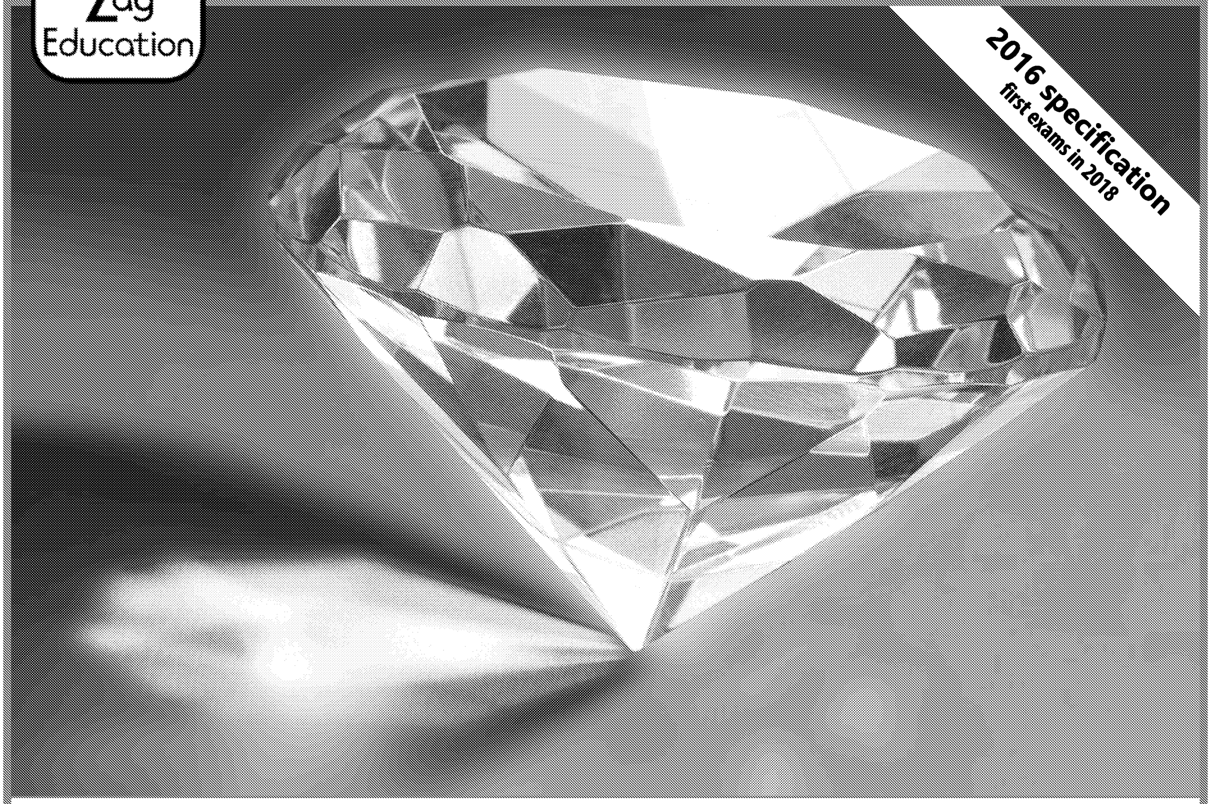
Combined Science

GCSE (9–1) | AQA | 8464



End-of-Topic A4 Quick-Mark Homeworks

for GCSE AQA Combined Science

Chemistry Topics 1–5

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Contents

Teacher's Introduction

These End-of-Topic Quick-Mark Homeworks are designed to test and consolidate students' knowledge of the **AQA GCSE (9–1) Combined Science** course, **Chemistry Topics 1–5**.

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

The first half of the Chemistry course is split into nine topics, each covered by at least 40 questions for a total of over 440 questions.

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

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

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

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

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

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

I hope you find this resource useful in your teaching.

April 2025

Specification Reference Table

Homework	Title	Specification Reference
1	A Simple Model of the Atom	5.1.1
2	The Periodic Table	5.1.2
3	Chemical Bonds	5.2.1
4	Bonding and Structure	5.2.2
5	Carbon and Surface Properties and Quantitative Chemistry	5.2.3, 5.3.1, 5.3.2.5
6	Quantitative Chemistry (HT only)	5.3.2.1–5.3.2.4
7	Metals and Acids	5.4.1–5.4.2
8	Electrolysis	5.4.3
9	Energy Changes	5.5

Topic 1 — A Simple Model of th

Fundamentals

1. What is the name of a substance that contains only one kind of atom?
2. What is the chemical symbol for sodium?
3. What is the name of a substance that contains more than one kind of atom bonded together?
4. Is the air in the ... an element, a mixture ... compound?
5. State the ... technique that can be used to separate sand from salt water.
6. Name the three types of subatomic particle found in an atom.
7. What is the charge on a neutron?
8. What is the relative charge of an electron?
9. What is the name of the element with 12 protons and 12 neutrons?
10. Name the third element in group 1.
11. What does the atomic number tell you about an atom?
12. What separation technique would you use a fractionating column for?
13. Describe the previously accepted plum pudding model of the atom.
14. What is the electronic structure of an element with 3 electrons?
15. How do the masses of protons, ... and electrons compare?
16. Name the ... equipment you would use to sep... ...t glitter and water.
17. What is the difference between separating the elements in a mixture and in a compound?

Ch

1. Write the molecular form ... ic, 1 sulfur and 4 oxyg
2. An atom gains an electro
3. What is the name of the
4. What comes out of a con
5. What is the name of the separate a dissolved soli
6. Name a solute in seawat
7. How many electrons can of an atom?
8. What experiment led to is found in the nucleus?
9. The number of which sub determines which eleme
10. What did the work of Jam evidence for?
11. An atom has a mass num of 9. How many neutron
12. Where is the majority of
13. How does paper chroma
14. Write the electron config
15. Give two ways in which a ... chemical process.
16. Write a word equation f $Mg + 2HCl \rightarrow MgCl_2 + H_2$
17. Describe how isotopes o terms of their subatomic
18. How does the Bohr mode pudding model?

