Zig Zag Education

Combined Science GCSE (9–1) | AQA | 8464

End-of-Topic A4 Quick-Mark Homeworks

for GCSE AQA Combined Science

Chemistry Topics 6–10

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Contents

Teacher's Introduction

These End-of-Topic Quick-Mark Homeworks are designed to test and consolidate students' knowledge of the **AQA GCSE (9–1) Combined Science** course, **Chemistry Topics 6–10**.

> **Remember!**
> Always check the exam board website for new information, including changes to the specification and sample assessment material.

The second half of the course is split into six topics, five of which are covered by approximately 50 questions, with one shorter 22-question test for a total of over 280 questions.

The questions increase in difficulty across each homework, with an extension section at the bottom of each homework. The **Fundamentals** section on each homework is targeted at students aiming for grade 4–5. The **Challenge** section is targeted at students aiming for grade 6. The **Extension** section is targeted at students aiming for grade 7 and above. All Higher-tier-only content is in the extension section, so the main body of the homework is suitable for students completing Foundation-tier exams.

All of the topics are in the same order as in the specification.

Maths questions and some shorter-answer questions may contain working or explanation that is not required in the answer so that students can more easily understand and follow difficult answers.

The homeworks are intended to be used at the end of each topic, but they can also be used at the end of the course to aid revision. Alternatively, you may choose to use them as tests in class or for students to work through by themselves or in pairs to test their understanding of the course material.

The first set of fundamentals questions for each homework are presented at the back of the pack for use with weaker students who may struggle with the full homework. These can be cut down to use one test at a time or to test two or three topics at a time.

Answers are presented at the back of the resource, enabling students to check their answers, or teachers to mark students' work, quickly and easily.

I hope you find this resource useful in your teaching.

April 2025

Specification Reference Table

Homework	Title	Specification Reference
1	Rates of Reactions	5.6.1
2	Reversible Reactions and Dynamic Equilibrium	5.6.2
3	Carbon Compounds as Fuels and Feedstock	5.7.1
4	Chemical Analysis	5.8
5	Chemistry of the Atmosphere	5.9
6	Potable Water and Life Cycle Assessments	5.10.1–5.10.2

Topic 1 — Rates of Reactio

Fundamentals

1. The concentration of acid used in an experiment is increased. How does this affect the rate?
2. Give the units of mean rate of reaction if the volume of product/reactant is measured.
3. Give the units of mean rate of reaction if the mass of product/reactant is measured.
4. What is the name for the minimum amount of energy needed for a successful reaction?
5. In a rate graph, where do you find the steepest part of the curve?
6. Give the equation for the mean rate of reaction with respect to products.
7. What is the name given to a biological catalyst?
8. How does the reaction profile of a catalysed reaction compare to that of an uncatalysed one?
9. How does adding a catalyst affect the rate of a reaction?
10. Name two factors that affect the rate of a reaction involving a gas.
11. 30 cm^3 of reactant A was used up in 89 s. Calculate the mean rate of reaction to 2 s.f.
12. Calculate the surface area of a cube with a side length of 3 cm.
13. What feature of a rate graph tells you how quickly the reaction is happening?
14. Give the equation for the mean rate of reaction with respect to reactants.
15. A chemical reaction turns the solution cloudy. Suggest how to record the rate of reaction.
16. State the conditions needed for a reaction to occur, according to collision theory.
17. Explain what is meant by the term 'higher concentration'.

C

1. 0.02 g of product Calculate the me
2. State the labels c
3. Is the tangent to middle or end o
4. Why are catalyst equation for a re
5. Compare the acti reaction and an u
6. Calculate the sur cube with side le
7. Predict what will the concentratio
8. Name two factor involving solutio
9. Predict what will reaction if the pr
10. 15.1 moles of rea Calculate the me
11. Why does the cu period of time?
12. Which catalyst w or a solid lump?
13. What does it mea
14. Explain what is m 'higher pressure'
15. Particles react wi collision leads to
16. Describe how to produced using a other equipment
17. Explain how a cat

