**OASB Science Department**

**Chemistry Paper 2 Revision Pack (Combined – HT)**

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| Contents | Lesson | Page |
| Mastery Matrix Chemistry Paper 2 |  | 2-4 |
| Knowledge | 1 | 5 |
| Notes | 6 |
| Rates of reaction & reversible reactions Summary Page | 7-9 |
| Exam Questions | 10-13 |
| Knowledge | 2 | 14-15 |
| Chemical tests, Mixtures & Organic Chemistry Summary Page | 16-17 |
| Notes page | 18 |
| Exam Questions | 19-23 |
| Knowledge | 3 | 24 |
| The Earth’s Early Atmosphere & Global warming Summary Page | 25-26 |
| Notes page | 27 |
| Exam Questions | 28-29 |
| Knowledge | 4 | 30 |
| Air Pollution & Finite resources Summary Page | 31-32 |
| Notes page | 33 |
| Exam Questions | 34-37 |
| Knowledge | 5 | 38 |
| Water and waste & Life Cycle Assessments Summary Page | 39-40 |
| Notes page | 41 |
| Exam Questions | 42-45 |



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| **Unit** | **Topic** | **Tier** | **Page** | **Learning statement** |
| Chemistry Fundamentals | Mixtures | F | 140 | Define ‘pure substances’ and explain the difference between its scientific and everyday meaning |
| Chemistry Fundamentals | Mixtures | F | 140 | Use melting and boiling point data to establish pure substances from mixtures |
| Chemistry Fundamentals | Mixtures | F | 140 | Describe what a ‘formulation’ is and give examples (Fuels, cleaning agents, paints, medicines, alloys, fertilisers and foods) |
| Chemistry Fundamentals | Mixtures | F | 140 | Describe the two phases (stationary and mobile) of chromatography and its purpose |
| Chemistry Fundamentals | Mixtures | F | 141 | Calculate Rf values |
| Chemistry Fundamentals | Mixtures | F | 140 | Interpret chromatograms to decide whether a substance is pure of a mixture |
| Chemistry Fundamentals | Mixtures | F | 140 | RP Chromatography: Use paper chromatography to investigate the colours within different substances and calculate Rf values |
| Chemistry Fundamentals | Mixtures | F | 88+89 | Explain the difference in difficulty of separating compounds compared to mixtures |
| Chemistry Fundamentals | Metals in the periodic table | F | 101 | Explain what an alloy is and how it’s properties differ from a pure metal |
| Chemistry Fundamentals | Groups in the periodic table | F | 141 | Describe the gas test for carbon dioxide, hydrogen, oxygen and chlorine |
| Reacting substances | Rates of reaction | F | 124 | Calculate the mean rate of reaction |
| Reacting substances | Rates of reaction | F | 124 | Recall the units for mass (g), volume (cm3) and rate (g/s, cm3/s, mol/s) |
| Reacting substances | Rates of reaction | F | 125 | Draw tangents on curves in order to calculate rates of reaction |
| Reacting substances | Rates of reaction | F | 124 | Explain the collision theory and link to activation energy |
| Reacting substances | Rates of reaction | F | 124  125  126 | Describe and explain factors that affect rates of reaction (concentration, pressure, surface area, catalysts and temperature) |
| Reacting substances | Rates of reaction | F | 125 | Plot and interpret graphs showing rates of reaction |
| Reacting substances | Rates of reaction | F | 105 | Explain why one reactant is used in excess in a chemical reaction |
| Reacting substances | Rates of reaction | F | 105 | Describe what is meant by ‘a limiting reactant’ |
| Reacting substances | Rates of reaction | F | 125 | RP Rates of Reaction: Investigate how changes in concentration affect the rates of reactions by measuring volume of the gas and change of colour |
| Reacting substances | Rates of reaction | F | 126 | Give examples of catalysts |
| Reacting substances | Rates of reaction | F | 121 | Draw a reaction profile for a catalysed reaction |
| Reacting substances | Reversible reactions | F | 126 | Use the appropriate symbol to denote a reversible reaction |
| Reacting substances | Reversible reactions | F | 126 | Explain energy changes in reversible reactions (ammonium chloride and hydrated copper sulphate) |
| Reacting substances | Reversible reactions | F | 127 | Explain what is meant by the term ‘equilibrium’ |
| Reacting substances | Reversible reactions | HT | 127 | Explain and use Le Chatelier principle to make predictions about reactants and products (HT only) |
| Reacting substances | Reversible reactions | HT | 127 | Explain the effect of changing concentration, pressure and temperature on equilibrium (HT only) |
| Humans and the Earth | The Earths Early Atmosphere | F | 143 | Describe the composition of the atmosphere and how long this has been the case |
| Humans and the Earth | The Earths Early Atmosphere | F | 142 | Describe the development from early atmosphere to present day |
| Humans and the Earth | The Earths Early Atmosphere | F | 142 | Draw links between the early Earth’s atmosphere and that of other planets (Mars and Venus) |
| Humans and the Earth | The Earths Early Atmosphere | F | 142 | Evaluate different theories regarding the Earth’s early atmosphere |
| Humans and the Earth | The Earths Early Atmosphere | F | 143 | Explain why oxygen levels increased and carbon dioxide levels decreased (linking to photosynthesis and sedimentation) |
| Humans and the Earth | Global Warming | F | 144 | Describe the term ‘greenhouse gases’ and give three examples (water vapour, carbon dioxide and methane) |
| Humans and the Earth | Global Warming | F | 144 | Describe the ‘greenhouse effect’ linking to the wavelength of radiation |
| Humans and the Earth | Global Warming | F | 144 | Describe the effect of human activities on the levels of greenhouse gases, recalling two that affect methane and two that affect carbon dioxide |
| Humans and the Earth | Global Warming | F | 144 | Explain how peer review evidence have linked these activities to global climate change |
| Humans and the Earth | Global Warming | F | 144 | Explain why it is difficult to model this and how this has led to simplification, speculation and biased opinions in the media |
| Humans and the Earth | Global Warming | F | 145 | Describe 4 potential effects of global climate change |
| Humans and the Earth | Global Warming | F | 145 | Discuss the scale, risks and environmental implication of global climate change |
| Humans and the Earth | Global Warming | F | 145 | Describe what is meant by the term ‘carbon footprint’ |
| Humans and the Earth | Global Warming | F | 145 | Describe actions to reduce our carbon footprint and explain why these actions may have limited impact |
| Humans and the Earth | Air pollution | F | 144 | Describe combustion as a major source of atmospheric pollution |
| Humans and the Earth | Air pollution | F | 143 | Name gases release when fuels such as coal are burnt (carbon dioxide, water vapour, carbon monoxide, sulphur dioxide and nitrogen oxides) and predict which of these would be produced from a given fuel composition |
| Humans and the Earth | Air pollution | F | 144 | Describe ‘particulates’ |
| Humans and the Earth | Air pollution | F | 144 | Describe issues arising from carbon dioxide, sulphur dioxide, nitrogen oxides and particulates |
| Humans and the Earth | Finite resources | F | 146 | Recalls that humans use the Earth’s resources to provide; warmth, shelter, food, transport (through timber, clothing, fuels/energy and other materials) |
| Humans and the Earth | Finite resources | F | 146 | Define what is meant by the term ‘finite resource’ |
| Humans and the Earth | Finite resources | F | 146 | Define what is meant by the term ‘sustainable development’ and explain the role that chemistry plays in developing agricultural and industrial processes |
| Humans and the Earth | Finite resources | F | 146 | Explain how some natural products are being replaced by some agricultural and synthetic products |
| Humans and the Earth | Water and waste | F | 146 | Describe the properties of potable water (is safe to drink) linking to purity, salt and microbe levels |
| Humans and the Earth | Water and waste | F | 146 | Describe the different sources of drinking water in the UK and the process that it must undergo before it is potable |
| Humans and the Earth | Water and waste | F | 146 | Describe the process of desalination (distillation or reverse osmosis) |
| Humans and the Earth | Water and waste | F | 146 | Evaluate the methods to produce potable water (linking to location and potential water supply) |
| Humans and the Earth | Water and waste | F | 147 | RP Water Purification: Analyse and purify water samples from different sources, including pH, dissolved solids and distillation |
| Humans and the Earth | Water and waste | F | 147 | Explain why large amounts of waste water are produced (urban life styles and industrial processes) |
| Humans and the Earth | Water and waste | F | 147 | Explain what needs to be removed from sewage and agricultural waste in comparison with industrial waste water |
| Humans and the Earth | Water and waste | F | 147 | Describe the 4 steps of sewage treatment |
| Humans and the Earth | Water and waste | F | 146 | Compare the relative ease of obtaining potable water from waste, the ground and salt water |
| Humans and the Earth | Life Cycle Assessments | HT | 147 | Explain how phytomining and bioleaching and scrap iron and electrolysis can be used to extract copper from low grade ores |
| Humans and the Earth | Life Cycle Assessments | F | 148 | Describe what is meant by the term ‘life cycle assessment’ |
| Humans and the Earth | Life Cycle Assessments | F | 148 | Describe the 4 stages of a life cycle assessment |
| Humans and the Earth | Life Cycle Assessments | F | 148 | Explain that water resources, energy and waste production can be easily quantified whereas pollutant effects are hard to quantify |
| Humans and the Earth | Life Cycle Assessments | F | 148 | Describe how simplified life cycle assessments can be used in a biased manner to support advertising claims in the media |
| Humans and the Earth | Life Cycle Assessments | F | 148 | Use data to carry out LCA for shopping bags made from plastic and paper |
| Humans and the Earth | Life Cycle Assessments | F | 149 | Explain how we can reduce our use of limited resources (reduce, reuse, recycle) |
| Organic Chemistry | Alkanes and Alkenes | F | 136 | Explain what crude oil is and how it is formed |
| Organic Chemistry | Alkanes and Alkenes | F | 136 | Define ‘alkanes’ and give the general formula |
| Organic Chemistry | Alkanes and Alkenes | F | 137 | Recall the formulae and structures for the first 4 alkanes (methane, ethane, propane and butane) |
| Organic Chemistry | Alkanes and Alkenes | F | 138 | Define ‘alkenes’ and give the general formula |
| Organic Chemistry | Alkanes and Alkenes | F | 138 | Recall the formulae and structures for the first 4 alkenes (ethene, propene, butane, pentene) |
| Organic Chemistry | Alkanes and Alkenes | F | 136 | Define the terms ‘saturated’ and ‘unsaturated’ and link to alkanes and alkenes |
| Organic Chemistry | Alkanes and Alkenes | F | 139 | Use the bromine test to identify whether there are alkanes or alkenes present |
| Organic Chemistry | Fractional Distillation | F | 136 | Explain the process of fractional distillation |
| Organic Chemistry | Fractional Distillation | F | 136 | Name and describe the uses (fuels and feedstock for the petrochemical industry e.g. solvents, lubricants, polymers and detergents) of each of the fractions produced (petrol, diesel, kerosene, heavy fuel oil and LPG) |
| Organic Chemistry | Fractional Distillation | F | 136 | Describe why carbon can form such a vast array of natural and synthetic compounds |
| Organic Chemistry | Fractional Distillation | F | 136 | Explain how the size of hydrocarbon is linked to their boiling point, viscosity and flammability |
| Organic Chemistry | Fractional Distillation | F | 137 | Describe the combustion of hydrocarbons and write balanced symbol equations |
| Organic Chemistry | Cracking | F | 138 | Describe what is meant by ‘cracking’ |
| Organic Chemistry | Cracking | F | 138 | Describe why cracking is required |
| Organic Chemistry | Cracking | F | 138 | Describe the methods and conditions used for ‘catalytic cracking’ and ‘steam cracking’ |
| Organic Chemistry | Cracking | F | 138 | Recall the uses of alkenes produced during cracking (polymers) |
| Organic Chemistry | Cracking | F | 138 | Balance chemical equations for cracking |