Extension

1. Two liquids are separated by fractional distillation. What property of the liquids all
2. The atomic number of Ca^{2+} is 20 and the mass number is 40. How many electrons d
3. What is roughly the radius of an atom, in standard form?
4. Give the approximate radius of an atomic nucleus in metres (m).
5. What is the electronic structure of an element with 19 electrons?
6. Boron is 20 % ^{10}B and 80 % ^{11}B. Calculate the relative atomic mass of boron.
7. What elements does the compound $Ca(OH)_2$ contain?
8. What equation can you use to work out the number of ne...ns in an atom?
9. Which scientist suggested electrons orbit the nu... ...ecific distances?
10. What is the overall electrical charge of an atom?
11. Name a suitable piece of appa... ...ch to heat seawater to form salt crystals.
12. An ion with a charge ... electrons. What is the identity of the ion?
13. Explain ... th... ...e atomic mass' of an element means.
14. Why ... s have no overall electric charge?
15. What ... alpha particle scattering experiment tell us about the structure of the
16. In ancient times, what did people think atoms were?
17. In terms of subatomic particles, how is an ion different from its corresponding ato

Topic 2 — The Periodic Tab

Fundamentals

1. The elements are arranged on the periodic table in ascending order of what?
2. What is the same about the electronic structure of all elements in a group of the periodic table?
3. Are group 1 elements metals or non-metals?
4. Who first placed elements in groups based on their reactivity?
5. What [illegible] name given to the group [illegible]ents?
6. What type of elements form positive ions?
7. Which element has the chemical symbol P?
8. What type of elements are found at the top-right of the periodic table?
9. Name the compound formed when potassium reacts with chlorine gas.
10. State the reactivity of the group 0 elements.
11. Name the group in the periodic table whose elements have 8 outer electrons.
12. What kind of molecules do group 7 elements form?
13. Describe the trend in reactivity down group 1 of the periodic table.
14. Describe how the physical states of a metal and a non-metal differ at room temperature.
15. Describe what you would see when potassium reacts with water.
16. Write the word equation for the reaction between sodium and chlorine [illegible].

C

1. What property of el reorder them in the
2. How many outer ele
3. Which noble gas has electrons from the o
4. Give the name and c formed when potass
5. What type of reactio with KBr to form KCl
6. Is the boiling point o that of neon?
7. Write a balanced eq lithium and oxygen.
8. The electronic struct What group in the p
9. Name two things wh down group 7.
10. Name one problem periodic table.
11. Describe two observ reaction between li
12. What do all group 7 terms of electrons?
13. Why did Mendeleev
14. Why is carbon place
15. Explain why there is and NaCl.

Extension

1. Give the electronic structure of the atom directly below the atom with electronic st
2. Astatine is at the bottom of group 7. Is it likely to be solid, liquid or gas at room tem
3. Write a balanced symbol equation for the displacement of Br from LiBr by Cl.
4. Cl_2 can displace I^- ions in solution. What property of Cl means that it can do this?
5. What do O^{2-} and Mg^{2+} have in common, in terms of electronic structure?
6. Identify which of the following elements reacts most vigorously with chlorine: Li, N
8. Chlorine water is added to potassium bromide solution. Predict the colour of the fi
9. Compare the density of iron (a metal) and the density of carbon (a non-metal).
10. An unknown element is in group 4. What can you tell about the element's electroni
11. A teacher adds sodium and universal indicator to water. Explain why the solution is
13. Why does bromine have a higher boiling point than [illegible]ne?
14. Explain why group 0 elements are so unreactive?
15. Explain why isotopes mean that elements are not necessarily ordered by atomic we
16. What does 'periodic' mean in terms of the periodic table?
17. Explain why group [illegible] elements form one bond with other elements.
18. Explain why reactivity increases down group 1.

Topic 3 — Chemical Bond

Fundamentals

1. Name the type of bonding in pure iron.
2. Predict the kind of bonding in copper chloride, a metal bonded with a non-metal.
3. What charge would a group 1 ion have?
4. What do the dots and crosses represent in a dot-and-cross diagram?
5. What is the name of the covalent molecule with the formula CO_2?
6. What is the name for the attractive forces between ions?
7. What symbol is used to indicate a large number when representing polymer structures?
8. In the formula Fe_2O_3, what do the numbers represent?
9. Give the chemical formula of a chlorine molecule.
10. Name the type of bonding in polymer molecules.
11. Predict the formula of the compound formed between calcium and fluorine.
12. What kind of molecule is poly(ethene)?
13. What type of bonding is found in diamond?
14. Describe how a single covalent bond can be represented in diagrams of molecules.
15. What are delocalised electrons in metallic bonding?
16. Describe the bonding and structure of [illegible]
17. Describe the dot-and-cross diagram for NH_3.
18. Give the definition of [illegible]

##

1. In the ionic com
   of element is X?
2. What kind of stru
3. Predict the charg
   compound calciu
4. Predict the bond
5. How many electr
   when it reacts to
6. In the formation
   gains electrons?
7. What type of bo
   oppositely charg
8. Which represent
   the bonds and th
9. Give the empiric
10. What is the nam
    represent electr
11. What type of bo
    attracted to delo
12. How many covale
13. What kind of bon
14. Identify one limi
    diagram to repre
15. Describe the elec
    compared to an
16. In polymer diagr
17. Describe the diff
    and ionic bondin
18. Name one bene
    dot-and-cross di
    covalent compo

Extension

1. How many electrons will bromine have in its outer shell when it forms a -1 ion?
2. In an oxygen molecule, how many electrons are shared between the atoms?
3. How many covalent bonds can a group 7 element form?
4. Which element will form an ionic compound with fluorine – lithium or carbon?
5. A 3D diagram shows 9 Fe ions and 18 Cl ions. Predict the empirical formula of the c
6. In a covalent bond, what is the positive component of the electrostatic attraction?
7. Describe the structure and bonding in silicon dioxide.
8. Name a type of diagram that shows the 3D shape of a molecule or structure.
9. What type of bonds form between two non-metallic elements?
10. What kind of molecule has a long chain-like structure?
11. How many delocalised electrons are there per atom in solid magnesium metal?
12. Predict the type of bonding in an alloy of iron, nickel and chromium.
13. Describe the structure of an ionic compound.
14. Why is it impossible to form an ionic compound between oxygen and chlorine?
15. Describe the structure and bonding of pure sodium.
16. Explain why the bonding in magnesium (a group 2 metal) is stronger than the bon
17. What is an 'empirical formula' in terms of ionic compounds?

Topic 4 — Bonding and Struc

Fundamentals

1. Name the three states of matter.
2. Name the state change from a gas to a liquid.
3. What phase transition occurs when a material freezes?
4. Polymers have strong forces between particles. Describe how this affects their melting points.
5. Why do metals have high melting and boiling points?
6. What symbol is used to show an aqueous solution?
7. What type of bonding is found in magnesium oxide?
8. What is the name for a mixture of metals?
9. Name the only group of elements that do not form chemical bonds.
10. What is the name for the structure of diamond and silica?
11. Add in the state symbols to the reaction: $Ca + H_2SO_4 \rightarrow H_2 + CaSO_4$
12. Describe how the properties of pure iron and steel (an iron alloy) are different.
13. Describe the attractive forces in a giant ionic lattice.
14. Why are polymers usually solid at room temperature?
15. Pure metals are malleable. What does 'malleable' mean?
16. Describe why metals can be bent and shaped.
17. Describe the type of structure adopted by silicon.