Extension

1. How does lowering the activation energy affect reaction rate?
2. Name three quantities that the amount of a substance can be measured in.
3. Which factor should you change to alter the energy that particles have?
4. Give the equation for calculating the gradient of a tangent.
5. Give the units of mean rate of reaction if the number of moles of product/reactant
6. Why does changing the pressure not alter the rate of this reaction? A(s) + B(aq) → C
7. 530 cm^3 of product Z was made in 1 hour. Calculate the mean rate of reaction to 2 s
8. Pressure of A and concentration of B are doubled. How is rate affected? A(g) + B(aq
9. How is a catalyst affected by a reaction it takes part in?
10. In a reaction, 19 g of Na was used up in 125 s. Find the rate of reaction in mol/s.
11. Predict what happens to the rate if the concentration of B doubles: A(s) + B(aq) → C
12. What happens to the rate of reaction if the size of the container is reduced? A(g) +
13. In a reaction, 6.2 g H_2 was formed at a rate of 0.079 mol/s. Find the time taken in s.
14. Why does a greater surface area increase the rate of reaction?
15. Describe how temperature affects reaction rate and explain this in terms of collisio
16. "If the temperature doubles, the rate doubles." Explain why this statement is incor
17. Explain in terms of collision theory how reducing the pressure will affect the rate o
18. Explain why keeping something cold slows down any reactions in it.

Topic 2 — Reversible Reactions and Dy

Fundamentals

1. In a balanced equation, what does the symbol $\rightleftharpoons$ mean?
2. Write the equation for the reverse reaction: $2SO_2 + O_2 \rightarrow 2SO_3$
3. If a forward reaction is exothermic, what does this mean about the reverse reaction?
4. What do we call a system where forward and reverse reactions happen at the same rate?
5. A reversible reaction is heated to form products. How would you form the reactants again?
6. The backward reaction is being favoured. Where is the equilibrium position?
7. What happens to the amounts of products and reactants at equilibrium?
8. What is an exothermic reaction?
9. Is dissolving salt in water a reversible process?
10. Define the term 'reversible reaction'.
11. Describe how the rate of the forward reaction changes over time in a reversible reaction.
12. Why can't a reversible reaction go to completion?
13. What conditions are required for a system to reach equilibrium?
14. What is meant by a 'closed system'?
15. What does 'backward reaction' mean?
16. Why can a reversible reaction never have a 100 % yield?

Cha

1. How is equilibrium achieved?
2. If the position of equilibrium i reaction is being favoured?
3. How can you make a reaction
4. Describe the relative rates of at equilibrium.
5. A reaction is endothermic in t What happens if the tempera
6. State one thing in a reaction t than equilibrium position.
7. The energy change in a reacti What is it in the reverse direc
8. As temperature increases, the What can you say about the r
9. What happens if more water i $BiCl_3(aq) + H_2O(l) \rightleftharpoons BiOCl(s)$ +
10. Explain why a reaction involvi won't reach equilibrium.
11. What happens to a system in reaction conditions is change
12. Where should the equilibrium more products than reactants
13. Define the term 'dynamic equ
14. What happens to position of e and why? $A(g) + B(g) \rightleftharpoons C(g)$ +
15. Describe the relative levels o equilibrium position is to the
16. What happens to the amount reactants is reduced at equilib
17. Describe what you would see reaction: $NH_4Cl(s) \rightarrow NH_3(g)$ +
18. There is no overall energy ex reversible reaction. What doe

Extension

1. If the equilibrium position is exactly halfway between reactants and products, wh
2. During a reversible reaction, more reactant is added. What happens to the equilib
3. How does adding a catalyst affect the position of equilibrium?
4. Anhydrous reactants are added to water to form hydrated products. How do you
5. Where must the equilibrium position be to maximise the yield of a reaction?
6. If temperature is decreased, which side of a reversible reaction is favoured?
7. Suggest a way to increase yield in this reaction: $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$
8. As temperature increases, the percentage of reactant increases. What can you te
9. If pressure is increased, which side of a reversible reaction is favoured?
10. Describe what would happen to the amounts of A and B when the amount of C is
11. Explain why combustion of a fuel can't reach equilibrium.
12. The forward reaction is exothermic. How does increasing temperature affect posi
13. What would happen to the equilibrium if NaCl was added, and why? $PbCl_2(s) \rightleftharpoons$ P
14. Explain what happens to the position of equilibrium if the pressure is increased: 2
15. What does le Châtelier's principle state?
16. Suggest why low temperatures aren't used in industry even if they favour product
17. Describe a situation where high pressure would increase rate but decrease yield.