**Lesson 1**

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|  | **Topic:** | **Rates of reaction (C.17)** |
| 1 | What are the two equations for calculating mean rate of reaction? | mean ROR = quantity of reactant used/time take or quantity of product formed/time taken |
| 2 | If the mass of the product or reactant is given in grams, which unit should you use for the rate? | g/s |
| 3 | If the volume of the product or reactant is given in cm3, which unit should you use for the rate? | cm3/s |
| 4 | If the amount of the product or reactant is given in moles, which unit should you use for the rate? (HT only) | mol/s |
| 5 | What does a steep gradient on a graph tell us about the rate of a reaction? | The rate of reaction is fast |
| 6 | What does a flat line (0 gradient) on a graph tell us about the rate of a reaction? | The reaction has stopped |
| 7 | What has a higher surface area? A powder or lumps of a substance? | Powder because more particles are exposed and able to successfully collide |
| 8 | How does increasing concentration increase rate of reaction? | More particles -> more frequent successful collisions |
| 9 | How does increasing temperature increase rate of reaction? | Particles have more kinetic energy -> more collisions with activation energy |
| 10 | How does increasing pressure increase rate of reaction? | Particles closer together -> more frequent successful collisions |
| 11 | How does a catalyst increase rate of reaction? | Provides an alternative pathway for the reaction with a lower activation energy |
| 12 | What is activation energy? | The minimum amount of energy that particles must have to react |
| 13 | State 4 factors that affect rate of reaction | Pressure (in gases), concentration, temperature, a catalyst |
| 14 | How can you measure volume of gas produced? | Gas syringe |
| 15 | How can you use turbidity (cloudiness) to measure rate of reaction? | Record time for a cross to disappear |
|  | **Topic:** | **Reversible reactions and low grade copper ores (C.18)** |
| 1 | What is a reversible reaction? | A reaction that can go both forwards (to form the products) and backwards (to form the reactants) |
| 2 | Give two examples of reversible reactions | Ammonium chloride ⇌ ammonia + hydrogen chloride Hydrated copper sulphate (blue) ⇌ anhydrous copper sulphate (white) + water |
| 3 | Is ammonium chloride -> ammonia + hydrogen chloride an endothermic or exothermic reaction? | Endothermic |
| 4 | What is it called when the forward and reverse reactions occur at exactly the same rate? | Equilibrium |
| 5 | The effects of changing conditions on a system at equilibrium can be predicted using …? (HT only) | Le Chatelier's Principle |
| 6 | Which 3 factors affect the position of equilibrium? | Pressure (gases), temperature, concentration |
| 7 | When the pressure of a system is increased, equilibrium will shift towards which side? (HT only) | Least molecules |
| 8 | When the pressure of a system is decreased, equilibrium will shift towards which side? (HT only) | Most molecule |
| 9 | When the temperature of a system is increased, the equilibrium will shift towards which side? (HT only) | Endothermic reaction |
| 10 | When the temperature of a system is decreased, the equilibrium will shift towards which side? (HT only) | Exothermic reaction |
| 11 | If the concentration of the reactants are increased, which reaction will be favoured? (HT only) | The forwards reaction (to make more product) |
| 12 | If the concentration of the reactants are decreased, which reaction will be favoured? (HT only) | The backwards reaction (to make more reactants) |
| 13 | What is a closed system? | A reaction (system) where no reactants are added or products removed. |
| 14 | What is the symbol for a reversible reaction? | ⇌ |
| 15 | What is the general equation for a reversible reaction? | A + B ⇌ C + D |

Notes

**Chemistry Revision:**

1. 1. Calculate rate of reaction AND write the word and symbol equation in each of these scenarios:
2. (a) Sarah is reacting calcium carbonate with hydrochloric acid. She times how much gas is produced in 2 minutes 30 using a gas syringe. She find that 45cm3 of gas is produced in this time.

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Word: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Symbol: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. (b) Abdi is reacting copper carbonate with hydrochloric acid. He sets this up on a top pan balance. The initial mass of the two substances is 450g. After 10 minutes, the mass of the conical flask and it’s contents is 200g.

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Word: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Symbol: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. (c) Linda reacts 5g of magnesium with sulphuric acid. It takes 5 minutes for the magnesium to have reacted completed. Calculate the rate of reaction, giving your answer in mol/s.

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Word: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Symbol: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mastery Matrix Points

|  |
| --- |
| Calculate the mean rate of reaction |
| Recall the units for mass (g), volume (cm3) and rate (g/s, cm3/s, mol/s) |
| Draw tangents on curves in order to calculate rates of reaction |
| Explain the collision theory and link to activation energy |
| Describe and explain factors that affect rates of reaction (concentration, pressure, surface area, catalysts and temperature) |
| Plot and interpret graphs showing rates of reaction |
| Explain why one reactant is used in excess in a chemical reaction |
| Describe what is meant by ‘a limiting reactant’ |
| **RP Rates of Reaction:** Investigate how changes in concentration affect the rates of reactions by measuring volume of the gas and change of colour |
| Give examples of catalysts |
| Draw a reaction profile for a catalysed reaction |

**Rates of reaction**

Key Knowledge

**TWO** equations for calculating rate of reaction:

Mean rate of reaction = \_\_\_\_\_\_\_\_\_\_\_\_

Mean rate of reaction = \_\_\_\_\_\_\_\_\_\_\_\_

Units for rate of reaction:

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5 factors that affect rate of reaction:

1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Define:

Activation energy:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Catalyst: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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According to **collision theory**, particles must collide with \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ to react.

Draw a reaction profile for a reaction with and without a catalyst.

3. Describe AND explain the effect of the 4 factors on rate of reaction:

(a) Concentration: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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(b) Temperature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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(c) Surface area: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

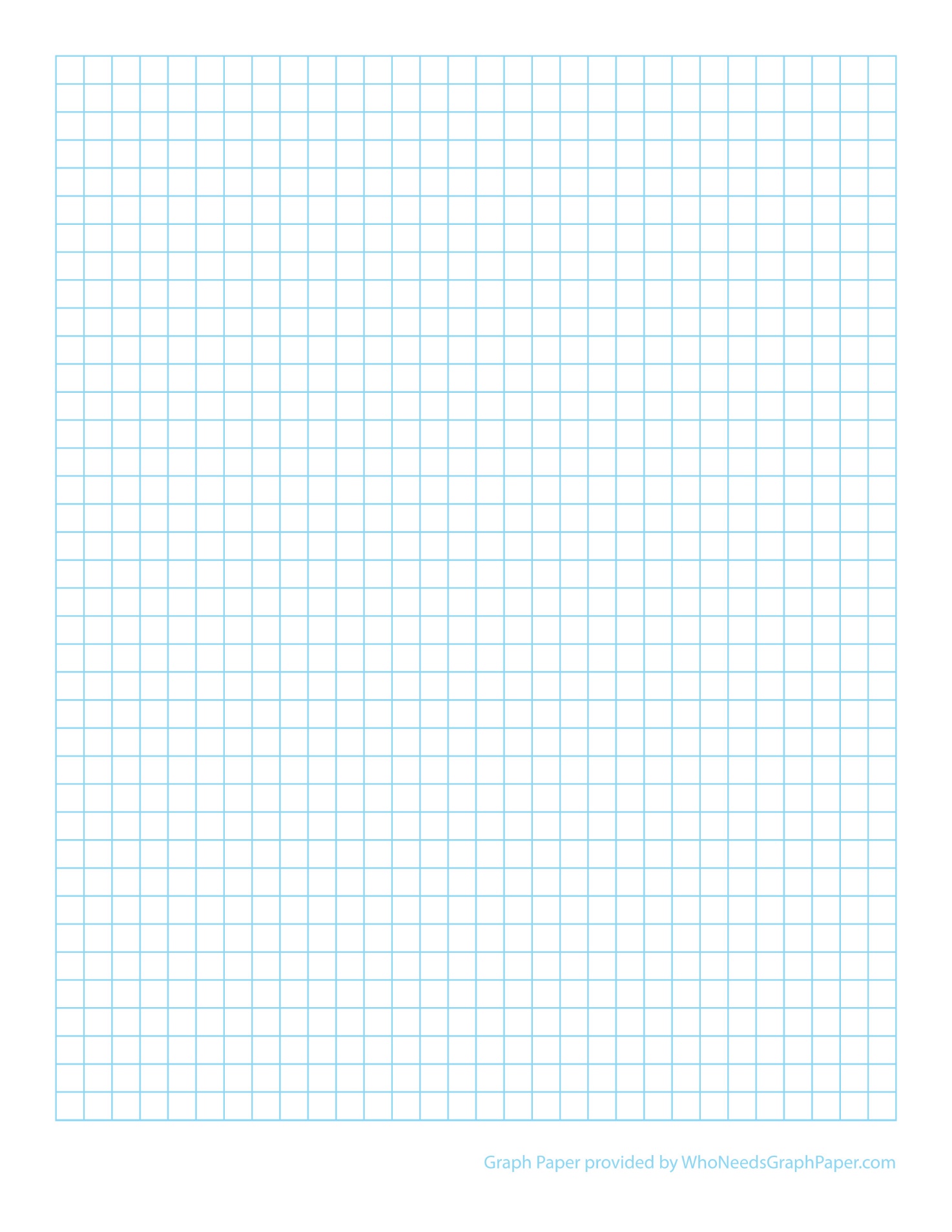
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(d) Catalyst: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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|  |  |
| --- | --- |
| Time (s) | Volume of CO2 (cm3) |
| 0 | 0 |
| 10 | 10 |
| 20 | 18 |
| 30 | 24 |
| 40 | 30 |
| 50 | 35 |
| 60 | 38 |
| 70 | 40 |
| 80 | 41 |
| 90 | 41 |
| 100 | 41 |

3. a) Plot the graph to show these results.

