Revision Chemistry Workbook

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| THIS BOOK DOES NOT COVER THE ENTIRE COURSE. IT ONLY CONTAINS TOPICS HAVE MORE REGULARLY APPEARED ON PREVIOUS YEARS EXAM PAPERS. |

* Section 1 – Calculations Page 2
* Section 2 – Specification checklist for the entire course Page 19
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Exam Information

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| Paper | Duration | Topics Covered |
| 1 | 1 hour and 10 minutes | Topics 1-4 (Book 1 - all of year 10) |
| 2 | 1 hour and 10 minutes | Topic 1 (Book 1)  Topics 6-8 (Book 2 – year 11) |

Calculations.

Qr code

Description automatically generatedYou must answer each of these questions correctly before sitting your GCSE

**Calculate the relative atomic mass.**

A sample of silicon contains

92.2% of silicon-28 atoms

4.7% of silicon-29 atoms

3.1% of silicon-30 atoms.

Use this information to calculate the relative atomic mass of this sample of silicon.

A sample of magnesium contains 95% sulfur – 32, 1%, sulfur -33 and 4% sulfur 34 atoms. Calculate the relative atomic mass of sulfur. (2)

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A sample of sulfur contains 79% magnesium – 24, 10%, magnesium -25 and 11% magnesium 26 atoms. Calculate the relative atomic mass of magnesium (2)

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A sample of naturally occurring chromium is comprised: 4% Chromium – 50, 84% Chromium – 52, 10% Chromium – 53, 2% Chromium – 54. Calculate the relative atomic mass of this sample of chromium. (3)

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18.75 g of copper sulfate was dissolved in 325 cm3 of water. What is the concentration of this solution in g dm-3? Give your answer to 3 significant figures. (3)

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**Counting the number of atoms.**

Count the number of atoms in Aluminium nitrate Al(NO3)3.

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**Calculate relative formula mass.**

Calculate the relative formula mass of ammonium nitrate, NH4NO3.

(relative atomic masses: H = 1, N = 14, O = 16).

Calculate the relative formula mass of copper carbonate, CuCO3. (2)

Relative atomic masses: Cu = 63.5, C = 12, O = 16

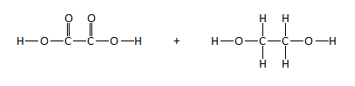
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Calculate the relative formula mass of glucose, C6H12O6. (2)

Relative atomic masses: C = 12, O = 16, H = 1.

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Calculate the relative formula mass of the polyester made from 3250 molecules of:



Give your answer to 2 significant figures. (3)

Relative atomic masses: C = 12, O = 16, H = 1

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**Calculating percentage**

1 kg of spring water contains 66.2 mg of calcium ions. What is the percentage by mass of calcium ions in the water. Give your answer to 2 significant figures.

Copper can be extracted using plants to concentrate copper ions found in soils. 1 tonne (1000 Kg) of plant material can be processed into 80 450 g of copper compounds. Calculate the percentage by mass of copper compounds in the original plant material. Give your answer to 2 decimal places. (3)

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A 22 carat gold necklace is 91.6% gold. The necklace has a mass of 14.26 g. Calculate the mass of gold in the necklace.

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What is the percentage by mass of copper in Cu2O. Give your answer to 3 significant figures. (2)

Relative atomic masses: Cu = 63.5, O = 16

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Calculate the percentage by mass of nitrogen in magnesium nitrate, Mg(NO3)2. (2)

Relative atomic masses: Mg = 24, O = 16, N = 14

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Potassium was left in 20 cm3 air. After a period of time the volume of air had reduced to 15.8 cm3. Use this data to calculate the percentage of oxygen in the air.

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Ammonia is neutralised with nitric acid to make ammonium nitrate fertiliser. 238 Kg of ammonia is reacted with nitric acid in an industrial process 93.8 % of the ammonia reacts. How many Kg of ammonia is left not reacted? Give your answer to 3 significant figures. (3)

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Description automatically generatedCalculate the percentage by mass of aluminium in aluminium oxide, Al2O3 Give your answer to 2 significant figures. (3)

(relative atomic masses: Al = 27, O = 16).

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**Empirical Formulae**

A 46.4 g sample of iron oxide contains 33.6 g of iron. Calculate the empirical formulae of this oxide.

5.29 g of element X combines with 1.84 g of element Z. Calculate the empirical formula of this compound.

Relative atomic masses: X = 23, Z = 16

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6.93 g of Manganese combines with 2.688 g of oxygen to form an oxide of manganese. Calculate the empirical formula of this manganese oxide. (3)

Relative atomic masses: Mn = 55, O = 16.

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0.96 g of titanium combines with 2.84 g of chlorine. Calculate the empirical formula of titanium chloride. (3)

Relative atomic masses: titanium = 48, chlorine = 35.5

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Description automatically generatedIt was found 8.4 g of iron combined with 4.8 g of oxygen. The relative formula mass of this iron oxide is 176. What is the formula of this iron oxide? (relative atomic masses: Fe = 56, O = 16) (4)

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**Empirical formulae and relative formula mass**

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Description automatically generatedA hydrocarbon contains 3 g of carbon and 0.5 g of hydrogen. The relative formula mass of this molecule is 56. Calculate the molecular formula of this hydrocarbon.

(relative atomic masses: H = 1, C = 12).

A hydrocarbon has the empirical formula CH2, its relative formula mass is 154, what is its molecular formula?

Relative atomic masses: C = 12, H = 1.

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Description automatically generated**Calculating Quantities**

The equation for the electrolysis of aluminium oxide is

2Al2O3 🡪 4Al + O2

Calculate the maximum mass of aluminium that can be obtained from 510 tonnes of aluminium oxide.(relative atomic masses: O = 16, Al = 27).

The formula of aluminium oxide is Al2O3. What is the maximum mass of aluminium that can be obtained from the electrolysis of 51 Kg of aluminium oxide? (relative atomic masses: Al = 27, O = 16) (3)

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Two different copper ores are: Cu2O and CuO. Copper can be produced by reducing the ores with excess carbon. The equations for the two reductions are below:

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| Reduction A | 2Cu2O + C 🡪 CO2 + 4Cu |
| Reduction B | 2CuO + C 🡪 CO2 + 2Cu |

429 Kg of one of these ores produces 381 Kg of copper.

Carry out a calculation to decide whether reduction **A**  or  **B** is taking place.

Relative atomic masses: Cu = 63.5, O = 16.

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What is the minimum mass of lithium needed to react with 0.23 moles of oxygen? (2)

4Li + O2 🡪 2Li2O

Relative atomic mass: Li = 7

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26.4 g of a sample of zinc sulfate, ZnSO4.7H2O, was strongly heated until no further change in mass was recorded. On heating, all the water of crystallisation evaporated as follows:

ZnSO4.7H2O 🡪 ZnSO4 + 7H2O

Calculate the mass, in grams, of water lost during heating. (3)

Relative atomic mass: Zn = 65, S = 32, O = 16, H = 1

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7g of nitrogen reacts with 1 mole of hydrogen. Show that the hydrogen is in excess. (2)

N2 (g) + 3H2 (g) ⇌ 2NH3 (g)

Relative atomic mass: N = 14.

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20 g of calcium reacts with half a mole of nitric acid. Which reagent is in excess? (2)

Ca + 2HNO3 🡪 Ca(NO3)2 + H2O

Relative atomic masses: Calcium = 40.

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Two reactions of copper with chlorine are:

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| A | Cu + Cl2 🡪 CuCl2 |
| B | 2Cu + Cl2 🡪 2CuCl |

In an experiment, 15g of chlorine reacts with copper to make 41.62 g copper chloride. Work out whether equation A or B is taking place. (3)

Relative atomic masses: Cu = 63.5, Cl = 35.5

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The balanced equation for the production of ammonium sulfate fertiliser from ammonia and sulfuric acid is:

2NH3 + H2SO4 🡪 (NH4)2SO4

Calculate the minimum mass of ammonia needed to produce 330 Kg of ammonium sulfate. (3)

Relative atomic masses: N = 14, H = 1, S = 32, O = 16.

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What mass of iron(III) bromide, FeBr3, is produced when 2.78 g of iron is reacted with excess bromine? (3)

2Fe + 3Br2 🡪 2FeBr3

Relative atomic masses: Fe = 56, Br = 80

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What mass of hydrogen is produced when 3.45 g of sodium is reacted with excess water?

2Na + 2H2O 🡪 2NaOH + H2

Relative atomic masses: Na = 23, H = 1

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In a reaction 0.48 g of magnesium produces 0.747 g of iron. Which equation represents the reaction taking place? (3)

Equation 1

Qr code

Description automatically generated3Mg + Fe2(SO4)3 🡪 3MgSO4 + 2Fe

Equation 2

Mg + FeSO4 🡪 MgSO4 + Fe

Relative atomic masses: Mg = 24, Fe = 56

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Description automatically generatedWhen 48.00 g of magnesium reacts with oxygen 80.00g of magnesium oxide is produced. What mass of oxygen reacts with the magnesium? Give your answer to 3 significant figures. (2) Relative atomic mass: Mg = 24, O = 16

2Mg (s) + O2 (g) 🡪 2MgO (s)

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Description automatically generated**Concentration (g dm-3)**

Sodium chloride solution was prepared by dissolving 9.11 g of solid in water and making the volume up to 200 cm3.

Calculate the concentration of sodium chloride in g dm-3. Give your answer to 3 significant figures.



A copper sulfate solution is made by dissolving 20 g of copper sulfate to make 250 cm3 of solution, calculate the concentration in g dm-3 (2)

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A potassium hydroxide solution was made by dissolving 12.7 g of potassium hydroxide in water to make 750 cm3 of solution. Calculate the concentration of this solution in g dm-3 . Give your answer to 2 significant figures. (3)

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Description automatically generated**Using the Avogadro constant.**

Calculate the number of molecules in 5 moles of glucose, C6H12O6.

(Avogadro constant = 6.02 x 1023)

A beaker of water contains 4.214 x 1024 molecules. How many moles of water are present?

(Avogadro constant = 6.02 x 1023)

Calculate the number of atoms in 2 moles of carbon dioxide, CO2. (3)

Avogadro constant = 6.02 x 1023

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My wedding ring contains 6.23 g of platinum. Calculate the number of platinum atoms in the ring. Give your answer to 3 significant figures (3)

Relative atomic masses: Pt = 195. Avogadro constant = 6.02 x 1023

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Description automatically generatedNitrogen gas is diatomic and has the formula N2. Calculate the number of atoms in 0.5 moles of nitrogen gas. Give your answer to 2 significant figures. (Avogadro constant = 6.02 x 1023) (3)

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**Calculating Moles**

How many moles of ammonia, NH3 are present in a 51 g sample?

(relative atomic masses: H = 1, N = 14).

Calculate the number of moles in 258 grams iron chloride hexahydrate, FeCl3. 6H2O.

Relative atomic mass: Fe = 56, Cl = 35.5, H = 1, O = 16

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How many moles are there in 3.8 g hydrogen chloride, HCl? Give your answer to 3 significant figures. (2)

Relative atomic masses: hydrogen = 1, chlorine = 35.5

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Calculate the mass of iron in 220 g of iron oxide, Fe2O3. (2)

Relative atomic masses: Fe = 56, O = 16. Relative formula mass: Fe2O3 = 160.

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Description automatically generated**Avogadro constant and moles**

How many molecules are present in a 23 g sample of ethanol, C2H5OH? (Avogadro constant = 6.02 x 1023)Ar C = 12, H = 1, O = 16



Calculate the mass, in grams, of a sulfur dioxide (SO2) molecule.

Relative formula mass: SO2 = 64 Avogadro constant = 6.02 x 1023

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Calculate the total number of atoms in 25 g of ammonium sulfate, (NH4)2SO4. (3)

Relative atomic masses: N = 14, H = 1, S = 32, O = 16. Avogadro constant = 6.02 x 1023.

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Calculate the total number of molecules in 0.09 g of water. Give your answer to 2 significant figures. (3)

Relative formula masses: H2O = 18. Avogadro constant = 6.02 x 1023.

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The formula of iron (III) sulfate is Fe2(SO4)3.

Calculate the total number of atoms present in 23.42g of iron (III) sulfate. (4)

Qr code

Description automatically generatedRelative atomic masses: Fe = 56, S = 32, O = 16. Avogadro constant = 6.02 x 1023.

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**Stoichiometry**

The equation for the production of ammonia is:

N2 (g) + 3H2 (g) ⇌ 2NH3 (g)

How many moles of nitrogen would react with 12 moles of hydrogen?

Assuming a 100% yield, how many moles of ammonia would be produced from 12 moles of hydrogen?

**Calculating Rf**

In a chromatography experiment a coloured substance in a food dye moved 2.1 cm when the solvent front moved 2.6 cm.

Calculate the Rf value for this substance, giving your answer to 2 significant figures.

**Law of Conservation of Mass**

Copper oxide thermally decomposes on heating to form copper oxide and carbon dioxide.

CuCO3 (s) 🡪 CuO (s) + CO2 (g)

Qr code

Description automatically generated61.75 g of copper carbonate was heated. 39.75 g of solid remained, calculate the mass of carbon dioxide produced.

10 g of green copper carbonate, CuCO3, thermally decomposes on heating to form 6.437 g of black copper oxide. What mass of carbon dioxide is also produced? (1)

CuCO3 🡪 CuO + CO2

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**Qr code

Description automatically generated**

**Concentration (mol dm-3)**

Copper sulfate, CuSO4 solution was prepared by dissolving 39.875 g of solid in water and making the volume up to 100 cm3.

Calculate the concentration of copper sulfate in mol dm-3. (relative atomic masses: Cu = 63.5, S = 32, O = 16).

A bottle of nitric acid (HNO3) is labelled as having a concentration of 0.1 mol dm-3. What is its concentration in g dm-3?

Relative atomic masses: N = 14, H = 1, O = 16

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A sodium hydroxide, NaOH, solution was prepared of 10 g dm-3 concentration. 25 cm3 of this solution was used for a titration. How many moles of sodium hydroxide were in 25 cm3 of this solution? (3)

Relative atomic masses: Na = 23, H = 1, O = 16

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How would you convert 50 cm3 of 2 mol dm-3 sulfuric acid into 0.5 mol dm-3 acid? (2)

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Qr code

Description automatically generated25 cm3 of copper sulfate was used in an electrolysis practical. 1 dm3 of this solution contains 159.5 g copper sulfate. What mass of copper sulfate would be used in 10 similar experiments? (2) Relative atomic masses: Cu = 63.5, S = 32, O = 16)

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**Bond Energy Calculations**

Qr code

Description automatically generatedEthanol can be used as a renewable fuel in place of petrol. Calculate the energy change when ethanol burns. State whether this reaction is exothermic or endothermic. (4)



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| bond | Bond energy in KJ mol-1 |
| C-C | 348 |
| C-H | 413 |
| C-O | 358 |
| O-H | 464 |
| O=O | 498 |
| C=O | 805 |

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Calculate the energy change when chlorine is reacted with ethene. State whether this reaction is exothermic or endothermic. (4)

Qr code

Description automatically generated

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| bond | Bond energy in KJ mol-1 |
| C-C | 348 |
| C-H | 413 |
| C=C | 614 |
| Cl-Cl | 242 |
| C-Cl | 328 |

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Qr code

Description automatically generatedHydrogen bromide decomposing to form hydrogen and bromine. State whether this reaction is exothermic or endothermic.



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| bond | Bond energy in KJ mol-1 |
| H-Br | 366 |
| H-H | 436 |
| Br-Br | 193 |

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Qr code

Description automatically generatedHydrogen reacts with chlorine to form hydrogen chloride. Use the bond energies below to calculate the energy change for this reaction and state whether it is exothermic or endothermic. (4)

H2 + Cl2 🡪 2HCl

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| bond | Bond energy in KJ mol-1 |
| H-Cl | 431 |
| H-H | 436 |
| Cl-Cl | 244 |

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Paper 1

**Topic 0 - Content and Checklist**

For each content point put a tick next to it firstly when you understand it and secondly when you have learnt it. If you don’t understand a content point you must ask your teacher.