Topic 3 — Carbon Compounds as Fuel

Fundamentals

1. Write the general formula for alkanes.
2. Give two examples of products of cracking that are useful to us.
3. Name the chemical with the formula C_2H_6.
4. Using whole numbers, balance the combustion equation:
   $?C_2H_6 + ?O_2 \rightarrow ?CO_2 + ?H_2O$
5. Name two products of complete combustion of a hydrocarbon.
6. Predict the second product of the cracking of octane: $C_8H_{18} \rightarrow C_3H_6 + ?$
7. Name the types of bonds present in an alkane.
8. Name the alkane with four carbon atoms.
9. Name the apparatus in which fractional distillation takes place.
10. Give the condition(s) needed for complete combustion to occur.
11. What product(s) form(s) instead of carbon dioxide in incomplete combustion of alkanes?
12. Name the process by which hydrocarbons in crude oil are separated.
13. Give one observation that would indicate that a fuel is not burning efficiently.
14. Crude oil is a finite resource. Explain what the term 'finite resource' means.
15. C_9H_{20} is cracked to form … and another product. Give the chemical formula of the other product.
16. What classifies a molecule as a hydrocarbon?
17. Define the term 'feedstock'.
18. Compare the reactivity of alkenes and alkanes.

C

1. Name the first four
2. Write the balanced combustion of prop
3. Write the chemical nine carbons.
4. Name two non-fuel hydrocarbons from
5. What do all the diff have in common?
6. In fractional distillat hydrocarbons collec
7. Describe how ease size increases.
8. Describe the differe and $C_{18}H_{38}$.
9. Give two examples oil fractions.
10. Name the two types alkane undergoes cr
11. Write the balanced combustion of meth
12. Describe how boilin increases.
13. Why are alternative being developed?
14. Define the term 'ho
15. Why do alkanes and bromine water?
16. Crude oil is a fossil f how it is formed.
17. Explain why crackin
18. Why are there so m

Extension

1. Name the conditions required for steam cracking.
2. Describe the colour change observed when bromine water is added to an alkene.
3. Give two common uses of alkenes.
4. Predict the chemical formula of the alkane with 20 carbons.
5. Describe how viscosity changes as hydrocarbon size increases.
6. An alkane fuel is burned in a container with poor air flow. Predict any observatio
7. Define the term 'petrochemicals'.
8. Alkanes are described as being 'saturated'. What does this mean?
9. Describe the temperature distribution in a fractionating column.
10. Ethane is bubbled through bromine water. Predict any observations.
11. Name the phase change that must occur for fractions to be separated.
12. Explain why hydrocarbons get separated out in fractional distillation.
13. Name the conditions required for catalytic cracking and the effects they have.
14. A machine needs a liquid fuel. Which is better suited, and why – $C_{30}H_{62}$ or C_7H_{16}?
15. Explain how molecular size affects boiling point in alkanes.
16. Why are some hydrocarbon fractions more desirable than others?
17. Cracking is a thermal decomposition reaction. What does this mean?

Topic 4 — Chemical Analy

Fundamentals

1. On a chromatogram, the solvent moved 9.4 cm and a spot moved 7.1 cm. Calculate the R_f value.
2. Describe the chemical test and positive result for identifying oxygen gas.
3. What happens to a formulation if the components aren't in the correct ratios?
4. Carbon dioxide is bubbled through lime water. Describe what you would see.
5. A lighted splint is held over a test tube and a squeaky pop is heard. Identify the substance detected.
6. Describe how litmus paper is used to detect chlorine gas.
7. Describe a pure substance using everyday terms and chemistry terms.
8. Two samples of a substance have melting points of 86 °C and 83 °C. Explain which sample is more impure.
9. Define the term 'formulation'.

1. Give the equati chromatograph
2. Describe the ch identifying carb
3. Identify the sta paper chromato
4. Is air a pure sub
5. Describe the di substance and
6. A chemist mea substance. How is pure?
7. Explain why chr separation tech
8. Give three ever

Extension

1. What role does a solvent have in a formulation?
2. A paint formulation contains 20 % solvent, 30 % pigment and 25 % binder. How m
3. Compounds have the same R_f value in any solvent – true or false?
4. How does a substance interact with the mobile phase if it moves very far on a chr
5. Explain why, in a paper chromatography experiment, the start line must be above

Topic 5 — Chemistry of the At

Fundamentals

1. What percentage of Earth's modern atmosphere is nitrogen?
2. Name two human activities that increase carbon dioxide levels in the atmosphere.
3. Name three gases that are pres... s ... gases in the atmosphere.
4. What gas mak... g... 20 % of Earth's mo... mo... re?
5. In t... nhouse effect', what type of radiation is reflected back into space by the atmosphere?
6. Name an atmospheric pollutant that causes acid rain.
7. Name two human activities that increase methane levels in the atmosphere.
8. In the 'greenhouse effect', what type of radiation passes through the atmosphere?
9. Give the word equation for the sunlight-catalysed process that uses up CO_2.
10. Why does carbon monoxide present a hazard?
11. How would global temperature be different if the greenhouse effect didn't occur?
12. Describe how coal is formed.
13. List four possible effects of global climate change.
14. Describe how the atmosphere 4 billion years a... was different from the atmosphere tod...
15. What causes sulfur dioxide t... into the atmosphere?
16. Describ... ho... activity billions of years ago... d ... atmosphere.
17. Des... w the world's first oceans formed.

