

Chemical Changes Part 4

Q1.

An oven cleaner solution contained sodium hydroxide. A 25.0 cm^3 sample of the oven cleaner solution was placed in a flask. The sample was titrated with hydrochloric acid containing 73 g/dm^3 of hydrogen chloride, HCl.

- (a) Describe how this titration is carried out.

(3)

- (b) Calculate the concentration of the hydrochloric acid in mol/dm^3 .

Relative atomic masses: H 1; Cl 35.5

Answer = _____ mol/dm^3

(2)

- (c) 10.0 cm^3 of hydrochloric acid were required to neutralise the 25.0 cm^3 of oven cleaner solution.

- (i) Calculate the number of moles of hydrochloric acid reacting.

Answer = _____ mol

(2)

- (ii) Calculate the concentration of sodium hydroxide in the oven cleaner solution in mol/dm^3 .

Answer = _____ mol/dm^3

(2)

(Total 9 marks)

Q2.

Calcium tablets are taken to build and maintain strong bones and teeth.



- (a) These tablets react with hydrochloric acid in the stomach.



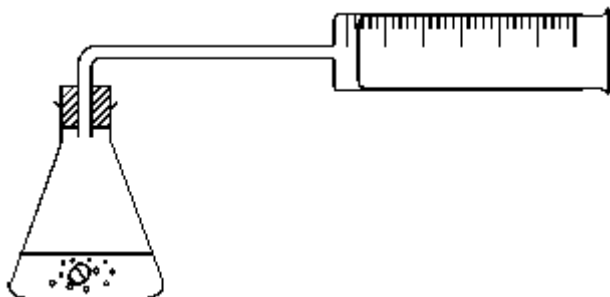
- (i) Add all these missing state symbols aq g l s to the balanced chemical equation.

(2)

- (ii) The calcium salt that is formed is absorbed during digestion. What is the name of the calcium salt?

(1)

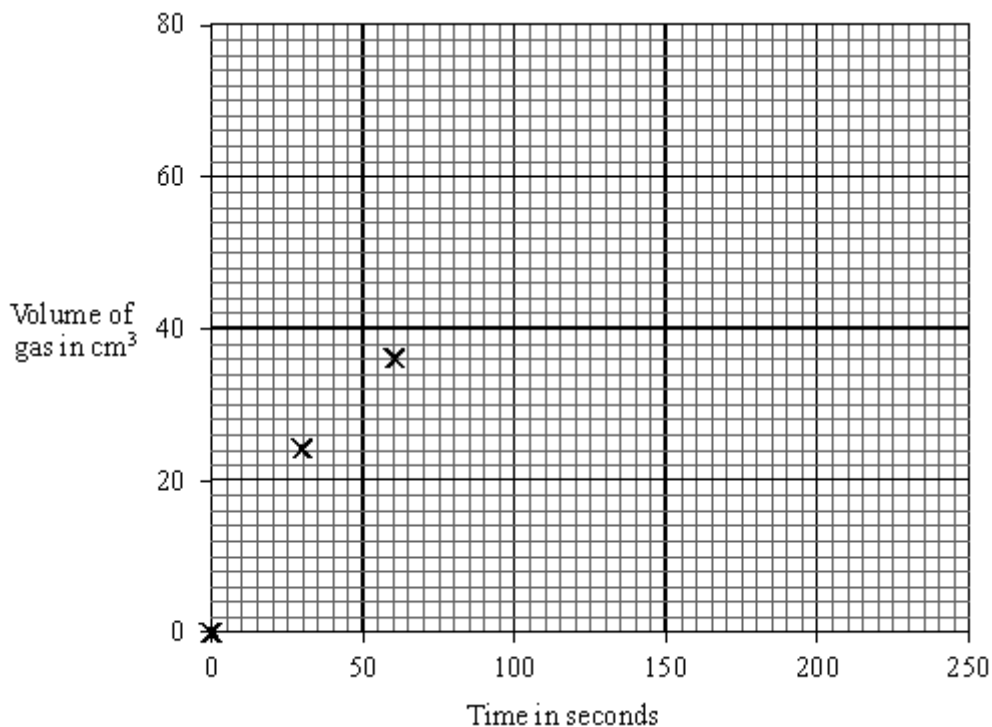
- (b) The volume of carbon dioxide produced by one calcium tablet in the stomach can be found as shown.



The volume of carbon dioxide was recorded every 30 seconds until the reaction stopped.

Time in seconds	0	30	60	90	120	150	180	210	240
Volume of gas in cm³	0	24	36	46	52	56	59	60	60

- (i) Complete the graph of these results.



(3)

- (ii) Describe **one** way in which this reaction can be made to go faster.