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|  | Content | Understand it | Learnt it |
| 0.1 | Learn the formulae of simple elements, compounds and ions. |  |  |
| 0.2 | Write word equations for reactions. |  |  |
| 0.3 | Write balanced symbol equations for reactions including state symbols (s), (l), (g) and (aq). |  |  |
| 0.4 | **Write balanced ionic equations (higher only)** |  |  |
| 0.5 | Name the common hazard symbols, know why these substances are dangerous and know the precautions that need to be taken when working with them. |  |  |
| 0.6 | Be able to recognise the risks associated with an experiment and suggest suitable safety precautions. |  |  |

**Topic 1 - Content and Checklist**

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|  | Content | Understand it | Learnt it |
| 1.1 | Know the Dalton model of the atom and explain how the model today is similar, but different. |  |  |
| 1.2 | Be able to draw, label and explain what an atom looks like. That is, they are made from a nucleus containing protons and neutrons, surrounded by electrons in shells. |  |  |
| 1.3 | Learn the relative charges and masses of protons, neutrons and electrons. |  |  |
| 1.4 | Explain why the numbers of protons and electrons in atoms are equal. |  |  |
| 1.5 | Be able to picture the relative size of the nucleus compared with the rest of the atom. |  |  |
| 1.6 | Learn that most of the mass of the atom is found in the nucleus. |  |  |
| 1.7 | Learn the meaning of the term: mass number of an atom |  |  |
| 1.8 | Learn that atoms of the same element have the same number of protons in the nucleus and that this number is unique to that element. |  |  |
| 1.9 | Learn the definition of an isotope: atoms of the same element with the same number of protons but a different number of neutrons. |  |  |
| 1.10 | Be able to calculate the number of protons, neutrons and electrons present in an atom when given mass and atomic numbers. |  |  |
| 1.11 | Be able to explain why elements like chlorine have a relative atomic mass that is not a whole number. E.g. Chlorine has a relative atomic mass of 35.5. |  |  |
| **1.12** | **Be able to calculate the relative atomic mass of an element when given the mass number and relative abundance of each isotope.** |  |  |
| 1.13 | Know who Mendeleev is and learn how he arranged the elements in his periodic table by looking at the properties of the known elements and their compounds. |  |  |
| 1.14 | Be able to explain how Mendeleev used his table to predict the existence and properties of yet to be discovered elements. |  |  |
| 1.15 | Explain why Mendeleev had to alter the position of a small number of elements when he arranged his table in order of atomic mass. Your explanation needs to involve detail about the relative abundance of isotopes of these elements. |  |  |
| 1.16 | Learn the meaning of the term: atomic number |  |  |
| 1.17 | Learn that the elements in the periodic table are arranged in order of increasing atomic number. Also know that the horizontal rows of the periodic table are called periods and the vertical columns contain elements with similar chemical properties and are called groups. |  |  |
| 1.18 | Learn the position of metals and non-metals in the periodic table. |  |  |
| 1.19 | Be able to draw and write the electronic configuration of the first 20 elements in the periodic table. |  |  |
| 1.20 | Explain how the electronic configuration of an element is related to its position in the periodic table. |  |  |
| 1.21 | Be able to draw diagrams and explain how ionic bonds are formed. |  |  |
| 1.22 | Learn the meaning of the terms: ion, cation, and anion. |  |  |
| 1.23 | Calculate the numbers of protons, neutrons and electrons in simple ions when given atomic and mass numbers. |  |  |
| 1.24 | Explain how ions are formed and be able to predict the charges of ions from elements in group 1, 2, 6 and 7 of the periodic table. |  |  |
| 1.25 | Correctly use the endings –ide and –ate when naming compounds. |  |  |
| 1.26 | Work out the correct formulae of an ionic compound when given the constituent ions. |  |  |
| 1.27 | Be able to draw and describe the structure of an ionic compound. You must use the term: ionic lattice. You must learn that the ionic lattice is made from a regular arrangement of ions and they are held in place by strong electrostatic forces of attraction between oppositely charged ions. |  |  |
| 1.28 | Learn that a covalent bond is formed when a pair(s) of electrons is shared between 2 atoms. |  |  |
| 1.29 | Learn that covalent bonding results in the formation of molecules. |  |  |
| 1.31 | Be able to draw dot and cross diagrams and explain how the covalent bonds are formed in: hydrogen, hydrogen chloride, water, methane, oxygen and carbon dioxide. |  |  |
| 1.32 | Learn the difference between ionic structures, simple molecular structures, giant molecular structures and metallic structures. Also learn which structures are likely to have high or low melting and boiling points, which structures conduct electricity and which structures are likely to dissolve in water. |  |  |
| 1.33 | Learn and explain why ionic substances have high melting points and why they do not conduct electricity in the solid state but they will when molten or dissolved. |  |  |
| 1.34 | Learn and explain why simple molecular substances have low melting and boiling points and why they are poor conductors of electricity. |  |  |
| 1.35 | Learn that carbon diamond and carbon graphite are examples of giant covalent structures. |  |  |
| 1.36 | Be able to recognise and explain the structures of carbon diamond and carbon graphite. |  |  |
| 1.37 | Use the structure of carbon diamond to explain why it is used for cutting tools and the structure of carbon graphite to explain why it is used for electrodes and as a lubricant. |  |  |
| 1.38 | Learn the properties of fullerenes (including C60) and be able to use the structure to explain these properties. |  |  |
| 1.39 | Learn that polymers like polyethene are made from large molecules containing many carbon atoms. |  |  |
| 1.40 | Learn and use the metallic structure to explain why metals are malleable and able to conduct electricity. |  |  |
| 1.41 | Understand that diagrams showing bonding do not always give you an idea of what the bonding will actually look like. For this 3 D diagrams would be better but are very difficult to draw. |  |  |
| 1.42 | Learn that metals are shiny solids, have high melting points, high density and are good conductors of electricity. Whereas non-metals have low melting points and are poor conductors of electricity. |  |  |
| 1.43 | Use relative atomic masses to calculate the relative formula mass. |  |  |
| 1.44 | Learn how to calculate empirical formulae. |  |  |
| 1.45 | Work out: 1) the empirical formula of a compound from the formula of its molecule and: 2) the molecular formula of a compound from its empirical formula and its relative molecular mass. |  |  |
| 1.46 | Explain how you could carry out an experiment to work out the empirical formula of magnesium oxide. |  |  |
| 1.47 | Understand the law of conservation of mass. Be able to make predictions of the mass of a container in which: 1) all reactants and products are enclosed. 2) A container from which a gas is escaping. 3) A reaction that is reacting with a gas in the air to make a solid. |  |  |
| 1.48 | Use a reaction equation to be able to calculate the mass of a reactant or product using the mass of one other substance. |  |  |
| 1.52 | **Be able to explain why one reactant is often in excess.** |  |  |
| 1.53 | **Work out the stoichiometry of a reaction from the masses of the reactants and products.** |  |  |
| 1.49 | Work out the concentration of a solution in g dm-3 |  |  |
| 1.50 | **Learn that 1 mole of a substance is the Avogadro constant number of particles of that substance.** |  |  |
| 1.51 | **Be able to calculate: 1) the number of moles of a substance when given a mass. 2) The number of particles of a substance given the number of moles. 3 The number of particles of a substance given the mass.**  **For each of the above you need to be able to do the calculation the other way round as well.** |  |  |

**Topic 2, States of matter and mixtures – Checklist**

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|  | Content | Understand it | Learnt it |
| 2.1 | Be able to draw a diagram and describe the arrangement particles in a solid, liquid and gas. Know about the relative energy of particles in each |  |  |
| 2.2 | Know the names given to the changes of state and that these are physical changes. Be able to recognise a physical or chemical change. |  |  |
| 2.3 | Explain the changes in arrangement, movement and energy of particles during changes of state. |  |  |
| 2.4 | Use melting and boiling point data to predict whether a substance will be a solid, liquid or gas. |  |  |

**Topic 2,** **Methods of separating and purifying substances – Checklist**

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|  | Content | Understand it | Learnt it |
| 2.5 | Explain the difference between a pure substance and a mixture |  |  |
| 2.6 | Understand that mixtures melt over a range of temperatures whereas pure substances have very sharp melting points. You must be able to recognise this in data. |  |  |
| 2.7 | For each of the following separating techniques you must know: 1) what they are used for, 2) the apparatus used.   * Simple distillation * Fractional distillation * Filtration * Crystallisation * Paper chromatography. |  |  |
| 2.8 | Be able to identify the correct separating technique for the correct mixture. |  |  |
| 2.9 | Be able to explain that paper chromatography can separate a mixture of soluble substances by running a solvent (mobile phase) through the mixture on the filter paper (stationary phase), which causes the substances to move at different rates over the paper. |  |  |
| 2.10 | Look at the results of paper chromatography and:   1. Identify whether the substance was pure or a mixture. 2. Identify substances by comparison with other known substances. 3. Calculate and use Rf values to identify substances. |  |  |
| 2.12 | Describe how ground water found outside can be made safe to drink (potable) using: 1) sedimentation, 2) filtration, 3) chlorination.  Describe how sea water can be made potable by simple distillation.  Understand that water used in analysis must not contain any dissolved salts. |  |  |

**Topic 3, Chemical change: Acids - Checklist**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Content | Understand it | Learnt it |
| 3.1 | Learn that acids are sources of hydrogen ions and alkalis are sources of hydroxide ions. |  |  |
| 3.2 | Learn that pH solutions with a pH of 1-6 are acidic, 7 are neutral and 8-14 are alkali. |  |  |
| 3.3 | Learn the colour changes of the following indicators with acid and alkali:   1. Litmus 2. Methyl orange 3. Phenolphthalein |  |  |
| **3.4** | **Learn the link between hydrogen ion concentration and pH. The higher the concentration of hydrogen ions the lower the pH. Also know that the higher the concentration of hydroxide solutions the higher the pH.** |  |  |
| **3.5** | **Learn that, as the hydrogen ion concentration increases by a factor of 10, the pH of the solution decreases by 1.** |  |  |
| 3.6 | Know how the pH changes when powdered calcium hydroxide is added a bit at a time to hydrochloric acid. |  |  |
| **3.7** | **Know the meanings of the words: dilute, concentrated. Talk about the amount of particles in solution.** |  |  |
| **3.8** | **Know the meaning of the phrases: strong acid, weak acid. Be able to talk about the degree of dissociation into ions.** |  |  |
| 3.9 | Know what a base is and that it will react with an acid to make a salt and water. |  |  |
| 3.10 | Know that an alkali is a base that is soluble in water. |  |  |
| 3.11 | Write equations for acids with:   1. Metals 2. Metal oxides 3. Metal hydroxides 4. Metal carbonates   Know that in each case that these are neutralisation reactions and a salt is always produced. |  |  |
| 3.12 | Know the tests for:   1. Hydrogen 2. Carbon dioxide |  |  |
| 3.13 | Know what a neutralisation reaction is. |  |  |
| 3.14 | Know that in an acid alkali neutralisation reaction hydrogen (H+) ions from the acid react with hydroxide (OH-) ions from the alkali. |  |  |
| 3.15 | Know that when you prepare a soluble salt from an acid an insoluble reactant why:   1. Excess insoluble reactant is added. 2. The excess reactant is removed 3. The solution remaining is only salt and water |  |  |
| 3.16 | Know that when you prepare a soluble salt from an acid and a soluble reactant why:   1. Titration must be used 2. The acid and the soluble reactant are mixed in the correct proportions 3. The solution remaining at the end will only be salt and water. |  |  |
| 3.17 | Know exactly the apparatus and procedure used to prepare a pure dry sample of copper sulphate from acid and copper oxide. |  |  |
| 3.18 | Know exactly what apparatus and indicator to use to carry out an acid alkali titration to prepare pure crystals of sodium chloride. |  |  |
| 3.19 | Learn which salts are soluble:   1. All common sodium, potassium and ammonium salts are soluble. 2. All nitrates are soluble. 3. Common chlorides are soluble except those of silver and lead. 4. Common sulphates are soluble except those of lead, barium and calcium. 5. Common carbonates and hydroxides are insoluble except those of sodium, potassium and ammonium. |  |  |
| 3.20 | Use the solubility rules to predict whether a salt produced in a chemical reaction will be soluble. |  |  |
| 3.21 | Be able to write a method detailing how to prepare a pure, dry sample of an insoluble salt. |  |  |

**Topic 3, Chemical change: Electrolytic processes – Checklist**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Content | Understand it | Learnt it |
| 3.22 | Learn that for electrolysis to happen you must have an electrolyte. The electrolyte is a molten or dissolved ionic substance. |  |  |
| 3.23 | Learn that electrolysis is a chemical reaction that is occurring because electrical energy from direct current supply is being passed through an electrolyte. This causes the electrolyte to decompose. |  |  |
| 3.24 | Understand and explain that during electrolysis:   1. the positively charged ions (cations) move to the negatively charged electrode (cathode); 2. the negative charged ions (anions) move to the positively charged electrode (anode). |  |  |
| 3.25 | Learn the products of the following electrolysis reactions, using inert electrodes.   1. Molten lead bromide 2. Water (acidified with sulfuric acid). 3. Copper chloride solution 4. Sodium chloride solution 5. Sodium sulfate solution |  |  |
| 3.26 | Learn the rules for products likely to be produced in electrolysis reactions, then use those rules to predict products that might be formed. |  |  |
| **3.27** | **Be able to write half equations for the reactions that take place at the anode and the cathode in electrolysis.** |  |  |
| **3.28** | **Learn that oxidation is loss of electrons and reduction is gain of electrons.** |  |  |
| **3.29** | **Learn that reduction occurs at the cathode and oxidation occurs at the anode.** |  |  |
| 3.30 | Explain how electrolysis can be used to purify copper by using copper electrodes and a solution of copper sulfate. |  |  |
| 3.31 | Investigate what happens to the mass of the anode and the cathode when copper sulfate is electrolysed using copper electrodes. |  |  |

**Topic 4, Obtaining and using metals – Checklist**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Content | Understand it | Learnt it |
| 4.1 | Construct a reactivity series of metals by looking at their reactions with water, acids and displacement reactions with salt solutions. |  |  |
| **4.2** | **Understand that displacement reactions are redox reactions. Also explain what is oxidised and reduced.** |  |  |
| 4.3 | Explain the reactivity series of metals (potassium, sodium,  calcium, magnesium, aluminium, (carbon), zinc, iron,  (hydrogen), copper, silver, gold) in terms of the reactivity of  the metals with water and dilute acids and that these  reactions show the relative tendency of metal atoms to form  cations. |  |  |
| 4.4 | Learn that: 1) most metals are extracted from ores that are found in the Earth’s crust. 2) Unreactive metals like gold are found in the Earth’s crust as the uncombined elements (if you’re lucky enough). |  |  |
| 4.5 | Learn that oxidation is defined as the loss of electrons and reduction is defined as gaining electrons. |  |  |
| 4.6 | Learn that extraction of metals involves the reduction of ores. |  |  |
| 4.7 | Be able to explain that the method of extraction used to obtain a metal is related to its position in the reactivity series and the cost of the process. For example iron and aluminium. |  |  |
| **4.8** | **Learn the advantages and disadvantages of alternative methods of metal extraction. For example bacterial and phytoextraction.** |  |  |
| 4.9 | Predict a metal’s resistance to oxidation by looking at its position in the reactivity series. |  |  |
| 4.10 | Evaluate the advantages of recycling metals, including  economic implications and how recycling can preserve both  the environment and the supply of valuable raw materials |  |  |
| 4.11 | Learn about ‘life time assessment’ of a product. This involves evaluating the effect on the environment of obtaining the raw materials, manufacturing the product, using the product and disposing of it when it is no longer useful. |  |  |
| 4.12 | Look at data of a life time assessment of a product and use it to answer questions about the product. |  |  |

**Topic 4, Reversible reactions and equilibria - Checklist**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Content | Understand it | Learnt it |
| 4.13 | Know that some chemical reactions are reversible and where this is the case the following symbol is used: ⇌ |  |  |
| 4.14 | Learn the definition of dynamic equilibrium. |  |  |
| 4.15 | Learn how ammonia is formed from nitrogen (from the air) and hydrogen (obtained from natural gas) and understand that it is a reversible reaction and that it can reach a dynamic equilibrium. |  |  |
| **4.17** | **Learn how changing:**   1. **Temperature** 2. **Pressure** 3. **Concentration**   **Can change the position of a dynamic equilibrium.** |  |  |

Paper 2

**Topic 6 - Content and Checklist**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Content | Understand it | Learnt it |
| 6.1 | Identify on the periodic table the position of: group 1 (the alkali metals), group 7 (the halogens), group 0 (the noble gases). |  |  |
| 6.2 | Learn that alkali metals: are soft and have low melting points. |  |  |
| 6.3 | Describe the reactions of lithium, sodium and potassium with water and learn the reaction equations. |  |  |
| 6.4 | Use the observations of the reactions of lithium, sodium and potassium with water to predict the reactivity of the other alkali metals further down the group. |  |  |
| 6.5 | Use the electronic configuration of lithium, sodium and potassium to explain the trend in reactivity. |  |  |
| 6.6 | Learn the colours and physical states (solid, liquid or gas) of chlorine, bromine and iodine at room temperature. |  |  |
| 6.7 | Know the pattern of melting/boiling point and colour intensity as you go down the halogen group. Can you use this trend to make predictions about a halogen with unknown data? |  |  |
| 6.8 | Learn the chemical test for chlorine. |  |  |
| 6.9 | Describe the reactions of the halogens (chlorine, bromine and iodine) with metals to form metal halides (be able to write balanced symbol equations). Use the pattern to predict the reactions of other halogens. |  |  |
| 6.10 | Learn the equations for the reaction of hydrogen with chlorine, bromine and iodine to form hydrogen halides. Learn that when these hydrogen halides are added to water and an acidic solution is formed. This is also true for the other halogens. |  |  |
| 6.11 | Learn the trend in reactivity within the halogen group. Understand this can be observed by the reactions of halogens with halide ions in aqueous solutions. Be able to use displacement theory to predict reactions of other halogens including astatine. |  |  |
| **6.12** | **Write balanced symbol equations for displacement reactions of halogens; then identify what is oxidised and reduced. Also say what gains electrons and what loses electrons. Use this information to explain why displacement reactions are redox reactions.** |  |  |
| 6.13 | Use the electronic configuration of fluorine and chlorine to explain the trend in reactivity of the halogen group. |  |  |
| 6.14 | Use the electronic configuration of helium, neon and argon to explain why the noble gases are inert (don’t react with anything). |  |  |
| 6.15 | Learn properties and uses of argon, neon and helium; use these properties to explain why the gas is suitable for a particular use. Properties to be included are inertness, low density and non-flammability. |  |  |
| 6.16 | Use the physical properties of some noble gases and their position in the periodic table to predict the physical properties of other noble gases. Be able to identify the trend in the group from the physical properties. |  |  |

**Topic 7 – Rate of reaction**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Content | Understand it | Learnt it |
| 7.1 | Know how to perform rate of reaction experiments which investigate the effects of changing the conditions of reactants by:   1. Measuring the production of carbon dioxide when calcium carbonate reacts with hydrochloric acid. 2. Watching the colour change in the reaction between sodium thiosulfate and hydrochloric acid |  |  |
| 7.2 | Look at the reactants/products and the state symbols in a reaction equation and make a suggestion as to how the rate of reaction could be monitored. |  |  |
| 7.3 | Learn that for a reaction to occur then:   1. Particles must collide 2. The collision must have enough energy.   Be aware that if you can increase either or both of these factors then the rate of reaction will increase. |  |  |
| 7.4 | Explain using particle theory how:   * Concentration and pressure * Temperature * Surface area * Catalyst   Affect the rate of a chemical reaction |  |  |
| 7.5 | Be able to interpret (understand and explain) rate of reaction graphs when the reactants (or products) mass, volume or concentration is plotted against time. |  |  |
| 7.6 | Learn that a catalyst is a substance that speeds up a chemical reaction without being changed itself. At the end of the reaction the catalyst will have the same mass and be chemically unchanged. |  |  |
| 7.7 | Explain how a catalyst works. This explanation must include ‘activation energy’. |  |  |
| 7.8 | Learn that enzymes are biological catalysts and that enzymes are used to produce alcoholic drinks. |  |  |

**Topic 7 – Heat energy changes in chemical reactions**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Content | Understand it | Learnt it |
| 7.9 | Learn that changes in heat energy accompany the following changes:   1. Salts dissolving in water 2. Neutralisation reactions 3. Displacement reactions 4. Precipitation reactions   Also know that when these reactions happen in solution the temperature changes can be measured. |  |  |
| 7.10 | Learn the definition of an exothermic reaction: a reaction or change that gives out heat energy. |  |  |
| 7.11 | Learn the definition of an endothermic reaction: a reaction or change that takes in heat energy. |  |  |
| 7.12 | Understand that in all reactions the first change is the breaking of reactants bonds followed by the making of products bonds. Learn that breaking bonds is an endothermic process and making bonds is exothermic. |  |  |
| 7.13 | Be able to explain that the overall heat energy change in a reaction is:   1. Exothermic if more heat energy is released in forming bonds in the products than is needed to break the bonds in the reactants. 2. Endothermic if more heat energy is needed to break the bonds in the reactants than is produced when new product bonds are made. |  |  |
| **7.14** | **Use the energies of bonds (in KJ mol-1). These values are the energy required to make and break bonds to calculate the energy change in a reaction.** |  |  |
| 7.15 | Learn the meaning of the term: activation energy. |  |  |
| 7.16 | Be able to draw and label an energy level diagram for both an exothermic and endothermic reaction. You must be able to label the axis and identify activation energy and state where bonds are being made and broken. |  |  |