C

1. Roughly how long atmosphere been
2. Name one proces decreased atmos
3. Name the process atmospheric O_2 a
4. Predict the atmos combustion of et
5. List two problems released by the c
6. How is carbon m
7. Which will have h London or the Ar
8. Predict the atmos combustion of ca
9. State the first typ
10. Why did nitrogen early atmosphere
11. How has the level over the past 20
12. What effect is risi to have on the cl
13. Explain how the f CO_2 levels in the a
14. Define the term '
15. How did the form affect the compo
16. Describe how lim
17. Define the term 'g

Extension

1. The early atmosphere of Earth more closely resembled that of which planets?
2. A car produces 371 g of CO_2 on its journey. Calculate the number of moles of C
3. Name a greenhouse gas that human activity has little effect on.
4. What pollutant is caused by diethyl sulfide contamination in fuels?
5. Why is carbon monoxide difficult to detect?
6. How can the amount of pollutants released from a fuel be reduced?
7. Name three materials formed over millions of years that initially reduced CO_2 le
8. Not all solar radiation reaches Earth. What happens to the rest?
9. Give three ways in which we can reduce our carbon fo... nt.
10. Why have CO_2 emissions increased so much i... la... 00 years?
11. What is meant by the term 'peer re...
12. What does the term 'carbo... ean?
13. Explain why it is di... dict the effect of rising greenhouse gases on the c
14. Give ... p... at make reducing the global carbon footprint difficult.
15. Exp... nitrous oxides are produced in a car engine.
16. Expl... correlation between global temperature and atmospheric CO_2 levels.
17. Why are there competing theories about Earth's early development?
18. Write a balanced equation for photosynthesis.

Topic 6 — Potable Water and Life Cyc

Fundamentals

1. What does 'LCA' stand for?
2. Suggest a synthetic alternative to using wool in clothing.
3. Define the term 'finite resource'.
4. List three things we use Earth's resources for.
5. Suggest a source of renewable power that could help replace fossil fuels.
6. Name the first step in treating waste water.
7. Name two sterilising agents used to treat fresh water.
8. Define the term 'potable water'.
9. What non-renewable resource could solar power help to replace?
10. Name three ways in which we (as product users) can reduce the use of limited resources.
11. What is the name given to the liquid portion of sewage treated to be made drinkable?
12. Name three sources of fresh water used to make potable water in the UK.
13. Why is it more environmentally friendly to recycle than make new products?
14. Explain why sterilisation is needed when treating fresh water for drinking.
15. Explain why screening and filtration are needed when treating fresh water for drinking.
16. Is coal a renewable or finite resource? Explain your answer.
17. What does the process of desalination do?
18. Why is reverse osmosis an expensive process?

Cl

1. Name two methods o from seawater.
2. What is the term give down by bacteria?
3. In the treatment of wa effluent after primary
4. Name two things that
5. Give three sources of
6. How would the boilin compare to that of an
7. What is the purpose o waste water?
8. Why do some countri water from salt water
9. Name three materials
10. How can a pH meter b and impure water sam
11. What is meant by the
12. Describe how distillat
13. Describe how the sem osmosis works.
14. Name the four key sta cycle assessment.
15. Waste water treatmen this sludge can be ma
16. A study states that 'th 20 years'. State three

Extension

1. What is the copper-containing solution produced by bacteria in bioleaching called
2. What does 'low-grade' mean when referring to ores?
3. Name two ways in which copper metal can be obtained from copper compounds.
4. Write the ionic equation for the displacement of copper by iron.
5. How can cobalt chloride paper be used to test for the presence of water?
6. Which source of drinking water requires the most purification steps?
7. Suggest a disadvantage of using bioleaching to extract copper from ores.
8. Why might an LCA published by a manufacturer of a product be untrustworthy?
9. Name something that can't be easily quantified when carrying out an LCA.
10. Name three ways in which traditional copper mining damages the environment.
11. Describe how copper compounds can be extracted using phytomining.
12. Give two reasons why we need alternative methods of extracting copper from th
13. Describe how scrap steel is used in the recycling of iron. How is this beneficial?
14. Compare the ease of obtaining potable water from groundwater, salt water and
15. Explain a disadvantage of using land to grow plants for phytomining.
16. Explain why it is difficult to estimate when a finite resource will run out.
17. When might the recycling of a material not be preferred to making it from scratc

Fundamentals Test

Topic 1 — Rates of Reactions

1 The concentration of acid used in an experiment is increased. How does
2 Give the units of mean rate of reaction if the volume of product/reactant
3 Give the units of mean rate of reaction if the mass of product/reactant is
4 What is the name for the minimum amount of energy needed for a succe
5 In a rate–time graph, where do you find the steepest part of the curve?
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17 Explain what is meant by the term 'higher concentration'.