(b) Use it to calculate the rate of reaction at 15 seconds.

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(c) describe AND explain the pattern shown by the results.

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**Chemistry Revision: Reversible Reactions**

Mastery Matrix Points

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|  |
| Use the appropriate symbol to denote a reversible reaction |
| Explain energy changes in reversible reactions (ammonium chloride and hydrated copper sulphate) |
| Explain what is meant by the term ‘equilibrium’ |
| Explain and use Le Chatelier’s principle to make predictions about reactants and products (HT only) |
| Explain the effect of changing concentration, pressure and temperature on equilibrium (HT only) |

Key Knowledge

Define:

Reversible reactions: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Endothermic reaction: \_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Exothermic reaction: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Equilibrium: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Complete the word equation:

Ammonium chloride Equilibrium symbol \_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

If a reaction is endothermic in one direction, the opposite direction would be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

For e.g.

Hydrated copper sulphate (blue) Equilibrium symbol anhydrous copper sulphate (white) + water

The forward reaction is endothermic, so the backward reaction is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

The 3 factors that affect equilibrium:

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Use Le Chatelier's principle to predict how the changes listed will affect the following equilibrium reaction:

**2HI(g) ⇆ H2(g) + I2(g) Δ9400 (endothermic)**

1. What is the effect on the concentration of HI if a small amount of H2 is added?

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1. What is the effect on the concentration of HI if the pressure of the system is increased?

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1. What is the effect on the concentration of HI if the temperature of the system is increased?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. What is the effect on the concentration of HI if a catalyst is added?





1. Methanol (methyl alcohol) can be manufactured using the following equilibrium reaction. Predict the effect of the following changes on the equilibrium concentration of CH3OH(g).

CO(g) + 2H2(g) ⇆ CH3OH(g) + energy Δ-75

1. a decrease in temperature



1. an increase in pressure



1. addition of H2(g)



1. addition of a catalyst

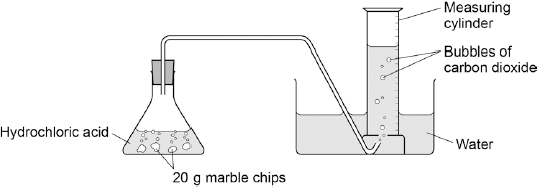
**Guided Exam Question**

**Q1.**Marble chips are mainly calcium carbonate (CaCO3).

A student investigated the rate of reaction between marble chips and hydrochloric acid (HCl).

**Figure 1** shows the apparatus the student used.

**Figure 1**

****

(a)     Complete and balance the equation for the reaction between marble chips and hydrochloric acid.

..................  +  ..................  →    CaCl2  +  ..................  +  ..................

**(2)**

(b)     The table below shows the student’s results.

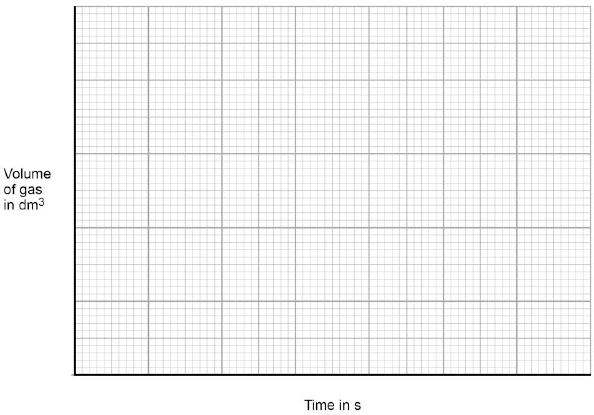
|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Time in s** | **Volume of gas in dm3** |
|  |  | 0 | 0.000 |
|  |  | 30 | 0.030 |
|  |  | 60 | 0.046 |
|  |  | 90 | 0.052 |
|  |  | 120 | 0.065 |
|  |  | 150 | 0.070 |
|  |  | 180 | 0.076 |
|  |  | 210 | 0.079 |
|  |  | 240 | 0.080 |
|  |  | 270 | 0.080 |

On **Figure 2**:

•        Plot these results on the grid.

•        Draw a line of best fit.

**Figure 2**

****

**(4)**

(c)     Sketch a line on the grid in **Figure 2** to show the results you would expect if the experiment was repeated using 20 g of smaller marble chips. Label this line **A**.

**(2)**

(d)     Explain, in terms of particles, how and why the rate of reaction changes during the reaction of calcium carbonate with hydrochloric acid.

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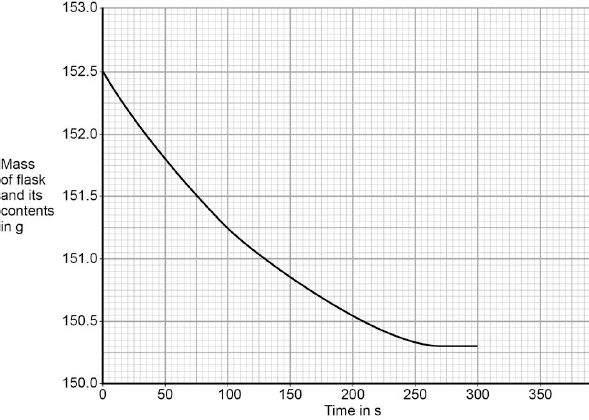
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**(4)**

(e)     Another student investigated the rate of reaction by measuring the change in mass. **Figure 3** shows the graph plotted from this student’s results.

**Figure 3**

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Use **Figure 3** to calculate the mean rate of the reaction up to the time the reaction is complete. Give your answer to three significant figures.

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       Mean rate of reaction = ........................................... g / s

**(4)**

(f)     Use **Figure 3** to determine the rate of reaction at 150 seconds.Show your working on **Figure 3**.

Give your answer in standard form.

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  Rate of reaction at 150 s = ........................................... g / s

**(4)**

**(Total 20 marks)**

**Independent Exam Question**

**Q2.**A company manufactures ethanol (C2H5OH).The reaction for the process is:

C2H4(g) + H2O(g)        C2H5OH(g)            Δ*H* = −45 kJ per mole

The temperature and pressure can be changed to increase the yield of ethanol at equilibrium.

(a)     Explain what is meant by equilibrium.

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**(3)**

(b)     (i)      How would increasing the temperature change the **yield** of ethanol at equilibrium? Give a reason for your answer.

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**(2)**

(ii)     How would increasing the pressure change the **yield** of ethanol at equilibrium?Give a reason for your answer.

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**(2)**

(c)     A catalyst is added to increase the rate of the reaction.Explain how adding a catalyst increases the rate of a chemical reaction.

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**(2)**

**Lesson 2**

|  |  |  |
| --- | --- | --- |
|  | **Topic:** | **Mixtures (C.3)** |
| 1 | Define "pure" substance | A single element or compound |
| 2 | What temperature is the melting point of water? | 0⁰C |
| 3 | What temperature is the boiling point of water? | 100⁰C |
| 4 | Define "formulation" | A mixture designed as a useful product |
| 5 | Give three examples of a formulation | Fuel, paint, alloys |
| 6 | Define "soluble" | Can dissolve |
| 7 | Define "insoluble" | Cannot dissolve |
| 8 | Define "solute" | A solid which can dissolve |
| 9 | Define "solvent" | A liquid in which a solid will dissolve |
| 10 | Define "solution" | A mixture of a dissolved solute and solvent |
| 11 | What is filtration used to separate? | An insoluble solid and a liquid |
| 12 | What is crystallisation used to separate? | A soluble solid and a solvent (collect solid) |
| 13 | What is simple distillation used to separate? | A soluble solid and a solvent (collect liquid) |
| 14 | What is fractional distillation used to separate? | Liquids with different boiling points |
| 15 | What is chromatography used to separate? | Different colours of ink or dye |
|  |  |  |
|  | **Topic:** | **Chromatography (C.4)** |
| 1 | What are the two "phases" in chromatography? | Mobile and stationary phase |
| 2 | What is the "mobile phase" in chromatography | The solvent (that travels up the paper) |
| 3 | What is the "stationary phase" in chromatography | The paper |
| 4 | Why should the start line be drawn in pencil? | Because pencil will not dissolve and affect the results. |
| 5 | Why should the start line sit above the solvent? | So that the dots of ink or dye do not wash off the paper |
| 6 | Why do the dots of ink or dye need to be the same size? | To make it a fair test |
| 7 | How is the Rf value calculated? | Rf = distance by dye / distance by solvent |
| 8 | What does a high Rf value tell us? | The substance is more soluble and travelled further |
| 9 | What does a low Rf value tell us? | The substance is less soluble and travelled less distance |
| 10 | What should the Rf value always be? | A number between 0 - 1 |
| 11 | What solvents are used in chromatography? | Water, alcohol, acetone |
| 12 | Where should the distance moved by the dye be measured from? | The same place each time (top, bottom or middle) |
| 13 | What is chromatography used for? | To separate different coloured compounds(dyes or inks) |
| 14 | How will temperature affect the rate of chromatography? | The higher the temperature, the faster the rate |
| 15 | How can chromatography be used to identify an unknown substance? | Compare with a known substance |
| 12 | What is the test for hydrogen gas? | A burning splint will make a squeaky pop |
| 13 | What is the test for carbon dioxide gas? | Limewater will turn cloudy |
| 14 | What is the test for oxygen gas? | A glowing splint will relight |
| 15 | What is the test for chlorine gas? | Damp litmus paper will be bleached and turned white |
|  | **Topic:** | **Alkanes and alkenes (C.28)** |
| 1 | Name the first 4 alkenes | Ethene, propene, butene, pentene |
| 2 | What is the difference between an alkane and an alkene? | Alkanes have single C-C bonds, alkenes have double C=C bonds |
| 3 | What does saturated mean? | Single bonds only |
| 4 | Do alkenes or alkanes burn with a smoky flame? | Alkenes |
| 5 | What is the test for an alkene? | Turns orange bromine water colourless |
| 6 | How many carbons does "meth" tell us a compound contains? | 1 |
| 7 | How many carbons does "eth" tell us a compound contains? | 2 |
| 8 | How many carbons does "prop" tell us a compound contains? | 3 |
| 9 | How many carbons does "but" tell us a compound contains? | 4 |
| 10 | How many carbons does "pent" tell us a compound contains? | 5 |
| 11 | What is the general equation for combustion? | Hydrocarbon + oxygen -> water + carbon dioxide |
| 12 | What is a hydrocarbon? | A compound containing only carbon and hydrogen |
| 13 | What is the general formula for an alkane? | CnH2n+2 |
| 14 | What is the general formula for an alkene? | CnH2n |
| 15 | Which type of hydrocarbon is saturated - alkanes or alkenes? | Alkanes |
|  | **Topic:** | **Fractional Distillation (C.29)** |
| 1 | Which part of the fractional distillation column is the hottest? | The bottom |
| 2 | Which part of the fractional distillation column is the coldest? | The top |
| 3 | Where do short chain hydrocarbons condense and collect? | At the top of the column |
| 4 | Where do long chain hydrocarbons condense and collect? | At the bottom of the column |
| 5 | Put the fractions of crude oil into order (short chain first!) | Petroleum gases, Petrol, Kerosene, Diesel oil, heavy fuel oil |
| 6 | What are the two industries that make use of the products of fractional distillation? | Petrochemical & fuel industry |
| 7 | State 3 properties of short chain hydrocarbons | \*low MP/bp, \*volatile \*low viscosity |
| 8 | State 3 properties of long chain hydrocarbons | \*high MP/bp, \*not volatile \*high viscosity |
| 9 | Why is cracking done? | There is a higher demand for shorter chain hydrocarbons |
| 10 | What is cracking? | Thermal decomposition reaction breaking long chain hydrocarbons into short ones |
| 11 | What are the two types of cracking? | Steam & catalytic cracking |
| 12 | What are the stages of thermal cracking? | 1) hydrocarbons heated until vaporised, 2) vapour passed over hot catalyst, 3) thermal decomposition takes place |
| 13 | What are the stages of steam cracking? | 1) hydrocarbons mixed with steam, 2) heated to a high temperature |
| 14 | What are the two products of cracking? | Short chain alkanes and an alkene |
| 15 | What can the alkenes be used for? | To make new compounds, polymers and alcohol |