(1)

- (iii) A calculation, using the mass of this tablet, showed that 80 cm³ of carbon dioxide would be produced if the tablet was pure calcium carbonate. What do the results show about the purity of the tablet? Explain your answer by calculating the purity of this tablet.

(3)

(Total 10 marks)

Q3.

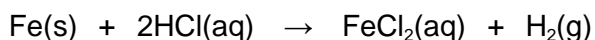
This article appeared in a newspaper.

EXPLOSIVE GAS SCARE

WORKERS EVACUATED FROM FACTORY

An explosive gas was released by a leak of concentrated hydrochloric acid reacting with steel

- (a) The balanced chemical equation shows the reaction between steel and hydrochloric acid.



- (i) Which metal in steel reacted with the hydrochloric acid?

(1)

- (ii) The gas released was described as explosive. Explain why.

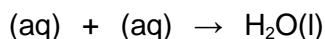
(3)

- (b) In the factory hydrogen chloride is manufactured by reacting hydrogen with chlorine. Hydrochloric acid is formed when hydrogen chloride forms a solution in water.

- (i) Water was sprayed on the steel and hydrochloric acid. This slowed the rate of reaction. Explain why.

(2)

- (ii) It would have been better to neutralise the acid with an alkali rather than to just add water. Hydrochloric acid can be neutralised by reaction with sodium hydroxide. Complete the ionic equation for the neutralisation reaction.



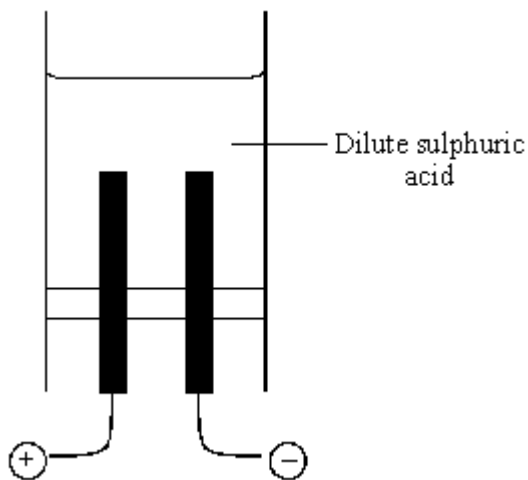
(2)

- (iii) In the factory the acid leak was neutralised with slaked lime, Ca(OH)_2 , and not sodium hydroxide, NaOH . Suggest why.

(2)
(Total 10 marks)

Q4.

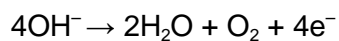
An electric current was passed through dilute sulphuric acid. The apparatus used is shown. Oxygen was formed at the anode.



- (a) What name is given to solutions which decompose when electricity is passed through them?

(1)

- (b) The ionic equation for the reaction at the anode is:



Explain this type of reaction.

(2)

- (c) Write a **balanced** ionic equation for the reaction at the cathode.

(2)

- (d) What happens to the concentration of the sulphuric acid as the electricity is passed through it? Explain your answer.

(3)
(Total 8 marks)

Q5.

A student carried out a titration to find the concentration of a solution of hydrochloric acid. The following paragraph was taken from the student's notebook.

I filled a burette with hydrochloric acid. 25.0 cm³ of 0.40 mol/dm³ potassium hydroxide was added to a flask. 5 drops of indicator were added. I added the acid to the flask until the indicator changed colour. The volume of acid used was 35.0 cm³.

- (a) What piece of apparatus would be used to measure 25.0 cm³ of the potassium hydroxide solution?

(1)

- (b) Name a suitable indicator that could be used.

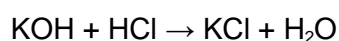
(1)

- (c) Calculate the number of moles of potassium hydroxide used.

Moles of potassium hydroxide = _____ mol

(2)

- (d) Calculate the concentration of the hydrochloric acid. The equation for the reaction is:



Concentration of hydrochloric acid = _____ mol/dm³

(2)

(Total 6 marks)

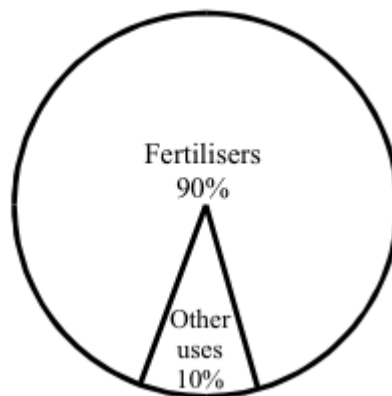
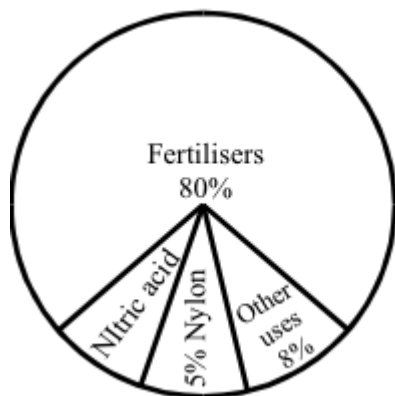
Q6.