C

1. Which state of m regularly arrange
2. Which phase cha between solid an
3. Which occurs at or evaporation?
4. In what state of r room temperatu
5. What property o than pure metals
6. What state of ma material conden
7. Brass is made of material is brass
8. Describe the rela and intermolecu
9. Select the most l 480 °C, 2850 °C
10. What is it about electricity to be c
11. How do the boili change down the
12. Ethanol melts at state is ethanol i
13. The forces betwe water than in me points differ.
14. In a metal, what attractions betw
15. Describe the par particle model.
16. Describe the ioni
17. Explain why simp melting points th

Extension

1. Which state involves particles which are touching and moving around each other?
2. Which pure substances can conduct electricity in liquid form: carbon dioxide, lead b
3. CS_2 is a small covalent molecule. Predict its state at room temperature.
4. Explain why liquid ammonia (NH_3) cannot conduct electricity.
5. How many electrons are transferred in the formation of $AlCl_3$?
6. What type of particle can move through water and conduct electricity in aqueous N
7. As the size of covalent molecules increases, how does the melting/boiling point cha
8. NaCl is an ionic compound; HCl is a small molecule. Which has the higher melting p
9. Iodine (I_2) is a larger molecule than fluorine (F_2). How will their boiling points differ
10. What is shown inside the square brackets in the diagram of a polymer?
11. Carbon forms many strong covalent bonds in diamond. What two properties result
12. Explain why simple covalent molecules can't conduct electricity.
13. Name three limitations of the particle model.
14. Explain why the alloy steel is harder than pure iron.
15. Solid KCl can't conduct electricity, but molten KCl can. Explain why this is.
16. Explain the thermal conductivity of metals.
17. Why are polymers typically solid at room temperature?

Topic 5 — Carbon and Surface Properties and Qu

Fundamentals

1. What kind of bonding exists in diamond?
2. What shape are carbon nanotubes?
3. What material contains many layers of carbon atoms in hexagonal rings?
4. Give the name of the spherical mo[illegible]e [illegible]ining 60 carbon atoms.
5. Name one propert[illegible] [illegible]n [illegible]u that makes it suite[illegible] [illegible]e i[illegible] [illegible]ips.
6. What [illegible]me given to hollow carbon [illegible]uctures?
7. State one property that graphite has in common with metals.
8. What is the symbol for relative formula mass?
9. In a reaction, the sum of the reactant masses is 100 g. What is the sum of the product masses?
10. Give the units of concentration in terms of mass per given volume.
11. What is 230 cm^3 in dm^3?
12. What is the relative formula mass of NaOH?
13. What is the name given to a solid dissolved in a solvent to make a solution?
14. Calculate the concentration of a solution of 5 g NaCl in 0.1 dm^3.
15. Five volumes are recorded: 31, 29, 32, 46 and 30 cm^3. Identify the anomalous result.
16. Calculate the mean of the follo[illegible] [illegible]su[illegible] to 3 sf: 3.40, 3.60, 3.55, 3.70.
17. Give the e[illegible]uat[illegible] [illegible] calculate the conce[illegible] [illegible] solution in g/dm^3.
18. How w[illegible]u estimate the uncertainty in the mean of a set of values?
19. What does the '3' in NH_3 mean?
20. Balance the equation: $?Li + ?O_2 \rightarrow ?Li_2O$

C

1. How many bonds d
2. What kind of bon
3. What holds togeth
4. Other than electric of graphene which
5. In graphite, what p structure and carry
6. How many bonds c carbon nanotubes
7. Explain why diamo
8. Which is best suite buckminsterfullere
9. Describe the struct
10. Na reacts with O_2 t react, how many m
11. What is the relativ
12. Give the equation concentration and
13. How much solvent make a 17 g/dm^3 s
14. Calculate the mean 31 cm^3, 32 cm^3, 3
15. How many grams o of a 12 g/dm^3 solut
16. Balance the equati $?Mg + ?H_2O \rightarrow ?M$
17. 0.48 g of Mg was b 0.80 g of MgO. Wh
18. State the law of co
19. A metal is heated i heavier once the re
20. What is 'uncertaint experimental meas
21. What is the definit

Extension

1. In graphite, layers can slide over each other. What property does this lead to?
2. What is the name of a long hollow cylinder made from carbon?
3. Can a buckminsterfullerene conduct electricity?
4. What kind of structure does graphene have?
5. In carbon nanotubes, each atom forms three bonds. Expl[illegible] why carbon nanotubes
6. Explain how the structure of graphite makes it s[illegible] [illegible]e [illegible] use in pencil lead.
7. Why is graphene suitable for electronic[illegible] [illegible] [illegible]mond?
8. What is the relative formula m[illegible] [illegible]$_3)_2$?
9. 0.031 kg of KCl is diss[illegible] [illegible]0 cm3 of water. Find the concentration in g/dm^3.
10. Calcula[illegible] u[illegible] [illegible] in the mean of the following values: 20.5 g, 20.1 g, 20.5 g
11. Balan[illegible] [illegible]quation: $?C_5H_{12} + ?O_2 \rightarrow ?H_2O + ?CO_2$
12. Give th[illegible] [illegible]ation used to calculate the volume of solvent from mass and concentra
13. Acid is added to magnesium and the reaction stops. What would happen if more m
14. Give three reasons why one reaction pathway might be chosen over another.
15. In a solution, more water is added but no more solute is added. Explain why the co
16. Copper carbonate thermally decomposes when heated. What happens to the mass

Topic 6 — Quantitative Chemistry (

Fundamentals

1. What unit symbol is used for moles?
2. How many moles are in 24 g of NH_3? (M_r = 17)
3. 1 mole of N_2 reacts with 1.5 moles H_2. How many moles of NH_3 are formed?
4. How much does one mole of iron weigh?
5. Give the equation for converting mass to number of moles.
6. How many particles are there in one mole of a substance?
7. How much KCl is formed if 20.0 g HCl reacts with excess KOH? $HCl + KOH \rightarrow KCl + H_2O$
8. What is the relative formula mass of Fe_2O_3?
9. 0.5 mol of CH_4 is burned. What volume of oxygen must be used to ensure complete combustion?
10. What is a limiting reactant?
11. In a reaction between Mg and HCl, HCl is in excess. What happens if more Mg is added?
12. Describe two ways of increasing the concentration of a solution.
13. True or false; one mole of NH_3 contains twice as many molecules as one mole of H_2?
14. If X and Y react in the ratio 2 : 3, how many moles of X are needed to react with 12 moles of Y?

