affecting rates

Connection

Q1. State whether burning thermite has a slow or fast rate of reaction

Q2. State how to work out the rate of reaction from a graph

Q3. In a reaction, 70 cm^3 of sulphur dioxide is produced in 20 seconds. Calculate the rate

Activation

LI: Identify which factors affect the rate of reactions

1. https://www.youtube.com/watch?v=-4HXaUBbv04
2. Make a note of the title and the LI
3. Read pages 200-201
4. Define the key words on page 200
5. Draw and label figure 6.15 page 201

Demonstration

Attempt questions 1-9
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C6 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers:C6.4 – Factors affecting rates

Connection

1 It would be a relatively fast rate of reaction

2 Measure the gradient

3 70/20 = 3.5 cm^3/s

Demonstration

1 34 seconds
2 As the temperature increases, the time taken decreases and therefore the rate increases.
3 Time taken would decrease and rate would increase.
4 It is not valid. The aim was to see how concentration affected the rate. The concentration and temperature change in the 2 experiments so variables have not been controlled.
5 1.5 g
6 As the size of the chips decrease, the time taken to produce a given volume of CO2 decreases and therefore rate increases. In other words increasing surface area increases rate.
7 Powder: 2.2/0.8 = 2.75 g/min. Small chips: 2.2/4.6 = 0.48 g/min. Single chip: 2.2/7.6 = 0.29 g/min.
8 The same mass of calcium carbonate and concentration of hydrochloric acid was used each time.
9 • Increase temperature. Rate would increase.
• Increase concentration of HCl. Rate would increase.
• Increase surface area of Mg (use Mg powder for instance). Rate would increase.

Lesson 5: C6.5 – Required practical: Investigate how changes in concentration affect the rates of reactions by a method involving the production of a gas and a method involving a colour change

Connection

Q1. State two factors that affect the rate of reaction

Q2. Explain how using smaller marble chips in their reaction with acid increases the rate of reaction

Q3. Explain how increasing temperature increases the rate of reaction

Activation

LI: Plan experiments to test hypotheses

1. https://www.youtube.com/watch?v=N5p06i9ilmo
2. Make a note of the title and the LI
3. Read pages 202-203
4. Define the key words on page 202
5. Draw and label figure 6.16 page 202

Demonstration

Attempt questions 1,2,3,4,6,7,11,12,14,15
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C6 DIP file

Answers:C6.5 – Required practical – rates of reaction

Connection

1Temperature
Concentration of reactants
Pressure of reacting gases
Surface area of reactant solids
Presence of catalysts

2 As the surface area has been increased

3 Increasing temperature increases the kinetic energy of the particles which will increase the likelihood of successful collisions and thus the rate of rate of reaction

Demonstration

1 The higher the temperature, the greater the number of successful collisions and the greater the rate.
2 Temperature.
3 Concentration (and volume) of acid. The identity of the acid e.g. hydrochloric acid. Mass of Mg and its particle size (e.g. ribbon or powder).
4 The volume of gaseous hydrogen produced per time is being used to follow rate. A gas syringe is a convenient and accurate way of measuring gas volume
6 The effect that increasing temperature has on the rate of reaction between calcium carbonate and hydrochloric acid.
7 45 cm3 at 30 o C is anomalous. This point should be discarded.
11 The evidence supports their conclusion. Increasing temperature increases the rate of reaction between calcium carbonate and hydrochloric acid. The experiment was carried out twice at each temperature with similar results so the experiment is repeatable. This gives validity to their conclusion.
12 They repeated their experiment twice at each of the temperatures and obtained similar
14 They would need to place the conical flask in a thermostatted water bath so that the temperature was constant throughout the run. They could place the magnesium in a small tube in the conical flask. The open end of the tube would be above the acid level. To start the reaction, the conical flask could be tipped so that the acid made its way into the tube. This would avoid losing hydrogen through replacing the bung at the start.
15 Carry out the experiment with different metals and different acids. Extend to carbonates and metal oxides.

Lesson 6: C6.6 – Factors increasing the rate

Connection

Q1. State why a gas syringe is used to collect gas

Q2. State what gas is given off when magnesium is added to the hydrochloric acid

Q3. Explain how to test for the gas in the answer to question 2

Activation

LI: predict the effect of changing conditions on the rate of reaction

1. https://www.youtube.com/watch?v=OttRV5ykP7A
2. Make a note of the title and the LI
3. Read pages 204-205
4. Define the key words on page 204
5. Draw and label figure 6.18 and 6.19 page 205

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C6 DIP file

Demonstration

Attempt questions 1-10
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers:C6.6 – factors increasing the rate

Connection

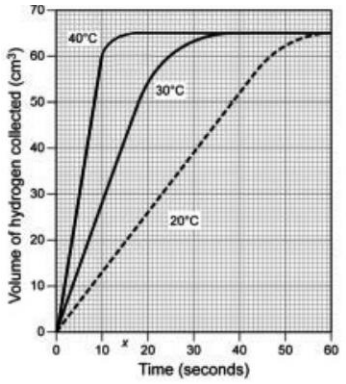
1 Using a gas syringe is more accurate way of collecting gas than merely counting bubbles – it allows you to see what volume has been released