**Topic 8 – Fuels and Earth Science**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Content | Understand it | Learnt it |
| 8.1 | Learn that hydrocarbons are compounds that contain hydrogen and carbon **only.** |  |  |
| 8.2 | Be able to explain that crude oil:   1. Contains many different size hydrocarbon molecules. 2. Contains molecules in which some of the carbon chains are straight but in others they can join up to form rings. 3. Is tremendously useful to humans both as fuels and as raw materials for making other substances. 4. Is a finite resource (non-renewable). |  |  |
| 8.3 | Before crude oil can be used it must first be separated into simpler more useful mixtures. Learn that this is done by **fractional distillation**. Be able to explain how fractional distillation works. |  |  |
| 8.4 | Learn the names and uses of the main fractions of crude oil and the order in which they come out of the distillation tower.   1. Gases – used in the home for cooking and heating. 2. Petrol – used as a fuel for cars. 3. Kerosene – used as a fuel for aircraft. 4. Diesel oil – used as a fuel for some cars, lorries and trains. 5. Fuel oil – used as a fuel for large ships and in some power stations where it is burnt to generate electricity. 6. Bitumen – used to surface roads and roofs. |  |  |
| 8.5 | For the fractions of crude oil learn that they are alkanes and the trends in:   1. Number of carbon and hydrogen atoms in the molecule. 2. Boiling points. 3. Ease of ignition 4. Viscosity. |  |  |
| 8.6 | Learn that a homologous series is a family of hydrocarbons with molecules:   1. Of the same general formula. 2. That differ by CH2 in molecular formulae from their neighbouring compounds. 3. That show a gradual variation in physical properties, for example boiling point and viscosity. 4. That have similar chemical properties. |  |  |
| 8.7 | Learn that in the complete combustion of a hydrocarbon:   1. Carbon dioxide and water are produced. 2. The reaction is exothermic and heat energy is given out. |  |  |
| 8.8 | Understand that there is another type of combustion called incomplete combustion. Explain why incomplete combustion can produce the products carbon and carbon monoxide. |  |  |
| 8.9 | Be able to explain in your own words why carbon monoxide behaves as a toxic gas. |  |  |
| 8.10 | Understand how incomplete combustion can occur in the home and the problems it can cause. |  |  |
| 8.11 | Explain how sulfur impurities in hydrocarbon fuels lead to the production of sulfur dioxide. |  |  |
| 8.12 | Name some of the problems from acid rain. Learn that acid rain is caused by the sulfur dioxide produced from burning hydrocarbon fuels. |  |  |
| 8.13 | Understand how nitrogen oxides are also produced when hydrocarbon fuels are burnt in engines. The high temperatures of the engine cause the nitrogen and the oxygen in the air to react. |  |  |
| 8.14 | Hydrogen is seen by some as the fuel of the future for cars. Name the advantages and disadvantages of using hydrogen, rather than petrol, as a fuel for cars. |  |  |
| 8.15 | Learn that petrol, kerosene and diesel oil are non-renewable fossil fuels found in crude oil. Learn also that methane is a non-renewable fossil fuel found in natural gas. |  |  |
| 8.16 | Learn that cracking long chain hydrocarbons involves taking a large alkane (saturated) molecule and breaking it down, cracking it.  Long chain hydrocarbons are cracked because they are not that flammable. This produces a shorter chain alkane (saturated), which is more flammable and therefore more useful as a fuel and a smaller alkene (unsaturated) molecule. |  |  |
| 8.17 | Be able to explain why cracking is a necessary process. |  |  |

**Topic 8 – Earth and atmospheric science**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Content | Understand it | Learnt it |
| 8.18 | Know that the first atmosphere was formed from the gases produced by volcanic activity. |  |  |
| 8.19 | Learn that scientists think that the Earth’s early atmosphere contained:   1. Little or no oxygen. 2. Lots of carbon dioxide. 3. Water vapour. 4. Small amounts of other gases. |  |  |
| 8.20 | Be able to explain how the first oceans were formed from condensing water vapour. |  |  |
| 8.21 | Learn that the amount of carbon dioxide in the early atmosphere was reduced because it dissolved in the oceans. |  |  |
| 8.22 | Be able to explain how the carbon dioxide levels fell further as the growth of the first green plants used carbon dioxide and released oxygen by photosynthesis. Understand that this increased the amount of oxygen in the atmosphere. |  |  |
| 8.23 | Learn the chemical test for oxygen. |  |  |
| 8.24 | Be able to write a detailed explanation to describe what the greenhouse effect is and what causes it. You should be able to name the following gases that are responsible: carbon dioxide, methane and water vapour. |  |  |
| 8.25 | Use evidence both for and against global warming to evaluate both sides of the argument as to whether human activity is causing climate change. The arguments that you must know are:   1. The link between the change in atmospheric carbon dioxide concentration , the use of fossil fuels and average global temperature. 2. The error margin in recording historic atmospheric and climatic data from ice cores and rocks and also from where it is taken. |  |  |
| 8.26 | Learn and be able to explain:   1. What the potential effects of increasing carbon dioxide and methane levels due to human activity might be on the planet. Learn that the human activity is burning fossil fuels and livestock farming. 2. How we could reduce the effects of climate change. Look at the advantages and disadvantages of these measures in terms of practicality (scale), risk and environmental implications. |  |  |

Qr code

Description automatically generated**Paper 1 and 2**

Give 3 pieces of equipment that would accurately measure out 25 cm3 of sodium hydroxide solution? (3)

|  |
| --- |
|  |

Qr code

Description automatically generated

Write a balanced symbol equation for the reaction of magnesium burning with the oxygen in the air. (3)

|  |
| --- |
|  |

Qr code

Description automatically generated

Write a word equation for the formation of ethyl ethanoate and water from ethanol and ethanoic acid. (1)

|  |
| --- |
|  |

Qr code

Description automatically generated

Write a balanced symbol equation for the reaction of potassium iodide solution reacting with chlorine water to make potassium chloride and iodine solution. Include state symbols. (4)

|  |
| --- |
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Qr code

Description automatically generated

Write an ionic equation for the reaction of magnesium ions with phosphate ions (PO43-) to form magnesium phosphate.

|  |
| --- |
|  |

Qr code

Description automatically generatedWrite a balanced symbol equation for the reaction of aluminium with bromine to form aluminium bromide. (3)

|  |
| --- |
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Qr code

Description automatically generatedWrite a balanced symbol equation for methane reacting with steam to form hydrogen and carbon monoxide. Include state symbols. (4)

|  |
| --- |
|  |

Qr code

Description automatically generatedWrite a balanced symbol equation for nitrogen reacting with oxygen to make nitrogen dioxide. (3)

|  |
| --- |
|  |

Qr code

Description automatically generatedWrite a balanced symbol equation for hydrogen reacting with iodine to form hydrogen iodide. (3)

|  |
| --- |
|  |

Qr code

Description automatically generatedWrite a balanced symbol equation for the reaction of fluorine with iron to make iron (III) fluoride. (3)

|  |
| --- |
|  |

Qr code

Description automatically generatedWrite an ionic equation for nitric acid reacting with sodium carbonate. (3)

Na2CO3 (aq) + 2HNO3 (aq) 🡪 2NaNO3 (aq) + CO2 (g) + H2O (l)

|  |
| --- |
|  |

Qr code

Description automatically generatedWrite a balanced symbol equation for the reaction between lithium and fluorine gas to make lithium fluoride solid. Include state symbols (4)

|  |
| --- |
|  |

Qr code

Description automatically generatedTitanium is extracted from its ore, rutile - TiO2. It is first converted into titanium(IV) chloride, this is achieved by heating with chlorine and carbon. As well as producing titanium (IV) chloride the reaction also produces carbon monoxide.

Write the balanced equation for this reaction. (3)

|  |
| --- |
|  |

Qr code

Description automatically generated

Describe what you would see when magnesium is added to copper sulfate solution. Magnesium sulfate solution is colourless. (2)

|  |
| --- |
|  |
|  |

Qr code

Description automatically generatedWrite a balanced symbol equation for the reaction of copper oxide and sulfuric acid. (2)

|  |
| --- |
|  |

Qr code

Description automatically generatedSmall amounts of copper carbonate are added to sulfuric acid until all the acid has reacted. What would you see as the reaction is taking place and how would you know when it has finished? (4)

|  |
| --- |
|  |
|  |
|  |

Hydrochloric acid reacts with sodium thiosulfate (Na2S2O3) to make sodium chloride, sulfur dioxide, sulfur and water. Complete the ionic equation for this reaction. (2)

\_\_\_\_ \_\_\_\_\_\_\_\_ (aq)  +  Na2S2O3(aq)  →        \_\_\_\_\_ Na+ (aq)    +      SO2(g)    +   S(s)  +  H2O(l)

Qr code

Description automatically generatedCalcium hydroxide (Ca(OH)2) solid reacts with hydrochloric acid (HCl) to make calcium chloride (CaCl2) solution and water. Write a balanced symbol equation including state symbols for this reaction. (4)

\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_) +\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_) 🡪\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_) +\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_)

Qr code

Description automatically generatedName a piece of equipment that could be used to accurately measure out 25 cm3 of hydrochloric acid. (1)

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

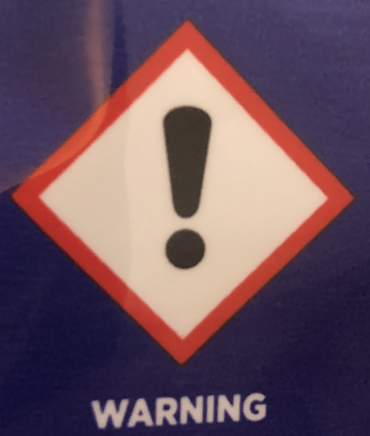
Qr code

Description automatically generatedWrite a balanced symbol equation for the reaction of ammonia and sulfuric acid. (3)

|  |
| --- |
|  |

The packaging of the dishwasher tablets in my kitchen has this hazard symbol.

Qr code

Description automatically generated

One of the tablets has split open and the liquid it contains has spilt out. What would be a sensible safety precaution to use when clearing up the mess (1)

|  |
| --- |
|  |
|  |

Qr code

Description automatically generatedWhat is this hazard symbol and state what safety precautions would be sensible when handling a substance labelled with this symbol. (3) 

|  |  |
| --- | --- |
| Symbol name | Safety precautions |
|  |  |
|  |

Qr code

Description automatically generated

What are the formulas of hydrochloric acid, sulfuric acid and nitric acid? (3)

|  |  |
| --- | --- |
| Acid | Formula |
| hydrochloric acid |  |
| sulfuric acid |  |
| nitric acid |  |

Qr code

Description automatically generated

Write a balanced symbol equation for the reaction of potassium with iodine. (3)

|  |
| --- |
|  |

Qr code

Description automatically generatedWhat is a precipitate? (1)

|  |
| --- |
|  |

Qr code

Description automatically generated**Atoms**

John Dalton came up with an early model of the atom over 200 years ago. Give differences between Dalton’s model of the atom and today’s model of the atom. (2)

|  |
| --- |
|  |
|  |
|  |



What is the definition of an isotope?

|  |
| --- |
|  |
|  |

Qr code

Description automatically generatedFill in the blank:

Elements of the same element contain the same number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. (1)

An element has a mass number of 23 and an atomic number of 11. State the electronic configuration. (1)

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

Qr code

Description automatically generatedAn element has a mass number of 9 and an atomic number of 4. How many protons, neutrons and electrons are there in this atom? (2)

|  |  |
| --- | --- |
| Protons |  |
| Neutrons |  |
| Electrons |  |

Qr code

Description automatically generated

A copper atom has 29 protons, 34 neutrons and 29 electrons. What is the mass number of this copper atom? (1)

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

Qr code

Description automatically generatedA potassium atom has 19 protons, 20 neutrons and 19 electrons. What is the electronic configuration of this potassium atom? (1)

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

Qr code

Description automatically generatedAn element has the electronic configuration: **2.8.4**

Explain which group and period of the periodic table would this element be found in? (4)

|  |
| --- |
|  |
|  |
|  |

Qr code

Description automatically generated

An atom has an atomic number of 15 and a mass number of 31. What is its electronic configuration? (1)

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

Qr code

Description automatically generatedAn atom of sodium has an atomic number of 11 and a mass number of 23, how many protons and neutrons are present in a sodium ion (Na+)? (1)

|  |  |  |  |
| --- | --- | --- | --- |
| Protons |  | Neutrons |  |

Qr code

Description automatically generated

What’s an isotope?

|  |
| --- |
|  |
|  |

Qr code

Description automatically generatedTwo isotopes of carbon are carbon-12 and carbon-14? How are these isotopes similar? (1)

|  |
| --- |
|  |
|  |

Qr code

Description automatically generated**Periodic table**

Name the element that is in period 2 group 4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (1)

Qr code

Description automatically generatedAn element has the electronic configuration: **2.8**

Explain which period of the periodic table would this element be found in? (2)

|  |
| --- |
|  |
|  |
|  |

Qr code

Description automatically generated

An element has the electronic configuration: **2.7**

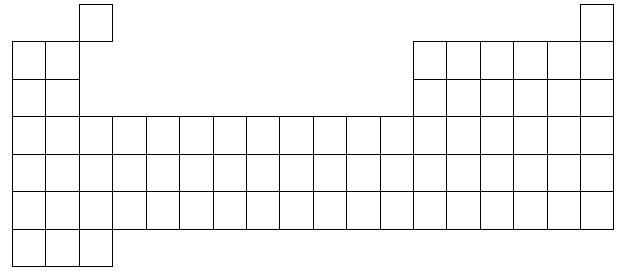
Which period and group of the periodic table would this element be found in? (2)

|  |  |
| --- | --- |
| Group |  |
| Period |  |

Qr code

Description automatically generatedDraw the metal/ non-metal divide on the periodic table below. (1)

Qr code

Description automatically generated

Where on the periodic table would we find elements that form a 2- charge?

Qr code

Description automatically generated\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Use the electronic configuration of an atom of chlorine to explain its position on the periodic table (2)

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**Empirical formula experiments**

Qr code

Description automatically generatedDescribe an experiment to determine the empirical formula of a calcium oxide. (3)

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Qr code

Description automatically generatedDescribe an experiment that could be used work out the mass of oxygen that would combine with 0.24 g of Magnesium.

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Qr code

Description automatically generated

Magnesium is heated in a crucible in an attempt to determine the empirical formula of the oxide?

1. What method will you use to ensure all the magnesium has reacted? (2)

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1. How would you ensure the actual yield was close to the theoretical yield? (2)

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Qr code

Description automatically generatedText

Description automatically generated with medium confidenceThe diagram below shows a molecule of but-1-ene. Give the molecular and the empirical formula of but-1-ene. (2)

Molecular formula \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Empirical formula \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Qr code

Description automatically generated**Bonding**

Why do metals have high melting points? (2)

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How does Mg turn into the Mg2+ ion? (2)

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Qr code

Description automatically generated

Aluminium chloride, AlCl3 is ionic. What are the charges on the aluminium and chloride ions? (2)

Aluminium ion \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Chloride ion \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is the formula of aluminium sulfate? (1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Qr code

Description automatically generatedHow many protons, neutrons and electrons are present in the S2- ion? (Atomic number 16, mass number 32) (2)

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Qr code

Description automatically generated

How many protons, neutrons and electrons are present in the Fe (III) ion? (Atomic number 26, mass number 56) (2)

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Qr code

Description automatically generated

What is the formula of sodium carbonate? (1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Qr code

Description automatically generatedMagnesium burns in oxygen to from magnesium oxide. What is the electronic configuration of the magnesium ion and the oxide ion? (2)

|  |  |
| --- | --- |
| Magnesium ion |  |
| Oxide ion |  |

Qr code

Description automatically generatedWhat are the physical properties of ionic solids? (2)

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Qr code

Description automatically generated

An oxide of iron has the formula Fe2O3. What is the charge on the iron ion? (1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Qr code

Description automatically generatedAluminium has an atomic number of 13. What is the electronic configuration of the aluminium ion? (1)

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

Qr code

Description automatically generatedWhat is the formula of iron (III) sulfate? (1)

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

Qr code

Description automatically generatedWhat is a covalent bond? (2)

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Draw a dot and cross diagram for an oxygen molecule. (2)

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Qr code

Description automatically generatedExplain why oxygen has a boiling point of -183 oC? (2)

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Qr code

Description automatically generatedDraw a dot and cross diagram for a carbon dioxide molecule. (2)

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Qr code

Description automatically generated

Qr code

Description automatically generatedDraw a dot and cross diagram for a carbon dioxide molecule. Show outer electrons only. (2)

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Explain whether you would you expect a sample of F2 to be a gas or a solid at room temperature. (2)

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Qr code

Description automatically generatedExplain why ammonia has a boiling point of -33 oC. (2)

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Qr code

Description automatically generatedComplete the table to give information about the bonding and properties about the 4 different allotropes of carbon. (6)

|  |  |  |  |
| --- | --- | --- | --- |
| Allotrope | Type of bonding | Melting point (explain) | Conductivity (explain) |
| Diamond |  |  |  |
|  |  |
|  |  |
|  |  |
|  |  |
| Graphite |  |  |  |
|  |  |
|  |  |
|  |  |
|  |  |
| Graphene |  |  |  |
|  |  |
|  |  |
|  |  |
|  |  |
| fullerene |  |  |  |
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Qr code

Description automatically generated

Explain in terms of bonding and structure why the substances listed have the different melting points and conductivities stated. (6)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Melting point | Conducts electricity in solid state (s) | Conducts electricity in liquid state (l) |
| Ammonia | Low | Poor | Poor |
| Iron | High | Good | Good |
| Sodium bromide | High | Poor | Good |

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Qr code

Description automatically generatedThree substances are: copper, carbon diamond and iron chloride. Use the information in the table to identify which is likely to be each of the named substances. Explain your answer in terms of bonding and structure why the substances listed have the different melting points and conductivities stated. (6)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Melting point | Conducts electricity in solid state (s) | Conducts electricity in liquid state (l) |
| **1** | Very high | Poor | Sublimes on melting |
| **2** | High | Good | Good |
| **3** | High | Poor | Good |

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Qr code

Description automatically generatedExplain why graphene is a good conductor of electricity. (3)

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Qr code

Description automatically generatedExplain why calcium chloride has a high melting point. (2)

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Qr code

Description automatically generatedA water molecule can be drawn in many different ways. Look at each representation in turn and explain what you learn from it.

|  |  |
| --- | --- |
| H2O |  |
|  |
|  |
| H-O-H |  |
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**Qr code

Description automatically generatedPaper 1**

**Separating techniques**

Explain how sea water can be turned into pure water (as part of your answer name the separating technique and explain how it works). (3)

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Qr code

Description automatically generatedDraw a labelled diagram that can be used to separate a mixture of sea water and sand? (2)

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Qr code

Description automatically generatedHow would you obtain pure dry crystals of the salts present in sea water? (3)

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Qr code

Description automatically generatedHow could a liquid with dissolved impurities be purified? (1)

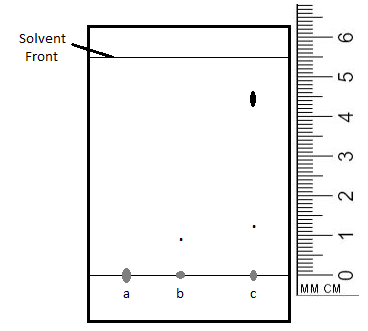
|  |
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Qr code

Description automatically generatedAfter fermentation of fruit there are solids mixed with the ethanol solution. What method would you use to obtain a pure ethanol solution? (2)

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The diagram below shows the chromatogram obtained when the inks from 3 pens were separated using chromatography.