C

1. In the reaction 2 how many mole of hydrogen?
2. Balance the equ
3. Find the mass o
4. Calculate the ma made with 200 g
5. What name is gi
6. Calculate the ma react with 40 g o
7. What volume of reacts with H_2? N
8. 7.2 g Mg reacts w Write a balanced
9. 4.5 g Mg reacts w HCl. Which is the
10. What does it me
11. Compare the nu to the number o
12. The mass of one to what?
13. How does conce no more solvent
14. If 1.20 moles of X many moles of Y

Extension

1. How many moles of oxygen need to react with six moles of C_2H_6? $2C_2H_6 + 7O_2 \rightarrow 4C$
2. How many moles of NH_3 get formed if nine moles of H_2 react? $N_2 + 3H_2 \rightarrow 2NH_3$
3. 0.65 moles of element Z weighs 12.35 g. Identify element Z.
4. 7.2 g Mg reacts with 4.8 g O_2 to form 12 g Mg. Find the balancing numbers for this r
5. Calculate the mass of $NaNO_3$ formed when 4 g of NaOH reacts. $NaOH + HNO_3 \rightarrow Na$
6. What mass of lithium reacts with 9.6 g of O_2? $2Li + O_2 \rightarrow 2Li_2O$
7. 25 cm^3 of 0.12 mol/dm^3 HCl reacts with 23 cm^3 LiOH. Find the concentration of KO
8. Calculate the mass of KCl in grams found in 0.6 dm^3 of a 2 mol/dm^3 solution, to 3 sf
9. Find the mass of NaBr needed to make a 0.5 mol/dm^3 solution in 65 cm^3 of water.
10. How many atoms are present in 32.5 g of silver?
11. Explain why, in a reaction, one reactant may be added in excess.
12. What is the definition of Avogadro's number, with respect to carbon?

Topic 7 — Metals and Aci

Fundamentals

1. Give the general name of the compound formed when a metal reacts with oxygen.
2. Describe reduction in terms of oxygen.
3. Which is the most alkaline – pH 3, pH 7 or [illegible]?
4. Name the metal salt formed when [illegible] reacts with hydrochloric [illegible]
5. In the formation of a metal salt, where does the negat[illegible] co[illegible] from?
6. Name [illegible] of metal salts formed from reacting with nitric acid.
7. Give the general equation for the reaction between a metal and an acid.
8. What is the difference between an alkali and a base?
9. Which is a 'strong' acid – hydrochloric acid or ethanoic acid?
10. Is the pH of an acid higher or lower than the pH of an alkali?
11. When an acid and an alkali react, what product is formed alongside the metal salt?
12. Write the chemical formula for calcium oxide.
13. Give the general equation for the reaction between a metal and water.
14. Name two pieces of equipment you could use to measure the pH of a solution.
15. What is an acid?
16. In preparing a soluble s[illegible] you know when all the ac[illegible] has [illegible]
17. What [illegible] of a metal determines its position in a re[illegible] series?
18. What is an alkali?

C

1. Name and give t formed when zi
2. What is pH a me
3. Name two non-m in a reactivity se
4. What is the nam acid and an alka
5. In the following r oxidised? 2ZnO +
6. Write a balanced between nitric a
7. Name the three between an acid
8. State the pH of a
9. Name a metal th from its ore by c
10. Write a balanced water in a neutr
11. Name the produ with a metal hyd
12. List all the conc cm^3, 21.20 cm^3,
13. What property m extracted from t
14. Write the balanc between calcium
15. Why is extractio necessary for go
16. Describe one wa an acid.
17. What is a reacti

Extension

1. Write the balanced equation for the formation of magnesium sulfate.
2. 21 cm^3 of NaOH reacted completely with 25 cm^3 of 0.10 mol/dm^3 HCl. Find the con
3. Describe oxidation in terms of electrons.
4. Which substance is being reduced in the following reaction? Ca(s) + Fe^{2+}(aq) → Ca^{2+}
5. How much more concentrated is a pH 2 acid than a pH 4 acid in terms of H^+?
6. Write the balanced equation for the formation of zinc chloride.
7. Calculate the average titre to the nearest 0.05 cm^3: 18.70 cm^3, 18.60 cm^3, 18.30 cm
8. Two acids are the same concentration. One is weak, one is strong. Which has a low
9. 16 cm^3 of HNO_3 reacted completely with 25 cm^3 of [illegible] mol/dm^3 KOH. Find the co
10. Write the ionic equation with state sym[illegible] for [illegible] displacement of Mg from MgCl
11. When preparing a soluble salt, [illegible] salt is used. Explain why.
12. Acid A has 1000 time[illegible] than Acid B. What would the difference in pH b
13. Give th[illegible] of [illegible]edox reaction.
14. What [illegible] fference between a dilute acid and a concentrated acid?
15. What i[illegible] difference between a strong acid and a weak acid?

Topic 8 — Electrolysis

Fundamentals

1. What is the negative electrode called?
2. What is the positive electrode called?
3. Predict the products formed from the electrolysis of molten copper chloride.
4. Name the main compound that aluminium is extracted from using electrolysis
5. In the electrolysis of a molten ionic compound, which electrode does the metal form at?
6. In the electrolysis of molten zinc chloride, what ions are attracted to the cathode?
7. Identify the ions in an aqueous solution of copper sulfate.
8. What is the name given to a liquid that can conduct electricity?
9. In the electrolysis of $AgNO_3(aq)$, a grey solid forms at the cathode. Identify the solid.
10. In the electrolysis of molten LiCl, a colourless gas is formed at the anode. Identify the gas.
11. What carries the electric current through the wires?
12. What type of ions are attracted to the cathode?
13. What happens to water molecules during electrolysis of aqueous solutions?
14. Give two reasons why extracting aluminium from ores using electrolysis is expensive.
15. Explain why solid lithium chloride cannot be electrolysed.
16. What is an inert electrode?
17. Describe the set-up of a simple electrolysis cell.

C

1. What type of io the anode?
2. What can you sa it forms at the ca
3. What conditions compound to be
4. How do you kno produced during
5. What forms at th elements, compo
6. In the extractio electrodes made
7. Name the substa in the extraction
8. In the electrolysi product forms at
9. Predict the two p of aqueous zinc b
10. During electrolys flow between th
11. In electrolysis of circumstances d
12. In the electrolysi you expect to ob
13. Why is it importa using electrolysis
14. What is the defin
15. Aluminium can't carbon. Explain w
16. Under what cond cathode in the el

Extension

1. Predict the products formed from the electrolysis of aqueous sodium chloride.
2. At which electrode do oxidation reactions occur during electrolysis?
3. In the electrolysis of NaCl, what is getting reduced, and to what?
4. Write the half-equation for the reaction at the cathode in the electrolysis of molte
5. Write the half-equation occurring at the anode in the electrolysis of aqueous $FeSO_4$
6. In the electrolysis of MgO, which substance is being oxidised, and to what?
7. Is this half-equation showing reduction or oxidation? $Fe^{3+} + 3e^- \rightarrow Fe$
8. Write the half-equation occurring at the anode in aqueous copper nitrate.
9. Write a half-equation showing that aluminium oxide gets reduced to form alumini
10. What is formed at the cathode in the electrolysis of NaBr(aq), and how can you tes
11. Why are the products of electrolysis of a molten compound different from its aqueo
12. Explain why the anode in the extraction of aluminium must be constantly repl
13. Describe, in terms of electrons, what happens to chloride ions at the anode.
14. What is formed at the anode in the electrolysis of $Cu(NO_3)_2(aq)$, and how can you t
15. Why is cryolite added to aluminium oxide during electrolysis?
16. Why is copper extracted from its ore using carbon, but magnesium is obtained usi
17. A student electrolyses $AlCl_3(aq)$ and expects Al metal to form – but it doesn't. Expla

