

Kirkcaldy High School



Chemistry

National 5

**Unit 1 - Chemical Changes and
Structure**

TUTORIAL QUESTIONS

Introduction to Chemistry

1. Which box (or boxes) in the grid below shows:

- (a) something that always happens in a chemical reaction (2 boxes)
- (b) an example of an everyday chemical reaction (1 box)

A a gas given off	B a colour change	C a match burning
D a temperature rise	E a new substance forms	F an energy change occurs

2. In a table, divide the following list of substances into 2 groups: elements and compounds.

magnesium, iron, water, hydrogen, carbon dioxide, sodium chloride, nitrogen dioxide, lead

3.

(a) Which two boxes show

- (i) elements only
- (ii) a 2 element compound

(b) Which one box shows

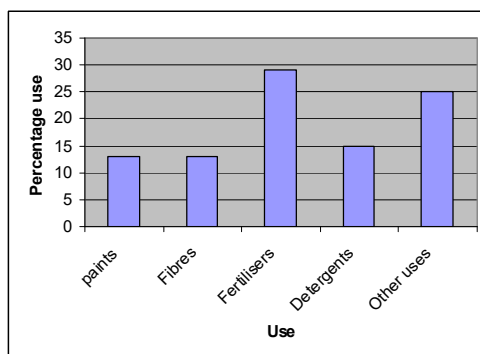
- (i) a 3 element compound
- (ii) a mixture

A sodium chloride	B copper oxide	C carbon
D helium and hydrogen	E chlorine	F barium nitrate

4. When the following elements react, name the compound they form:

- (a) iron and sulphur
- (b) magnesium and chlorine
- (c) zinc, sulphur and oxygen
- (d) lead, carbon and oxygen

5. Which elements are found in:
- (a) aluminium sulphide
 - (b) magnesium nitrate
 - (c) hydrogen chloride
 - (d) lithium sulphate
 - (e) calcium hydroxide
 - (f) silicon oxide
6. If a copper and sulphur mixture is heated, a red glow is seen to spread through the mixture and this continues even when the heating has stopped. A black solid remains at the end.
- (a) What is the difference between a mixture and a compound?
 - (b) Give 2 pieces of evidence that suggest that a chemical reaction has taken place.
 - (c) Name the black solid. Is it an element or a compound?
7. Jennifer makes a salt solution by dissolving salt in water.
- (a) Which substance is the solute and which is the solvent?
 - (b) What could she add to the solution to make it
 - (i) more dilute?
 - (ii) more concentrated?
 - (c) Vinegar can be made by dissolving ethanoic acid in water. Use a diagram to show how this could be done and label the solute, solvent and solution.
8. Sulphuric acid is one of the world's most important chemical compounds. This bar chart shows the uses of sulphuric acid in this country.
- (a) What is most sulphuric acid used to make?
 - (b) What % of sulphuric acid is used to make detergents?



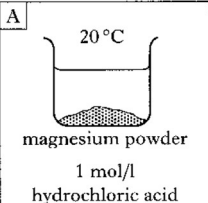
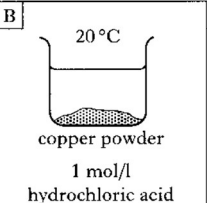
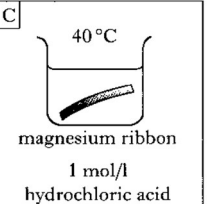
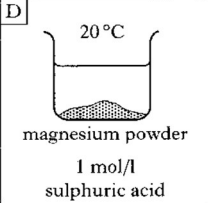
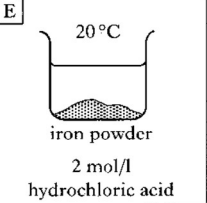
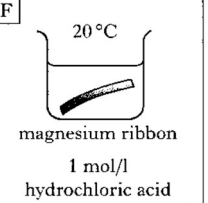
(a) Rates of Reaction

1. A pupil reacted 3g of calcium carbonate lumps with 50cm³ of 1mol l⁻¹ hydrochloric acid at room temperature. Suggest three changes that could be made to

(a) speed up this reaction

(b) slow this reaction

2.