**Chemistry Revision: Mixtures**

Mastery Matrix Points

|  |
| --- |
| Use key terms (soluble, insoluble, solute, solvent and solution) correctly to describe a substance dissolving |
| Explain how to separate given mixtures (filtration, crystallisation, simple distillation, fractional distillation, chromatography) |
| Explain the difference in difficulty of separating compounds compared to mixtures |

Key Knowledge

Mixture –

Soluble –

Insoluble –

Solute –

Solvent –

Filtration

Used to separate:

Equipment:

Crystallisation

Used to separate:

Equipment:

Simple distillation

Used to separate:

Equipment:

Chromatography

Used to separate:

Equipment:

Fractional distillation

Used to separate:

Equipment:

Understanding and Explaining

1. Mixtures be separated by physical processes. Explain what a physical process is and give four examples.





1. Explain why compounds cannot be separated by physical processes.







1. Describe the process of filtration using sandy water as an example.







1. Describe the process of crystallisation using copper sulfate solution as an example.







1. Describe the process of paper chromatography and how you could use it to see if a food dye is pure.







1. Describe the process of distillation using an ethanol and water mixture as an example.







1. Explain the difference between simple distillation and fractional distillation.







**Chemistry Revision: Chemical tests & Organic Chemistry**

Mastery Matrix Points

|  |
| --- |
| Describe the gas test for carbon dioxide, hydrogen, oxygen and chlorine |
| Recall the formulae and structures for the first 4 alkanes (methane, ethane, propane and butane) |
| Explain the process of fractional distillation |
| Describe what is meant by ‘cracking’ |
| Recall the uses of alkenes produced during cracking (polymers) |
| Balance chemical equations for cracking |

Understanding and Explaining

1. Describe how I would test to see if an unknown substance was an alkene.

2. Explain how refinery gases are extracted from crude oil using fractional distillation. (4 marks)

Two methods of cracking are:

1)

2)

Complete the symbol equations to predict the products of these cracking reactions. (4 marks)

C10H22 -> C2H4  + \_\_\_\_\_\_\_\_\_

C4H10 -> C2H6  + \_\_\_\_\_\_\_

C5H12 -> \_\_\_\_\_\_\_\_   + C2H4

C4H10  -> \_\_\_\_\_\_\_\_\_\_  + C3H6

Key Knowledge

What was crude oil made from?

Define:

*Organic compound:*

*Saturated:*

*Unsaturated:*

**Alkanes and Alkenes:**

|  |  |  |
| --- | --- | --- |
| **Homologous group** | Alkane | Alkene |
| **General formula** |  |  |
| *Name & formula with..* | | |
| 1 carbon |  |  |
| 2 carbons |  |  |
| 3 carbons |  |  |
| 4 carbons |  |  |
| 5 carbons |  |  |

Write the general word equation for combustion of a hydrocarbon:

Key Knowledge

**Gas tests:**

|  |  |  |  |
| --- | --- | --- | --- |
| Gas | Description of test | Positive result | Negative result |
| O2 |  |  |  |
| H2 |  |  |  |
| CO2 |  |  |  |
| Cl2 |  |  |  |

General formula for alkanes: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

General formula for alkenes: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Draw the structural formula for:

a. Butane b Propene

c. Methane d. Ethene

Notes

**Guided Exam Question**

**Q3.**This is part of an article about food additives.

|  |  |
| --- | --- |
|  | **THE PERIL OF FOOD ADDITIVES** |
|  | Some orange drinks contain the additives E102 (Tartrazine), E104 (Quinoline Yellow) and E110 (Sunset Yellow).These three coloured additives are thought to cause hyperactivity in children. |

(a)     State **two** reasons that a manufacturer might give to justify the use of these additives.

1 ....................................................................................................................

.......................................................................................................................

2 .....................................................................................................................

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**(2)**

(b)     Some scientists asked 4000 twelve-year-old children to help them investigate if there is a link between these three coloured additives and hyperactivity.

How would the scientists use these 4000 children to investigate if there is a link between these three coloured additives and hyperactivity in children?

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**(4)**

(c)     A manufacturer used an independent scientist to show that their orange drink did not contain these three coloured additives.

(i)      Suggest why the manufacturer would use a scientist who was independent instead of using their own scientist.

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**(1)**

(ii)     The scientist had samples of E102, E104 and E110 and the orange drink. The scientist used paper chromatography for the test.Describe how the scientist could use the results to show if the orange drink contained any of these three coloured additives.You may include a diagram of the paper chromatography results.

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**(2)**

**Independent Exam Question**

**Q4.**

This question is about hydrocarbons.

(a)     The names and formulae of three hydrocarbons in the same homologous series are:

Ethane             C2H6

Propane           C3H8

Butane             C4H10

The next member in the series is pentane.

What is the formula of pentane?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(b)     Which homologous series contains ethane, propane and butane?

|  |  |
| --- | --- |
| Tick **one** box. |  |
| Alcohols |  |
| Alkanes |  |
| Alkenes |  |
| Carboxylic acids |  |

**(1)**

(c)     Propane (C3H8) is used as a fuel.

Complete the equation for the complete combustion of propane.

C3H8     +     5O2      →   3    \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   + 4  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(d)     Octane (C8H18) is a hydrocarbon found in petrol.

Explain why octane is a hydrocarbon.

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**(2)**

(e)     The table below gives information about the pollutants produced by cars using diesel or petrol as a fuel.

|  |  |  |  |
| --- | --- | --- | --- |
| **Fuel** | **Relative amounts of pollutants** | | |
| **Oxides of Nitrogen** | **Particulate matter** | **Carbon dioxide** |
| Diesel | 31 | 100 | 85 |
| Petrol | 23 | 0 | 100 |

Compare the pollutants from cars using diesel with those from cars using petrol.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(3)**

(f)     Pollutants cause environmental impacts.

Draw **one** line from each pollutant to the environmental impact caused by the pollutant.

|  |  |  |
| --- | --- | --- |
| **Pollutant** |  | **Environmental impact caused by the pollutant** |

|  |  |  |
| --- | --- | --- |
|  |  | Acid rain |
|  |  |  |
| Oxides of nitrogen |  | Flooding |
|  |  |  |
|  |  | Global dimming |
|  |  |  |
| Particulate matter |  | Global warming |
|  |  |  |
|  |  | Photosynthesis |

**(2)**

**(Total 11 marks)**

Crude oil is a fossil fuel.

(g)     Describe how crude oil is separated into fractions.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(4)**

(h)     Fuel oil is one of the fractions from crude oil.

Power stations burn fuel oil to generate electricity. The waste gases from the combustion of fuel oil contain carbon dioxide, water vapour, sulfur dioxide and oxides of nitrogen.

The waste gases are passed through a suspension of limestone in water. Limestone is mainly calcium carbonate.

Suggest how the use of a suspension of limestone decreases one of the environmental impacts that the waste gases would cause.

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**(3)**

(i)     Some fractions from crude oil contain large hydrocarbon molecules.

(i)      Hydrocarbon molecules, such as decane, can be cracked to produce smaller, more useful molecules.

Write the correct formula of the third product to complete the chemical equation.

You do not need to give the name of this product.

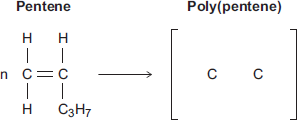
C10H22          C5H10            +            C3H8              +         \_\_\_\_\_\_\_\_\_\_\_

decane                 pentene                      propane

**(1)**

(ii)     Pentene is used to produce poly(pentene).

Complete the equation and the displayed structure of poly(pentene).



**(3)**

(iii)    Some polymers are described as smart polymers.