Topic 9 — Energy Change

Fundamentals

1. What type of reaction is combustion – exothermic or endothermic?
2. In an exothermic reaction, how does the energy of the products compare to that of the reactants?
3. A chemical reaction releases 105 kJ of energy. How much energy is gained by the surroundings?
4. What is the name given to the minimum amount of energy particles need to react?
5. In reaction profiles, what does the distance between reactants and the top of the curve represent?
6. The temperature in a reaction changes from 20.3 °C to 17.1 °C. What is the temperature change?
7. Name a piece of equipment you could use to monitor the temperature change of a reaction.
8. Name one thing that enables you to tell that an endothermic reaction is happening.
9. When measuring the temperature change in a reaction, why is a polystyrene container used?
10. In a reaction, the products have less energy than the reactants. What happened to the extra energy?
11. Describe how a sports injury pack works.
12. Define the term 'endothermic reaction'.
13. True or false; in any reaction, products always have less energy than reactants?
14. If the products of a reaction have 50 kJ/mol of energy and the reactants have 67 kJ/mol, is the reaction endothermic or exothermic?

1. Give an exam exothermic re
2. In reaction pr between reac
3. In an exother change positi
4. State the labe reaction profi
5. The products the reactants energy chang
6. In a reaction higher than th reaction is thi
7. The products reactants hav energy chang
8. What happen universe duri
9. What happen reaction is be
10. Describe the
11. True or false; bonds are for energy of the energy of the
12. The temperat 19.7 °C to 21.

Extension

1. The energy change for breaking a C–C bond is +346 kJ/mol. What is the energy char
2. Two moles of H_2O are formed. An H–O bond has an energy of 463 kJ. What is the to
3. When a bond is broken, is energy taken in or given out?
4. Find the overall energy change if bonds broken = 36 kJ/mol and bonds formed = 54
5. Why must energy be supplied during a chemical reaction?
6. Is forming a bond exothermic or endothermic?
7. Two molecules collide but do not react. Explain why not.
8. Find the overall energy change if bonds broken = 298 kJ/mol and bonds formed = 2
9. Three moles of C–O are formed. A C–O bond has an energy of 1072 kJ. What is the
10. Give the formula for calculating the energy change of a reaction using bond energie
11. The overall energy change of a reaction has a negative sign. What does this mean?
12. Describe an endothermic reaction in terms of the energy needed to make and brea
13. When a sports injury pack is activated, the pack feels cold. Explain what is happenin
14. A reaction has a high activation energy. Explain this in terms of energy changes.

Fundamentals Tests

Topic 1 — A Simple Model of the At

1. What is the name of a substance that contains only one kind of atom?
2. What is the chemical symbol for sodium?
3. What is the name of a substance that contains more than one kind of atom
4. Is the air in the atmosphere an element, mixture or a compound?
5. State the practical technique that can be used to separate sand from salt w
6. Name the three types of subatomic particle found in an atom.
7. What is the charge on a neutron?
8. What is the relative charge of an electron?
9. What is the name of the element with 12 protons and 12 neutrons?
10. Name the third element in group 1.
11. What does the atomic number tell you about an atom?
12. What separation technique would you use a fractionating column for?
13. Describe the previously accepted plum pudding model of the atom.
14. What is the electronic structure of an element with 3 electrons?
15. How do the masses of protons, neutrons and electrons compare?
16. Name the pieces of equipment you would use to separate out glitter and w
17. What is the difference between separating the elements in a mixture and i

Topic 2 — The Periodic Table

1. The elements are arranged on the periodic table in ascending order of what
2. What is the same about the electronic structure of all elements in a group o
3. Are group 1 elements metals or non-metals?
4. Who first placed elements into groups based on their reactivity?
5. What is the common name given to the group 0 elements?
6. What type of elements form positive ions?
7. Which element has the chemical symbol P?
8. What type of elements are found at the top-right of the periodic table?
9. Name the compound formed when potassium reacts with chlorine gas.
10. State the reactivity of the group 0 elements.
11. Name the group in the periodic table whose elements have 8 outer electro
12. What kind of molecules do group 7 elements form?
13. Describe the trend in reactivity down group 1 of the periodic table.
14. Describe how the physical states of a metal and a non-metal differ at room
15. Describe what you would see when potassium reacts with water.
16. Write the word equation for the reaction between sodium and chlorine ga

Topic 3 — Chemical Bonds

1. Name the type of bonding in pure iron.
2. Predict the kind of bonding in copper chloride, a metal bonded with a non-
3. What charge would a group 1 ion have?
4. What do the dots and crosses represent in a dot-and-cross diagram?
5. What is the name of the covalent molecule with the formula CO_2?
6. What is the name for the attractive forces between ions?
7. What symbol is used to indicate a large number when representing polyme
8. In the formula Fe_2O_3, what do the numbers represent?
9. Give the chemical formula of a chlorine molecule.
10. Name the type of bonding in polymer molecules.
11. Predict the formula of the compound formed between calcium and fluorin
12. What kind of molecule is poly(ethene)?
13. What type of bonding is found in diamond?
14. Describe how a single covalent bond can be represented in diagrams of mo
15. What are delocalised electrons in metallic bonding?
16. Describe the bonding and structure of water.
17. Describe the dot-and-cross diagram for NH_3.
18. Give the definition of a polymer.

Topic 4 — Bonding and Structure

1. Name the three states of matter.
2. Name the state change from a gas to a liquid.
3. What phase transition occurs when a material freezes?
4. Polymers have strong forces between particles. Describe how this affects t
5. Why do metals have high melting and boiling points?
6. What symbol is used to show an aqueous solution?
7. What type of bonding is found in magnesium oxide?
8. What is the name of the structure of metals?
9. Name the only group of elements that do not form chemical bonds.
10. What is the name for the structure of diamond and silica?
11. Add in the state symbols to the reaction: $Ca + H_2SO_4 \rightarrow H_2 + CaSO_4$
12. Describe how the properties of pure iron and steel (an iron alloy) are differ
13. Describe the attractive forces in a giant ionic lattice.
14. Why are polymers usually solid at room temperature?
15. Pure metals are malleable. What does 'malleable' mean?
16. Describe why metals can be bent and shaped.
17. Describe the type of structure adopted by silicon.