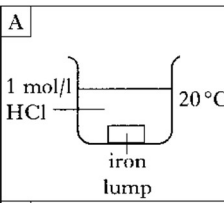
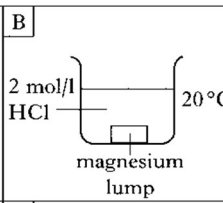
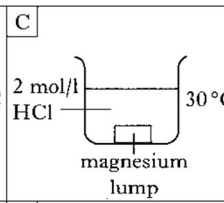
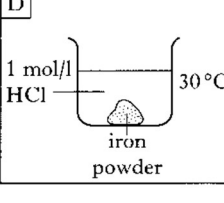
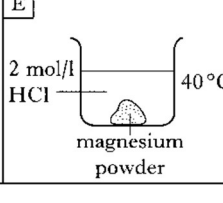
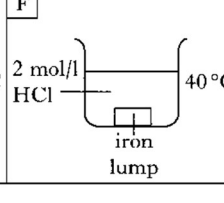
A  20°C magnesium powder 1 mol/l hydrochloric acid	B  20°C copper powder 1 mol/l hydrochloric acid	C  40°C magnesium ribbon 1 mol/l hydrochloric acid
D  20°C magnesium powder 1 mol/l sulphuric acid	E  20°C iron powder 2 mol/l hydrochloric acid	F  20°C magnesium ribbon 1 mol/l hydrochloric acid

(a) Identify the 2 experiments which should be compared to show the effect of particle size on the reaction rate.

(b) State which factor is being studied if experiments C and F are compared.

(c) Assuming the order of reactivity of metals is Mg>Fe>Cu, state which experiment would show the fastest reaction.

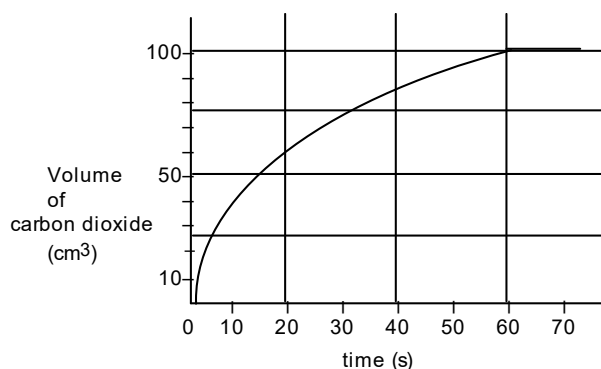
3.

A  1 mol/l HCl 20°C iron lump	B  2 mol/l HCl 20°C magnesium lump	C  2 mol/l HCl 30°C magnesium lump
D  1 mol/l HCl 30°C iron powder	E  2 mol/l HCl 40°C magnesium powder	F  2 mol/l HCl 40°C iron lump

(a) Identify the 2 experiments which should be compared to show the effect of temperature on the reaction rate.

(b) Explain why experiments A and F could not be used to study the effect of concentration on reaction rate.

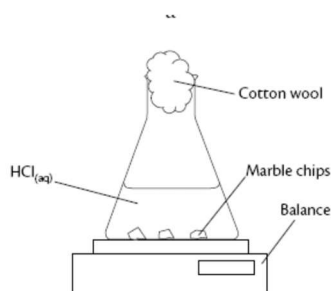
4. Everyday reactions: use your knowledge of the factors that affect reaction rate to explain the following.
- Why do powders that neutralize acid indigestion in your stomach work faster than tablets?
 - Explain why food is kept fresher for longer if stored in a refrigerator.
 - Explain why car exhausts rust faster than the underside of cars.
5. The graph below shows the volume of carbon dioxide released when an excess of powdered marble chips react with dilute acid.



- Explain why the slope of the graph is steepest at the start of the reaction.
 - Sketch the graph in your jotter and draw and label the curves you would expect if the experiment was repeated using:
 - a lower temperature
 - marble powder instead of lumps
 - Calculate the average rate of the chemical reaction in cm^3s^{-1} between 0s and 60 s
6. Which two boxes in the grid below show changes which happen when a catalyst is added to a reaction?

A The temperature increases	B Some of the catalyst is used up	C The rate of reaction is increased
D The catalysts can be recovered unchanged	E The number of reactants is increased	F A gas is always released

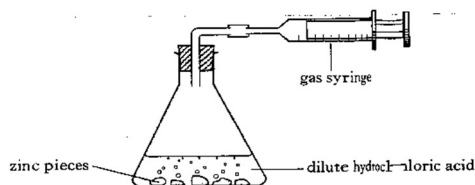
7. A group of pupils measured the speed of a reaction between marble chips and dilute acid. As the marble chips reacted, the balance recorded a change in mass. At the end of the reaction, all of the calcium carbonate has been used up.



Time /min	0	15	30	45	60	75	90
Mass loss /g	0	0.81	1.29	1.50	1.61	1.70	1.70

- (a) Explain why the mass decreased during the reaction.
- (b) Draw a line graph of mass versus time.
- (c) Sketch a line on your graph to show the result you would expect if the same experiment was repeated with a catalyst.
- (d) Calculate the average rate of the chemical reaction in g s^{-1} between 30s and 75 s
8. A pupil observed that the chemical hydrogen peroxide gives off oxygen gas when it is left sitting in a test tube. She also noted that when she added 2g of manganese dioxide to the hydrogen peroxide, the rate at which the oxygen was given off increased.
- (a) What name is given to chemicals such as manganese dioxide which speed up a reaction?
- (b) What mass of manganese dioxide would be left at the end of the experiment?