Ammonia and nitric acid are both important chemicals. Nitric acid is made from ammonia.

The charts below show substances made from ammonia and nitric acid.

Substances made from
ammonia

Substances made from
nitric acid



(a) Use the charts to help you answer these questions.

(i) What is the main use of both ammonia and nitric acid?

(1)

(ii) Work out the percentage of ammonia used to make nitric acid.

Percentage = _____ %

(1)

(iii) 100 million tonnes of ammonia are made in the world each year.

How much of this ammonia is used to make nylon?

_____ million tonnes

(1)

(b) The word equations below show how nitric acid is made.

1. nitrogen + hydrogen → ammonia

2. ammonia + oxygen → nitrogen monoxide + water

3. nitrogen monoxide + oxygen → nitrogen dioxide

4. nitrogen dioxide + water → nitric acid

Use the word equations to help you answer these questions.

(i) From which **two** elements is ammonia made?

_____ and _____

(1)

(ii) Name **two** of the raw materials needed to make nitric acid.

_____ and _____

(2)

(c) A large amount of nitric acid is reacted with ammonia to make a fertiliser.

nitric acid + ammonia → fertiliser

- (i) The reaction is a neutralisation reaction.

What type of chemical must ammonia be?

(1)

- (ii) Complete the chemical name for the fertiliser made from ammonia and nitric acid.

ammonium _____

(1)

- (iii) The reaction of nitric acid with ammonia is exothermic.

Name the piece of equipment you could put into the solution to prove that the reaction is exothermic.

(1)

(Total 9 marks)

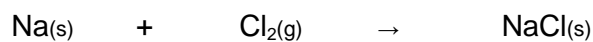
Q7.

This question is about sodium chloride (common salt) which is an important chemical.

Sodium chloride can be made by burning sodium in chlorine gas.

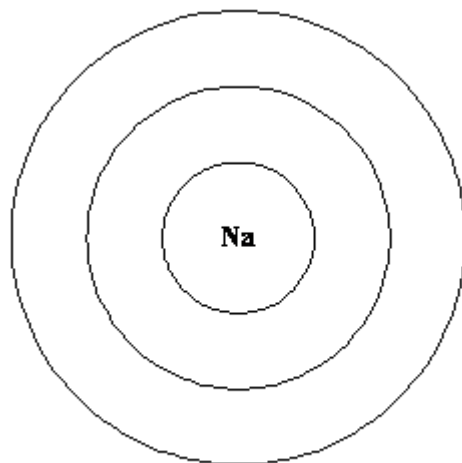


- (a) Balance the symbol equation for the reaction of sodium with chlorine.

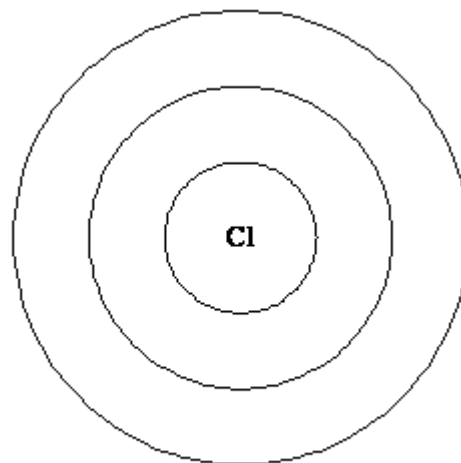


(1)

- (b) (i) Complete the diagrams below to show the electronic structures of a sodium and a chlorine atom. (Atomic number of sodium = 11 and chlorine = 17.)



Sodium



Chlorine

(3)

- (ii) When sodium reacts with chlorine the sodium atoms are changed into sodium ions (Na^+) and the chlorine atoms are changed into chloride ions (Cl^-).

Explain how:

1. a sodium atom changes into a sodium ion;

(2)

2. a chlorine atom changes into a chloride ion.

(2)

- (c) The element potassium is in the same group of the Periodic Table as sodium. Potassium reacts with chlorine to make potassium chloride which is sometimes used instead of common salt in cooking.

- (i) Predict the formula of potassium chloride.