Topic 5 — Carbon and Surface Properties and Quantitative Chemistry

1 What kind of bonding exists in diamond?
2 What shape are carbon nanotubes?
3 What material contains many layers of carbon atoms in hexagonal rings?
4 Give the name of the spherical molecule containing 60 carbon atoms.
5 Name one property of diamond that makes it suited for use in drill tips.
6 What is the name given to hollow carbon structures?
7 State one property that graphite has in common with metals.
8 What is the symbol for relative formula mass?
9 In a reaction, the sum of the reactant masses is 100 g. What is the sum of the product masses?
10 Give the units of concentration in terms of mass per given volume.
11 What is 230 cm^3 in dm^3?
12 What is the relative formula mass of NaOH?
13 What is the name given to a solid dissolved in a solvent to make a solution?
14 Calculate the concentration of a solution of 5 g NaCl in 0.1 dm^3.
15 Five volumes are recorded: 31, 29, 32, 46 and 30 cm3. Identify the anomalous result.
16 Calculate the mean of the following results to 3 sf: 3.40, 3.60, 3.55, 3.70.
17 Give the equation used to calculate the concentration of a solution in g/dm^3.
18 How would you estimate the uncertainty in the mean of a set of values?
19 What does the '3' in NH_3 mean?
20 Balance the equation: ?Li + ?O_2 → ?Li_2O

Topic 6 — Quantitative Chemistry (HT only)

1 What unit symbol is used for moles?
2 How many moles are in 24 g of NH_3? (M_r = 17)
3 1 mole of N_2 reacts with 1.5 moles H_2. How many moles of NH_3 are formed?
4 How much does one mole of iron weigh?
5 Give the equation for converting mass to number of moles.
6 How many particles are there in one mole of a substance?
7 How much KCl is formed if 20.0 g HCl reacts with excess KOH? HCl + KOH → KCl + H_2O
8 What is the relative formula mass of Fe_2O_3?
9 0.5 mol of CH_4 is burned. What volume of oxygen must be used to ensure complete combustion?
10 What is a limiting reactant?
11 In a reaction between Mg and HCl, HCl is in excess. What happens if more Mg is added?
12 Describe two ways of increasing the concentration of a solution.
13 True or false; one mole of NH_3 contains twice as many molecules as one mole of H_2?
14 If X and Y react in the ratio 2 : 3, how many moles of X are needed to react with 12 moles of Y?

Topic 7 — Metals and Acids

1 Give the general name of the compound formed when a metal reacts with oxygen.
2 Describe reduction in terms of oxygen.
3 Which is the most alkaline – pH 3, pH 7 or pH 13?
4 Name the metal salt formed when magnesium reacts with hydrochloric acid.
5 In the formation of a metal salt, where does the negative ion come from?
6 Name the type of metal salts formed from reacting with nitric acid.
7 Give the general equation for the reaction between a metal and an acid.
8 What is the difference between an alkali and a base?
9 Which is a 'strong' acid – hydrochloric acid or ethanoic acid?
10 Is the pH of an acid higher or lower than the pH of an alkali?
11 When an acid and an alkali react, what product is formed alongside the metal salt?
12 Write the chemical formula for calcium oxide.
13 Give the general equation for the reaction between a metal and water.
14 Name two pieces of equipment that you could use to measure the pH of a solution.
15 What is an acid?
16 In preparing a soluble salt, how do you know when all the acid has reacted?
17 What property of a metal determines its position in a reactivity series?
18 What is an alkali?

Topic 8 — Electrolysis

1 What is the negative electrode called?
2 What is the positive electrode called?
3 Predict the products formed from the electrolysis of molten copper chloride
4 Name the main compound that aluminium is extracted from using electroly
5 In the electrolysis of a molten ionic compound, wh... electrode does the n
6 In the electrolysis of molten zinc chloride, w... nat ...s are attracted to the ca
7 Identify the ions in an aqueous ... copper sulfate.
8 What is the name given ... liquid that can conduct electricity?
9 In the electrol... NO_3(aq), a grey solid forms at the cathode. Identify t
10 In th... ol... of molten LiCl, a colourless gas is formed at the anode. Id
11 What ... the electric current through the wires?
12 What type of ions are attracted to the cathode?
13 What happens to water molecules during electrolysis of aqueous solutions?
14 Give two reasons why extracting aluminium from ores using electrolysis is e
15 Explain why solid lithium chloride cannot be electrolysed.
16 What is an 'inert' electrode?
17 Describe the set-up of a simple electrolysis cell.

Topic 9 — Energy Changes

1 What type of reaction is combustion – exothermic or endothermic?
2 In an exothermic reaction, how does the energy of the products compare to
3 A chemical reaction releases 105 kJ of energy. How much energy is gained b
4 What is the name given to the minimum amount ... energy particles need to
5 In reaction profiles, what does the distance between reactants and the top
6 The temperature in a reaction ... from 20.3 °C to 17.1 °C. What is the
7 Name a piece of equi... could use to monitor the temperature char
8 Name ... thi... enables you to tell that an endothermic reaction is hap
9 When ... ring the temperature change in a reaction, why is a polystyren
10 In a re... on, the products have less energy than the reactants. What happe
11 Describe how a sports injury pack works.
12 Define the term 'endothermic reaction'.
13 True or false; in any reaction, products always have less energy than reacta
14 If the products of a reaction have 50 kJ/mol of energy and the reactants hav endothermic or exothermic?

Answers

Topic 1 — A Simple Model of the Atom

Fundamentals

1. Element
2. Na
3. Compound
4. A mixture
5. Filtratic
6. Protons, ...ns, neutrons
7. 0
8. -1
9. Magnesium
10. Potassium
11. Number of protons
12. Fractional distillation
13. Balls of positive charge with negative electrons dotted inside
14. 2, 1
15. Protons and neutrons have a mass of 1; the mass of electrons is much smaller
16. Beaker, funnel, filter paper
17. Compounds are separated by chemical processes, mixtures by physical processes

Challenge

1. $ZnSO_4$
2. -1
3. Fluorine
4. A liquid
5. Crystallisation
6. Salt / sodium chloride
7. 8
8. Alpha particle scattering experiment
9. Proton
10. The neutron
11. 10
12. The nucleus
13. Each ink travels a different distance up the paper
14. 2, 8
15. No reaction involved / More easily reversed / No new substance made
16. Magnesium + Hydrochloric acid → Magnesium chloride + Hydrogen
17. Atoms have the same number of pro... s ... electrons but a different num... r of ... utrons
18. Plum pudding mode... ...electrons inside a large p... ma... model: negative electrons orbiting ... positive nucleus.

Extension

1. Different boiling
2. 18
3. 1×10^{-10} m
4. 1×10^{-14} m
5. 2, 8, 8, 1
6. 10.8
7. Calcium, oxygen,
8. Mass number –
9. Niels Bohr
10. 0
11. Evaporating dish
12. Cl^-
13. Average value o... element, taking i...
14. The number of p... number of negat...
15. Most of the mass ... nucleus) and the
16. Tiny solid spheres ... any further
17. It has the same n... a different numb...