9. Zinc reacts with hydrochloric acid to produce hydrogen gas.



Results	
Time (seconds)	Volume of gas (cm ³)
0	0
10	20
20	40
30	58
40	72
50	80
60	

- State the test for hydrogen gas.
- During the experiment, the test tube becomes warm. What term is used to describe a reaction which gives out heat?
- Calculate the average rate of the chemical reaction in cm³s⁻¹ between 10s and 40s.
- Why would increasing the concentration of the acid increase the rate of the reaction?
- Explain why the reaction rate decreases as the reaction progresses.

(b) Atomic structure and bonding related to properties of materials

(i) Periodic Table and atoms

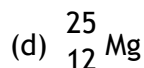
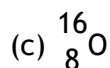
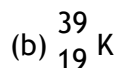
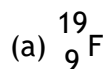
1. Draw a labelled diagram of the atom to show the nucleus, protons, electrons and neutrons.
2. Copy and complete the following table to show the masses and charges of the sub-atomic particles.

Name of particle	Mass /amu	Charge
Proton		
Electron		
Neutron		

3. State the charge of the nucleus.
4. Explain why atoms are neutral.
5. Use your data booklet to copy and complete the following table.

Element	Li	Na	K	Rb	Cs
Atomic number					
Melting point / °C					

- (a) What is the relationship between atomic number and melting point for the group 1 elements?
 - (b) In terms of electron, why do these elements have similar chemical properties?
 - (c) What name is given to this group of elements?
6. State the number of protons, electrons and neutrons in the following atoms.



7. Copy and complete the following table

Element	Atomic number	Mass number	Number protons	Number neutrons	Electron arrangement
Carbon	6	12			
Potassium		39			2,8,8,1
			18	22	

8.

(a) Name the elements with the following electron arrangements:

- (i) 2,8,1
- (ii) 2,8,8
- (iii) 2,4
- (iv) 2,8,18,7

(b) From the list above name the element that is a member of:

- (i) the alkali metals
- (ii) the halogens
- (iii) the noble gases

9. Write nuclide notation for the following atoms:

- (a) An oxygen atom with 10 neutrons
- (b) An atom with atomic number 6 and 7 neutrons
- (c) An atom with 17 protons and 20 neutrons
- (d) An atom of hydrogen, mass number 3.

10. ${}_{12}^{25}\text{Mg}$ and ${}_{12}^{24}\text{Mg}$ are two different kinds of magnesium atom.

- (a) What word is used to describe these types of atoms?
- (b) Explain why they can be regarded as atoms of the same element?
- (c) The relative atomic mass of magnesium is 24.3. What does this tell you about the relative amounts of each atom?

11. An atom has atomic number 23 and mass number 51. The number of electrons is

- (a) 23
- (b) 28
- (c) 51
- (d) 74

12. An atom is neutral because

- (a) the number of protons equals the number of neutrons
- (b) the number of electrons equals the number of protons
- (c) the number of electrons equals the number of protons plus neutrons
- (d) the number of neutrons equals the number of protons plus electrons

13. Which of the following is the electron arrangement of a metal?

- (a) 2,8,1
- (b) 2,8,5
- (c) 2,8,7
- (d) 2,8,8

14. Different isotopes of the same element have identical

- (a) nuclei
- (b) mass numbers
- (c) number of neutrons
- (d) number of protons

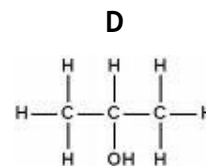
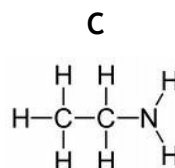
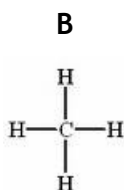
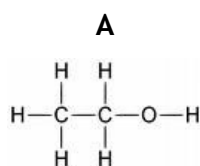
15. Copy and complete the table to show the particles present in the following atoms

and ions.

Particle	Ion or atom?	Atomic number	Mass number	Number of protons	Number of electrons	Number of neutrons
$^{27}_{13}\text{Al}^{3+}$						
$^{35}_{17}\text{Cl}^-$						
$^{24}_{12}\text{Mg}$						
$^{18}_8\text{O}^{2-}$						
$^{40}_{20}\text{Ca}^{2+}$						

(ii) Covalent Bonding

1. Write the chemical formula for the following molecules



2. Which of the following 2 chemicals will be made up of molecules?

A Sodium Chloride	B Hydrogen bromide	C Carbon dioxide	D Zinc chloride
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3.