2 Hydrogen gas

3 The test for hydrogen is to hold a lit splint inside a test tube of the gas and if present, hydrogen will burn with a squeaky pop

Demonstration

1 21 seconds (when the line becomes horizontal).
2 Metal and acid e.g. magnesium and hydrochloric acid.
3 The limiting reactant has been used up so there are no more collisions between the reactant particles. No more product is produced and rate drops to zero.
4 60/10 = 6 cm3 /s
5 Table 6.2: 13 cm3 . As the concentration of hydrochloric acid increases, a greater volume of hydrogen is collected in 10 seconds. Rate increases. Table 6.3: 13 cm3 . As the temperature increases, a greater volume of hydrogen is collected in 10 seconds. Rate increases.
6 65 cm3 . The same concentration of HCl was used and it was in excess. The same mass of Mg was used.
7



8 a When twice the mass (moles) of magnesium was used, twice the volume (moles) of hydrogen were produced. b The gradient is greater for the reaction with higher mass. So the rate is greater for the higher mass.
9 The final volumes for the 2 masses are 33 and 66 cm3 . 0.0495 g is halfway between the 2 masses. Therefore the final volume will be 49.5 cm3 . The curve will have a gradient in between the red and the blue curve.
10 a $CaCO_3$ (s) + $2HNO_3$ (aq) → $Ca(NO_3)_2$ (aq) + H_2O (l) + CO_2 (g) b The rate of reaction has increased (approximately doubled) between experiments 1 and 2 (0.37 cm3 /s and 0.71 cm3 /s). The total volume has doubled which suggests that the concentration of nitric acid has doubled. Calcium carbonate must have been in excess.

Lesson 7: C6.7 – Collision theory

Connection

Q1. State what will happen to the rate of reaction if the concentration of the reactants is increased

Q2. Explain why increasing the rate does not increase the amount of product formed

Q3. Describe how the gradient on a graph would change if the rate of reaction was increased

Activation

LI: Describe a reaction by particles colliding

1. https://www.youtube.com/watch?v=eSInI1xHvh4
2. Make a note of the title and the LI
3. Read pages 206-207
4. Define the key words on page 206
5. Draw and label figure 6.23 and 6.24 page 207

Demonstration

Attempt questions 1-4
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C6 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers:C6.7 - Collision theory

Connection

1 The rate of reaction will increase

2 Despite product being formed more quickly, the total amount of product formed at the end of the reaction will be the same as there was no change to the amount of reactant added

3 the gradient will become steeper

Demonstration

1 Increasing pressure means there are more particles per volume. Therefore there are more collisions and more successful collisions. The rate increases.

2 • HCl molecules move faster as the temperature increases.
• This means that the proportion of HCl molecules that have an energy equal to or greater than the activation energy increases.
• So the number of successful collisions with magnesium increases and the rate of reaction increases.
• Also, as temperature increases, the increased kinetic energy means that there are more collisions with magnesium.

3 Increasing concentration of HCl means there are more molecules per volume. Therefore there are more collisions and more successful collisions. The rate increases.

4 1 × 106 /5 x1010 = 2 × 10–5 s

Lesson 8: C6.8 – Catalysts

Connection

Q1. State what happens to particles in a reaction when the temperature is increased

Q2. State one way to increase the frequency of collisions

Q3. Explain why increasing the pressure of reacting gases will increase the rate of reaction. Answer in terms of collision theory

Activation

LI: Explain what is meant by activation energy

1. https://www.youtube.com/watch?v=m_9bpZep1QM
2. Make a note of the title and the LI
3. Read pages 208-209
4. Define the key words on page 208
5. Draw and label figure 6.27 page 209

Demonstration

Attempt questions 1-4
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C6 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers:C6.8 - Catalysts

Connection

1 When the temperature is increased, the kinetic energy of the particles increases and so particles are moving more quickly and so more likely to have successful collisions

2 One way to increase the frequency of collision is to increase the concentration of the reactants

3 If the pressure of reacting gases increases then there will be more particles crowded in the same volume, this will mean there will be more collisions and so more chance of successful collision and rate of reaction will increase

Demonstration

1 • Magnesium chloride: Not a catalyst. No decrease in time to collect 100cm3 of gas.
• Copper chloride: Not a catalyst. Although time was reduced (greater rate), it did not remain unchanged at the end (it was a different colour). In fact Zinc displaces copper ions to form copper. It is the copper that acts as a catalyst.
• Copper: It is a catalyst. There was a decrease in time to collect 100cm3 of gas. Copper remained unchanged at the end of the reaction.
2 $Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$ Editor: Write Cu (s) over the arrow to show the catalyst.
3 Vanadium pentoxide provides an alternative reaction pathway with lower activation energy. So a greater number of molecules have an energy equal to or greater than the activation energy. The number of successful collisions increases and so does the rate.
$2SO_2 + O_2$ $2SO_3$
4 a $2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$
b Catalase. Provides and alternative reaction pathway with lower activation energy.
c 75 kJ/mol. Any value greater than 58 kJ/mol since catalysts lower activation energy.
d Hydrogen peroxide is toxic to cells. Catalase increases the rate of decomposition so it prevents the cells being damaged.