Why has ink **a** not moved and how could we change the experiment to try and separate the inks in this sample? (2)

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Qr code

Description automatically generated

What is the Rf for the dye in sample **b**? Give your answer to 3 significant figures.(2)

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Qr code

Description automatically generated

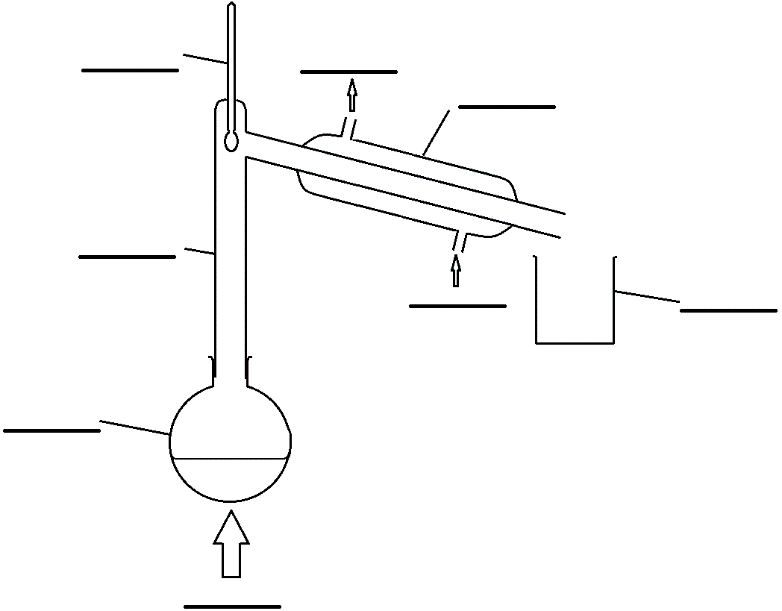
How many different dyes are in ink **c**?

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

Qr code

Description automatically generatedName this separating technique and label this apparatus

Qr code

Description automatically generated

Ethanol solution can be made by fermenting sugar, the solution is usually about 12% ethanol mixed with water. Describe the process used to concentrate the ethanol. (3)

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Qr code

Description automatically generated

After water has been through a treatment works it is described as, potable. What does, potable mean? (1)

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Qr code

Description automatically generatedExplain how is water made potable? (4)

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Qr code

Description automatically generated

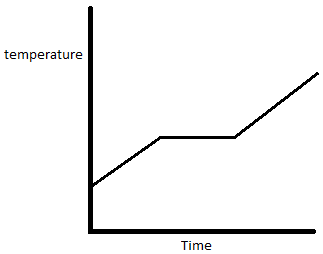
A student tries to separate ethanol from water using distillation apparatus, the resulting distillate is not pure. What could they do to improve the purity of the ethanol produced? (2)

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**Change of State**

Qr code

Description automatically generatedA solid is heated at a constant rate and its temperature is regularly recorded and a graph of the results plotted. Explain the shape of the graph in terms of the changes in movement and arrangement of the particles. (4)



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Qr code

Description automatically generatedDescribe the arrangement and movement of particles in a solid, liquid and gas. (3)

|  |  |  |
| --- | --- | --- |
| State of matter | Arrangement | Movement |
| Solid |  |  |
| Liquid |  |  |
| Gas |  |  |

Qr code

Description automatically generatedUse a line to join the change of state to its name. (3)

|  |  |  |
| --- | --- | --- |
| Change of state |  | Name |
| Solid to liquid |  | Boiling |
| Liquid to gas |  | Melting |
| Gas to liquid |  | Freezing |
| Liquid to solid |  | Condensing |

Qr code

Description automatically generatedOn heating a substance changes from a solid to a liquid. Explain what you could do next to conclude whether this was a chemical or physical change. (2)

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Qr code

Description automatically generated

An element has a melting point of -38.9 oC and a boiling point of 356.7 oC. What physical state would you expect it to be at room temperature (20 oC)? (1)

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Qr code

Description automatically generated**Gas tests**

What’s the test for hydrogen? (2)

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Qr code

Description automatically generated

A sample of hydrogen is burnt – what happens? (1)

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Qr code

Description automatically generatedA gas is produced in electrolysis that burns with a squeaky pop, identify the gas. (1)

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

Qr code

Description automatically generatedWhat’s the test for carbon dioxide? (2)

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What is a test for chlorine gas (2)

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**Indicators, pH and Neutralisation.**

What is the formula of the ion that causes a solution to be acidic? (1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is the formula of the ion that causes a solution to be alkaline? (1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Qr code

Description automatically generatedWhat is the name of the reaction between an acid and an alkali? (1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Why can strong acids be strong even when they are dilute? (2)

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Complete the table to show what effect acids and alkalis have on the following indicators.

|  |  |  |
| --- | --- | --- |
| Indicator | Acid | Alkali |
| Litmus |  |  |
| Methyl orange |  |  |
| phenolphthalein |  |  |

Qr code

Description automatically generatedIn an experiment to see how pH changes during neutralisation calcium hydroxide powder is added 1 g at a time to 50 cm3 hydrochloric acid. Phenolphthalein is used as the indicator. State what the colour at the start of the experiment and then at the end of the experiment after all the acid has reacted and there is an excess of calcium hydroxide.

Start: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ End: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (1)

Explain how and why the pH changes during this experiment (3)

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Qr code

Description automatically generatedExplain in terms of the particles present why the pH increases during an experiment where sodium hydroxide is steadily added from a burette to 25 cm3 of hydrochloric acid. (3)

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Qr code

Description automatically generatedOne of the core practical experiments was to slowly add calcium hydroxide to hydrochloric acid and monitor the pH. It is possible to monitor the pH with universal indicator paper. Describe how this could be done. (2)

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Qr code

Description automatically generatedMethyl orange is also an indicator. Why would this not be used to monitor the pH? (2)

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Qr code

Description automatically generated**pH**

1 cm3 of acid with a pH of 2 is made up to 1 dm3 with water. What is the pH of the new solution? (2)

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Qr code

Description automatically generatedIf the hydrogen ion concentration of a solution increases by a factor of 10 what effect does it have on the pH? (1)

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Qr code

Description automatically generated

What’s the most accurate way of measuring pH of a solution? (1)

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Qr code

Description automatically generated

Other than universal indicator, give another way of measuring the pH of a solution? (1)

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Qr code

Description automatically generatedWhat’s the most accurate way of measuring 25 cm3 of acid?

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Qr code

Description automatically generatedWhat is the difference in hydrogen ion concentration between 2 solutions if one has a pH of 3.2 and the other 5.2?

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Qr code

Description automatically generated

During neutralisation an acid changes pH from 1 to 6. How many times different is the concentration of hydrogen ions from before to after neutralisation? (1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Four solids are in no particular order: Copper (II) sulfate, Copper (II) carbonate, Copper (II) chloride, Copper (II) oxide

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | A | B | C | D |
| Colour of solid | Blue/green | Blue | Green | Black |
| Observation of solid added to water | Blue/green solution is formed | Blue solution is formed. | Green solid remains | Black solid remains |
| Products of electrolysis of solid added to water using carbon electrodes | Copper plated at cathode and chlorine produced at anode. | Copper plated at cathode and oxygen produced at anode | No reaction | No reaction |
| Reaction with dilute sulfuric acid | Solid dissolves to form blue solution. | No reaction | Effervescence and solid dissolves to form blue solution. | Solid dissolves to form blue solution. |

Qr code

Description automatically generatedUse the information in the table to identify each solid A, B, C and D. Explain how the information supports your conclusion. (6)

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Qr code

Description automatically generatedWhat’s a test for oxygen? (2)

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Qr code

Description automatically generatedWhat’s a test for carbon dioxide? (2)

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**Salt production**

Qr code

Description automatically generatedIn an attempt to produce pure dry crystals of copper sulfate a student adds sulfuric acid to copper carbonate (s). Quickly the copper carbonate completely dissolves. Why would it be very unlikely that the resultant solution would contain pure copper sulfate? (1)

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How can a pure dry sample of copper sulfate crystals be obtained from copper oxide and sulfuric acid? (4)

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How can a pure dry sample of copper sulfate crystals be obtained from copper carbonate and sulfuric acid? (4)

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Qr code

Description automatically generatedHow can a pure dry sample of potassium chloride crystals be obtained from potassium hydroxide and hydrochloric acid? (4)

KOH (aq) + HCl (aq) 🡪 KCl (aq) + H2O (l)

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To understand how much hydrochloric acid that is needed to completely neutralise sodium hydroxide it is added 1 drop at a time until phenolphthalein indicator changes from pink to colourless. At this point the solution is exactly neutral as neither reactant is in excess. Why is a student incorrect to think that a pure dry sample of sodium chloride can be obtained from this mixture? (1)

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Qr code

Description automatically generatedWhat is the formula of the salt produced when aluminium oxide (Al2O3) reacts with hydrochloric acid (HCl) (1)

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

What colours are:

1. Qr code

   Description automatically generatedMethyl orange
2. Phenolphthalein
3. Litmus

in acid and alkali?

|  |  |  |
| --- | --- | --- |
|  | Acid | Alkali |
| Methyl orange |  |  |
| Phenolphthalein |  |  |
| Litmus |  |  |

Qr code

Description automatically generated

Sulfuric acid is a strong acid and citric acid is a weak acid. Explain the difference between a strong and a weak acid. (2)

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Qr code

Description automatically generated

What is a precipitate? (1)

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Qr code

Description automatically generated**Ionic equations**

Write an ionic equation for the reaction of magnesium with hydrochloric acid. (3)

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Write an ionic equation for the reaction of calcium oxide with nitric acid. (3)

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Qr code

Description automatically generated**Metal extraction**

Iron can be produced in the thermite reaction by reacting iron (III) oxide with aluminium. This displacement reaction could be also described as a REDOX reaction. Explain, in terms of electrons, which particles have been oxidised and which particles have been reduced.

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Qr code

Description automatically generatedThe table below shows whether metals and salt solutions react or not. Draw a labelled diagram of the apparatus used for the reaction and explain how you can use the results to work out the order of reactivity of the metals. (3)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Copper sulfate | Zinc sulfate | Magnesium sulfate |
| Copper | X | X | X |
| Zinc | ✓ | X | X |
| Magnesium | ✓ | ✓ | X |

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Magnesium reacts with oxygen in the air to make magnesium oxide. What type of reaction is this an example of? (1)

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

Qr code

Description automatically generatedMetals are extracted from their ores. When this happens are the metal ores oxidised or reduced? (1)

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Qr code

Description automatically generatedWhy can aluminium not be extracted from its ore by heating with carbon? (2)

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Qr code

Description automatically generatedWhy is aluminium extracted from its ore using electrolysis and iron is extracted by heating with carbon? (3)

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Qr code

Description automatically generated

How can metals be sourced using phytoextraction? (2)

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Qr code

Description automatically generated

Give advantages of extracting metals by phytoextraction rather than from its ore. (2)

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Qr code

Description automatically generatedExplain how aluminium oxide can be reduced to produce aluminium. (2)

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Qr code

Description automatically generatedGive 2 disadvantages of phytoextraction as a way of extracting metals from the environment. (2)

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Qr code

Description automatically generatedDraw and label apparatus that could be used to extract copper from copper oxide in the laboratory. (2)

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Qr code

Description automatically generatedCopper oxide can be extracted from its ore by displacement with carbon. Use electrons to explain how this can be classified as a redox reaction. (3)

2CuO + C 🡪 2Cu + CO2

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Look at the observations of different metals reactions with sulfuric acid and place the metals in order of reactivity

1. Bubbles quickly and the test tube gets hot
2. No reaction
3. A very vigorous reaction is observed with gas rapidly being produced and the test tube gets very hot.
4. Qr code

   Description automatically generatedExtremely small bubbles can be seen slowly appearing on the surface of the metal.
5. No reaction initially observed but on revisiting 1 hour later very small bubbles were observed on the metal.
6. Bubbles form slowly on the surface of the metal and rise to the surface of the acid.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Most reactive |  |  |  |  |  |  | Least reactive |

Qr code

Description automatically generatedWhen lead reacts with sulfuric acid you initially see some bubbles but the surface of the lead turns white and the reaction stops despite their still being lead and sulfuric acid left in the test tube. Explain why the reaction stops. (2)

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**Electrolysis**

Qr code

Description automatically generatedExplain why calcium chloride in water would undergo electrolysis whereas calcium carbonate will not?

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What are the products of the electrolysis of molten lead bromide (1)

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Qr code

Description automatically generated

What are the products of the electrolysis of molten sodium chloride (1)

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Qr code

Description automatically generated

Sodium chloride and water will undergo electrolysis but silver chloride and water will not. Explain the difference. (2)

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Qr code

Description automatically generated

What are the products of the electrolysis of molten aluminium oxide? (1)

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Qr code

Description automatically generated

Why does molten lead bromide undergo electrolysis? (2)

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Qr code

Description automatically generated

Write a half equation for the formation of hydrogen gas from hydrogen ions. (2)

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Qr code

Description automatically generatedWrite the half equation for the formation of chlorine from chloride ions. (2)

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Qr code

Description automatically generatedWhat is a test for oxygen gas? (2)

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Qr code

Description automatically generated

Explain how hydrogen is produced when water is electrolysed. (2)

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Qr code

Description automatically generated

Write a half equation for the formation of copper from copper (II) ions. (2)

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Qr code

Description automatically generatedDraw a labelled diagram showing the apparatus required for the electrolysis of copper sulfate (aq) using carbon electrodes. (2)

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Qr code

Description automatically generatedDraw a labelled diagram showing the apparatus required for the electrolysis of copper sulfate (aq) using copper electrodes. (2)

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Qr code

Description automatically generatedCopper sulfate (s) and Copper sulfate (aq) were tested with a circuit containing a light bulb to investigate whether electricity can pass through them. What result would you expect and explain these results. (3)

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| --- | --- |
| Result |  |
| Explanation |  |
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Qr code

Description automatically generated

When the electrolysis of copper sulfate solution takes place using copper electrodes we would expect the mass of the electrodes to change. What change in mass would you expect and use half equations to explain your answer. (4)

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Qr code

Description automatically generatedWhen the electrolysis of copper sulfate solution takes place using carbon electrodes. What change in mass of electrodes would you expect and use half equations to explain your answer. (4)

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Qr code

Description automatically generated

When copper sulfate (aq) is electrolysed using copper electrodes what observations would you make?

|  |  |
| --- | --- |
|  | Observation |
| Anode |  |
| Cathode |  |
| Electrolyte |  |

Qr code

Description automatically generatedCopper is extracted from its ore by displacement with carbon. Why is it further processed with an electrolytic process? (1)

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Qr code

Description automatically generatedElectrolysis is often used to split compounds apart. Why is it important that inert electrodes are used? (1)

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Qr code

Description automatically generated**Reversible reactions**

What is the definition of, **dynamic equilibrium**? (1)

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Qr code

Description automatically generatedA student states you can tell that a reversible reaction is in a state of dynamic equilibrium when the concentrations of the reactants and products are equal. Explain why they are incorrect in saying this (1)

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Qr code

Description automatically generated

What is the name of the process used in industry to produce ammonia? (1)

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Qr code

Description automatically generated

How does a catalyst affect the rate of attainment of equilibrium? (1)

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Qr code

Description automatically generated

How does a catalyst affect the equilibrium yield of ammonia? (1)

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Qr code

Description automatically generated

Write a balanced symbol equation for the production of ammonia? (2)

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The following reaction is reversible.

[Co(H2O)6]2+ (aq) + 4Cl- (aq) ⇌ [CoCl4]2- (aq) + 6H2O (l)

[Co(H2O)6]2+ (aq) is pink solution

[CoCl4]2- (aq) is blue a blue solution

Cl- (aq) is hydrochloric acid and is colourless.

If left to reach dynamic equilibrium the solution is violet.

Qr code

Description automatically generatedStarting with three tubes of violet-coloured solution, keep one tube as a control, and place another tube in the hot water, you will observe it will turn blue. Put the third tube in the ice/water mixture and you will see it will turn pink. Following this, the tubes in the hot and cold water are swapped over and the pink and blue colours reverse to show the reaction is reversible.

Devise a different experiment to show that this is a reversible reaction.

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The following reaction is reversible.

[Co(H2O)6]2+ (aq) + 4Cl- (aq) ⇌ [CoCl4]2- (aq) + 6H2O (l)

[Co(H2O)6]2+ (aq) is pink solution

[CoCl4]2- (aq) is blue a blue solution

Qr code

Description automatically generatedCl- (aq) is hydrochloric acid and is colourless.

What would be the effect on the colour if you: (2)

1. Increase the concentration of the chloride ions: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Decrease the concentration of the chloride ions: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

In another reversible reaction a mixture of nitrogen dioxide (NO2) and dinitrogen tetroxide (N2O4) is left in a sealed container.

2NO2 ⇌ N2O4

Nitrogen dioxide (NO2) is brown and dinitrogen tetroxide (N2O4) is colourless.

A container left at a constant room temperature filled with these gases will reach a dynamic equilibrium and the colour is light brown.