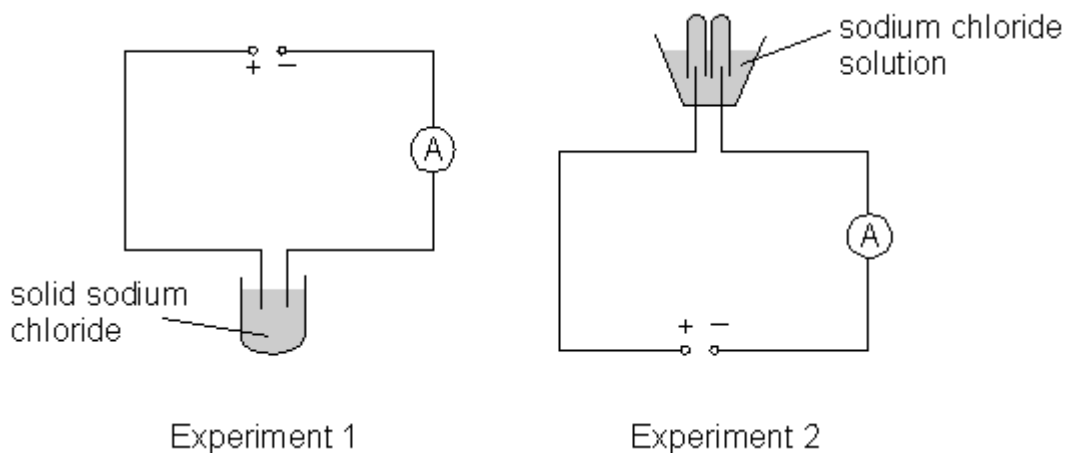
(1)

By reference to the electronic structures of potassium and sodium explain:

- (ii) Why the reaction of potassium with chlorine is similar to the reaction of sodium with chlorine.

(1)

- (d) The electrolysis of sodium chloride solution is an important industrial process. The diagrams below show two experiments set up during an investigation of the electrolysis of sodium chloride.



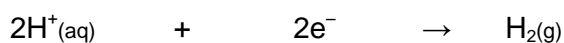
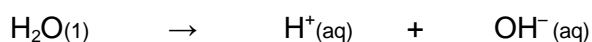
(i) What would be the reading on the ammeter in experiment 1?

_____ A

(ii) Explain your answer.

(3)

(e) The equations below show the reactions which take place in experiment 2.



(i) Which substance provides hydrogen ions?

(1)

(ii) Name the product formed at:

(A) the positive electrode;

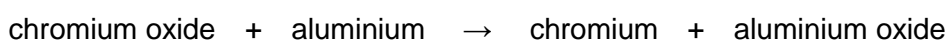
(B) the negative electrode.

(1)

(Total 15 marks)

Q8.

The word equation below shows a reaction used in an industrial process.



The reaction is highly exothermic.

(a) What is an exothermic reaction?

(2)

(b) Name the products of this reaction.

(1)

(c) In the reaction one substance is reduced.

(i) Name the substance which is reduced.

(1)

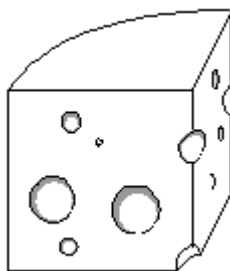
(ii) What happens to the substance when it is reduced?

(1)

(Total 5 marks)

Q9.

The salt sodium hydrogen phosphate (Na_2HPO_4) is used as a softening agent in processed cheese.



It can be made by reacting phosphoric acid (H_3PO_4) with an alkali.

(a) Complete the name of an alkali that could react with phosphoric acid to make sodium hydrogen phosphate.

_____ hydroxide

(1)

(b) What is the name given to a reaction in which an acid reacts with an alkali to make a salt?

(1)

(c) How would the pH change when alkali is added to the phosphoric acid solution?

(1)

(d) What ions are present when any acid is dissolved in water?

(1)

(e) What ions are present when any alkali is dissolved in water?

(1)

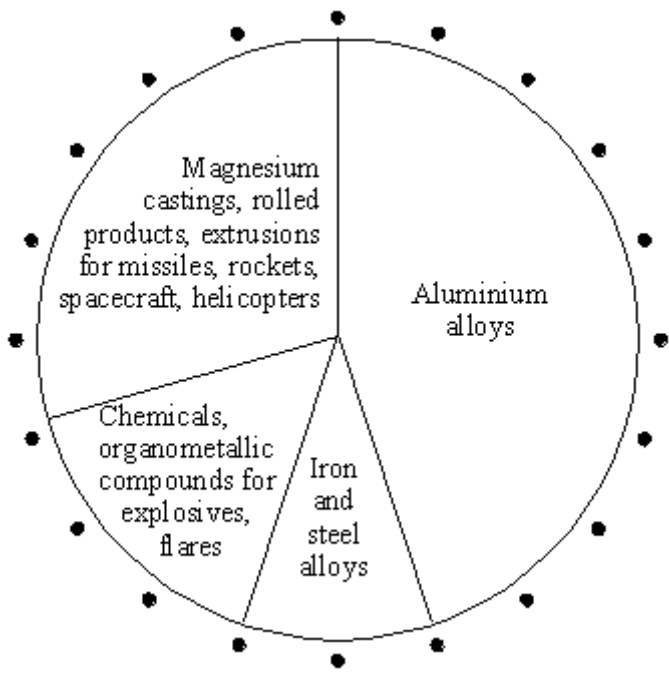
(f) Write a chemical equation for the reaction which takes place between the ions you have named in (e) and (f).