Topic 2 — The Periodic Table

Fundamentals

1. Atomic number
2. Number of outer electrons
3. Metals
4. Mendeleev
5. Noble gases
6. Metals
7. Phosphorus
8. Non-metals
9. Potassium chloride
10. Very low reactivity / Not reactive
11. Group 0
12. Molecules containing two atoms, e.g. Cl_2
13. Reactivity increases down the group
14. Metals are usually solid at room temperature, whereas non-metals are usually gases
15. Potassium fizzes violently, floats on the surface and burns with a lilac flame
16. Sodium + Chlorine → Sodium chloride

Challenge

1. Atomic number (and similar properties to choose groups)
2. 1
3. Helium
4. Potassium bromide, KBr
5. Displacement reaction
6. Higher
7. $4Li + O_2 \rightarrow 2Li_2O$
8. Group
9. Atomic / Boiling point / Melting point / Number of electrons
10. Elements were ordered by atomic weight and some were put in the wrong categories
11. Lithium floats on the water; bubbles are formed
12. They all have seven electrons in their outer shell
13. To leave space for elements that hadn't yet been discovered
14. It has four outer electrons
15. Br_2 is less reactive than Cl_2 so it can't displace the chloride ion

Extension

1. 2, 8, 5
2. Solid
3. $2LiBr + Cl_2 \rightarrow 2Li$
4. Cl is more reacti
5. Same number of
6. K
7. Orange
8. Iron is much den
9. It has four outer
10. NaOH is formed,
11. Particles are larg forces between
12. They don't need already have a f
13. An element with result in a higher element after it
14. Elements with si intervals / period
15. They have seven to gain a full out
16. As atomic size in away from the n to lose

Topic 3 — Chemical Bonds

Fundamentals

1. Metallic
2. Ionic
3. +1
4. Electrons
5. Carbon dioxide
6. Electrostatic forces
7. n
8. Ratio of i
9. Cl_2
10. Covalen
11. CaF_2
12. Polymer
13. Covalent
14. By a straight line
15. Electrons which move between metal atoms
16. Single covalent bonds between a central O atom and two H atoms
17. N in the middle, 2 electrons in each N–H overlap, 1 from N and 1 from H
18. A long chain molecule that is made up of many small molecules joined together

Challenge

1. A non-metal
2. Giant covalent structure
3. +2
4. Covalent
5. 2
6. The no
7. Ionic
8. 3D ball-and-stick model
9. NaCl
10. Dot-and-cross diagram
11. Metallic
12. 4
13. (Triple) covalent bond between N atoms
14. Suggests there are covalent bonds between the ions
15. It has lost two outer electrons to gain a group 0 configuration (full/empty outer shell)
16. The number of repeating units
17. In ionic bonding, electrons are transferred; in covalent bonding, electrons are shared
18. Benefit: shows where the electrons are being shared. Limitation: does not show the c bonds, only in 2D.

Extension

1. 8
2. 4 (two pairs)
3. 1
4. Lithium
5. $FeCl_2$
6. The nuclei of the
7. Giant covalent la
8. Ball-and-stick di
9. Covalent
10. Polymer
11. 2
12. Metallic
13. Regular arrange directions betwe
14. Both are non-me between a meta
15. Sodium is a gian atoms, which ar delocalised elect
16. Magnesium form delocalised elect stronger electros sodium only for
17. The simplest wh types of ions in t

Topic 4 — Bonding and Structure

Fundamentals

1. Solid, liquid, gas
2. Condensation
3. Liquid to solid
4. They have high melting points
5. Lots of strong metallic bonds
6. (aq)
7. Ionic
8. Alloy
9. Group [illegible] noble gases
10. Giant covalent lattice
11. $Ca(s) + H_2SO_4(aq) \rightarrow H_2(g) + CaSO_4(aq)$
12. Steel is harder than iron
13. Electrostatic attraction between oppositely charged ions
14. They are large molecules with many (relatively) strong intermolecular forces between them
15. Easy to hammer into shapes
16. Layers can slide over each other
17. Giant covalent structure

Challenge

1. Solid
2. Melting and freezing
3. Evaporation
4. Gas
5. Alloys are harder than pure metals
6. Liquid
7. Alloy
8. Covalent bonds are stronger than intermolecular forces
9. 2850 °C
10. Delocalised electrons
11. They increase
12. Liquid
13. Water has a higher boiling point – stronger interactions mean more heat energy is needed to overcome them
14. Negatively charged delocalised electrons and positively charged metal ions
15. Particles move around a lot and there is a lot of space between particles
16. Alternating positive sodium ions and negative chloride ions
17. Simple molecules only have weak intermolecular forces between them which are easier to overcome than covalent bonds

Extension

1. Liquid
2. Lead bromide, co
3. Gas
4. No overall electri
5. 3
6. Ion
7. It increases
8. NaCl
9. The boiling point
10. Repeating unit
11. High melting poi
12. No overall charge
13. No forces shown represented as s
14. Layer structure i prevents layers (
15. In solid KCl, the i ions are able to m
16. High thermal co thermal energy
17. Polymer molecul strong intermole

Topic 5 — Carbon and Surface Properties and Q
Chemistry

Fundamentals

1. Covalent
2. Cylindrical
3. Graphite
4. Buckminsterfullerene
5. Diamond is very hard
6. Fullerenes
7. It can c[illegible] ele[illegible]icity
8. M_r
9. 100 g
10. g/dm^3
11. $0.23\ dm^3$
12. 40
13. Solute
14. $50\ g/dm^3$
15. $46\ cm^3$
16. 3.55
17. Concentration = Mass ÷ Volume
18. Uncertainty = half the range of values
19. There are three hydrogen atoms in the molecule
20. $4Li + O_2 \rightarrow 2Li_2O$

Challenge

1. 4
2. Covalent
3. Weak intermolecular forc[illegible]
4. It is strong
5. Electro[illegible]
6. 3
7. Many strong covalent bonds which require a lot of heat energy to overcome
8. Buckminsterfullerenes
9. A single layer of graphite; each carbon atom makes three bonds in a hexagon pattern and has one delocalised electron
10. 5
11. 119
12. Mass = Concentration × Volume
13. $0.18\ dm^3$
14. $31\ cm^3$
15. 7.2 g
16. $Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$
17. 0.32 g
18. During a reaction no atoms are [illegible] so the mass stays the same thr[illegible]
19. The metal [illegible] from the oxygen in the air to f[illegible] oxi[illegible]
20. The rang[illegible] values in which the 'true' value sits
21. The sum of all the relative atomic masses in a compound

Extension

1. Softness
2. Carbon nanotub
3. Yes
4. Giant covalent la
5. One delocalised e move through th
6. Single layers are across each othe
7. Graphene has de electricity, wher
8. 164
9. $24.4\ g/dm^3$
10. 20.4 ± 2 g
11. $C_5H_{12} + 8O_2 \rightarrow 6H$
12. Volume = Mass ÷
13. It would react
14. Higher yield / Hi products / Chea
15. The volume of s solute stays cons
16. It decreases bec (carbon dioxide)

Topic 6 — Quantitative Chemistry (HT only)

Fundamentals

1. mol
2. 1.4 mol
3. 1 mole
4. 56 g
5. Mass ÷ M_r = Moles
6. 6.02×10^{23}
7. 41.0 g
8. 160
9. $24\ dm^3$
10. The reac[illegible] a reaction which limits the amount of product(s) that can be formed (has the least number of moles)
11. It will react with the excess HCl
12. Increase the amount of solute or decrease the volume of solvent
13. False; they contain the same number of molecules
14. 8