Qr code

Description automatically generatedThe container is put in the fridge and the colour lightens from light brown to yellow. (Assume the pressure remains unchanged.)

Explain what you observe.

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In the production of nitric acid ammonia is first reacted with oxygen to form nitrogen oxide. The reaction is reversible.

4NH3(g) + 5O2(g) ⇌ 4NO(g) + 6H2O(g)

Qr code

Description automatically generatedThe energy change of the forward reaction is -904 kJ mol-1

Is the forward reaction exothermic or endothermic? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

If you were to maximise the yield of nitrogen oxide in this reversible reaction what conditions would you choose and why? (6)

|  |  |
| --- | --- |
| Condition | Reason |
| Excess oxygen or add water |  |
|  |
|  |
| Temperature of 900 oC or room temperature. |  |
|  |
|  |
|  |
|  |
| 7 atm pressure or atmospheric pressure. |  |
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Qr code

Description automatically generatedThe reaction of carbon with steam to make hydrogen and carbon dioxide is reversible. The forward reaction is endothermic.

C (s) + 2H2O (g) ⇌ 2H2 (g) + CO2 (g)

Explain the effect of increasing the temperature on the yield of the products. (2)

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Qr code

Description automatically generatedWhat is the definition of dynamic equilibrium? (1)

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Qr code

Description automatically generatedAlcohols can be dehydrated to form ethene and steam in the presence of a catalyst. The forward reaction is endothermic. Explain how the conditions should be changed to maximise the yield of ethene. (6)

C2H5OH (g) ⇌ C2H4 (g) + H2O (g)

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Paper 2 Questions

Qr code

Description automatically generated

**Fuel Cells**

Write a balanced symbol equation for the reaction that takes place in a fuel cell. (3)

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Qr code

Description automatically generatedIn fuel cells there are reactions at both the cathode and anode. At the cathode, hydrogen gas reacts to make hydrogen ions. At the anode, oxygen gas reacts with hydrogen ions to make water.

Write half equations for both the cathode and anode. (4)

|  |  |
| --- | --- |
| Cathode |  |
| Anode |  |

Evaluate the advantages and disadvantages of fuel cell buses, chemical cell buses and diesel buses (6)

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Qr code

Description automatically generated

**Groups of the periodic table**

What would you expect to observe when rubidium is added to water? (2)

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Qr code

Description automatically generatedExplain why lithium is less reactive than potassium. (3)

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Qr code

Description automatically generatedIn the table below you need to draw a line to link the named element to the correct melting point. (2).

|  |  |
| --- | --- |
| Sodium | -210 oC |
| Iron | 1538 oC |
| Carbon (diamond) | 98 oC |
| Bromine | 3600 oC |
| Nitrogen | 4027 oC |
| Carbon (graphite) | -7.2 oC |

Qr code

Description automatically generated

Both sodium and magnesium react with water. Give 2 similarities in the products produced. (2)

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Qr code

Description automatically generated

Why is sodium’s reaction with water more vigorous than magnesium’s reaction with water?

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Qr code

Description automatically generated

Hydrogen bromide solution is added to methyl orange. State what you would expect to see. (1)

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Qr code

Description automatically generated

Write a balanced symbol equation including state symbols for potassium reacting with water (4)

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Qr code

Description automatically generated

Explain why potassium burns when it hits the water whereas lithium bubbles. (2)

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Qr code

Description automatically generatedWhat would you observe when rubidium is added to water? (3)

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Qr code

Description automatically generated

Why is caesium more reactive than rubidium? (2)

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Qr code

Description automatically generated

What would you observe when chlorine water is added to sodium bromide solution? (2)

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Qr code

Description automatically generatedExplain what is oxidised in the reaction below: (2)

Cl2 + 2NaBr 🡪 2NaCl + Br2

|  |
| --- |
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Qr code

Description automatically generated

What is a test for chlorine? (2)

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Qr code

Description automatically generated

What would be the name of the solution formed when hydrogen fluoride is dissolved in water? (1)

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

Qr code

Description automatically generatedWhat would you expect to be the colour and state of astatine to be at room temperature? (2)

|  |  |
| --- | --- |
| Colour |  |
| State |  |

You are given solutions of potassium iodide (colourless solution), potassium bromide (colourless solution), chlorine, bromine (orange solution) and iodine (brown solution). Your task is to use the chemicals to determine the reactivity of the halogens. What experiments and what observations would you expect to make to determine that the reactivity decreases as the halogen group is descended? (6)

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Qr code

Description automatically generatedA student tests for chlorine with dry red litmus paper. Why does the test not work? (2)

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Qr code

Description automatically generatedWhen a solution of chlorine is added to colourless sodium bromide the solution turns brown. What causes the brown colour? (1)

Cl2 (aq) + 2NaI (aq) 🡪 I2 (aq) + 2NaCl (aq)

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Qr code

Description automatically generatedExplain what is oxidised in this reaction. (2)

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Qr code

Description automatically generated4 Halogens are: chlorine, iodine, fluorine and bromine. Give these halogens in order of increasing boiling point.

|  |  |
| --- | --- |
| Lowest boiling point  Highest boiling point | 1) |
| 2) |
| 2) |
| 4) |

Qr code

Description automatically generated2 students are arguing about which would be the most explosive reaction. One argues that it would be potassium with fluorine, whilst the other argues for rubidium with chlorine. Explain why it is difficult to be certain which of them is correct. (6)

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Qr code

Description automatically generatedExplain why fluorine is more reactive than bromine. (3)

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Qr code

Description automatically generatedChlorine water is added to sodium iodide solution. What do you observe? (1)

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The ionic equation for this reaction is:

Qr code

Description automatically generatedCl2 + 2I- 🡪 I2 + 2Cl-

Use this equation to state and explain what has been reduced. (2)

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Qr code

Description automatically generatedExplain why 18Ar is inert. (2)

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Qr code

Description automatically generated

Helium and Argon are both inert. Explain which you would use to fill a party balloon. (2)

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Qr code

Description automatically generated

Name a noble gas in period 2 of the periodic table. (1)

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Qr code

Description automatically generated**Energy Changes**

Draw an energy level diagram for an endothermic reaction. (3)

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Qr code

Description automatically generated

Explain in terms of bond making and breaking why a reaction might be endothermic. (3)

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Qr code

Description automatically generatedDraw an energy level diagram (including labelled axis) for an exothermic reaction and use it to explain why a reaction is exothermic (4). Also label the activation energy (1)

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Qr code

Description automatically generatedReactions involve both breaking bonds and making bonds. Us this to explain why some reactions are exothermic and some reactions are endothermic (2)

|  |  |
| --- | --- |
| Exothermic |  |
|  |
| Endothermic |  |
|  |

Qr code

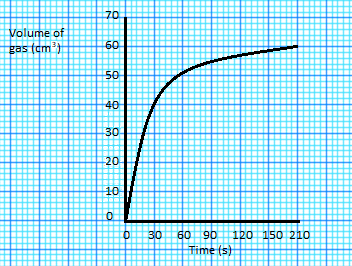
Description automatically generated**Rate of Reaction**

Calcium carbonate reacts with hydrochloric acid to make calcium chloride, carbon dioxide and water. Draw and label the apparatus you would use to monitor the rate of this reaction. (2)

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Qr code

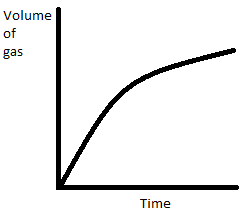
Description automatically generatedCalculate the rate of reaction for the start of this reaction. Include a unit for rate. (3)



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Look at the following rate of reaction graph.

Qr code

Description automatically generated

Using the graph explain how you know whether the reaction is complete or incomplete. (2)

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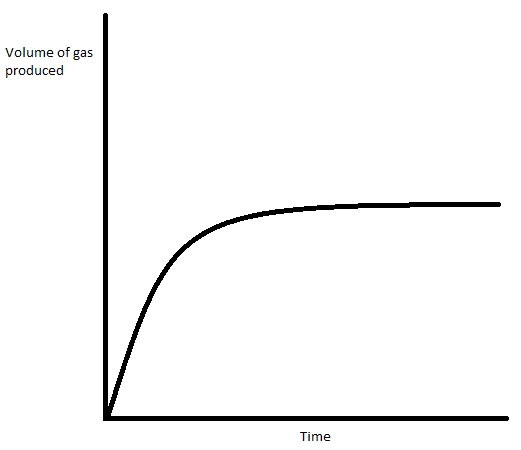
Qr code

Description automatically generatedA student is keen to measure the volume of gas given off in a reaction. What is the most accurate piece of equipment they could choose to measure the volume of gas produced? (1)

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

The graph below shows how quickly carbon dioxide is given off when 50 cm3 of 1 mol/dm3 hydrochloric acid is reacted with excess calcium carbonate powder.





The experiment was repeated on several occasions changing one variable each time. For each different experiment, sketch the likely curve of carbon dioxide produced on the original graph.

1. Exactly the same as the original experiment but with 50 cm3 of 2 mol/dm3 hydrochloric acid. Label this curve B. The calcium carbonate is still present in excess.
2. Exactly the same as the original experiment but 10 oC hotter. Label this curve C.
3. Exactly the same as the original experiment but using calcium carbonate lumps (bigger pieces). Label this curve D
4. Exactly the same as the original experiment but with a catalyst added. Label this curve E.

Explain in terms of the behaviour of particles how:

1. Qr code

   Description automatically generatedIncreasing concentration of a reactant.
2. Increasing the temperature.

Change the rate of reaction.(4)

|  |  |
| --- | --- |
| Increasing concentration |  |
|  |
|  |
| Increasing temperature |  |
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Qr code

Description automatically generated

Draw a diagram of the apparatus that could be used to monitor the rate of reaction between calcium carbonate and nitric acid by collecting the carbon dioxide gas produced. (2)

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The following procedure was used to investigate how temperature affects the rate of a reaction. Name a weakness in this method and suggest an improvement. (2)

1. Use a syringe and the measuring cylinders to put 4cm3 of potassium manganate (VII), 25cm3 dilute sulphuric acid and 100cm3 of water into a beaker. Be careful here, the potassium manganite (VII) will stain your clothes.

2. Warm the beaker in the water bath until the temperature of the liquid is at 50⁰C. Whilst you are waiting for that to heat up to the correct temperature, fill a test tube up to the brim with glucose solution and place it in the rack until needed.

3. Place the beaker on the white tile and note down its exact temperature in the results table.

4. Take the beaker out of the water bath. Pour the glucose into the beaker and start the clock. Time how long it takes for the purple colour to disappear (in seconds) and write the results down in the results table.

5. Repeat the experiment at the following temperatures(REMEMBERING TO WASH THE BEAKER THOROUGHLY, AND USING **EXACTLY** THE SAME QUANITITIES OF REACTANTS): 45⁰C, 40⁰C, 35⁰C, 30⁰C.

|  |  |
| --- | --- |
| Weakness |  |
| Improvement |  |
|  |

Qr code

Description automatically generatedQr code

Description automatically generated

The temperature is the variable that is being changed in this reaction. Name 2 variables that need to be controlled. (2)

|  |  |
| --- | --- |
| 1 |  |
| 2 |  |

Qr code

Description automatically generatedCalculate the rate of reaction at 60 seconds for the experiment in the graph below. Include a unit for rate. (3)

Chart

Description automatically generated

|  |
| --- |
|  |

Qr code

Description automatically generated

10 g calcium carbonate was reacted with 50 cm3 acid in 2 experiments. The first one used large lumps of calcium carbonate and the second small lumps of calcium carbonate. Explain which reaction had the faster rate. (3)

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5g calcium carbonate pieces size A and 5g calcium carbonate pieces size B were both added to 50 cm3, 1 mol dm-3 nitric acid. The volume of carbon dioxide produced was collected in a gas syringe. Using the results below state what conclusion you can make about the size of calcium carbonate pieces A and B. (1)

|  |  |
| --- | --- |
| Calcium carbonate pieces | Volume of carbon dioxide produced in 2 minutes (cm3) |
| A | 24 |
| B | 116 |

|  |
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Qr code

Description automatically generated

Calculate the average rate of both reactions in cm3 s-1? (3)

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| --- |
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Qr code

Description automatically generatedWhy does increasing the temperature speed up the rate of a chemical reaction? (3)

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Qr code

Description automatically generatedThe rate of the reaction between sodium thiosulfate and different concentrations of hydrochloric acid was investigated in a core practical. As the reaction progressed the mixture turned cloudy. Why did this happen? (2)

2HCl(aq)  +  Na2S2O3(aq)  →        2NaCl(aq)    +      SO2(g)    +   S(s)  +  H2O(l)

|  |
| --- |
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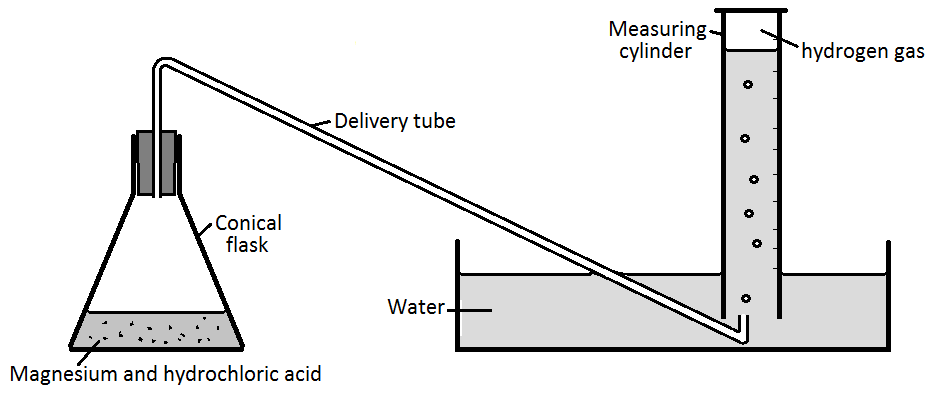
Qr code

Description automatically generatedHow was the rate of reaction measured in this core practical? (2)

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The rate of reaction between magnesium and hydrochloric acid was investigated with this apparatus:

Qr code

Description automatically generated

What would be more accurate equipment for measuring the rate of production of hydrogen gas?

|  |  |
| --- | --- |
| Apparatus used |  |
| Reason |  |
|  |

The volume of gas given off every 30 s when magnesium reacts with hydrochloric acid is shown in the graph below. Calculate the rate of production of hydrogen over the first 150 seconds, in cm3 s-1. (3)

Qr code

Description automatically generated

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Qr code

Description automatically generatedLook at the experimental data above and explain if the reaction has stopped. (2)

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Qr code

Description automatically generatedWhy does increasing the concentration of a reactant speed up the rate of reaction? (2)

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| --- |
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Qr code

Description automatically generatedGive 4 methods of speeding up the rate of a chemical reaction. (2)

|  |  |
| --- | --- |
|  | Speed up rate of reaction |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |

Qr code

Description automatically generatedWhat would you see if effervescence was observed?

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Qr code

Description automatically generatedWhat are catalysts? Name some examples and use bond energy diagrams to explain why catalysts speed up the rate of a chemical reaction. (6)

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Qr code

Description automatically generated**Atmosphere**

The Earth’s first atmosphere contained large amounts of water. Explain why this changed to what it has in today’s atmosphere (2)

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Qr code

Description automatically generated

Name a gas not present in the first atmosphere and explain why it is now present. (2)

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Explain currently what causes the percentage of carbon dioxide in the Earth’s atmosphere vary? (4)

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Qr code

Description automatically generated

Explain how humans are causing global warming through their dependence on crude oil. (3)

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Qr code

Description automatically generated

4 gases in the air are: carbon dioxide, oxygen, nitrogen and argon.

Put them in order from the most common to the least common.

|  |  |
| --- | --- |
| Most common  Least common | 1) |
| 2) |
| 3) |
| 4) |

A class tried to work out the percentage of oxygen in the atmosphere with the following apparatus:

Diagram

Description automatically generated

Two gas syringes were connected with a piece of glass tubing that contained copper turnings. One gas syringe was filled to exactly 50 cm3 with air from the room and the other was left empty. The copper turnings were then heated and the air from the syringe was passed over them and into the other syringe. This process was repeated for several minutes.

Qr code

Description automatically generated

After the tubes had cooled down, did the volume of gas go up, down or stay the same? Explain your answer.

|  |  |
| --- | --- |
| Up/down/same |  |
| Explanation |  |
|  |
|  |
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Qr code

Description automatically generated

At the start of the experiment the gas syringes contained 50 cm3 of air. Given the air is 20% oxygen calculate the volume of gas you would expect at the end of the experiment. (2)

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Qr code

Description automatically generatedExplain why the amount of oxygen in the Earth’s early atmosphere increase as time passed by? (2)

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An experiment was carried out to determine the mass of iron oxide formed when iron wool reacts with oxygen in the air.

Qr code

Description automatically generatedThis is the method used.

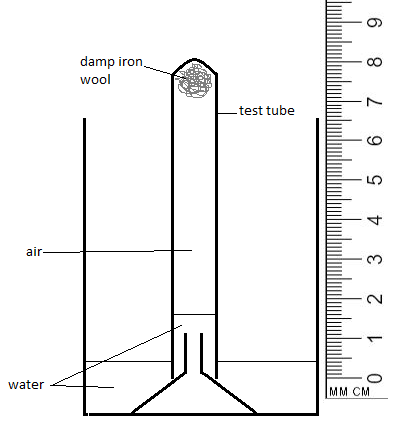
* Weigh crucible and lid
* Add iron wool then weigh the iron, crucible and lid.
* Heat for 10 minutes with a roaring Bunsen flame slightly lifting the lid occasionally.
* Let crucible cool and weigh.