(1)

(Total 6 marks)

Q10.

280 000 tonnes of magnesium are produced in the world each year. The pie chart below shows the ways in which magnesium is used.



(a) (i) Use the pie chart to calculate the percentage of magnesium used to make aluminium alloys.

_____ %

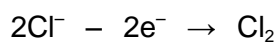
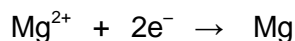
(1)

(ii) How many tonnes of magnesium are used to make aluminium alloys each year?

_____ tonnes

(1)

- (b) Magnesium is produced by the electrolysis of molten magnesium chloride. The reactions which take place at the electrodes are represented by the equations below.



- (i) Calculate the mass of chlorine produced when one kilogram of magnesium is made.
(Relative atomic masses: Mg = 24, Cl = 35.5)

(3)

- (ii) Give a use for chlorine.

(1)

(Total 6 marks)

Q11.

Ammonium nitrate is an important fertiliser. It is made by reacting nitric acid with the alkali ammonia.

- (i) State the type of reaction taking place.

(1)

- (ii) The equation for this reaction is:



Calculate the number of tonnes of ammonium nitrate that can be made from 68 tonnes of ammonia.

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

(3)

(Total 4 marks)

Q12.

(a) This label has been taken from a packet of *Andrews Antacid*.

Andrews[®] Antacid

**FAST EFFECTIVE RELIEF FROM
3 KINDS OF INDIGESTION**

**HEARTBURN
ACID INDIGESTION
TRAPPED WIND**

DISPERSE IN THE MOUTH

When your stomach produces more acid than it can cope with, symptoms can strike in different ways. Andrews Antacid tablets neutralise excess acid and give fast and effective relief from all 3 kinds of indigestion - heartburn, acid indigestion and trapped wind.

DOSE: Adults - suck or chew 1 to 2 tablets as required.
Not recommended for children

Do not exceed 12 tablets in 24 hours. If symptoms persist consult your doctor. Store below 25°C in a dry place.

Active ingredients:	
Calcium Carbonate	600mg,
Magnesium Carbonate	125mg

STERLING
HEALTH

GUILDFORD,
SURREY
PL 0071/0321

(i) Write the simplest ionic equation which represents a neutralisation reaction.

(1)

(ii) Chewing the tablet cures indigestion faster than swallowing the tablet whole. Explain why.

(1)

(b) The active ingredients in the *Antacid* react with hydrochloric acid in the stomach to give salts, water and carbon dioxide.

A student investigated how quickly the tablets react with **excess** hydrochloric acid.

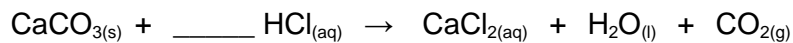
40 cm³ of dilute hydrochloric acid were placed in a conical flask. The flask was placed on a direct reading balance. Two *Antacid* tablets were quickly added to the flask. The apparatus was weighed immediately. At the same time, a stop clock was started. The mass was recorded every half minute for 5 minutes.

The results are shown in the table below.

Mass of flask + contents (g)	92.0	90.0	89.0	88.3	87.8	87.5	87.3	87.1	87.0	87.0	87.0
Time (minutes)	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0

The main active ingredient in *Andrews Antacid* is calcium carbonate.

- (i) Balance the equation which represents the reaction between calcium carbonate and hydrochloric acid.



(1)