Topic 2 — Reversible Reactions and Dynami

1 In a balanced equation, what does the symbol ⇌ mean?
2 Write the equation for the reverse reaction: $2SO_2 + O_2 \rightarrow 2SO_3$
3 If a forward reaction is exothermic, what does this mean about the rever
4 What term describes a system where forward and reverse reactions hap
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6 The forward reaction is being favoured. Where is the equilibrium positi
7 What happens to the amounts of products and reactants at equilibrium?
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12 Why can't a reversible reaction go to completion?
13 What conditions are required for a system to reach equilibrium?
14 What is meant by a 'closed system'?
15 What does 'backward reaction' mean?
16 Why can a reversible reaction never have a 100 % yield?

Topic 3 — Carbon Compounds as Fuels and

1 Write the general formula for alkanes.
2 Give two examples of products of cracking that are useful to us.
3 Name the chemical with the formula C_2H_6.
4 Using whole numbers, balance this combustion equation: $?C_2H_6 + ?O_2 \rightarrow$
5 Name the two products of complete combustion of a hydrocarbon.
6 Predict the second product of the cracking of octane: $C_8H_{18} \rightarrow C_3H_6 + ?$
7 Name the types of bonds present in an alkane.
8 Name the alkane with four carbon atoms.
9 Name the apparatus in which fractional distillation takes place.
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14 Crude oil is a finite resource. Explain what the term 'finite resource' mean
15 C_9H_{20} is cracked to form C_7H_{16} and another product. Give the chemical for
16 What classifies a molecule as a hydrocarbon?
17 Define the term 'feedstock'.
18 Compare the reactivity of alkenes and alkanes.

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8 Two samples of a substance have melting points of 86 °C and 83 °C. Expla
9 Define the term 'formulation'.

Topic 5 — Chemistry of the Atmosp

1 What percentage of Earth's modern atmosphere is nitrogen?
2 Name two human activities that increase carbon dioxide levels in the atm
3 Name three gases that are present as trace gases in the atmosphere.
4 What gas makes up roughly 20 % of Earth's modern atmosphere?
5 In the 'greenhouse effect', what type of radiation is reflected back into sp
6 Name an atmospheric pollutant that causes acid rain.
7 Name two human activities that increase methane levels in the atmosphe
8 In the 'greenhouse effect', what type of radiation passes through the atm
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12 Describe how coal is formed.
13 List four possible effects of global climate change.
14 Describe how the atmosphere 4 billion years ago was different from the a
15 What causes sulfur dioxide to be released into the atmosphere?
16 Describe how volcanic activity billions of years ago affected the atmosphe
17 Describe how the world's first oceans formed.

Topic 6 — Potable Water and Life Cycle As

1 What does 'LCA' stand for?
2 Suggest a synthetic alternative to using wool in clothing.
3 Define the term 'finite resource'.
4 List three things we use Earth's resources for.
5 Suggest a source of renewable power that could help replace fossil fuels.
6 Name the first step in treating waste water.
7 Name three sterilising agents used to treat fresh water.
8 Define the term 'potable water'.
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11 What is the name given to the liquid portion of sewage treated to be mad
12 Name three sources of fresh water used to make potable water in the UK.
13 Why is it more environmentally friendly to recycle than make new produc
14 Explain why sterilisation is needed when treating fresh water for drinking.
15 Explain why screening and filtration are needed when treating fresh wate
16 Is coal a renewable or finite resource? Explain your answer.
17 What does the process of desalination do?
18 Why is reverse osmosis an expensive process?