Suggest **one** property of a smart polymer that is different to that of an ordinary polymer.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**(1)**

**Lesson 3**

|  |  |  |
| --- | --- | --- |
|  | **Topic:** | **The Earth's Early Atmosphere (C.20)** |
| 1 | When did the Early Atmosphere form? | 4.6 billion years ago |
| 2 | State the four gases present in the Early Atmosphere? | Carbon dioxide (70%), methane (10%), ammonia (10%) and water vapour (10%) |
| 3 | Where did the gases in the early atmosphere come from? | Volcanic activity |
| 4 | What are the 2 most prevalent gases in the atmosphere today? | Nitrogen (78%) and Oxygen (21%) |
| 5 | How much carbon dioxide is there in the Earth's atmosphere today? | 0.0004 |
| 6 | State the substances that have trapped carbon dioxide under the ground | Fossil Fuels and Sedimentary rocks |
| 7 | Name the process by which the oceans are thought to have formed | Condensation of water vapour |
| 8 | Where do our current levels of nitrogen come from? | Volcanoes |
| 9 | Name the process that converts carbon dioxide into oxygen. | Photosynthesis |
| 10 | Which organism is responsible for releasing nitrogen from plants? | Bacteria |
| 11 | State the naturally occurring phenomenon that is believed to have converted gases into nitrogen? | Lightening |
| 12 | State the process that releases nitrogen from organisms on death | Decomposition |
| 13 | State the 4 processes that lead to a reduction in CO2 between the Early Atmosphere and today. | 1) Dissolved in seas 2) Trapped in rocks 3) Photosynthesis 4) Trapped in fossil fuels |
| 14 | Name the process that caused an increase in oxygen levels | Photosynthesis |
| 15 | Which two organisms caused an increase in oxygen levels? | Algae and green plants |
|  |  |  |
|  | **Topic:** | **Global warming and air pollution (C.21)** |
| 1 | Name the 3 greenhouse gases | Water, Methane, carbon dioxide |
| 2 | Name the greenhouse gas produced by rice fields | Methane (CH4) |
| 3 | Name the three types of radiation emitted by the sun | Infrared (long wave), visible light (short wave) and UV (short wave) |
| 4 | Name the one type of radiation emitted by the Earth | Infrared radiation (long wave) |
| 5 | What happens to the majority of radiation emitted by the sun when it gets to the Earth's atmosphere? | It passes through (is transmitted) |
| 6 | What happens to the majority of radiation emitted by the Earth when it reaches the atmosphere? | It is absorbed |
| 7 | State 2 human activities that increase the amount of carbon dioxide in the atmosphere | Burning fossil fuels, deforestation |
| 8 | State 3 human activities that increase the amount of methane in the atmosphere | Decaying organic matter, growing rice, cattle farming |
| 9 | Why is global climate change difficult to model? | Involves many factors |
| 10 | What is the main cause of global climate change? | Increase in average global temperature |
| 11 | State 6 potential effects of global climate change | 1) Ice caps melting 2) Sea level rising 3) Loss of habitats 4) Desertification 5) Changes in migratory patterns 6) Drought |
| 12 | Define 'carbon footprint' | The total amount of CO2 and other greenhouse gases emitted over the full life cycle of a produce, service or event |
| 13 | State three ways we can reduce our carbon footprint? | 1) recycle 2) take public transport 3) use renewable energies |
| 14 | State two effect of carbon particulates (soot) being released into the atmosphere | Global dimming & asthma |
| 15 | State the effect of sulphur dioxides and nitrogen oxides being released into the atmosphere | Acid rain & respiratory problems |

**Chemistry Revision: The Earth’s Early Atmosphere**

Mastery Matrix Points

|  |
| --- |
| Describe the composition of the atmosphere and how long this has been the case |
| Describe the development from early atmosphere to present day |
| Draw links between the early Earth’s atmosphere and that of other planets (Mars and Venus) |
| Evaluate different theories regarding the Earth’s early atmosphere |
| Explain why oxygen levels increased and carbon dioxide levels decreased (linking to photosynthesis and sedimentation) |

Key Knowledge

Which gases were in our atmosphere 4.6 billion years ago when the Earth was created?

\_\_\_\_\_% of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_% of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_% of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_% of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The atmosphere was very similar to the current atmosphere on two other planets \_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The majority of these gases are thought to have been produced by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Which gases are currently in our Earth’s atmosphere?

\_\_\_\_% of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_ % of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Very small amounts of \_\_\_+++\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

State the 4 ways that is thought to have led to a decrease in the concentration of CO2 in the atmosphere between the Early Atmosphere and today.

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The process which caused water vapour in the atmosphere to reduce was \_\_\_\_\_\_\_. This formed the \_\_\_\_\_\_\_\_\_ on our planet.

The process which caused oxygen levels to increase was \_\_\_\_\_\_\_\_\_\_\_\_. This was carried out by \_\_\_\_\_\_\_ and algae.

Understanding and Explaining

1. Write the word and balanced symbol equation for photosynthesis.





1. Compare and contrast the composition of the current atmosphere to that of the atmosphere 4.6 billion years ago. (4 marks)













1. The current atmosphere contains significantly more oxygen than the early atmosphere. Explain why. (4 marks)











1. The current atmosphere contains significantly less carbon dioxide than the early atmosphere. Explain why. (4 marks)













**c**

**Chemistry Revision: Global warming**

Mastery Matrix Points

|  |
| --- |
| Describe the term ‘greenhouse gases’ and give three examples (water vapour, carbon dioxide and methane) |
| Describe the ‘greenhouse effect’ linking to the wavelength of radiation |
| Describe the effect of human activities on the levels of greenhouse gases, recalling two that affect methane and two that affect carbon dioxide |
| Explain how peer review evidence have linked these activities to global climate change |
| Explain why it is difficult to model this and how this has led to simplification, speculation and biased opinions in the media |
| Describe 4 potential effects of global climate change |
| Discuss the scale, risks and environmental implication of global climate change |
| Describe what is meant by the term ‘carbon footprint’ |
| Describe actions to reduce our carbon footprint and explain why these actions may have limited impact |

Key Knowledge

Name the 3 main greenhouse gases:

-

-

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The waves entering the atmosphere from the sun are made up of \_\_\_\_\_\_\_\_\_\_\_ wavelength radiation that is easily able to pass through the atmosphere.

Some of this is \_\_\_\_\_\_\_\_\_\_\_\_\_ by the surface of the Earth whilst some is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ wavelength radiation. This cannot pass through the atmosphere and so more is reflected back to the earth’s surface or absorbed causing the atmosphere to \_\_\_\_\_\_\_\_\_\_\_ in temperature.

Name 2 human activities that increase the amount of:

1. Methane:

-

-

1. Carbon dioxide:

-

-

State 4 potential effects of global climate change

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-

Define ‘carbon footprint’:

State 3 ways to reduce our carbon footprint:

-

-

-

Understanding and Explaining

1. Explain why we need some greenhouse gases in our atmosphere.













1. Use the graph to describe the average global temperature between 1860

and today.











1. Humans are said to be having an effect on the increasing global temperature. Give two reasons why humans may be to blame and two ways that humans can help to reduce their impact over the next ten years.





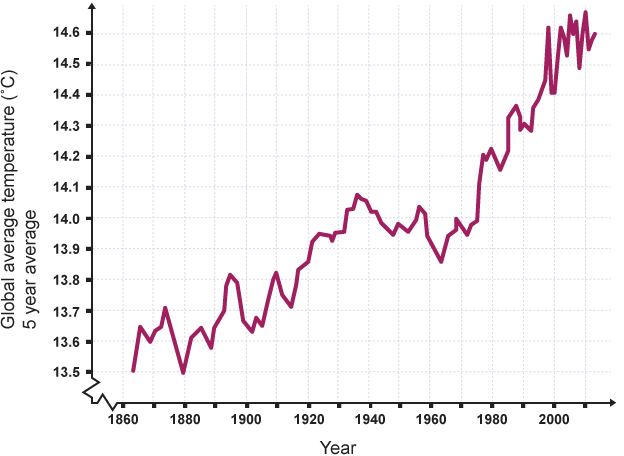












Notes

**Guided Exam Question**

**Q5.**This question is about the temperature of the Earth’s atmosphere.

(a)     Give **one** reason why it is difficult to produce models for future climate change.

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**(1)**

(b)     Describe how carbon dioxide helps to maintain temperatures on Earth.

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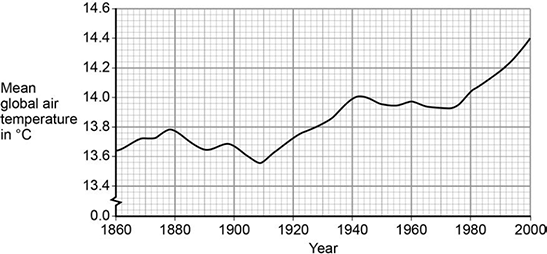
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**(3)**

(c)     The figure below shows the change in mean global air temperature from 1860 to 2000.



Explain how human activities have contributed to the main trend shown from 1910 in the figure above.

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**(3)**

**Independent Exam Question**

**Q6.** (a)     For the last 200 million years the amount of carbon dioxide in the atmosphere has remained almost the same. Describe the natural processes which remove carbon dioxide from the atmosphere.

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**(4)**

(b)     The amount of carbon dioxide in the atmosphere has increased over the last one hundred years. Suggest **two** reasons why this has happened.