(a) Explain what is meant by a diatomic molecule?

(b) Give three examples of diatomic elements.

4. Write the chemical formula for the following elements

A Fluorine	B Magnesium	C Nitrogen	D Phosphorus
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5. Write the chemical formula for the following compounds

A Hydrogen chloride	B Phosphorus oxide	C Nitrogen hydride
D Carbon iodide	E Silicon oxide	F Hydrogen sulphide

6. Write the chemical formula for the following compounds

A Carbon dioxide	B Nitrogen trichloride	C Sulphur trioxide
D Carbon monoxide	E Carbon tetrachloride	F Silicon tetrafluoride

7. Draw the electron arrangement diagrams to show how the electrons are shared in the following molecules.

- (a) Hydrogen joined to carbon
- (b) Nitrogen joined to chlorine
- (c) Hydrogen joined to oxygen
- (d) Nitrogen joined to nitrogen

8. Hence, write the chemical formula for the molecules in Q.7

9. Describe how the covalent bond holds the atoms together in a molecule of hydrogen chloride. Use a diagram to illustrate your answer.

10. Why does hydrogen exist as 2 atoms joined together?

11. Write chemical formula for following molecules:

A Phosphorus iodide	B Carbon fluoride	C Silicon bromide
D Silicon tetrachloride	E Phosphorus oxide	F Hydrogen sulphide
G Sulphur iodide	H Oxygen	I Fluorine

12. For the following molecules,

- (a) write the chemical formula
- (b) draw the shape.

A Carbon hydride	B Nitrogen hydride	C Hydrogen oxide
D Phosphorus fluoride	E Hydrogen chloride	F Silicon fluoride

13. Draw electron arrangement diagrams to show how the following molecules form covalent bonds.

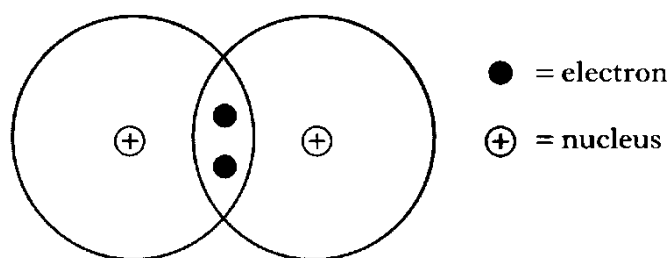
- (a) Fluorine
- (b) Oxygen
- (c) Nitrogen
- (d) Hydrogen iodide
- (e) Nitrogen hydride
- (f) Carbon hydride

14. Write chemical formula for the following

- (a) Nitrogen
- (b) Aluminium
- (c) Hydrogen
- (d) Chlorine
- (e) Bromine
- (f) Hydrogen oxide
- (g) Carbon chloride
- (h) Nitrogen fluoride
- (i) Silicon bromide
- (j) Silicon dioxide
- (k) Silicon tetraoxide
- (l) Dinitrogen tetraoxide

15.

In a hydrogen molecule the atoms share 2 electrons in a covalent bond.



(a) Explain how the covalent bond holds the 2 hydrogen atoms together.

(b) The hydrogen molecule can be represented more simply as



Showing all outer electrons, draw a similar diagram to represent a molecule of ammonia NH_3 .

(c) Draw another diagram to show the shape of an ammonia molecule.

16. Draw the true shapes for the following molecules:

(a) SiCl_4

(b) H_2S

(c) NF_3

(d) HCl

(e) CH_4

17.

(a) Name the charged particle that flows through metals when they conduct.

(b) Name a non-metal element that conducts electricity.

(c) Draw a labelled diagram of an experiment you would perform to test if a substance was an electrical conductor or insulator.

(iii) Ionic Compounds

1. For the following compounds, state whether the bonding is likely to be ionic or covalent.

- (a) Lithium iodide
- (b) Zinc oxide
- (c) Aluminium nitride
- (d) Carbon chloride
- (e) Fluorine
- (f) Magnesium sulphide
- (g) Nitrogen hydride

2.

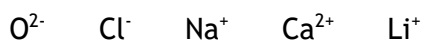
A Sodium iodide	B Silicon dioxide
C Bromine	D Gold
E Carbon graphite	F Magnesium nitrate

- (a) Which letter shows a non-metallic conductor?
 - (b) Which two letters show substances that never conduct?
 - (c) Which two letters shows a substance that conducts when solid?
 - (d) Which letter show a covalent compound?
 - (e) Which two letters show substances which could form an electrolyte?
 - (f) Which two letters show substances which conduct by movement of electrons?
3. During the electrolysis of a molten compound, the elements lead and chlorine were formed.
- (a) What is meant by electrolysis?
 - (b) Name the compound being electrolysed.
 - (c) What type of bonding is present in this compound?
 - (d) Explain why the compound must be molten for electrolysis to work.
 - (e) At which electrode will the (i) lead (ii) chlorine be formed?
 - (f) Using page 10 of the data booklet, write ion electron equations for the formation of lead and chlorine.