Answers

Topic 1 — Rates of Reactions

Fundamentals

1. Rate increases
2. cm^3/s
3. g/s
4. Activation energy
5. At the st...
6. Amou... duct formed ÷ time taken
7. An enzy...
8. Catalysed reaction has a smaller curve / lower activation energy
9. Increases the rate
10. Pressure, temperature
11. $0.34\ cm^3/s$
12. $54\ cm^2$
13. The steepness of the curve
14. Amount of reactant used up ÷ time taken
15. Place the reaction flask on top of a black cross and record the amount of time it takes for the solution to become completely opaque / the cross to no longer be visible
16. Particles must collide with each other, and with enough energy
17. There are more molecules of a substance dissolved in the same volume of solvent

Challenge

1. 0.000741 g/s
2. x-axis ... ke... y-axis: amount of product formed OR rea... ed up
3. The start of the reaction
4. They don't get used up
5. Catalysed reaction has a lower activation energy
6. 3 : 5
7. The rate doubles
8. Temperature, concentration
9. The rate is halved
10. 0.0028 mol/s
11. The reaction has stopped
12. Powder
13. Draw a straight line that is parallel to the curve at a single point
14. The same number of gas molecules are in a smaller volume
15. Particles need to collide with enough e... he activation energy)
16. Fill the cylinder with w... ert in a water bath. Pla... de... between the reaction vessel ... m... suring cylinder. Gas bubbles into the cyl... d the volume of gas at the top can be recorded.
17. It reduces the activation energy by providing an alternative reaction path. More particles now have enough energy to react, so the rate increases.

Extension

1. Rate increases
2. Mass; volume; a... of moles
3. Temperature
4. Change in y valu...
5. mol/s
6. There are no gas...
7. $1.5 \times 10^{-7}\ m^3/s$
8. Rate increases b...
9. It isn't / it doesn...
10. 0.0066 mol/s
11. Rate doubles / in...
12. The rate increase...
13. 39 s
14. There are more ... and react, so the ... successful collisi...
15. When temperatu... energy and mov... frequent and mo... energy. The rate...
16. Rate is not prop... change in tempe...
17. A lower pressure ... apart from each ... Collisions occur ... reaction is decre...
18. Particles have le... collisions are les... the activation en...

Topic 2 — Reversible Reactions and Dynamic

Fundamentals

1. The reaction is reversible
2. $2SO_3 \rightarrow 2SO_2 + O_2$
3. It is endothermic
4. Dynamic equilibrium
5. Cool it down
6. The left-hand side of the equatic ·ie reactants side
7. They stay const...
8. A rea ... he ... energy is given out
9. Yes
10. The products can react to form the reactants again
11. Initially fast; slows down as reactants are used up; constant when equilibrium is reached
12. There will always be some reactant present as the reactants continually reform from the products
13. Must occur in a closed system, reaction must be reversible
14. A container/system that reactants/products can't get into or out from
15. (In a reversible reaction) when the products react to reform the reactants
16. Some of the product will always react to reform the reactants

Challenge

1. A reversible reaction occurs in a close... system where reactants and ... t get out
2. The reverse reactior
3. Add a ... st
4. They ... same
5. The pr... cts are formed/favoured
6. Rate of reaction
7. + 50 kJ
8. The forward reaction is endothermic
9. Position of equilibrium shifts to the right and products are favoured
10. The system is not closed
11. The system opposes the change to restore equilibrium
12. On the right-hand side of the equation
13. A stage in a reversible reaction where the forward and backward reactions are happening at the same rate and the amount of product/reactant stays constant
14. Changing the pressure has no effect ... there is an equal number of moles of ... side
15. There are more rea... products
16. Amo... rc... reduce (and amount of react... increase)
17. Heati... $_4$Cl: white powder decomposes and forms gas; cooling the gas: white powder reforms
18. The amount of energy given out by one reaction is equal to the amount taken in by the reverse reaction

Extension

1. Neither / both
2. The position of ... favours the pro
3. It has no effect
4. Evaporate the
5. Far to the right
6. The exotherm
7. Increase the pr
8. The forward re
9. The side with fe
10. The amounts o
11. The system is n
12. Equilibrium fav ... takes in heat a ... The position of ... towards the re
13. Equilibrium po... / the reactants ... been added
14. The equilibriu ... side / favour t ... moles of gas (t ... the pressure)
15. If the conditio... changed, the sy ... minimise the e
16. At low tempera
17. In a reversible ... of gas on the ri

Topic 3 — Carbon Compounds as Fuels and F

Fundamentals

1. C_nH_{2n+2}
2. Fuels / precursors for polymers / precursors for other chemicals / solvents / lubricants
3. Ethane
4. $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$
5. Carbon dioxide and water
6. C_5H_{12}
7. C–H and C–C
8. Buta[illegible]
9. Fracti[illegible] column
10. A good supply of oxygen
11. Carbon particles / carbon monoxide
12. Fractional distillation
13. Burns with a smoky flame
14. Once the resource has been used up it can't be replenished
15. C_2H_4
16. It must contain only carbon and hydrogen atoms
17. A raw material for use in an industrial process
18. Alkenes are much more reactive