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**(2)**

**Lesson 4**

|  |  |  |
| --- | --- | --- |
|  | **Topic:** | **Global warming and air pollution (C.21)** |
| 1 | Name the 3 greenhouse gases | Water, Methane, carbon dioxide |
| 2 | Name the greenhouse gas produced by rice fields | Methane (CH4) |
| 3 | Name the three types of radiation emitted by the sun | Infrared (long wave), visible light (short wave) and UV (short wave) |
| 4 | Name the one type of radiation emitted by the Earth | Infrared radiation (long wave) |
| 5 | What happens to the majority of radiation emitted by the sun when it gets to the Earth's atmosphere? | It passes through (is transmitted) |
| 6 | What happens to the majority of radiation emitted by the Earth when it reaches the atmosphere? | It is absorbed |
| 7 | State 2 human activities that increase the amount of carbon dioxide in the atmosphere | Burning fossil fuels, deforestation |
| 8 | State 3 human activities that increase the amount of methane in the atmosphere | Decaying organic matter, growing rice, cattle farming |
| 9 | Why is global climate change difficult to model? | Involves many factors |
| 10 | What is the main cause of global climate change? | Increase in average global temperature |
| 11 | State 6 potential effects of global climate change | 1) Ice caps melting 2) Sea level rising 3) Loss of habitats 4) Desertification 5) Changes in migratory patterns 6) Drought |
| 12 | Define 'carbon footprint' | The total amount of CO2 and other greenhouse gases emitted over the full life cycle of a produce, service or event |
| 13 | State three ways we can reduce our carbon footprint? | 1) recycle 2) take public transport 3) use renewable energies |
| 14 | State two effect of carbon particulates (soot) being released into the atmosphere | Global dimming & asthma |
| 15 | State the effect of sulphur dioxides and nitrogen oxides being released into the atmosphere | Acid rain & respiratory problems |



**Chemistry Revision: Air Pollution**

Mastery Matrix Points

|  |
| --- |
| Describe combustion as a major source of atmospheric pollution |
| Name gases release when fuels such as coal are burnt (carbon dioxide, water vapour, carbon monoxide, sulphur dioxide and nitrogen oxides) and predict which of these would be produced from a given fuel composition |
| Describe ‘particulates’ |
| Describe issues arising from carbon dioxide, sulphur dioxide, nitrogen oxides and particulates |

Key Knowledge

One of the biggest sources of atmospheric pollution is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of fuels.

The gases released into the atmosphere when a fuel is burned include:

-

-

-

-

-

Solid particles of hydrocarbons released into the atmosphere are called \_\_\_\_\_\_\_\_.

State 3 properties of carbon monoxide:

1)

2)

3)

State 2 effects of increased sulphur dioxide and nitrogen oxides being released into the atmosphere:

1)

2)

State 2 effects of increased particulates being released into the atmosphere:

1)

2)

To test for the presence of carbon dioxide, I would….

To test for the presence of water, I would….

Understanding and Explaining

1. Oxides of nitrogen are produced when fuels are burnt. Write a balanced symbol equation for the production of nitrogen dioxide (NO2) from nitrogen and oxygen.





2. Coal is a fossil fuel. Coal contains the elements hydrogen, sulfur, oxygen and carbon. Name two products of burning coal that have an impact on the environment. What impact does each of the products you named have on the environment?











3. Fuels react with oxygen to produce carbon dioxide. The reaction of a fuel with oxygen can produce a different oxide of carbon. Name this different oxide of carbon and explain why it is produced.







4. The table to the right shows the composition of gases found in the exhaust of a car.

Explain how nitrogen oxides are formed in a car’s engine.





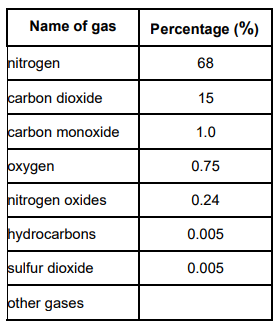












**Chemistry Revision: Finite Resources**

Key Knowledge

Define:

*“Finite resource”:*







*“Renewable resource”:*

**

**

**

*“Synthetic”:*

**

**

**

*“Sustainable development”:*

**

**

**

Humans use the Earth’s resources for 4 things:

1) 

2) 

3) 

4) 

Give two examples of synthetic materials that are used because we do not have sufficient natural resources.

-

-

Mastery Matrix Points

|  |
| --- |
| Recalls that humans use the Earth’s resources to provide; warmth, shelter, food, transport (through timber, clothing, fuels/energy and other materials) |
| Define what is meant by the term ‘finite resource’ |
| Define what is meant by the term ‘sustainable development’ and explain the role that chemistry plays in developing agricultural and industrial processes |

Understanding and Explaining

1. Coal is described as a *‘finite’* resource. Explain why.





1. Using manure from cows is described as a ‘*sustainable’* way of farming. Explain why.







1. Recycling is viewed as being more sustainable than incinerating our waste or placing it into landfill sites. Explain why recycling is better for the environment and future population than either of the alternatives.







1. Wind turbines are very expensive to build yet the government has agreed £274 million of funding to build more wind farms around the UK. Suggest why they have made this decision.











1. Developments in farming have led to the use of synthetic fertilisers. State two advantages and two disadvantages of using man made fertilisers rather than using natural fertilisers like manure.













Notes

**Guided Exam Question**

**Q7.1**

Coal is used as a fuel in power stations.

The table shows the percentage of carbon and sulfur in four different coal samples.

|  |  |  |
| --- | --- | --- |
| **Sample** | **Percentage (%) by mass in coal** | |
| **Carbon** | **Sulfur** |
| **A** | 22.1 | 0.4 |
| **B** | 46.8 | 0.6 |
| **C** | 66.3 | 0.9 |
| **D** | 92.0 | 0.7 |

(a)     Sulfur produces a gas that causes acid rain.

Name the gas.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(b)     Give **one** environmental effect caused by acid rain.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(c)     Which coal sample produces the most acid rain from 1 kg of coal?

Use the table above.

Give a reason for your answer.

Sample \_\_\_\_\_\_\_\_\_\_

Reason \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

(d)     Calculate the mass of coal sample **A** that would produce the same amount of carbon dioxide as 1 kg of coal sample **C**.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Mass of coal sample **A** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ kg

**(2)**

(e)     Incomplete combustion of coal can produce carbon monoxide.

Carbon monoxide is a toxic gas.

Give **two** reasons why people may be unaware of the presence of carbon monoxide.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

**(Total 8 marks)**

**Q7.2**

This information about diesel was printed in a magazine.

Almost all of the crops that we eat can be converted into fuel for cars.  
Vegetable oils can be used as biodiesel. Diesel from crude oil is called fossil diesel.  
When either biodiesel or fossil diesel burn they both produce similar amounts of carbon dioxide.  
Both types of diesel produce carbon monoxide. However, biodiesel produces fewer carbon particles and less sulfur dioxide.

(a)     Carbon monoxide can be produced when diesel burns in a car engine. Explain how.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

(b)     Use the information at the start of this question and your knowledge and understanding to evaluate the use of biodiesel compared with fossil diesel as a fuel for cars.

Remember to give a conclusion to your evaluation.

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**(5)**

**(Total 7 marks)**

**Independent Exam Question**

**Q8.** Since 2000 there has been a lot more research into alternative, environmentally-friendly fuels for road transport.Several pollutants are found in the exhaust emissions produced when fossil fuels are used for road transport.

Carbon monoxide (CO) interferes with the way that red blood cells carry oxygen. Carbon dioxide (CO2) increases the level of carbon dioxide in the atmosphere and causes global warming.

Oxides of nitrogen (NOx) are produced at high temperatures when nitrogen and oxygen from the atmosphere combine.

Sulfur dioxide (SO2) is produced when sulfur impurities in the fuel combine with oxygen in the atmosphere.

Tiny particles of solids are produced when the fuel does not burn completely. This increases the level of particulates (PM10) in the atmosphere.

(a)     Name the environmental effect caused by:

(i)      oxides of nitrogen (NOx) and sulfur dioxide (SO2)

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**(1)**

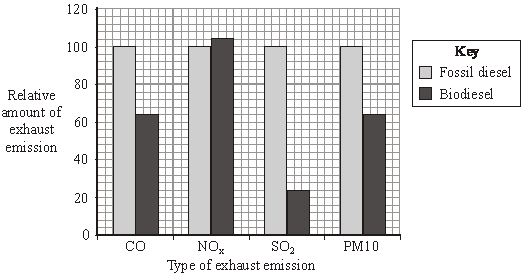
(ii)     the increased level of particulates (PM10).

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**(1)**

(b)     Diesel obtained from crude oil is often called fossil diesel. Biodiesel can be made from many vegetable oils. One research project compared the exhaust emissions when fossil diesel or biodiesel were used as fuels.

Some of the relative amounts of these exhaust emissions are shown in the bar chart.



(i)      Use your knowledge and the information above to explain the environmental benefits of using biodiesel as a sustainable, low pollution fuel.

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**(3)**

(ii)     Biodiesel is called a green fuel.This is because the life-cycle emission of carbon dioxide from biodiesel is less than that from fossil diesel.

Use your knowledge and the information above to explain why biodiesel’s contribution to global warming is considered to be much less than that of fossil diesel.

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**(3)**

**Lesson 5**:



**Chemistry Revision: Waste & water**

Mastery Matrix Points

|  |
| --- |
| Describe the properties of potable water (is safe to drink) linking to purity, salt and microbe levels |
| Describe the different sources of drinking water in the UK and the process that it must undergo before it is potable |
| Describe the process of desalination (distillation or reverse osmosis) |
| Evaluate the methods to produce potable water (linking to location and potential water supply) |
| **RP Water Purification:** Analyse and purify water samples from different sources, including pH, dissolved solids and distillation |
| Explain why large amounts of waste water are produced (urban life styles and industrial processes) |
| Explain what needs to be removed from sewage and agricultural waste in comparison with industrial waste water |
| Describe the 4 steps of sewage treatment |
| Compare the relative ease of obtaining potable water from waste, the ground and salt water |

Key Knowledge

Define ‘*potable’*:





What are the two steps in producing **potable** water from **ground** (rain/fresh) water?

1) 



2) 



Give three substances that can be used to **sterilise** water:

-

-

-

What are the two steps taken during **desalination** of salty water?

1)



2)



Which 2 substances must be removed from waste water from agriculture and sewage?

1)

2)

Which two substances must be removed from industrial waste water?

1)

2)

Understanding and Explaining

1. Describe the 4 stages of treating sewage. (4 marks)







1. Compare and contrast waste water from agriculture (farming) and from a factory. (2 marks)







1. Which method of creating potable water would be used in the lake district? Give reasons for your choice. (3 marks)







1. Which method of creating potable water is likely to be used in Istanbul? Give reasons for your choice. (3 marks)









**Chemistry Revision: Life cycle assessments**

Mastery Matrix Points

|  |
| --- |
| Explain how phytomining and bioleaching and scrap iron and electrolysis can be used to extract copper from low grade ores |
| Describe what is meant by the term ‘life cycle assessment’ |
| Describe the 4 stages of a life cycle assessment |
| Explain that water resources, energy and waste production can be easily quantified whereas pollutant effects are hard to quantify |
| Describe how simplified life cycle assessments can be used in a biased manner to support advertising claims in the media |
| Use data to carry out LCA for shopping bags made from plastic and paper |
| Explain how we can reduce our use of limited resources (reduce, reuse, recycle) |

Key Knowledge

Name 2 ways of extracting copper from low grade ores:

1)

2)

Give 3 advantages of using these methods instead of more traditional mining methods:

1)

2)

3)

How can copper be removed from the metal compounds produced by these two methods?