4. Name the products at the (i) positive electrode (ii) negative electrode when melts of the following compounds are electrolysed:
- Lithium iodide
 - Calcium chloride
 - Zinc fluoride
 - Nickel bromide
5. Write ion electron equations for the following (use page 10 of the data booklet):
- forming copper from copper(II) ions
 - forming lithium from lithium ions
 - forming chlorine from chloride ions
 - forming fluorine from fluoride ions
6. For the following compounds, suggest whether they will have (i) high melting points or (ii) low melting points
- Silver iodide
 - Carbon fluoride
 - Titanium oxide
 - Silicon bromide
7. Explain fully why:
- covalent compounds do not conduct electricity.
 - metals conduct in the solid state.
 - solid ionic compounds do not conduct.
 - ionic compounds have very high melting points.
 - carbon diamond has a high melting point.
8. Using sodium chloride and hydrogen chloride as examples, explain how an ionic bond and covalent bond are formed.
9. Copy and complete the following table

Particle	Atomic no.	Mass no.	No. of neutrons	Electron arrangement
Ar		40		2,8,8
F ⁻	9		11	
Al ³⁺	13	27		

10.



Which of the above ions has the same electron arrangement as neon?

11. Write formula, showing ions for the following compounds:

- (a) Calcium oxide
- (b) Lithium bromide
- (c) Aluminium oxide
- (d) Sodium sulphate
- (e) Magnesium hydroxide
- (f) Zinc (II) sulphide
- (g) Lead (II) chloride
- (h) Silver (I) oxide
- (i) Copper (II) nitrate
- (j) Ammonium nitrate
- (k) Potassium phosphate
- (l) Aluminium phosphate

12. Study the table below, and use the information to work out the expected colour of

- (a) nickel chloride
- (b) Potassium dichromate
- (c) Ammonium nitrate
- (d) Ammonium nickel sulphate

Substance	Colour
Ammonium chloride	Colourless
Sodium nitrate	Colourless
Potassium sulphate	Colourless
Ammonium dichromate	Orange
Nickel nitrate	Green

(c) Formulae and reacting quantities

(i) Chemical Formulae

1. Write the chemical formula for the following compounds:

- (a) Hydrogen chloride
- (b) Phosphorus oxide
- (c) Nitrogen hydride
- (d) Magnesium hydride
- (e) Carbon iodide
- (f) Silicon oxide
- (g) Sodium chloride
- (h) Potassium chloride

2. Write the chemical formula for the following compounds:

- (a) Sulphur dioxide
- (b) Carbon dioxide
- (c) Dinitrogen tetraoxide
- (d) Dihydrogen oxide
- (e) Carbon monoxide
- (f) Nitrogen trihydride
- (g) Dihydrogen dioxide

3. Write the chemical formula, showing charges for the following compounds:

- (a) Copper (II) oxide
- (b) Silver (I) hydride
- (c) Cobalt (II) chloride
- (d) Zinc (III) iodide
- (e) Iron (III) oxide
- (f) Copper (I) hydride
- (g) Nickel (II) sulphide
- (h) Lead (I) sulphide

4. Write the chemical formula, showing charges for the following compounds:

- (a) Sodium sulphate
- (b) Magnesium hydroxide
- (c) Ammonium nitrate
- (d) Calcium carbonate
- (e) Potassium phosphate
- (f) Calcium chromate
- (g) Potassium hydroxide
- (h) Lithium nitrate

5. Write the chemical formula, showing charges for the following compounds:

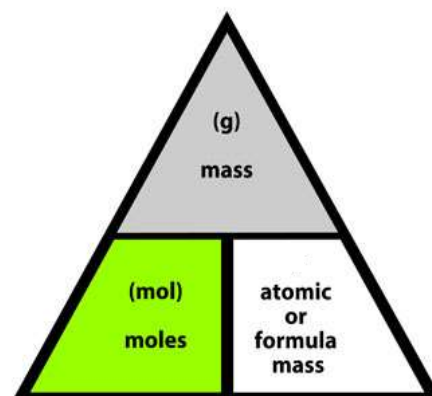
- (a) Zinc (II) sulphate
- (b) Lead (II) sulphide
- (c) Silver (I) oxide
- (d) Copper (II) nitrate
- (e) Sodium chloride
- (f) Copper (II) carbonate
- (g) Sodium hydroxide
- (h) Silver (II) nitrate

(ii) Calculations involving the mole and balanced equations

Show your working clearly and remember to include units in answers!