What would the student do next to determine whether all the iron has reacted with oxygen? (1)

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A class sets up apparatus to deduce the amount of oxygen in air. The experiment was left for a week and it looked like this:

Qr code

Description automatically generated

Why has the water risen up the test tube? (2)

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|  |

Qr code

Description automatically generatedThis experiment could be made much more accurate. Which piece of equipment would you change and what would you replace it with? (2)

|  |  |
| --- | --- |
| Equipment changed | Replacement equipment |
|  |  |

Qr code

Description automatically generatedUse the results shown in the diagram to calculate the percentage of oxygen in air. At the start of the week there was no water in the upturned test tube, only air. (2)

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Qr code

Description automatically generated**Crude Oil**

Name the process that is used to: 1) separate crude oil. 2) break long chain hydrocarbons. (2)

|  |  |
| --- | --- |
| Separate crude oil |  |
| Break long chain alkanes |  |

Qr code

Description automatically generated

What is a hydrocarbon? (2)

|  |
| --- |
|  |
|  |

Qr code

Description automatically generatedHow would you describe crude oil? (1)

|  |
| --- |
|  |

Qr code

Description automatically generatedState a use of kerosene and bitumen. (2)

|  |  |
| --- | --- |
| Kerosene |  |
| Bitumen |  |

Qr code

Description automatically generated

How are the properties of kerosene different to bitumen? (2)

|  |
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Qr code

Description automatically generatedHow are the fractions obtained at the top of the industrial distillation column different from the fractions obtained at the bottom of the column? (3)

|  |
| --- |
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Qr code

Description automatically generatedWhy would you crack long chain hydrocarbons? (2)

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Qr code

Description automatically generated

Complete the following equation for cracking. (1)

C11H24 → C8H18 + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Qr code

Description automatically generatedIn another cracking experiment 1 mole of C16H34 is cracked to produce 1 mole of C9H20, 1 mole of propene and 2 moles of ethene. Write a balanced symbol equation for this reaction. (2)

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Qr code

Description automatically generated

Write a balanced symbol equation for the complete combustion of propene. (3)

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Qr code

Description automatically generated

An impure hydrocarbon is burnt, the gaseous products were first cooled then tested with litmus solution and limewater. What observations would be made? (3)

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Qr code

Description automatically generated

Catalytic convertors were introduced in the 1990s. Their introduction reduced the nitrogen oxides in a car’s exhaust emissions. What effect did this have on the environment? (1)

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Qr code

Description automatically generatedAfter the year 2000 the government, for a period of time, promoted the use of diesel cars as they produce less carbon dioxide than petrol cars. However diesel is less flammable than petrol so not all the diesel completely combusts, cities such as London are now taking measures to limit these vehicles on the road. The reason is not that they give off extra carbon monoxide.

What benefit to the environment did the government see in promoting diesel cars? (1)

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

Explain what environmental problem diesel cars are causing in cities (2)

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Qr code

Description automatically generated

How can carbon monoxide be formed during the combustion of hydrocarbon molecules? (1)

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Qr code

Description automatically generatedWhy is carbon monoxide toxic? (2)

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Qr code

Description automatically generatedDomestic gas boilers use methane as a fuel. On a cold day what is likely to be observed where the waste gases are vented from the property? (1)

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Data for the emissions of 2 cars, 1 petrol and 1 diesel, is shown below:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Car | Carbon dioxide (gkm-1) | Carbon monoxide (gkm-1) | Nitrogen oxides (gkm-1) | Unburnt hydrocarbons (gkm-1) | Particulate matter (gkm-1) |
| Petrol | 212 | 0.314 | 0.032 | 0.073 | 0.0006 |
| Diesel | 132 | 0.258 | 0.135 | 0.021 | 0.3 |

Qr code

Description automatically generated

Give 2 reasons why are diesel cars thought to be worse for the environment? (2)

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| --- | --- |
| 1 |  |
|  |
| 2 |  |
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Qr code

Description automatically generated15 years ago it was thought petrol cars were worse for the environment. Use the data in the table above to explain why this was the case.

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Qr code

Description automatically generated

**Homologous Series**

What is the general formula for the alkane homologous series? (1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Qr code

Description automatically generatedGive 3 reasons why 2 molecules might be in the same homologous series. (3)

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Qr code

Description automatically generatedLooking at the formula of 2 alkenes below explain why they are in the same homologous series. (2)



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Qr code

Description automatically generated

What do methane, ethane, propane and butane have in common? (3)

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Qr code

Description automatically generated

Why are the alkenes described as unsaturated hydrocarbons (2)

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Core Practical

2.11 *Investigate the composition of inks using simple distillation and paper chromatography*

Draw and label the apparatus for chromatography and simple distillation

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Why is it important to draw the lines and write labels on the chromatography paper in pencil and not in ink?

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Why should the spots of ink be above the level of the solvent in the beaker?

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What is meant by the term ‘solvent front’?

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What would happen if you used permanent ink instead of water soluble ink?

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Which is the mobile phase?

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Which is the stationary phase?

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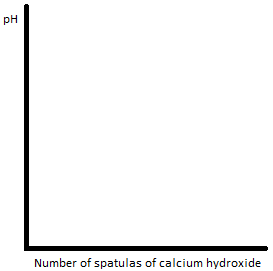
Explain how simple distillation works.

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3.6 *Investigate the change in pH on adding powdered calcium hydroxide or calcium oxide to a fixed volume of dilute hydrochloric acid*

You are going to react 50 cm3 of hydrochloric acid (1 M) with calcium hydroxide monitoring the pH as you add each spatula of calcium hydroxide?

What would you expect the graph of pH versus the quantity of calcium hydroxide to look like?



What volume of hydrochloric acid are you using? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is the best piece of apparatus to measure the volume of hydrochloric acid?

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Why is that the best piece of apparatus?

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Why is it necessary to stir the mixture when the calcium hydroxide powder is added?

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What are the risks in this practical?

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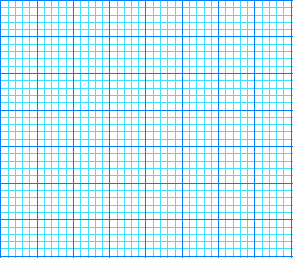
Suggest how to manage these risks

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A sample set of results is shown, process and calculate the average.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of spatulas of calcium hydroxide | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| pH | Experiment 1 | 2 | 2 | 1 | 2 | 12 | 12 | 12 | 12 |
| Experiment 2 | 2 | 2 | 2 | 2 | 2 | 12 | 12 | 12 |
| Experiment 3 | 2 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Average |  |  |  |  |  |  |  |  |

Plot a graph of the results.



What are the main errors in this experiment?

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How could you improve the method?

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How do you know when the hydrochloric acid is exactly neutralised?

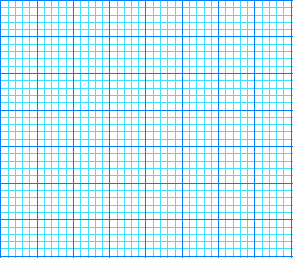
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Plot a graph of pH against mass of calcium hydroxide added to hydrochloric acid. Draw a line of best fit. (3)

|  |  |
| --- | --- |
| Mass of calcium hydroxide (g) | pH of mixture |
| 0 | 1 |
| 0.25 | 1 |
| 0.5 | 1 |
| 0.75 | 6 |
| 1 | 11 |
| 1.25 | 12 |
| 1.5 | 12 |

Qr code

Description automatically generated



3.17 *Investigate the preparation of pure, dry hydrated copper sulfate crystals starting from copper oxide including the use of a water bath*

Use copper(II) oxide and sulfuric acid to prepare a pure sample of the soluble salt. Copper(II) oxide is insoluble.

What salt is produced and write a word equation for the reaction.

|  |  |
| --- | --- |
| Salt produced |  |
| Symbol equation |  |

Write a method for this experiment.

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Why was it necessary to warm the sulfuric acid in a water bath?

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Why is it essential to use an excess of copper(II) oxide?

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What does excess mean? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

How is the excess copper oxide removed? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What observations can you make of this reaction?

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What is left after the excess copper oxide has been removed? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

How do you now get just the salt?

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What is the filtrate in this experiment? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is the residue in this experiment? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What safety precautions should you take when carrying out this experiment and why?

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3.31 *Investigate the electrolysis of copper sulfate solution with inert electrodes and copper electrodes*

This experiment will catch loads of students out!!!!! These are 2 different things.

Experiment 1 – Electrolysis with inert electrodes.

Draw a labelled diagram.

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What are the products?

|  |  |
| --- | --- |
| Anode |  |
| Cathode |  |

Write anode and cathode half equations.

|  |  |
| --- | --- |
| Anode half equation |  |
| Cathode half equation |  |

Experiment 1 – Electrolysis with copper electrodes.

Draw a labelled diagram.

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What happens at the:

|  |  |
| --- | --- |
| Anode? |  |
| Cathode? |  |

Write anode and cathode half equations.

|  |  |
| --- | --- |
| Anode half equation |  |
| Cathode half equation |  |

Qr code

Description automatically generated

A core practical involves electrolysing copper sulfate with copper electrodes. Draw a labelled diagram to show the apparatus that could be used. (2)

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Qr code

Description automatically generatedTo accurately measure the mass change of copper electrodes in the electrolysis of copper sulfate the electrodes first need to be prepared. Explain what should be done to prepare the electrodes. (2)

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Qr code

Description automatically generatedExplain the mass change that takes place at the anode and cathode when copper sulfate is electrolysed using copper electrodes. (4)

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Qr code

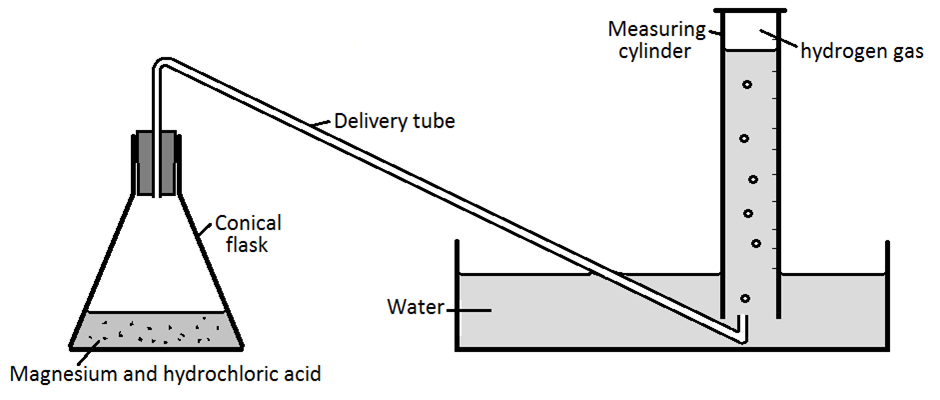
Description automatically generatedWhen copper sulfate solution is electrolysed for 4 minutes the mass of the anode decreased by 0.16 g. In another experiment also lasting 4 minutes the decrease in mass was 0.32 g. Explain what change was made to the procedure to bring about this change in results. (2)

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7.1 *Investigate the effects of changing the conditions of a reaction on the rates of chemical reactions by:*

*a measuring the production of a gas (in the reaction between hydrochloric acid and marble chips)*

If we were planning to monitor how changing the concentration of acid changed the rate of reaction using this apparatus there would be a number of variables that we would have to control. What are these variables, why do we need to control them and how will they be controlled?

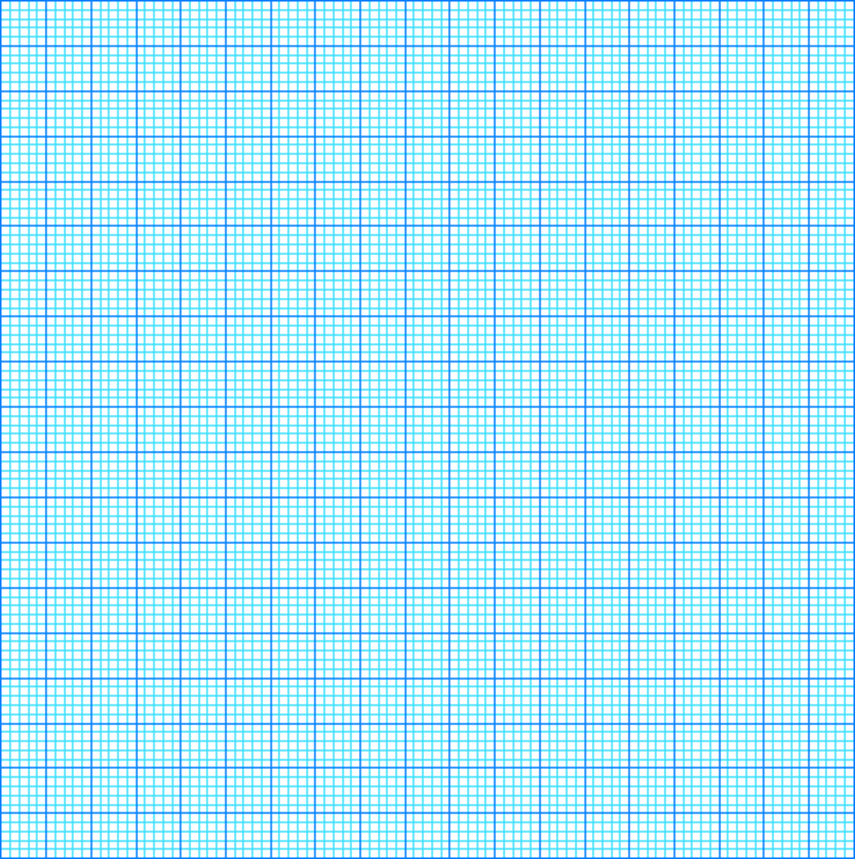


|  |  |  |
| --- | --- | --- |
| Variable | How is it controlled | Why does it need to be controlled |
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What are the strengths and weaknesses of this apparatus? How would you improve the weaknesses?

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Assume the acid is in excess. Sketch a likely graph that you would expect with this experiment.



*b observing a colour change (in the reaction between sodium thiosulfate and hydrochloric acid)*

Hydrochloric acid + sodium thiosulfate → sodium chloride + sulfur dioxide + sulfur + water.  
2HCl(aq)  +  Na2S2O3(aq)  →        2NaCl(aq)    +      SO2(g)    +   S(s)  +  H2O(l)

How will you monitor the rate of this reaction?

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Draw a diagram of the apparatus.

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Plot a graph of the experimental data below:

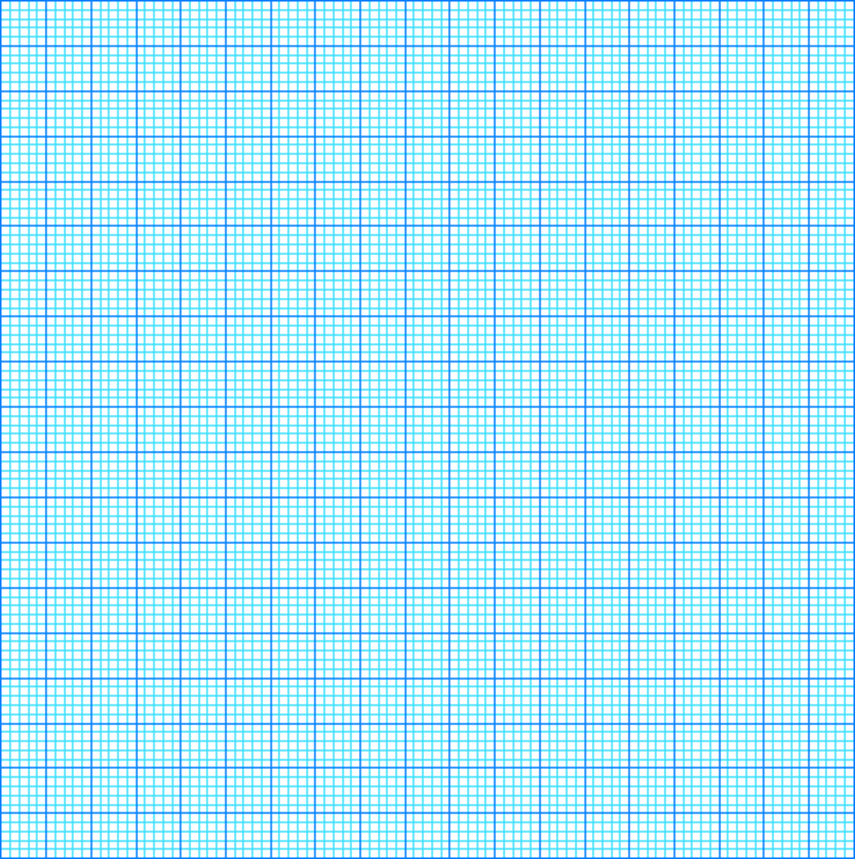
|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Temperature oC | 22 | 25 | 30 | 35 | 40 | 45 | 50 | 55 |
| Time (s) | 67 | 45 | 35 | 23 | 29 | 12 | 10 | 5 |

Which goes on the x axis?

Does the temperature axis have to start at zero?

Remember – use a sharp pencil

Remember – if it’s possible to double an axis size you should do so.