1)

2)

Name the 4 stages that must be evaluated during an LCA.

1)

2)

3)

4)

Understanding and Explaining

1. Describe the 3 steps to producing copper compounds using **plants**: (3 marks)





1. Describe 2 steps to producing copper compounds using **bacteria**: (2 marks)





1. Jared tells Waeil that an LCA is not an objective process.

Explain why this is the case (2 marks)







1. Use the information to the right to carry out a simple LCA for plastic

and paper shopping bags. Use this to decide which is better for us to use

and why. The number indicates the relative quantities e.g. paper bags

require 4 times more water during their entire life time. (6 marks)

















|  |  |  |
| --- | --- | --- |
|  | **Plastic** | **Paper** |
| Consumption of non-renewable energy | 1 | 1.1 |
| Consumption of water | 1 | 4 |
| Greenhouse gas emissions | 1 | 3.3 |
| Solid waste produced | 1 | 1.7 |
| Average number of uses | 10 | 2 |
| Years taken to biodegrade | 25 | 2 |

Notes

**Guided Exam Question**

**Q9.1**Water in Britain is taken from reservoirs to use as drinking water.

(a)     What are the **two** main steps used to treat water from reservoirs?

Give **one** reason for each step.

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**(4)**

(b)     Some people use water filters to treat water before drinking it.

(i)      Water filters remove hardness from hard water. What is in water filters that removes hardness from water?

………………………………........................................................................................................................

………………………………........................................................................................................................

**(1)**

(ii)     Suggest why water filters used in the home contain particles of silver.

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………………………………........................................................................................................................

**(1)**

(c)     Pure water can be produced by distillation.Why is distillation **not** usually an economic method of treating water for drinking?

………………………………........................................................................................................................

………………………………........................................................................................................................

**(1)**

(d)     Drinking hard water has health benefits.State **one** health benefit of drinking hard water.

………………………………........................................................................................................................

………………………………........................................................................................................................

**(1)**

**Q9.2**

Read the article and then answer the questions.

|  |
| --- |
| **Supermarkets launch eco-friendly plastic milk bags. Could this be the end of the milk bottle?** |
|  |
| Milk bottles are made from glass or from plastic. |
| Glass milk bottles contain 0.5 litres of milk. When the milk is used up the empty bottles are returned to be re-used. Glass milk bottles are re-used 24 times on average. The glass to make new milk bottles is produced when a mixture of sand, limestone, soda and recycled glass is heated to about 1600 °C in a furnace. There are almost unlimited amounts of the raw materials needed to produce this glass. About 35% of used glass is recycled. |
| The most common plastic milk bottles contain 2 litres of milk. When the milk is used up the empty bottles are discarded as waste. The plastic used to make these milk bottles is poly(ethene). Poly(ethene) is produced from crude oil by first using fractional distillation, then cracking the naphtha fraction and finally polymerising the ethene. About 5% of used poly(ethene) is recycled. |
| The new plastic milk bags contain 2 litres of milk. The milk bags are also made from poly(ethene). A milk bag uses 75% less poly(ethene) than is used to make the poly(ethene) milk bottles. When the milk is used up the empty bags are discarded as waste. |

(b)     Supermarkets claim that using milk bags instead of milk bottles would have less environmental impact.

Do you agree with this claim?

Use the information in the article and your knowledge and understanding to make appropriate comparisons to justify your answer.

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**(4)**

**Independent Exam Question**

**Q10.1**

Plastic and glass can be used to make milk bottles.

(b)     The table below gives information about milk bottles.

|  |  |  |
| --- | --- | --- |
|  | **Glass milk bottle** | **Plastic milk bottle** |
| Raw materials | Sand, limestone, salt | Crude oil |
| Bottle material | Soda-lime glass | HD poly(ethene) |
| Initial stage in production of bottle material | Limestone and salt used to produce sodium carbonate. | Production of naphtha fraction. |
| Maximum temperature in production process | 1600 °C | 850 °C |
| Number of times bottle can be used for milk | 25 | 1 |
| Size(s) of bottle | 0.5 dm3 | 0.5 dm3, 1 dm3, 2 dm3, 3 dm3 |
| Percentage (%) of recycled material used in new bottles | 50 % | 10 % |

Evaluate the production and use of bottles made from soda-lime glass and those made from HD poly(ethene).

Use the information given and your knowledge and understanding to justify your choice of material for milk bottles.

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**(6)**

**Q10.2**This question is about copper.

(b) Read the information in the box.

|  |  |
| --- | --- |
|  | **Copper extraction**  World demand for copper for the year 2011 was about 20 million tonnes.  World reserves of copper are estimated to be 700 million tonnes.  Most of the copper used is obtained from copper ores, which are mined.  The copper ore chalcopyrite is heated in a furnace to produce copper sulfide, CuS  The furnace is heated by burning fossil fuels.  Air is then blown through the hot copper sulfide, to produce copper and sulfur dioxide.  CuS + O2 → Cu + SO2 |

A scientist made the statement: ‘Copper should be recycled’. Use the information in the box and your own knowledge and understanding to justify the scientist’s statement.

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**(6)**

(c)     Phytomining is used to obtain copper from land that contains very low percentages of copper compounds.

Describe how copper compounds are obtained by phytomining.

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………………………………........................................................................................................................

**(3)**























**M1.**(a)     CaCO3 + 2HCl   → CaCl2 + H2O + CO2

**2**

*allow* ***1*** *mark for correct formulae*

(b)     sensible scales, using at least half the grid for the points

**1**

all points correct

*± ½ small square*

*allow* ***1*** *mark if 8 or 9 of the points are correct*

**2**

best fit line

**1**

(c)     steeper line to left of original

**1**

line finishes at same overall volume of gas collected

**1**

(d)     acid particles used up

*allow marble / reactant used up*

**1**

**S**o concentration decreases

*allow surface area of marble decreases*

**1**

so less frequent collisions / fewer collisions per second

*do* ***not*** *accept fewer collisions unqualified*

**1**

so rate decreases / reaction slows down

**1**

**(**e)     mass lost of 2.2 (g)

**1**

time taken of270 s

*allow values in range 265 − 270*

**1**

****

*allow ecf for values given for mass and time*

**1**

0.00815 (g / s) **or** 8.15 × 10−3

*allow* ***1*** *mark for correct calculation of value to 3 sig figs*

*accept 0.00815 or 8.15 × 10−3 with no working shown for* ***4*** *marks*

**1**

(f)     correct tangent

**1**

eg 0.35 / 50

**1**

0.007

*allow values in range of 0.0065 − 0.0075*

**1**

7 × 10−3

**1**

*accept 7 × 10−3 with no working shown for* ***4*** *marks*

**[20]**

**M2.**(a)     the forward and backward reactions occur

*allow reversible*

**1**

at (exactly) the same rate

**1**

in a closed system

*allow therefore the concentrations / amounts of the reactants and products remain the same*

**1**

(b)     (i)      increasing the temperature would lower the yield of ethanol **or** the (position of) equilibrium moves to the left

*if student has stated that increasing the temperature increases the yield then award* ***0*** *marks*

**1**

since the backwards reaction is endothermic **or** the forward reaction is exothermic

**1**

(ii)     increasing the pressure would increase the yield of ethanol **or** the (position of) equilibrium moves to the right

*if student has stated that increasing the pressure decreases the yield then award* ***0*** *marks*

**1**

because the position (of equilibrium) moves in the direction of the lower number of moles (of gas)

*2 (moles / molecules / volumes / particles) on lhs / 1 (mole / molecule / volume / particle) on rhs*

**1**

(c)     (a catalyst) provides an alternative pathway

**1**

with lower activation energy

**or**

(a catalyst) lowers the activation energy (1)

so less energy is needed to react **or** more particles react (1)

**1**

**[9]**

**M3.**(a)    any **two** from:

*ignore reference to taste / shelf-life / sales etc*

•        improve the colour / appearance

•        additives are permitted / not banned / listed on the label

•        link between additives and hyperactivity not proved

•        maintain the low cost of the drink **or** natural colours would make the drink cost more

*allow cheaper if qualified*

**2**

(b)     have a control group / placebo **or** test children before any drink given

**1**

give a drink to at least 3 groups **or** give a drink at least 3 times

**1**

give each additive to different group / children / at different times

**1**

observe / monitor / compare behaviour of group / children

**1**

(c)     (i)      so that there would be trust / respect / no bias

**1**

(ii)     compare the colours / spots from the orange drink with those of the (three) additives

*accept diagram of chromatogram(s) with spots for E102, 104, 110 and sample from the orange drink*

**1**

**T**here should be no matching colours / spots

**1**

**[9]**

**M4.** (a)     C5H12

**1**

(b)     Alkanes

**1**

(c)     (3) CO2

**1**

(4) H2O

**1**

*allow for* ***1*** *mark*

*4 CO2 + 3 H2O*

(d)     contains hydrogen and carbon

**1**

(hydrogen and carbon) only

**1**

(e)     *(diesel)*

produces more oxides of nitrogen

*allow converse answers in terms of petrol*

**1**

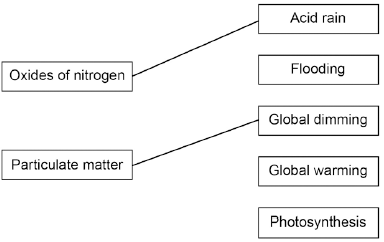
produces (more) particulate matter

**1**

produces less carbon dioxide

**1**

(f)



**2**

**[11]**

(g)     any **four** from:

•        (crude oil is) heated

•        to evaporate / vaporise / boil (the substances / hydrocarbons)

•        the column is hotter at the bottom or is cooler at the top

•        (vapours / fractions) condense

•        at their boiling points or at different levels.