1. Find the formula mass of the following:

- (a) NaCl
- (b) C₂H₆
- (c) calcium chloride
- (d) nitrogen dioxide
- (e) lead (II) bromide



2. Calculate the mass of the following:

- (a) 2 moles of CH₄
- (b) 10 moles of CO₂
- (c) 0.25 moles of calcium phosphate
- (d) 0.02 moles of copper (II) oxide
- (e) 3 moles of ammonium phosphate

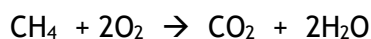
3. Calculate the number of moles in:

- (a) 20g of Calcium
- (b) 100g of NaOH
- (c) 128g of Sulphur dioxide
- (d) 25g of lithium chloride
- (e) 0.5g of iron (III) oxide

4. Balance the following equations:

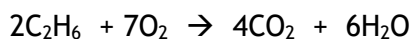
- (a) H₂ + O₂ → H₂O
- (b) Fe + Cl₂ → FeCl₃
- (c) Cu + AgNO₃ → Cu(NO₃)₂ + Ag
- (d) Zn + HCl → ZnCl₂ + H₂
- (e) Pb(NO₃)₂ + AlCl₃ → PbCl₂ + Al(NO₃)₃

5. Using the balanced equation:



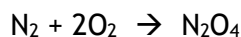
Calculate the mass of carbon dioxide formed when 70g of methane reacts with excess oxygen.

6. Using the balanced equation:



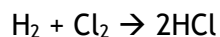
Calculate the mass of oxygen required to react with 100g of ethane.

7. Using the balanced equation:



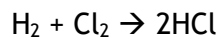
Calculate the mass of dinitrogen tetroxide formed when 400kg of nitrogen is reacted with excess oxygen.

8. Using the balanced equation:



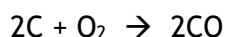
Calculate the mass of chlorine required to react with 400g of hydrogen.

9. Using the balanced equation:



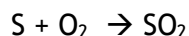
Calculate the mass of hydrogen required to react with 355g of chlorine.

10. Using the equation:



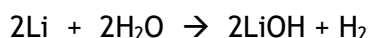
Calculate the mass of CO produced when excess C is burned in 64g of oxygen

11. Using the equation:



Calculate the mass of sulphur dioxide formed when 300tonnes of sulphur is reacted with excess oxygen.

12. Using the equation:



Calculate the mass of water needed to react with 350kg of Li.

(iii) Percentage Mass

1. Calculate the percentage mass of:

- (a) Nitrogen in nitrogen hydride
- (b) Oxygen in water
- (c) Iron in iron(III)sulfate
- (d) Carbon in carbon dioxide
- (e) Silicon in silicon chloride
- (f) Nitrogen in dinitrogen tetroxide
- (g) Sodium in sodium carbonate
- (h) Phosphorus in Magnesium phosphide
- (i) Carbon in sodium ethanoate
- (j) Hydrogen in ammonium phosphide

(d) Acids and bases

(i) pH

1. For these questions, make use of page 8 of your data booklet.

From the answer grid below, select the letter(s) which contain substances which could be used to make:

- (a) an acid
- (b) an alkali
- (c) a neutral solution

A Magnesium oxide	B Sulphur dioxide	C Copper(II)oxide
D Hydrogen oxide	E Calcium oxide	F Carbon dioxide

2. Describe how acid rain is formed and describe some of the effects of acid rain.

3.

- (a) Explain how nitrogen and oxygen can combine in a car engine.
- (b) Name a metal which can be used as a catalyst in the catalytic convertor.
- (c) Name the two pollutant gases changed by the catalyst and describe what they are changed into.

4. Explain why solid citric acid does not conduct electricity yet when it dissolves in water it does conduct.

5. Electrolysis of acids can be used to confirm the presence of hydrogen ions.

- (a) At which electrode will hydrogen form?
- (b) Write an ion-electron equation to show the formation of hydrogen (use page 10 of the data booklet)
- (c) State the test for hydrogen gas

6. Explain why pure water conducts electricity.

7. The grid below contains various statements which apply to solutions.

A It contains more H ⁺ ions than pure water	B It has a pH =7
C It has a pH less than 7	D It contains ions
E It contains more OH ⁻ ions than pure water	F It has a pH greater than 7

- (a) Which 3 boxes apply to an acid?
- (b) Which 2 boxes apply to pure water?
- (c) Which 3 boxes apply to an alkali?