**Essential Knowledge Questions**

**Learn the answers to each of these:**

|  |  |  |
| --- | --- | --- |
|  | **Question** | **Answer** |
| 1 | What is an atom? | The smallest particle that has the properties of a chemical element. |
| 2 | Describe the structure of an atom. | A nucleus containing protons and neutrons, surrounded by electrons in shells. |
| 3 | What are the relative charges and masses of protons, neutrons and electrons. | Protons: mass 1, charge +1  Neutrons: mass 1, charge 0  Electrons: mass almost zero, charge -1. |
| 4 | Why do atoms contain the same number of protons and electrons? | Atoms are neutrally charged so they must have the same number of positive particles (protons) as negative particles (electrons) |
| 5 | How would you describe the size of the nucleus relative to the rest of the atom? | Very small |
| 6 | Where is most of the mass of the atom found? | In the nucleus. |
| 7 | What is the mass number of an element? | The total number of protons and neutrons. |
| 8 | What is the atomic number of an element? | The number of protons. |
| 9 | The number of which particle is unique to an element and gives it its identity? | Protons |
| 10 | If an atom contains 12 protons, how many electrons will it have? | 12. |
| 11 | If an atom has a mass number of 23 and an atomic number of 11, how many protons, neutrons and electrons does it contain? | 11 protons  11 electrons  23-11 = 12 neutrons |
| 12 | What is an isotope? | Two or more atoms of the same element (the same number of protons) but with a different number of neutrons. |
| 13 | What is the relative atomic mass, (Ar)? | The relative mass of an atom compared to the one twelfth mass of an atom of carbon-12. |
| 14 | Why do some elements have a relative atomic mass that is not a whole number. | The relative atomic mass is an average mass of all the isotopes that make up the element. |
| 15 | What is the formula for calculating relative atomic mass of an element from the relative mass and abundance of its isotopes? |  |
| 16 | How did Mendeleev arrange the elements known at the time into a periodic table? | By using the mass number and the properties of the elements and the properties of their compounds of the elements. |
| 17 | How did Mendeleev use his table? | To predict the existence and properties of some elements that were still to be discovered. |
| 18 | Why does Mendeleev’s method of organising elements in order of increasing atomic mass not always work? | The relative abundancies of some elements isotopes means they can be placed in the wrong place. |
| 19 | How are elements in the modern periodic table arranged? | In order of increasing atomic number in rows called periods and elements with similar properties are placed in the same vertical columns called groups. |
| 20 | Where are the non-metals found in the periodic table? | At the top on the right hand side. |
| 21 | What do all elements in the same row of the periodic table have in common? | They have the same number of shells of electrons. |
| 22 | What do all elements in the same column of the periodic table have in common? | They have the same number of electrons in their outer shell (and therefore have similar chemical properties). |
| 23 | What is an ion? | A charged atom or group of atoms. |
| 24 | Describe how an ionic bond is formed. | A metal loses electron(s) to a non-metal. This results in the metal becoming a positively charged ion (cation) and the non-metal a negatively charged ion (anion). These oppositely charged ions then attract. |
| 25 | Is a cation positively or negatively charged? | Positive |
| 26 | Is a anion positively or negatively charged? | Negative |
| 27 | What charge do the ions have when formed from elements in group:   1. 1 2. 2 3. 6 4. 7 | 1. + 2. 2+ 3. 2- 4. - |
| 28 | What do the compound endings:   1. ide 2. ate   mean? | 1. ide – a compound of only the named substances 2. ate – a compound of the named substances and oxygen |
| 29 | What is the formula of the compounds formed from:   1. Mg2+ and Cl- 2. Na+ and O2-? | 1. MgCl2 2. Na2O |
| 30 | Describe the structure of ionic substances. | Ionic substances are a regular arrangement of oppositely charged ions held together in a lattice structure by strong electrostatic forces. |
| 31 | How many electrons does Mg2+ have? Mg has an atomic number of 12 | 10 |
| 32 | Describe what happens in covalent bonding? | Two non-metals overlap their outer electron shells and share at least one pair of electrons. |
| 33 | What does covalent bonding result in the formation of? | molecules |
| 34 | Name and explain two physical properties of ionic compounds. | 1. They have high melting and boiling points because there are strong electrostatic forces holding the oppositely charged ions in place, therefore a lot of energy is needed to separate the ions. 2. They can conduct electricity when molten or in aqueous solution (dissolved in water) because the ions are free to move and carry their charge. |
| 35 | Name and explain two physical properties of covalent, simple molecular compounds. | 1. They have low melting and boiling points because there are weak intermolecular forces of attraction between molecules. 2. They do not conduct electricity because the molecules are not charged. |
| 36 | Describe the structures of:   1. Diamond 2. Graphite | 1. Each carbon atom is held in place by 4 strong covalent bonds to other carbon atoms. This arrangement is replicated throughout the whole structure creating a giant structure. 2. Each carbon atom is held in place by 3 strong covalent bonds. This creates flat layers of carbon atoms which stack on top of each other. The unused outer electron on each carbon atom sits between these layers and is delocalised (free to move). |
| 37 | Why is diamond used in cutting tools? | Diamond is very hard because all the carbon atoms are joined by 4 strong covalent bonds. |
| 38 | Why does diamond have such a high melting point? | In diamond each carbon atom is held in place by 4 strong covalent bonds and it takes a lot of energy to break these bonds. |
| 39 | Why does graphite conduct electricity? | In graphite each carbon forms 3 bonds, this leaves one electron left over from each carbon atom which sits between the graphite layers and is free to move and carry a charge. |
| 40 | Why can graphite act as a lubricant? | The layers of carbon atoms in graphite are only very weakly joined and are therefore free to slide past each other. |
| 41 | What are fullerenes? Explain its properties in terms of its structure and bonding. | C60 is one example where 60 carbons bond together covalently making a structure that looks like a football. These are simple molecules and behave as such. It is possible to ‘dope ‘ the C60 with metal atoms and it then becomes a superconductor. |
| 42 | What is graphene? Explain its properties in terms of its structure and bonding. | Graphene is like graphite, just 1 layer thick. It therefore conducts electricity and for its thickness is very strong. |
| 43 | Describe polythene’s structure | Polythene is an example of a polymer. It is a large molecule containing chains of carbon atoms surrounded by hydrogen. |
| 44 | Describe the bonding in metals? | All metals form positive ions and their outer electrons are delocalised and sit between the metal ions (forming a ‘sea of electrons’). |
| 45 | Why do metals conduct electricity? | There are free electrons in the metallic structure that can move. |
| 46 | Why are metals malleable? | They bend because the ions can slide over one another. |
| 47 | Why is it difficult to represent models of compounds on paper? | Compounds are normally 3 dimensional and contain different sized atoms. This can give them particular shapes that are hard to draw clearly in 2 dimensions (on paper). |
| 48 | What are the properties of most metals? | Shiny solid, high melting points, high density and good conductors of electricity. |
| 49 | What is an empirical formula? | The simplest ratio of the elements in a compound. |
| 50 | What is the law of conservation of mass? | During any chemical reaction no particles are created or destroyed. So the overall mass of the reactants must equal the mass of the products. |
| 51 | What unit do we use for concentration? | g dm-3 (grams per decimetre cubed) |
| 52 | What is 1 mole of particles? | The Avogadro constant (6.02 x 1023 particles). |
| 53 | What is the formula to calculate moles? | Moles = Mass/Relative formula mass |
| 54 | What are the 3 states of matter? | Solid, liquid and gas |
| 55 | Name the interconversion between the:   1. Solid to the liquid state 2. Liquid to the gaseous state 3. gaseous state to the liquid state 4. Liquid to the solid state | 1. Melting 2. Evaporating (or if heated to boiling point – Boiling) 3. Condensing 4. Freezing |
| 56 | Describe how the particles arrangement, movement and energy changes during melting. | The particles energy increases on heating causing the vibrations between particles to increase to an extent that they break free from their regular arrangement and start moving over one another. |
| 57 | Describe how the particles arrangement, movement and energy changes during condensing. | The particles energy decreases on cooling causing the particles to slow down and become attracted to other particles. |
| 58 | What is the difference between a pure substance and a mixture? | A pure substance is made of just one thing whereas a mixture is made of more than one substance which are not chemically joined. |
| 59 | What type of mixtures can be separated by each of these techniques?   1. Simple distillation 2. Fractional distillation 3. Filtration 4. Crystallisation 5. Paper chromatography | 1. A dissolved solid where you want to keep the liquid or 2 liquids with very different boiling points. 2. A large sample of a mixture of liquids with similar boiling points 3. An insoluble solid and a liquid. 4. A dissolved solid where you do not want the liquid. 5. A small sample of a mixture of liquids. |
| 60 | What is Chromatography? | A separating technique used to separate mixtures of soluble substances by running a solvent (mobile phase) through the mixture on the paper (stationary phase) which causes the substances to move at different rates over the paper. |
| 61 | How can you use paper chromatography to identify a substance? | Each substance will run a specific distance up the paper and have its own unique Rf. |
| 62 | In chromatography, define the Rf value. | Rf = distance moved by the component  distance moved by the solvent |
| 63 | How can ground water be made potable? | Sedimentation, filtration and chlorination |
| 64 | How can sea water be made potable? | Distillation. |
| 65 | Why must water used in analysis not contain any dissolved salts? | Dissolved salts could cause an analysis to give a false positive result. In other words you might get a positive result for something that isn’t really there. |
| 66 | What are acids and alkalis sources of? | Acids – hydrogen ions  Alkalis – hydroxide ions |
| 67 | What are the colour changes of?   1. Litmus 2. Methyl orange 3. Phenolphthalein   With acid and alkali? | |  |  |  | | --- | --- | --- | |  | Acid | Alkali | | Litmus | red | blue | | Methyl orange | red | yellow | | Phenolphthalein | colourless | pink | |
| 68 | What is the link between hydrogen ion concentration and pH? | The higher the concentration of hydrogen ions the lower the pH (a stronger acid). As the hydrogen ion concentration increases by a factor of 10, the pH of the solution decreases by 1.The higher the concentration of hydroxide solutions the higher the pH. |
| 69 | When calcium hydroxide is added slowly to hydrochloric acid the pH of the resulting solution changes. What would the graph of this look like? |  |
| 70 | What pH could a concentrated acid have? | Anything between 1 and 6. Acid concentration refers to the dilution with water. A strong acid can still have a lot of hydrogen ions in solution even when it is of a weak concentration. |
| 71 | Which would have a pH of 1?   * 0.25M Sulphuric acid (a strong acid) * 10M Ethanoic acid (a weak acid) | Strong acids will always have low pH regardless of the concentration. |
| 72 | What is a base? | It is a substance that can react with an acid to make a salt and water. |
| 73 | What is an alkali? | A soluble base. |
| 74 | What type of reaction is it when an acid reacts with a base? | Neutralisation |
| 75 | What are the products of the following neutralisation reactions?   1. Metal + acid = 2. Metal oxide + acid = 3. Metal hydroxide + acid = 4. Metal carbonate + acid = | 1. Salt + hydrogen 2. Salt + water 3. Salt + water 4. Salt + water + carbon dioxide |
| 76 | What is the chemical test for?   1. Hydrogen 2. Carbon dioxide | 1. Lit splint gives a squeaky pop. 2. Bubbling carbon dioxide through limewater turns it milky. |
| 77 | Explain why water is produced when an acid reacts with an alkali? | The hydrogen ions (H+) from the acid react with the hydroxide ions (OH-) from the alkali to form water (H2O). |
| 78 | When preparing a soluble salt from an acid an insoluble reactant how do you ensure the salt is pure? | 1. Use excess insoluble reactant to neutralise all the acid. 2. Filter the resulting mixture to remove the excess reactant. |
| 79 | How do you prepare a soluble salt when both the reactants are soluble? | Titration is used to ensure the reactants are mixed in the correct proportions. |
| 80 | How would you prepare a sample of pure, dry hydrated copper sulfate crystals starting from copper oxide. | 1. Add excess copper oxide to sulfuric acid and place in a water bath to gently heat. 2. Filter the mixture to remove excess copper oxide. 3. Evaporate the mixture, this can be heated to start with but it must be left to evaporate at room temperature to produce hydrated crystals. |
| 81 | How do you carry out an acid-alkali titration, using burette, pipette and a suitable indicator, to prepare a pure, dry sample of sodium chloride? | 1. Fill a burette with hydrochloric acid. 2. Measure 25 cm3 of sodium hydroxide using a pipette and place in a conical flask. 3. Add a few drops of phenolphthalein indicator. 4. Place the conical flask on a white tile underneath the burette. 5. Run in hydrochloric acid fairly quickly at first whilst continually stirring. 6. When the neutralisation point is approaching start to add the acid drop wise. 7. Stop adding the acid the moment the indicator goes clear. 8. Repeat the titration 2 further times and average results. 9. Carry out titration one final time, this time without indicator to ensure the salt produced is pure. Stop adding acid when the average quantity previously identified has been added. |
| 82 | Are the common sodium, potassium and ammonium salts soluble or insoluble? | Soluble |
| 83 | Are nitrates soluble or insoluble? | Soluble |
| 84 | Are common chlorides soluble or insoluble? And what is the exception to the rule? | Soluble, except silver chloride and lead chloride. |
| 85 | Are common sulfates soluble or insoluble? And what is the exception to the rule? | Soluble, except lead sulphate, barium sulphate and calcium sulphate. |
| 86 | Are common carbonates and hydroxides soluble or insoluble? And what is the exception to the rule? | Insoluble, except sodium, potassium and ammonium. |
| 87 | What is a precipitate? | A solid formed from two reacting solutions. |
| 88 | What is the name of the insoluble precipitate formed when lead nitrate reacts with potassium chloride? | Lead chloride |
| 89 | How do you prepare a pure, dry sample of an insoluble salt? | Mix reacting solutions together in order to get the precipitate, then filter the precipitate out of the solution, wash it with distilled water and dry it. |
| 90 | What is an electrolyte? | An ionic compound in either the molten state or dissolved in water. |
| 91 | What is electrolysis? | A chemical process that decomposes an electrolyte using electrical energy from a direct current (DC) supply. |
| 92 | What are positively charged ions called? | Cations |
| 93 | What are negatively charged ions called? | Anions |
| 94 | What is the positive electrode called? | Anode |
| 95 | What is the negative electrode called? | Cathode |
| 96 | How do the ions move during electrolysis? | The cations migrate to the cathode.  The anions migrate to the anode. |
| 97 | What products are formed in the electrolysis of the following electrolytes:   1. Copper chloride solution 2. Sodium chloride solution 3. Sodium sulphate solution 4. Water acidified with sulphuric acid 5. Molten lead bromide | |  |  |  |  | | --- | --- | --- | --- | |  | Anode | Cathode | Left in solution | | 1 | Chlorine | Copper |  | | 2 | Chlorine | Hydrogen | Sodium hydroxide | | 3 | Oxygen | Hydrogen |  | | 4 | Oxygen | Hydrogen |  | | 5 | Bromine | Lead |  | |
| 98 | What is the cathode half equation when water is electrolysed? | 2H+ + 2e- → H2 |
| 99 | What is the anode half equation when water is electrolysed? | 2O2- → O2 + 4e- |
| 100 | Define oxidation and reduction. | Oxidation is loss of electrons and reduction is gain of electrons. |
| 101 | When water is electrolysed are the hydrogen ions oxidised or reduced? | Reduced |
| 102 | Does oxidation happen at the anode or cathode? | Anode |
| 103 | When purifying copper using electrolysis would you make the impure copper the anode or the cathode? | Anode |
| 104 | Write the half equation for the formation of copper at the cathode. | Cu2+ + 2e- → Cu |
| 105 | Magnesium produces small bubbles of gas when placed in water; it reacts rapidly with steam and acid. Lithium bubbles fizzes on the surface of water. Which is more reactive? | Lithium. |
| 106 | What is a displacement reaction? | A redox reaction in which a more reactive element displaces a less reactive element from its compound. Both metals and non-metals take part in displacement reactions. |
| 107 | In metal displacement reactions, is the reactive metal oxidised or reduced? | Oxidised |
| 108 | Where are most metals obtained from? | Ores found in the Earth’s crust. |
| 109 | Name a metal that is not extracted from an ore and explain why. | Gold because it is so unreactive it doesn’t combine with oxygen in the environment. |
| 110 | When metals are extracted are ores oxidised or reduced? | Reduced |
| 111 | Describe how iron is extracted from its ore. | Iron ore (iron oxide) is heated with carbon (the carbon displaces the iron. The iron is reduced – loses its oxygen to the carbon). |
| 112 | Describe how aluminium is extracted from its ore. | Aluminium is extracted by electrolysis. |
| 113 | Explain why aluminium is extracted in this way, and not by simply heating it with carbon. | Aluminium is a reactive metal.  Reactive metals bond strongly to the other elements in their ores. It requires a lot of energy to break these chemical bonds. Electrolysis can provide large amounts of electrical energy to separate the metal from the other elements in the ore.  All reactive metals have to be extracted by electrolysis. The disadvantage is that this method is expensive. |
| 114 | Why is iron not extracted from its ore using electrolysis? | It is cheaper to displace it with carbon. |
| 115 | How does the phyto extraction of copper work? | Some plants absorb copper compounds through their roots, the plant is then burnt and the copper extracted from the ash. |
| 116 | What is bioleaching? | A method of extracting copper that involves bacteria absorbing copper compounds. The bacteria then produce solutions called leachates which contain copper compounds from which the copper can be extracted. |
| 117 | Would you expect a metal low down the reactivity series to be susceptible to oxidation? | No, unreactive metals are much less likely to react with oxygen. |
| 118 | Why do we recycle scrap metal? | 1. It can often be cheaper to recycle rather than extract new metal from its ore. 2. Recycling cuts waste which could otherwise harm the environment. 3. Preserves the remaining raw materials on the planet. |
| 119 | What does a lifetime assessment of a product involve? | Evaluating the effect on the environment of:   1. Manufacturing 2. Using 3. Disposing |
| 120 | What does this symbol mean?  ⇌ | It shows a reaction is reversible |
| 121 | What is meant by the term ‘dynamic equilibrium’? | A reversible reaction is said to be in dynamic equilibrium when the rate of the forward reaction is equal to the rate of the backward reaction. |
| 122 | How can you change the equilibrium of a reversible reaction? | By changing the conditions, for example temperature and pressure. |
| 123 | What is the equation for the Haber process? | N2 (g) + 3H2 (g) ⇌ 2NH3 (g) |
| 124 | Where are the reactants obtained from in the Haber process? | The nitrogen is extracted from air and the hydrogen is obtained from natural gas. |
| 125 | What is the chemical formula for ammonia? | NH3 |
| 126 | What are the conditions used in the Haber process? | * temperature 450 °C * pressure 200 atmospheres * iron catalyst |
| 127 | How does increasing the temperature affect the yield of ammonia? | The production of ammonia is exothermic so increasing the temperature reduces the yield. |
| 128 | If increasing the temperature reduces the yield of ammonia why is a temperature of 450 oC used? | 450 oC is a compromise, the temperature is raised to increase the rate of reaction even though it decreases the yield. |
| 129 | How does increasing the pressure affect the yield of ammonia? | 4 molecules of reactants are needed to make 2 molecules of ammonia. If the pressure is raised more ammonia is produced because that would reduce the number of particles present. |
| 130 | How does adding a catalyst affect the yield of ammonia? | It does not affect the yield it just increases the rate. |
| 131 | How would the position of a dynamic equilibrium be affected by?   1. temperature? 2. pressure? 3. concentration? | 1. Increasing the temperature will move the dynamic equilibrium in the direction of the endothermic reaction. 2. Increasing the pressure will move the dynamic equilibrium towards the side where there are less gas molecules. 3. Increasing the centration of a substance will move the equilibrium to reduce the concentration of that substance. |