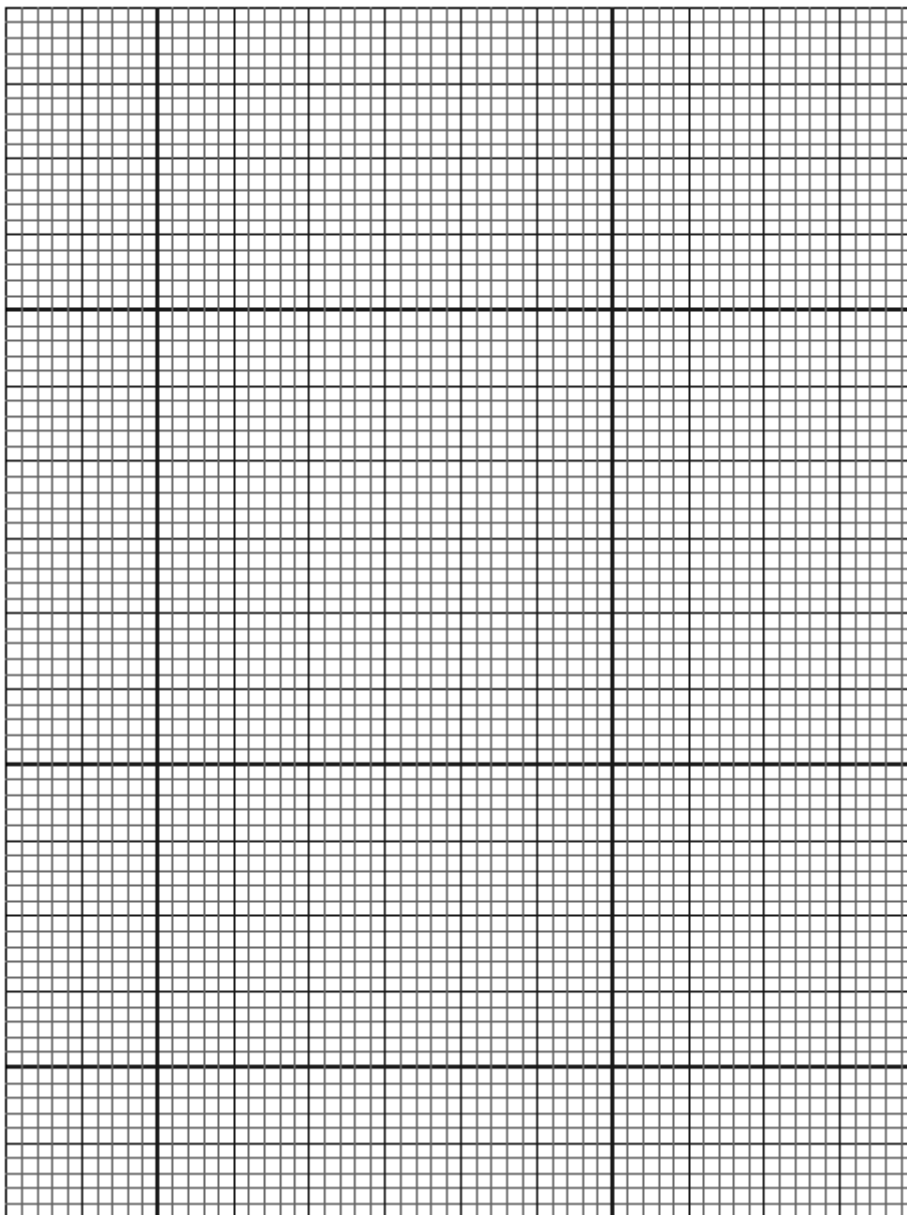
- (ii) State the meaning of the symbol “(aq)”.

(1)

- (iii) Why does the mass of the flask and contents decrease?

(1)

- (c) (i) Plot the results on the graph below and draw a smooth curve to show how the mass of the flask and its contents changes with time. Label this curve “A”.



(3)

- (ii) One of the results does not appear to fit the pattern. Circle this result on the graph.

(1)

- (d) The student did a second experiment. The only change was that the acid was twice as concentrated.

On the graph, sketch a second curve to show a possible result for this experiment. Label this curve "B".

(2)

(Total 12 marks)

Q13.

One step in the manufacture of lead is the reduction of lead oxide with carbon. Lead and carbon dioxide are the products of this reaction.

- (a) Write a word equation for this reaction.

(1)

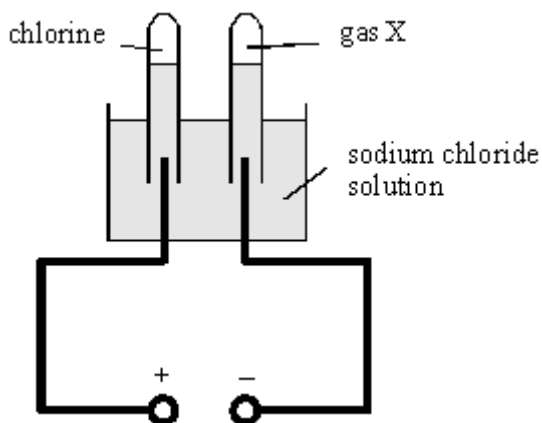
- (b) What is meant by "reduction"?

(1)

(Total 2 marks)

Q14.

- (a) In an industrial process electricity is passed through a solution of sodium chloride in water. A student set up the apparatus shown below to investigate this process.



- (i) Name gas X.

(1)

- (ii) Complete the half equation for the production of chlorine gas during the electrolysis.



(1)

- (iii) The student found that the solution left in the cell was alkaline.