*marks can be taken from a diagram*

*max 3 marks for reference to cracking*

*allow fractional distillation allow vapours (enter the column)*

*allow temperature gradient or (vapours) cool as they rise*

*allow description e.g. vapour turns to liquid)*

*allow they have different boiling points*

**4**

(h)     acid rain is caused by

*allow consequences of acid rain*

**1**

sulfur dioxide or oxides of nitrogen

*second marking point is dependent on first marking point*

**1**

they react with / are neutralised by calcium carbonate or limestone

**OR**

global warming is caused by

carbon dioxide

carbon dioxide will react or dissolve in suspension of limestone

*allow greenhouse effect is caused by or allow consequences of global warming*

**1**

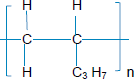
(i)     (i)      C2H4

*must be formula*

*ignore any name*

**1**

(ii)     a single bond between carbon atoms



*would score 3 marks*

**1**

other four bonds linking hydrogen atoms and C3H7 group plus two trailing / connecting bonds

**1**

n at the bottom right hand corner of the bracket

**1**

(iii)    has a shape memory

**or**

(a smart polymer) can return to original shape (when conditions change)

**1**

**[12]**

**5.**(a)     any **one** from:

•        complex systems

•        many different variables

•        many alternative theories

**1**

(b)     carbon dioxide allows short wavelength radiation to pass through

*allow greenhouse gas(es) for carbon dioxide*

**1**

the atmosphere to the Earth’s surface

**1**

carbon dioxide absorbs outgoing long wavelength radiation

**1**

(c)     general increase in temperature caused by increase in greenhouse gases

**1**

any **two** human activities correctly linked to a named greenhouse gas

*eg increased burning of fossil fuels causes more carbon dioxide*

**2**

*deforestation causes more carbon dioxide*

*more cattle production causes more methane*

*use of landfill causes more methane*

**[7]**

**M6.**          (a)     **Quality of written communication**

*for any two ideas sensibly stated*

**1**

any **three** from:

•        plants take in (CO2)

*accept photosynthesis uses (CO)*

•        converted to glucose / starch / carbohydrates

*ignore carbon compounds by itself*

•        CO2 locked up in fossil fuels

*accept coal / oil / natural gas / methane for fossil fuels*

•        CO2 reacts with / dissolves (sea)water

*accept ocean removes CO2*

•        producing hydrogencarbonates

*accept carbonic acid*

•        producing carbonates

*accept named carbonates*

•        marine animals use carbonates to make shells

*do* ***not*** *accept bones*

•        forms sedimentary rocks

*accept limestone / chalk  
accept marble  
do* ***not*** *accept sediments alone*

**3**

(b)     any **two** from:

•        burning of fossil fuels **or** cars /  
industry / air travel / power stations

*ignore increase in population  
ignore more use of electricity*

•        natural processes cannot absorb all the extra CO2

•        deforestation

*accept less photosynthesis  
ignore volcanic activity  
accept burn trees*

**2**

**[6]**

**Q7.1**

(a)     sulfur dioxide

**1**

(b)     any **one** from:

•   kills aquatic animals / plants

•   damages limestone buildings / statues

•   damage to forests

**1**

(c)     (sample) **C**

**1**

contains most sulfur

**or**

produces most sulfur dioxide

**1**

(d)     

**1**

= 3 (kg)

**1**

*an answer of 3 (kg) scores* ***2*** *marks*

(e)     any **two** from:

•   not easily detected

•   colourless

*allow cannot see it*

•   odourless

*allow cannot smell it*

**2**

**[8]**

**Q7.2**

(a)     carbon / diesel / it reacts / burns in oxygen / air

**1**

limited supply (of oxygen / air)

*accept incomplete combustion*

*2C  +  O2  → 2CO* ***or***

*C  +  CO2  →  2CO gains* ***2*** *marks*

**1**

(b)     any **four** from:

*accept converse statements for fossil diesel.*

*ignore cost / ease of manufacture / usage issues*

for biodiesel:

•        less global dimming (because fewer carbon particles)

•        less acid rain (because less sulfur dioxide)

*if neither point awarded, fewer carbon particles and less sulfur dioxide =* ***1*** *mark*

•        renewable resource / sustainable

*accept fossil fuel / diesel supplies are limited*

•        use waste vegetable oils / fats

•        vegetables / plants absorbed carbon dioxide / carbon neutral

*accept fossil fuel / diesel releases locked up carbon / is not carbon neutral*

•        uses land which could be used to produce food

•        third world countries can produce bio diesel

•        biodegrades easily

•        more NOx released

**4**

justified conclusion

**1**

**[7]**

**M8.**          (a)     (i)      acid rain

*accept consequences of acid rain*

*allow asthma / bronchitis*

*ignore toxic gas*

**1**

(ii)     global dimming

*accept dimming alone*

**1**

(b)     (i)      **sustainable:**

         maximum **two** from:

•        crops (that produce oil) can be grown in most places owtte

•        renewable

•        use less fossil fuels / diesel

•        use (refined) waste oils

**low pollution:**

         maximum **two** from:

*ignore references to CO2 here*

•        most emissions are lower **or** any two named emissions from CO / SO2 / PM10 are lower

•        much / lot less SO2 emissions (than the others) owtte

•        accept spillages / waste is biodegradable

•        less new CO2 **or** (more) carbon neutral

**3**

(ii)     plants / photosynthesis use carbon (dioxide) from the air\*

**1**

         it / biodiesel releases carbon (dioxide) from plants / crops / photosynthesis\*

*(\*) allow* ***1*** *mark for biodiesel is (more) carbon neutral*

**1**

         (fossil) diesel releases ‘locked up’ / new carbon (dioxide) / doesn’t  
absorb CO2 / absorbed it millions of years ago

**1**

**[8]**

**M9.1** (a)     filter

**1**

to remove *solids* ***or*** *insoluble particles*

***OR***

*add coagulant (1)*

flocculation / settling / remove solids (1)

**1**

(add) chlorine

*accept ozone / UV*

**1**

to reduce the number of microbes

*accept to kill microbes / bacteria / germs*

*accept sterilise*

*allow disinfect*

*ignore remove microbes*

**1**

(b)     (i)      ion exchange resin

*allow ion exchange column*

*allow sodium ions / Na+*

*allow hydrogen ions / H+*

**1**

(ii)     prevent growth of microbes

*accept sterilise*

*accept to kill microbes / bacteria / germs*

*accept to reduce the number of microbes*

*ignore remove microbes*

**1**

(c)     high cost of energy / *heating*

*allow uses a lot of energy*

**1**

(d)     any **one** from:

•        helps to develop / maintain bones

*allow any suitable positive effect on bones*

•        helps to develop / maintain teeth

*allow any suitable positive effect on teeth*

•        reduces heart disease

**1**

**[8]**

**Q9.2**

(b)     any **four** from:

*answer yes or no does not gain credit*

*ignore references to volume of milk held / number of bottles used / biodegradability / habitats / pollution / mining / dust*

*each marking point must be a comparison*

milk bag points

•        uses (75%) less **crude oil** to make (than a plastic milk bottle)

*allow eg uses 75% less*

*poly(ethene) which is made from crude oil*

•        uses less **energy** / fuel to make (than a plastic / glass milk bottle)

•        produces less **carbon dioxide** to manufacture (than a plastic / glass  
milk bottle)

*allow produces less greenhouse gases / causes less global warming*

*allow produces less CO2 on burning*

•        produces less **waste** (than a plastic / glass milk bottle)

*allow takes up less landfill (space)*

*allow an argued case for more waste eg milk bags are discarded / cannot be reused*

•        less fuel used for **transport** than glass milk bottles

•        (produces waste because) milk bags are only used once whereas  
glass bottles can be **re-used**

*allow milk bags are discarded but glass bottles can be reused (24 / many times)*

*allow glass bottles can be reused but milk bags can’t*

poly(ethene) points

•        uses a limited **raw material** / crude oil whereas the raw materials for  
glass are almost unlimited

•        **less** (5%) poly(ethene) is **recycled** (compared to glass (35%))

*allow (35%) glass is recycled or (5%) poly(ethene) (bottles) recycled BUT milk bags aren’t / are discarded*

***or***

*recycled poly(ethene) is not used to make new bags whereas recycled glass is used to make new bottles*

**4**

**[7]**

**Q10.1**

(b)     **Level 3 (5–6 marks):**

A detailed and coherent argument is provided which considers a range of issues and comes to a conclusion consistent with the reasoning.

**Level 2 (3–4 marks):**

An attempt to describe the advantages and disadvantages of the production and uses is made, which comes to a conclusion. The logic may be inconsistent at times but builds towards a coherent argument.

**Level 1 (1–2 marks):**

Simple statements made. The logic may be unclear and the conclusion, if present, may not be consistent with the reasoning.

**0 marks:**

No relevant content.

**Indicative content**

•        glass – 2 stages in production of soda-lime glass

•        glass – second stage, heating sand, limestone and sodium carbonate

•        HDPE – 3 stages in production

•        HDPE – second stage, cracking of naphtha to obtain ethene

•        HDPE – third stage, polymerisation of ethene

•        fewer stages in glass production, may be quicker

•        higher temperature in glass manufacture, therefore maybe higher energy requirement

•        glass bottle can be reused

•        consideration of collection / cleaning costs to reuse glass bottles

•        other glass products can be made from recycled glass

•        plastic has greater range of sizes

•        both produced from limited raw materials

•        higher percentage recycled materials in glass conserves raw materials

This indicative content is not exhaustive, other creditworthy

responses should be awarded marks as appropriate.

**6**

**10.2**

(b)     Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response.

**0 marks**

No relevant content

**Level 1 (1–2 marks)**

Simple list of a limited number of points given, with no linking between ideas

**Level 2 (3–4 marks)**

A broader set of points made. There will probably not be links between ideas

**Level 3 (5–6 marks)**

Answer includes linking between ideas, showing the consequence of either not recycling or the advantage of recycling. Answers such as less fossil fuel needed so less carbon dioxide produced **or** less carbon dioxide produced so less global warming

**examples of the points made in the response**

**resources**

**(recycling)** conserves supplies of ores

copper available for longer

as (at present rate of use) copper ores will run out in about 35 years

**(recycling)** conserves supplies of fossil fuels **or** energy

less fuel used at a lower cost

**land pollution**

mining scars landscape **or** produces noise pollution

mining destroys wildlife habitats

**(recycling)** less need to mine ores / fossil fuels

*so less habitat destroyed or less scarring of landscape*

**(recycling)** less need to use landfill for waste

**atmospheric pollution**

burning fossil fuels produces carbon dioxide / greenhouse gas

which (may) cause global warming **or** climate change

extraction produces sulfur dioxide

which causes acid rain

which can kill trees / fish

**6**

(c)     grow plants

*accept plants absorb copper (through roots)*

**1**

then plants are burned

**1**

ash (from burning) contains copper compounds

**1**

**[11]**