Challenge

1. Methane, ethane, propane, butane
2. $C_3H_8 + 5O_2 \rightarrow 4H_2O + 3CO_2$
3. C_9H_{20}
4. Polymers, solvents, lubricants [illegible]
5. They are a similar size / [illegible] similar number of carbon atoms / [illegible] point
6. At th[illegible] th[illegible] column
7. Flamm[illegible] decreases
8. $C_{18}H_{38}$ is much more viscous
9. Petrol, diesel, kerosene, petroleum gas
10. Alkane and alkene
11. $CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$
12. Boiling point increases
13. Crude oil is a finite resource and one day will run out
14. A family of molecules with different numbers of CH_2 units. They all have the same functional group and similar physical properties.
15. Alkenes are more reactive than alkanes
16. Crude oil is found in rocks underground / under the ocean. It is made from dead sea creatures from millions of years ago that got buried under mud and sediment.
17. Smaller hydrocarbons are bett[illegible] in higher demand, and th[illegible] lots of large hydrocarbons [illegible] from fractional distillation whic[illegible] ve[illegible] useful
18. Carbo[illegible] four bonds, leading to a large number of complex molecules, which group together to form families of similar compounds

Extension

1. Heat alkanes t
   steam and hea
2. Orange/brown
3. Feedstock for o
   make polymers
4. $C_{20}H_{42}$
5. Viscosity incre
6. Burns with a sm
7. Products deriv
8. They have the
   hydrogen atom
9. Very hot at the
10. No change / br
11. Evaporation/va
12. The column is c
    therefore, as h
    condense at d
    boiling points)
13. Heat alkenes t
    (zeolite) catal
14. C_7H_{16} – it will b
    pour/flow
15. Larger molecul
    forces between
    separate them
16. Smaller hydroc
    viscous, makin
    e.g. as fuels
17. A reaction whe
    being heated

Topic 4 — Chemical Analysis

Fundamentals

1. 0.76
2. Hold a glowing (not lighted) splint over the end of an open test tube – if the splint relights, oxygen gas is present
3. It won't have the desired effect / won't be as efficient / might not be safe to use
4. The liquid turns milky/cloudy
5. Hydrogen gas
6. Chlorine gas turns damp litmus paper white / bleaches it
7. Everyday: a substance that hasn't had anything added to it / mixed in with it; chemistry: a substance that only contains one element or compound
8. 83 °C (impurities lower the melting point of a substance)
9. A mixture with components in fixed ratios that has been designed as a product

Challenge

1. R_f = distance moved by substance ÷ distance moved by solvent
2. Bubble gas through lime water (calcium hydroxide solution) – if carbon dioxide is present, the lime water turns cloudy
3. Stationary phase: chromatography paper; mobile phase: solvent (e.g. water)
4. No – it contains molecules/atoms of multiple elements/compounds
5. A pure substance has a sharp melting point; an impure substance melts over a temperature range (usually lower than the pure substance)
6. The melting point is a single temperature (rather than a range of temperatures) and matches the value recorded in databases
7. Each component of the mixture interacts with the stationary phase to a different extent and, therefore, moves a different distance, causing separation
8. Fertiliser, medicines, cosmetics, cleaning products, fuels, pesticides, food products, cement, paints

Extension

1. It keeps everything dissolved / well mixed
2. 25 %
3. False (R_f values change depending on the solvent used)
4. Very strongly
5. If the sample is below the solvent level it will just dissolve into the solvent and won't travel up the paper

Topic 5 — Chemistry of the Atmosphere

Fundamentals

1. Between 78 % and 80 %
2. Deforestation, burning fossil fuels
3. Neon / krypton / xenon / carbon dioxide / water vapour / methane / NO_x compounds
4. Oxygen
5. Short-wave radiation
6. Sulfur dioxide / SO_2 or nitrogen oxides / NO_x
7. Agriculture / rice farming / keeping livestock / landfill
8. Long-wave radiation
9. Carbon dioxide + water → glucose + oxygen
10. It is toxic
11. It would be much colder
12. Dead material buried and compressed without oxygen for millions of years
13. Ice caps melting / loss of habitat for wildlife / sea levels rising / damage to ecosystems / loss of freshwater supplies / more frequent drought and flooding / more severe storms / higher ocean temperatures / more acidic ocean water (due to extra CO_2)
14. Barely any / no oxygen; very little nitrogen; lots of carbon dioxide
15. Combustion of fuels containing sulfur impurities
16. It greatly increased the amount of carbon dioxide and water vapour, and also introduced nitrogen, methane and ammonia
17. Water vapour emitted by volcanoes condensed into liquid and fell as rain