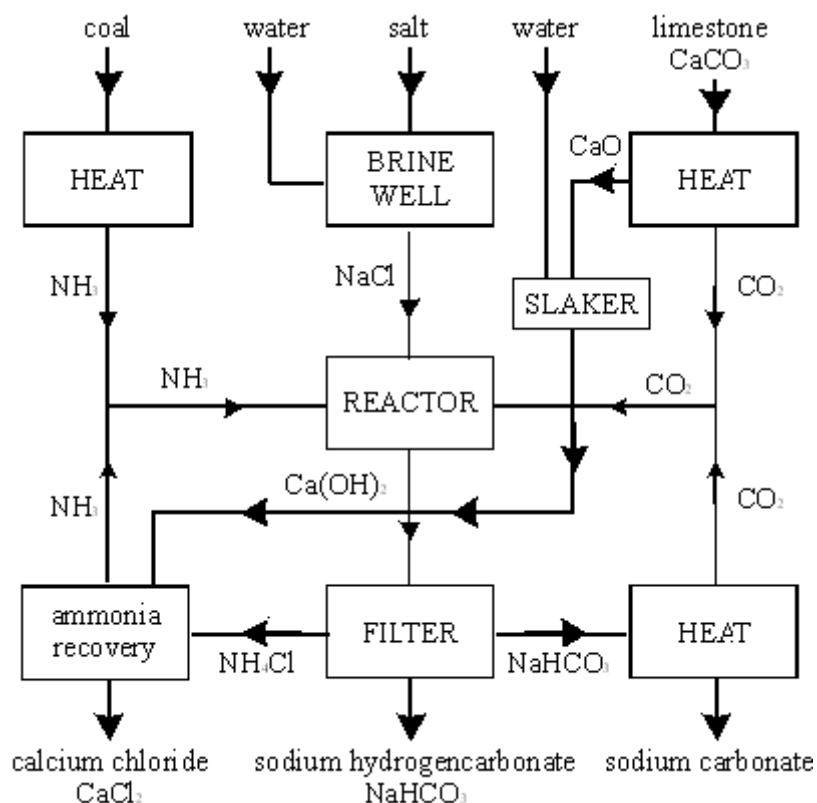
Which ion makes the solution alkaline?

(1)

(iv) Name the useful substance that can be obtained from the solution in the cell.

(1)

(b) Sodium carbonate is another useful chemical that can be made from sodium chloride. The flow chart below shows one way in which sodium carbonate can be made.



(i) Write the formula of sodium carbonate.
Use the Data Sheet to help you to answer this question.

(1)

(ii) Salt is one raw material used in this process.
Name **one** other raw material used in this process.

(1)

(iii) Sodium carbonate is one of the products of this process.
Name **one** other product.

(1)

(iv) 1. Give **one** example of a thermal decomposition reaction shown in the flow chart.

(1)

2. Explain what is meant by a thermal decomposition reaction.

(2)

(v) Name **one** substance that is recycled in this process.

(1)

(c) When sodium carbonate solution is added to zinc sulphate solution a white solid is precipitated.

(i) Use the Data Sheet to help you to name the white solid that is produced in this reaction.

(1)

(ii) State why this solid is formed.

(1)

(Total 13 marks)

Q15.

Sando-K is a medicine. It is given to people whose bodies contain too little of a particular element.

Sando-K is a mixture of two compounds. The formulae of the two compounds are given below.



(a) Which metal do people given Sando-K need?

(1)

(b) Sando-K contains the ion, CO_3^{2-} . Which gas would be produced if a dilute acid was added to Sando-K? (The Data Sheet may help you to answer this question.)

(1)

(c) The compounds in Sando-K contain ions.

Complete the two sentences below.

Atoms change into positive ions by _____ one or more
_____ .

Atoms change into negative ions by _____ one or
more _____ .

(4)

(d) Electricity can be used to show that an aqueous solution of Sando-K contains ions.

(i) Draw a diagram of an apparatus that you could use to prove that Sando-K contains ions.

(4)

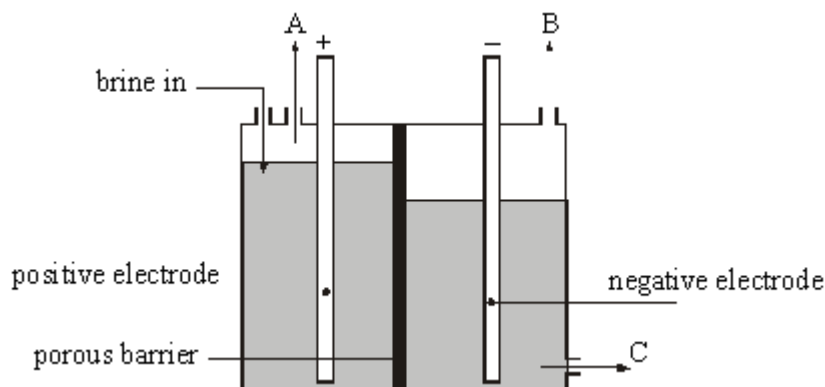
(ii) Explain, as fully as you can, what would happen when the electricity is switched on.