8. Write the chemical formula, showing charges for the following acids and bases:

- (a) sodium hydroxide
- (b) hydrochloric acid
- (c) nitric acid
- (d) sulphuric acid
- (e) potassium hydroxide

9. An electric current was passed through different solutions. The results are shown in the table.

Solution	Positive electrode product	Negative electrode product
Hydrochloric acid	Chlorine	Hydrogen
Potassium chloride	Chlorine	Hydrogen
Sulphuric acid	Oxygen	Hydrogen
Sodium nitrate	Oxygen	Hydrogen
Nitric acid	Oxygen	Hydrogen
Silver nitrate	Oxygen	Silver

- (a) From the results, suggest a general statement which can be made about acids.
- (b) From the results, predict the products at the positive and negative electrodes if potassium nitrate solution is used.
- (c) Explain why potassium chloride conducts electricity when dissolved in water, but not when solid.

(ii) Neutralisation reactions

1. Give two examples of everyday neutralisation.
2. Which of the following is not an example of a salt

A Sodium chloride	B Potassium nitrate
C Lithium sulphate	D Magnesium oxide

3. Name the salt formed in the following reactions:
 - (a) Hydrochloric acid + potassium hydroxide
 - (b) Sulphuric acid + calcium hydroxide
 - (c) Lithium hydroxide + nitric acid
 - (d) Sodium hydroxide + sulphuric acid
4. Write chemical equations for the reactions in question 3.
5. When substance X was added to hydrochloric acid a colourless gas Y (which turned limewater chalky) was given off. A flame test on X gave a bright yellow colour.
 - (a) Name gas Y
 - (b) What does the flame test tell you about X?
 - (c) Name X and write its chemical formula.
6. Write (i) word equations (ii) chemical equations for the following reactions:
 - (a) sodium hydroxide + sulphuric acid
 - (b) calcium carbonate + hydrochloric acid
 - (c) copper(II) carbonate + nitric acid
 - (d) potassium carbonate + sulphuric acid
7. Write (i) word equations (ii) chemical equations for the following reactions:
 - (a) magnesium + hydrochloric acid
 - (b) calcium oxide + sulphuric acid
 - (c) copper (II) oxide + nitric acid
 - (d) sodium hydroxide + sulphuric acid
 - (e) sodium oxide + nitric acid
 - (f) zinc + hydrochloric acid

8. A pupil tried to make copper (II) sulphate by reacting copper with sulphuric acid. Explain why this method would not work, and suggest an alternative method for making copper (II) sulphate.
9. Re-write the following equations, omitting spectator ions, to show the ions which react
- (a) $\text{Na}^+\text{OH}^- + \text{H}^+\text{Cl}^- \rightarrow \text{Na}^+ \text{Cl}^- + \text{H}_2\text{O}$
- (b) $\text{Na}^+\text{OH}^- + \text{H}^+\text{NO}_3^- \rightarrow \text{Na}^+ \text{NO}_3^- + \text{H}_2\text{O}$
- (c) $\text{Ca}^{2+}\text{CO}_3^{2-} + (\text{H}^+)_2\text{SO}_4^{2-} \rightarrow \text{Ca}^{2+} \text{SO}_4^{2-} + \text{CO}_2 + \text{H}_2\text{O}$
- (d) $\text{Mg} + 2 \text{H}^+\text{Cl}^- \rightarrow \text{Mg}^{2+}(\text{Cl}^-)_2 + \text{H}_2$
- (e) $\text{Ca}^{2+}\text{O}^{2-} + (\text{H}^+)_2\text{SO}_4^{2-} \rightarrow \text{Ca}^{2+} \text{SO}_4^{2-} + \text{H}_2\text{O}$

10. Name the insoluble salt formed in the following precipitation reactions:

- (a) silver nitrate (aq) + sodium chloride (aq) →
- (b) barium nitrate (aq) + copper(II) sulphate (aq) →
- (c) sodium carbonate (aq) + calcium nitrate (aq) →

11.

- (a) Re-write the word equations in Q10 as completed chemical equations, showing ions.
- (b) Re-write the equations omitting the spectator ions.

(iii) Neutralisation reactions can be used to prepare soluble salts



20cm³ of 1 mol l⁻¹ sodium hydroxide was neutralised by 40cm³ hydrochloric acid. Calculate the concentration of the acid.

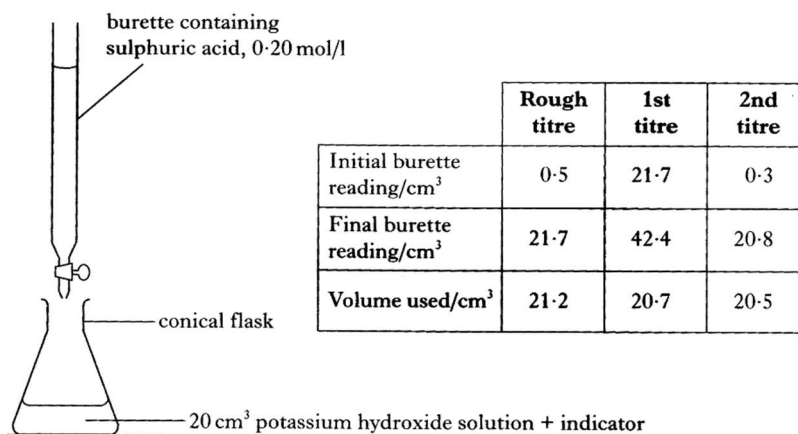


50cm³ of potassium hydroxide was required to neutralise 25cm³ of sulphuric acid (concentration 2 mol l⁻¹). Calculate the concentration of the potassium hydroxide.