Challenge

1. 200 million years
2. Dissolving in the oceans to form carbonates / formation of sediments and fossil fuels
3. The evolution of photosynthesis
4. CO_2, H_2O, CO, C
5. Contributes to global dimming, causes respiratory problems
6. Incomplete combustion
7. London
8. CO_2, SO_2, CO, C
9. Algae
10. It's unreactive so it didn't react to form other things
11. Increased
12. Rise in global average temperature
13. CO_2 dissolved in the water and formed carbonate precipitates/sediments so atmospheric CO_2 levels decreased
14. The total amount of carbon dioxide / other greenhouse gases released over the life cycle of a product/event/service
15. CO_2 levels were reduced as formation captured carbon which was not rereleased
16. Shells/bones of marine animals covered in sediment and heated/crushed
17. A gas in the atmosphere that contributes to the warming of Earth by absorbing radiation

Extension

1. Mars and Venu
2. 8.43 moles
3. Water vapour
4. Sulfur dioxide /
5. It is colourless
6. Increase comb
7. Limestone, coa
8. It is reflected b
9. Use fewer foss carbon capture carbon-neutral
10. Industrial Revo fuels on a large
11. Research is exa determine whe for publication or biased concl
12. A process that releases into th
13. Earth's climate to model – lead many factors th
14. Expensive / glo with population public underst existing infrastr
15. The high temp to react with o
16. CO_2 is a greenh higher the CO_2 the global aver
17. Nobody was th degraded or be
18. $6CO_2 + 6H_2O$ →

Topic 6 — Potable Water and Life Cycle Ass

Fundamentals

1. Life cycle assessment
2. Nylon, acrylic, polyester, etc.
3. A resource that can't be replenished once it has been used up
4. Food, shelter, warmth, energy, transport, clothing, etc.
5. Solar/wind/hydroelectric/biofuels/geothermal
6. Screening, filtering
7. Ozone, chlorine, ultraviolet light
8. water that is safe to drink
9. Fossil fuels / coal / crude oil / natural gas
10. Reduce use of products, reuse products, recycle materials
11. Effluent
12. Rivers, lakes, reservoirs, groundwater sources, rain tanks
13. Recycling reduces the amount of raw materials that need to be extracted/processed, which are limited / cause environmental damage
14. To kill any microbes in the water
15. To remove debris and small solid particles, e.g. sand, from the water
16. Finite – it took millions of years to form and, once it has been used up, we can't make more
17. Obtains potable water from seawater / salt water
18. A lot of energy is used to generate the high pressure of the water

Challenge

1. Distillation, reverse osmosis
2. Biodegradable
3. Aerobic treatment – air is pumped through the tank and 'good' bacteria kill harmful bacteria
4. Minerals; (low levels of) microbes; dissolved gases
5. Toilets, baths, sinks, showers, factories, farms
6. Pure water boils at 100 °C; impure water boils at a higher temperature / impurities increase the boiling point of impure water
7. Particles settle out to form a sludge at the bottom
8. Limited sources of fresh water
9. (Some) plastic; metal; glass; paper; cardboard
10. Pure water has a pH of 7.0, whereas impure water will have a pH that is higher or lower than 7.0
11. Using resources in a way that does not completely use them up so there is enough left for future generations
12. Water sample is heated – the water boils but the impurities do not, so they are left behind. Water vapour passes through a condenser and condenses as liquid in another container.

13. Salt water is pu
pressure – wat
but impurities c
14. Obtaining raw r
maintenance; d
15. Sludge gets ana
produces meth
16. Predictions are
system is comp
will happen / st
will change / co
up by other stu

Extension

1. Leachate
2. Ores that only c
compounds
3. Electrolysis, dis
4. Fe(s) + Cu^{2+}(ac
5. It turns from bl
6. Waste water
7. It's a very slow
small amount
8. It could be bias
it shows
9. Pollutants; CO_2
long-term impa
10. Water/air pollu
of rock/soil; def
11. Plants are grow
absorb copper c
The plants are b
copper compou
12. High-grade cop
mining method
or pollution
13. Scrap steel is a
reduces the am
extracted from
14. Groundwater is
salt water is eas
energy deman
due to greater
15. Large areas of l
plants to extrac
could have bee
other resource
16. Rate of use mig
we may not hav
much we have;
17. If recycling is m
than starting fr