**Essential Knowledge Questions**

**Learn the answers to each of these:**

|  |  |  |
| --- | --- | --- |
|  | **Question** | **Answer** |
| 1 | What do we call group 1, group 7 and group 0 in the periodic table? | The alkali metals, the halogens and the noble gases. |
| 2 | In terms of electronic configuration, what do all the elements in:   1. Group 1 have in common? 2. Group 7 have in common? 3. Group 0 have in common? | They have:   1. 1 electron on their outer shell 2. 1 electron is needed to complete their outer shell. 3. A full outer shell of electrons. |
| 3 | How are the alkali metals different from transition metals? | 1. They are soft (can be cut with a knife). 2. They have comparatively low melting points. |
| 4 | Describe the reaction of sodium with water. | 1. The metal reacts and moves around the surface of the water. 2. The reaction gives off a gas. 3. The product of the reaction is soluble in the water. |
| 5 | What two products are formed when alkali metals are added to water? | A hydroxide and hydrogen gas. |
| 6 | State the order of reactivity in group one and explain it. | Reactivity increases as you go down the group. This is because the outer electron is further away from the nucleus and is therefore more easily lost. |
| 7 | What are the colours and physical states of the halogens at room temperature? | Fluorine is a pale yellow gas. Chlorine is a yellow/green gas. Bromine is a brown liquid. Iodine is a grey solid. |
| 8 | What is the pattern in:   1. Boiling point 2. Colour intensity 3. Reactivity   As you go down the halogen group? | 1. Boiling point increases 2. Colour intensity increases 3. Reactivity decreases |
| 9 | What is the test for chlorine? | Chlorine turns damp litmus paper red and then bleaches it. |
| 10 | What is formed when halogens react with hydrogen? | Hydrogen halides. These can dissolve in water to from acids e.g. HCl, hydrogen chloride dissolves in water to form hydrochloric acid. |
| 11 | What is formed when halogens react with metals? | Metal halides. E.g. 2Fe + 3Cl2 = 2FeCl3 (iron(III)chloride) |
| 12 | State the order of reactivity of the halogens and explain it. | Reactivity decreases as you go down the group. |
| 13 | If chlorine is added to sodium bromide solution what happens? | A displacement reaction takes place forming sodium chloride solution and bromine. This is because the chlorine is more reactive than the bromine. |
| 14 | When chlorine reacts with sodium bromide what type of reaction is it? | Displacement reaction which is a redox reaction. |
| 15 | When chlorine reacts with sodium bromide, what is oxidised and what is reduced? Explain your answer in terms of electrons. | The chlorine will gain electrons and therefore be reduced.  The bromide ion will lose electrons and is therefore oxidised. |
| 16 | Why do the halogens become less reactive as you go down the group? | The halogens all need to gain an electron to complete their outer shells. The positive nucleus attracts the electron the halogens need to fill the outer shell. The halogens at the top of the group have less shells so the attractive force of the nucleus is much stronger as the gap is closer which makes them more reactive. |
| 17 | Why are the noble gases unreactive? | They already have a full outer shell of electrons. |
| 18 | What are the properties of the noble gases? | 1. Inertness (so used in welding and filament lamps). 2. Low density (used in balloons). 3. non-flammability. |
| 19 | What is the trend in density and boiling point as you go down the noble gas group? | Both the densities and the boiling points of the noble gases increase as you go down the group. |
| 20 | How could you monitor the rate of a reaction? | By looking at how quickly a product like a gas is produced, this could be done by collecting the gas in a syringe. Alternatively, by seeing how quickly a reactant is used up, this could be done by monitoring the mass of solid reactant. |
| 21 | If a reaction is to occur what 2 things need to happen between reacting particles? | The particles must collide and the collision must have enough energy. |
| 22 | Explain why increasing the temperature speeds up a reaction. | It gives the particles more energy so they collide more often and the collisions have more energy. |
| 23 | Explain why increasing the concentration of a solution speeds up a reaction. | It means there are more particles present so it will increase the number of collisions. |
| 24 | Explain why increasing the pressure on reactions involving gases speeds up the rate of reaction. | Increasing the pressure increases the number of gas particles present in a certain volume. This increases the number collisions between reacting particles, which increases the rate of reaction. |
| 25 | Explain how breaking up a solid reactant increases the rate of reaction. | Breaking up a solid increases the surface area. This means that there is a greater area of solid exposed for other particles to collide with. This increases the likelihood of a successful collision and therefore speeds up the reaction. |
| 26 | What happens to the rate as a reaction progresses and what would a rate of reaction graph look like? | Reactions start quickly and slow down as they progress. A rate curve will start off steep and the gradient will continually decrease to reflect the changing rate. |
| 27 | What is a catalyst? | A catalyst is a substance that speeds up the rate of a reaction without altering the products of the reaction, being itself unchanged chemically and in mass at the end of the reaction. |
| 28 | How does a catalyst speed up a reaction? | A catalyst provides an alternative route which requires less activation energy. |
| 29 | What are enzymes and what are they used for? | Enzymes are biological catalysts and they are used in the production of alcoholic drinks. |
| 30 | What is an exothermic reaction and give an example? | A reaction that gives out heat energy. For example combustion. |
| 31 | What is an endothermic reaction and give an example? | A reaction that takes in heat energy. For example photosynthesis. |
| 32 | Is the breaking of bonds exothermic or endothermic? | Endothermic. |
| 33 | Is the making of bonds exothermic or endothermic? | Exothermic. |
| 34 | Why is a reaction exothermic? | In an exothermic reaction less heat energy is needed to break bonds than is given out when new bonds are made. |
| 35 | Why is a reaction endothermic? | In an endothermic reaction less energy is released in forming bonds in the products than is required in breaking bonds in the reactants. |
| 36 | How do you calculate the energy change in a reaction? | Bond breaking – bond making.  The energy required to break bonds – energy given out when bonds are formed.  If the answer is negative then the reaction is giving out energy and is exothermic. |
| 37 | What is the unit for measuring the energy change in reactions? | KJ mol-1 (kilojoule per mole) |
| 38 | What is meant by the term activation energy? | The energy needed for a reaction to start. This is equal to the energy needed to break all the reactants’ bonds. |
| 39 | What does the reaction profile for an exothermic reaction look like? |  |
| 40 | What does the reaction profile for an endothermic reaction look like? |  |
| 41 | What is a hydrocarbon? | A hydrocarbon is a compound that contains hydrogen and carbon ONLY. |
| 42 | What is crude oil? | Crude oil is a complex mixture of alkane hydrocarbons. Some of these hydrocarbons contain molecules in which carbon atoms are in chains and in some, they are in rings. Crude oil is an important source of useful substances and a finite resource. |
| 43 | With respect to crude oil, what is a “fraction”? | A fraction is a simpler, more useful mixture of hydrocarbons with a similar boiling point, e.g. petrol or bitumen. |
| 44 | What is the name of the process used to separate crude oil into its fractions? | Fractional distillation. |
| 45 | How does the fractional distillation of crude oil work? | The crude oil is heated and boiled. The vapour is then passed into a cooling tower. The hot vapours rise up the tower and cool as they do so. The first substance in crude oil to change back to a liquid is bitumen and this falls to the bottom of the tower and exits, the hot vapours rise through the tower and pass through one-way traps. This process continues until all the fractions have been separated and the gases at room temperature leave at the top of the tower. |
| 46 | The fractions come off the fractionating column in the following order (starting from the top of the column). Name the uses of each fraction:   1. Refinery gases 2. Petrol 3. Kerosene 4. Diesel oil 5. Fuel oil 6. Bitumen | 1. domestic heating and cooking 2. fuel for cars 3. fuel for aircraft 4. fuel for some cars and trains 5. fuel for large ships and in some power stations 6. used to surface roads and roofs |
| 47 | Hydrocarbons in different fractions differ from each other in:  Number of carbon atoms in their molecules, boiling points, ease of ignition (flammability) and viscosity (stickiness).  a) which fraction has the most carbon atoms in its molecules (the longest carbon chain)?  b) which fraction has the lowest boiling point?  c) which fraction is the hardest to ignite (least flammable)?  d) which fraction has the lowest viscosity? | a) bitumen  b) refinery gases  c) bitumen  d) refinery gases |
| 48 | What is a homologous series? | A homologous series is a series of compounds that have similar properties and the same general formula. A compound will differ by CH2 in molecular formulae from neighbouring compounds. There will be a gradual change in physical properties as the carbon chain gets longer. |
| 49 | What are the reactants and products of the complete combustion of hydrocarbons? | Reactants – hydrocarbon and oxygen.  Products - carbon dioxide and water ONLY.  (Energy is released, but it is not a product, because it is not a chemical substance.) |
| 50 | What are the products of the incomplete combustion of hydrocarbons? Why are they different from the products of complete combustion? | Products – carbon monoxide and/or carbon and water. Incomplete combustion produces a mixture of carbon compounds.)  Carbon monoxide (CO) and/or carbon (C) are produced because there is not enough oxygen available to form carbon dioxide (CO2). |
| 51 | Why are we concerned about incomplete combustion? | Incomplete combustion can cause the release of carbon monoxide, which is toxic. The soot (carbon) produced can damage appliances. |
| 52 | What effect does carbon monoxide have on the body? | Carbon monoxide is toxic. It binds to heamoglobin and doesn’t let go. It therefore reduces the amount of oxygen that’s transported around the body by the blood depriving vital organs of oxygen. Unconsciousness and death follows. |
| 53 | What is “acid rain”, and how does it arise? | Acid rain is rain that is more acidic than normal.  All fossil fuels (coal, gas and crude oil) contain impurities, particularly sulfur. When the fuel is burnt the sulfur combines with oxygen to produce sulfur dioxide gas. When water vapour in the atmosphere condenses the sulfur dioxide gas dissolves in it to form an acidic solution. This can then fall as rain and because it is more acidic than normal rainwater it is called “acid rain”. |
| 54 | What are the problems associated with acid rain? | Acid rain makes rivers, lakes and soils acidic, harming the organisms living there.  Acid rain damages the leaves and roots of plants and trees.  Acid rain can speed up the weathering of limestone (rocks or buildings) and marble. |
| 55 | How are nitrogen oxides produced? | Many hydrocarbons are burnt in engines. The high temperatures involved mean that the nitrogen and oxygen from the air combine to produce oxides of nitrogen. |
| 56 | What is a nonrenewable fuel? | A fuel that once it has been used cannot be used again. E.g. kerosene, diesel, petrol, methane (from natural gas). |
| 57 | What is the cause of a sooty flame? | Incomplete combustion. (Not enough oxygen present to convert all the carbon in the hydrocarbon fuel to carbon dioxide, so carbon particles are one of the products of the reaction.) |
| 58 | Give an advantage and a disadvantage of combining hydrogen and oxygen in a fuel cell¸ rather than petrol, as a fuel for cars. | Advantage – hydrogen is a clean fuel. The only product of the combination of hydrogen and oxygen is water. Therefore no carbon dioxide, nitrogen oxide or acid rain would be produced.  Disadvantage – hydrogen can be explosive/hydrogen is not readily available in filling stations at present /the process needed to produce the hydrogen fuel results in the production of carbon dioxide. |
| 59 | Are alkanes saturated or unsaturated? | Saturated.  (They have no carbon-carbon double bonds that can open up to bond with any more hydrogen atoms – they are saturated with hydrogen.) |
| 60 | What is the formula for   1. methane 2. ethane 3. propane   Draw the structures of these molecules | 1. CH4 2. C2H6 3. C3H8   [http://t1.gstatic.com/images?q=tbn:ANd9GcRHV8YBDoVrMTNTFQq5O0GWnNfLSh2CqmUJW4qXIV9w1acfDqy9A3myUig:4.bp.blogspot.com/_NvQHHJRdJ9o/SY_WhQbFMEI/AAAAAAAAAGc/A0QAjg8-m7o/s400/methane.bmp](http://www.google.co.uk/imgres?imgurl=http://4.bp.blogspot.com/_NvQHHJRdJ9o/SY_WhQbFMEI/AAAAAAAAAGc/A0QAjg8-m7o/s400/methane.bmp&imgrefurl=http://thestephenation.blogspot.com/2009/02/lewis-structures.html&usg=__7oNgkdisXVk1uGY35JQA5CCu7-Q=&h=300&w=400&sz=5&hl=en&start=1&sig2=Ks4W1DCpO3rCwxMpGcqFSQ&zoom=1&tbnid=pPkBOOqwVFcaJM:&tbnh=93&tbnw=124&ei=oCUhT-7cDMTpOaG57agI&prev=/search?q=structure+of+methane&hl=en&safe=active&biw=1280&bih=836&gbv=2&sout=1&tbm=isch&itbs=1)[http://t2.gstatic.com/images?q=tbn:ANd9GcS_1NHbOMEiIKBKaSj1WtW1ijsLuKjedIxg0Fz-Y8Ht5p9ZV9PiIoEdlow:4.bp.blogspot.com/-Rhn6lTRfM9Q/TVZvFsrgwPI/AAAAAAAAAAo/l5Ig30ohHo4/s1600/Ethane-flat.png](http://www.google.co.uk/imgres?imgurl=http://4.bp.blogspot.com/-Rhn6lTRfM9Q/TVZvFsrgwPI/AAAAAAAAAAo/l5Ig30ohHo4/s1600/Ethane-flat.png&imgrefurl=http://intrestingthings4u.blogspot.com/2011_02_01_archive.html&usg=__1htOdJasotGwpF1fn-JyHDsBZ4w=&h=830&w=1100&sz=10&hl=en&start=4&sig2=GCpW0xxqN-YHskBulpOrYg&zoom=1&tbnid=YCdSuaZTUmnHpM:&tbnh=113&tbnw=150&ei=ySUhT5O9BYeSOoDpyL4I&prev=/search?q=structure+of+ethane&hl=en&safe=active&sa=G&biw=1280&bih=836&gbv=2&sout=1&tbm=isch&itbs=1) [http://t0.gstatic.com/images?q=tbn:ANd9GcQqZ2HRWFR67Xh669jiqxuhnP1puFMTohiY3N4Hx9f_T3rgawyuW2ikkCw:2.bp.blogspot.com/_5LxcnpPlBl4/Sdszr0VFaiI/AAAAAAAAAB8/jUn6JIlbTao/s320/propane.jpg](http://www.google.co.uk/imgres?imgurl=http://2.bp.blogspot.com/_5LxcnpPlBl4/Sdszr0VFaiI/AAAAAAAAAB8/jUn6JIlbTao/s320/propane.jpg&imgrefurl=http://sars-4a.blogspot.com/&usg=__IMW3nfB_MmTUwlvuMCIRW96cgZo=&h=192&w=320&sz=8&hl=en&start=14&sig2=EnjkJXF5B4sg-xXrxuhKBQ&zoom=1&tbnid=X_6EAqsRHqhvRM:&tbnh=71&tbnw=118&ei=DCYhT5vkI4HpOcbOubkI&prev=/search?q=structure+of+propane&hl=en&safe=active&sa=G&biw=1280&bih=836&gbv=2&sout=1&tbm=isch&itbs=1) |
| 61 | What is the formula for the alkenes   1. ethene 2. propene | 1. C2H4 2. C3H6 |
| 62 | a) Explain what “cracking” is, and what products are made.  b) Why do oil companies bother to carry out this reaction? | a) Cracking is the splitting (using heat) of a long chain saturated hydrocarbon (an alkane) to form a shorter chained alkane and an alkene.  b) Shorter chained hydrocarbons make better fuels. Crude oil contains too many of the longer chained molecules, so oil companies crack them to i) **make more of the useful fuels**, and ii) **make** **alkenes** (which can be used to make polymers). |
| 63 | How was the earth’s first atmosphere formed? | From gases produced by volcanic activity. |
| 64 | What are thought to be the relative proportions of the gases that formed the early atmosphere? | Little or no oxygen, large amounts of carbon dioxide, large amounts of water vapour and small amounts of other gases. |
| 65 | Why can’t we be certain about how the earth’s atmosphere formed? | There is only limited evidence (e.g. from rocks and ice cores) about the earth’s early atmosphere. |
| 66 | How were the earth’s oceans formed? | Water vapour, released by volcanoes, condensed to form the oceans. |
| 67 | How did the amount of oxygen in the atmosphere gradually increase? | Green plants evolved. The growth of these primitive plants used carbon dioxide and released oxygen by photosynthesis. |
| 68 | What is a chemical test for oxygen? | Oxygen will relight a glowing splint. |
| 69 | Describe the processes, other than photosynthesis, that reduced the amount of carbon dioxide in the atmosphere. | 1. Carbon dioxide dissolved into the oceans. 2. Dissolved carbon dioxide was incorporated into the shells of marine organisms. When marine organisms die their shells can eventually form carbonate rocks. |
| 70 | What is the greenhouse effect? | This is when various gases are added to the atmosphere, including carbon dioxide, methane and water vapour. These gases absorb heat radiated from the Earth and subsequently release the energy that keeps the Earth warm. |
| 71 | What evidence do we have for global warming and why can we not be absolutely certain about it? | Scientists have discovered a correlation between historical global temperature and carbon dioxide levels. They also know how much carbon dioxide we are presently adding to the atmosphere.  We cannot be certain about this because of historical accuracy of the temperature and carbon dioxide levels and also due to uncertainties caused by the location where measurements are taken. |
| 72 | List the percentages of the gases in our modern atmosphere. | Nitrogen 78%, oxygen 21%, 1% other gases (argon, carbon dioxide and water vapour). |
| 73 | What are the potential effects on the climate of increased levels of carbon dioxide and methane caused by human activity? | The climate will warm up although we cannot be certain by how much. It is also suspected we will have a long term change in weather (e.g. more/less rain) and more extreme weather events. |
| 74 | How might the greenhouse effect be mitigated? | We would need to reduce the consumption of fossil fuels by looking at alternative sources of energy e.g. nuclear or renewables. Also, a different fuel for transport e.g. electricity or fuel cells. |
| 75 | Why can we not just stop burning fossil fuels to generate electricity? | Nuclear power is not liked by all and the waste is a risk and can be a problem for the environment. Solar and wind don’t produce that much electricity so you would need thousands of solar and wind farms and this would take too much space and be extremely expensive. Generation from solar and wind is not always continuous. |

Qr code

Description automatically generatedQr code

Description automatically generatedBonding Summary

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Ionic | Covalent | | | Metallic |
| Description |  |  | | |  |
| Atoms Involved |  |  | | |  |
| Example |  | Qr code  Description automatically generated | | |  |
| Charges |  |
| Formula |  |
| Name |  |
| Structure |  | Simple Molecular | Giant Molecular | |  |
|  | Diamond | Graphite |  |
| Melting Point |  |  |  |  |  |
| Qr code  Description automatically generatedElectrical Conductivity |  |  |  |  |  |
| Solubility in water |  |  |  |  |  |

A picture containing crossword, text, black, white

Description automatically generatedSummary of preparation of pure, dry salts

|  |  |  |  |
| --- | --- | --- | --- |
| Type of reaction |  |  |  |
| Example |  |  |  |
| Method |  |  |  |

Qr code

Description automatically generatedOil Summary

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fractional Distillation**  Sketch apparatus and label key areas |  | Boiling point | Flammability | Viscosity |
| Long chain  Short Chain |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cracking**  Sketch apparatus and label key areas | Example equation | 2 Reasons for Cracking | Alkanes **(Separate Science only)** | | Alkenes **(Separate Science only)** | |
| Members | Characteristics | Members | Characteristics |
|  | Single/double carbon bond |  | Single/double carbon bond |
|  | More or less reactive | More or less reactive |
|  | Test with bromine water |  | Test with bromine water |
| Saturated or unsaturated | Saturated or unsaturated |

|  |  |  |  |
| --- | --- | --- | --- |
| **Complete Combustion**  Name the products | **Incomplete Combustion**  Name the products and explain why they are formed. | **Why is carbon monoxide toxic?** | **Advantages and disadvantages of using hydrogen as a fuel.** |

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Diagram

Description automatically generated with medium confidence