Challenge

1. 2
2. $2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$
3. 112.5 g
4. 250 g
5. The Avogadro constant
6. 16 g
7. $12\ dm^3$
8. $2Mg + O_2 \rightarrow 2MgO$
9. HCl becaus[illegible] enough moles to react with all the [illegible]87[illegible] mol Mg needs 0.375 mol HCl, but there is [illegible]356 available)
10. There is more of the reactant than can react, so some will be left unreacted
11. There are equal numbers of C atoms / CH_4 molecules
12. The relative formula mass in grams
13. Concentration increases because the mass/number of moles of solute has increased but the volume of solvent has not
14. 1.76

Extension

1. 21
2. 6
3. Fluorine
4. $2Mg + O_2 \rightarrow 2M$[illegible]
5. 8.5 g
6. 4.2 g
7. $0.13\ mol/dm^3$
8. 89.4 g
9. 3.35 g
10. 1.806×10^{23}
11. To ensure the ot[illegible]
12. The number of C[illegible]

Topic 7 — Metals and Acids

Fundamentals

1. Metal oxide
2. Loss of oxygen
3. pH 13
4. Magnesium chloride
5. The alkali/base/carbonate
6. Metal nitrates
7. Metal + Acid → Metal salt + Hydrogen
8. An alkali is a base that is soluble
9. Hydrochloric acid
10. Lower
11. Water
12. CaO
13. Metal + Water → Metal hydroxide + Hydrogen
14. Universal indicator, pH probe
15. A substance that releases H^+ ions in aqueous solution / has a pH lower than 7
16. Solid no longer reacts/dissolves and settles at the bottom of the reaction vessel
17. How easily it can lose electrons / form positive ions
18. A substance that releases OH^- ions in aqueous solutions / has a pH higher than 7

Challenge

1. Zinc sulfate / $ZnSO_4$
2. The concentration of H^+ ions
3. Carbon and hydrogen
4. Neutralisation
5. Carbon
6. $2HNO_3$ [illegible] → 2[illegible]$NO_3 + H_2O$
7. Metal salt, water and carbon dioxide
8. 7
9. Platinum / Gold / Silver
10. $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
11. Water and metal salt
12. 21.30 cm^3, 21.20 cm^3, 21.30 cm^3
13. Must be less reactive than carbon
14. $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$
15. Gold is very unreactive and it exists in the earth as a pure metal
16. React the acid with an insoluble metal/hydroxide/oxide/carbonate and crystallise
17. A list of metals placed in order of their reactivity

Extension

1. $Mg + H_2SO_4 \rightarrow M$
2. 0.12 mol/dm^3
3. Loss of electrons
4. Fe^{2+}
5. 100× more conce
6. $Zn + 2HCl \rightarrow ZnCl$
7. 18.65 cm^3
8. The strong acid
9. 0.23 mol/dm^3
10. $Mg^{2+}(aq) + 2Na(s)$
11. To make sure tha
12. The pH of Acid A of Acid B
13. A reaction in whi reduction occur
14. In a dilute acid, a solution. In a con dissolved in the s
15. In a strong acid, a In a weak acid, o molecules ionise.

Topic 8 — Electrolysis

Fundamentals

1. Cathode
2. Anode
3. Copper and chlorine
4. Aluminium oxide
5. Cathode
6. Zn^{2+}
7. Cu^{2+}, SO_4^{2-}, H^+, OH^-
8. Electrolyte
9. Ag / Silver metal
10. Cl_2
11. Electrons
12. Cations / Positively charged ions
13. They break down into H^+ and OH^- ions
14. A lot of fuel/energy is required to melt the ionic compounds and generate large amounts of electricity
15. It doesn't conduct electricity / The ions aren't free to move
16. An electrode that can be used for electrolysis but doesn't take part in the reaction itself
17. Two electrodes connected by a wire and a power source, and in contact with an electrolyte

Challenge

1. Anions / Negatively charged ions
2. It is less reactive than hydrogen
3. Needs to be in aqueous solution or molten
4. Colourless gas at the cathode
5. Elements
6. Carbon (graphite)
7. Cryolite
8. Chlorine
9. Hydrogen (H_2) and bromine (Br_2)
10. From the anode to the cathode
11. If there are no halide ions present in the solution
12. Colourless gas – sodium is more reactive than hydrogen so hydrogen gas is produced at the electrode
13. So the electrodes don't react and create impurities
14. The breakdown of ionic compounds using electricity to form elements
15. Aluminium is too reactive so carbon cannot reduce it
16. When the metal is more reactive than hydrogen

Extension

1. Hydrogen and chl
2. Anode
3. Na+ to Na
4. $K^+(aq) + e^- \rightarrow K(s)$
5. $4OH^- \rightarrow 4e^- + O_2$ +
6. O^{2-} to O_2
7. Reduction
8. $4OH^- + 4e^- \rightarrow 2H_2$
9. $Al^{3+}(aq) + 3e^- \rightarrow A$
10. H_2 gas (hold a bu squeaky 'pop')
11. Water molecules which can get dis
12. The electrode is r O^{2-} ions to produ
13. They lose electro get oxidised in th
14. Oxygen gas (test which relights if
15. Cryolite reduces t oxide so less ther the mixture
16. Magnesium is mo extracted using ca reactive, so it can
17. Aluminium is mor forms instead

Topic 9 — Energy Changes

Fundamentals

1. Exothermic
2. Energy of products is lower
3. 105 kJ
4. Activation energy
5. The activation energy
6. -3.2 °C
7. Thermometer
8. The temperature decreases, or the object/container feels cold
9. Polystyrene is an insulator so heat can't get out/get in
10. It got transferred to the surroundings
11. Once activated, an endothermic reaction occurs – this draws in energy from the surroundings and makes the pack feel cold
12. A reaction where energy is taken in from the surroundings
13. False; this is only true for exothermic reactions
14. Exothermic

Challenge

1. Hand warmer, self-heating can
2. Energy change of the reaction
3. Negative
4. x-axis: reaction progress; y-axis: energy
5. +16 kJ/mol
6. Exothermic
7. -20 kJ/mol
8. It stays the same
9. They do [illegible]ct
10. Energy can't be created or destroyed / The total energy of a system is the same before and after a reaction has occurred
11. False; the overall energy change of the reaction does not have to be 0
12. Exothermic

Extension

1. -346 kJ/mol
2. 1852 kJ
3. Taken in
4. -18 kJ/mol
5. To break the bon
6. Exothermic
7. The energy of the energy
8. + 77 kJ/mol
9. 3216 kJ
10. Energy change = reactants – Energ products
11. More energy is re reaction is exothe
12. The energy neede that released for
13. An endothermic r the pack, which t
14. A large amount o reaction to occur