100cm³ calcium hydroxide, concentration 2 mol l⁻¹ was required to neutralise hydrochloric acid, concentration 3 mol l⁻¹. Calculate the volume of hydrochloric acid.

4. A pupil carried out a titration using the chemicals and apparatus shown below.



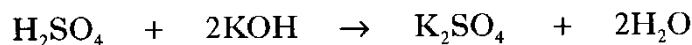
(a) How would the pupil know when to stop adding acid from the burette?

(b)

(i) What average volume should be used to calculate the number of moles of sulphuric acid needed to neutralise the potassium hydroxide solution?

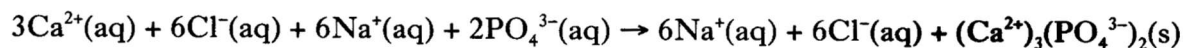
(ii) Calculate the number of moles of sulphuric acid in this average volume. Show your working clearly.

(c) The equation for the titration reaction is



Calculate the number of moles of potassium hydroxide in 20cm³ of the potassium hydroxide solution. Show your working clearly.

5. Bones are formed when calcium ions and phosphate ions combine to form insoluble calcium phosphate, Ca₃(PO₄)₂. This reaction can be reproduced in the laboratory by adding a solution of calcium chloride to a solution of sodium phosphate.



(a) Identify the spectator ions in the above equation.

(b) What technique could be used to remove the calcium phosphate from the mixture?

6. Roy was instructed to make 50cm³ of a 1 mol l⁻¹ solution of copper chloride, CuCl₂. Calculate the mass in grams of copper chloride needed.

7.

A sodium hydroxide	B potassium nitrate	C sodium chloride
D lithium carbonate	E sodium phosphate	F barium sulphate

(a) Identify the 2 bases.

(b) Identify the compound which could be prepared by precipitation. You may wish to refer to page 8 of the data booklet.

8. Precipitation reactions can be used to prepare some salts.

A copper nitrate	B barium sulphate
C lithium carbonate	D sodium chloride

(a) Identify the salt which can be prepared by a precipitation reaction.

(b) Identify the 2 soluble salts which would form a precipitate when mixed. You may wish to use page 8 of the data booklet.

9.

A	It reacts with magnesium.
B	It has a pH less than 7.
C	It does not conduct electricity.
D	It produces chlorine gas when electrolysed.
E	The concentration of $H^+(aq)$ ions in solution is equal to the concentration of $OH^-(aq)$ in solution.

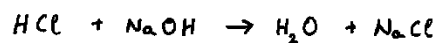
(a) Identify the 2 statements which can be applied to both dilute hydrochloric acid and dilute sulphuric acid.

(b) Identify the statement which can be applied to sodium chloride solution but not to dilute hydrochloric acid.

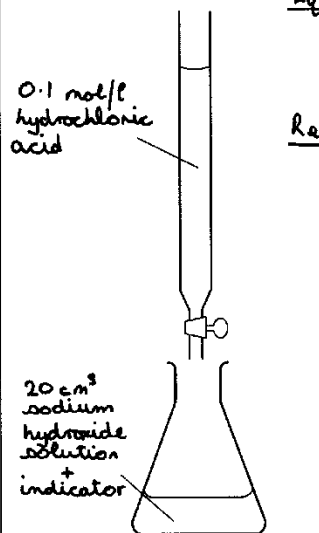
Titration experiment

Aim To find the concentration of a sodium hydroxide solution using 0.1 mol/l hydrochloric acid.

Equation



Results Volume of sodium hydroxide solution used = 20 cm³



	Rough titre	1st titre	2nd titre
starting vol. (cm ³)	0.0	15.9	31.0
final vol. (cm ³)	15.9	31.0	45.9
Total vol. (cm ³)	15.9	15.1	14.9

$$\begin{aligned} \text{Average volume of hydrochloric acid used} &= \frac{15.1 + 14.9}{2} \\ &= \underline{15.0 \text{ cm}^3} \end{aligned}$$

Teacher M. Finlay

Date 15.1.98

Use the pupil's results to calculate the concentration of the sodium hydroxide solution.