(3)

(Total 13 marks)

Q16.

Sodium hydroxide, hydrogen and chlorine can all be made in one industrial process. Electricity is passed through aqueous sodium chloride solution (brine). The diagram below shows a cell that can be used for this process.



(a) Name A, B and C.

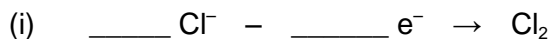
Gas A _____

Gas B _____

Solution C _____

(2)

(b) Balance the equations for the reactions at the electrodes.



(2)

(c) Name the compound in this cell which produces the hydrogen ions.

(1)

(d) Which type of particles must be able to pass through the barrier to allow the electrolysis to take place?

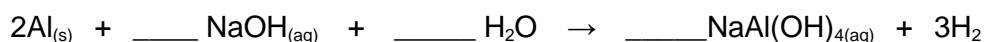
(1)

(Total 6 marks)

Q17.

Some drain cleaners contain a mixture of sodium hydroxide and powdered aluminium. When the mixture is poured into a drain it mixes with water and a chemical reaction takes place. The heat from the reaction helps to melt grease in the drain. Hydrogen gas is produced which stirs up the particles and helps to unclog the drain.

(a) Balance the equation for the reaction.



(2)

(b) Why do the solid sodium hydroxide and aluminium powder **not** react when stored in a sealed container?

(1)

(c) Sodium hydroxide is a strong alkali and would react with any acids in the drain.

(i) Name the ion produced when any alkali is dissolved in water.

(1)

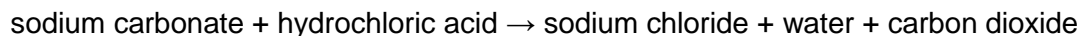
(ii) Name the ion produced when any acid is dissolved in water.

(1)

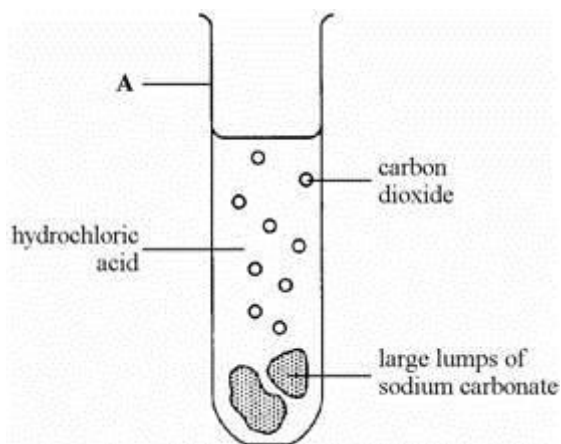
(iii) Name the compound formed when these ions react with each other.

Q18.

Dilute hydrochloric acid reacts with sodium carbonate. The word equation for this reaction is:



(a) The diagram shows apparatus used by student X to investigate this reaction.



(i) Name the piece of apparatus labelled **A**.

(1)

(ii) **NaCO₃** **NaCl** **Na₂CO₃** **Na₂Cl**

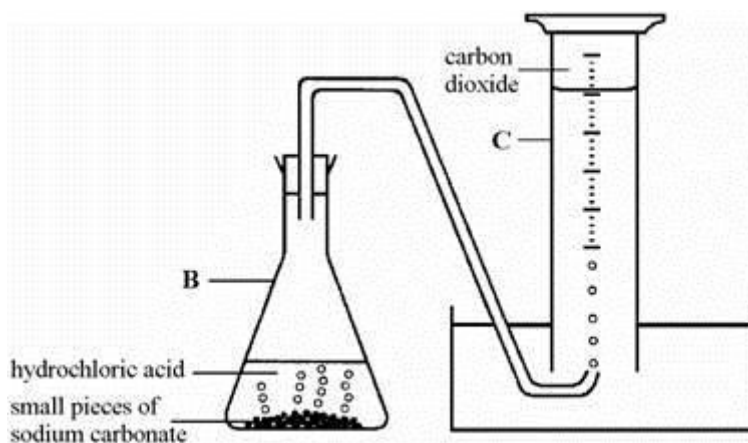
Use the Data Sheet to help you choose the correct formula from the list for:

sodium carbonate, _____

sodium chloride. _____

(2)

(b) The diagram below shows a different apparatus used by student Y to investigate the same reaction.



(i) Name the pieces of apparatus labelled **B** and **C**.

B _____

C _____

(2)

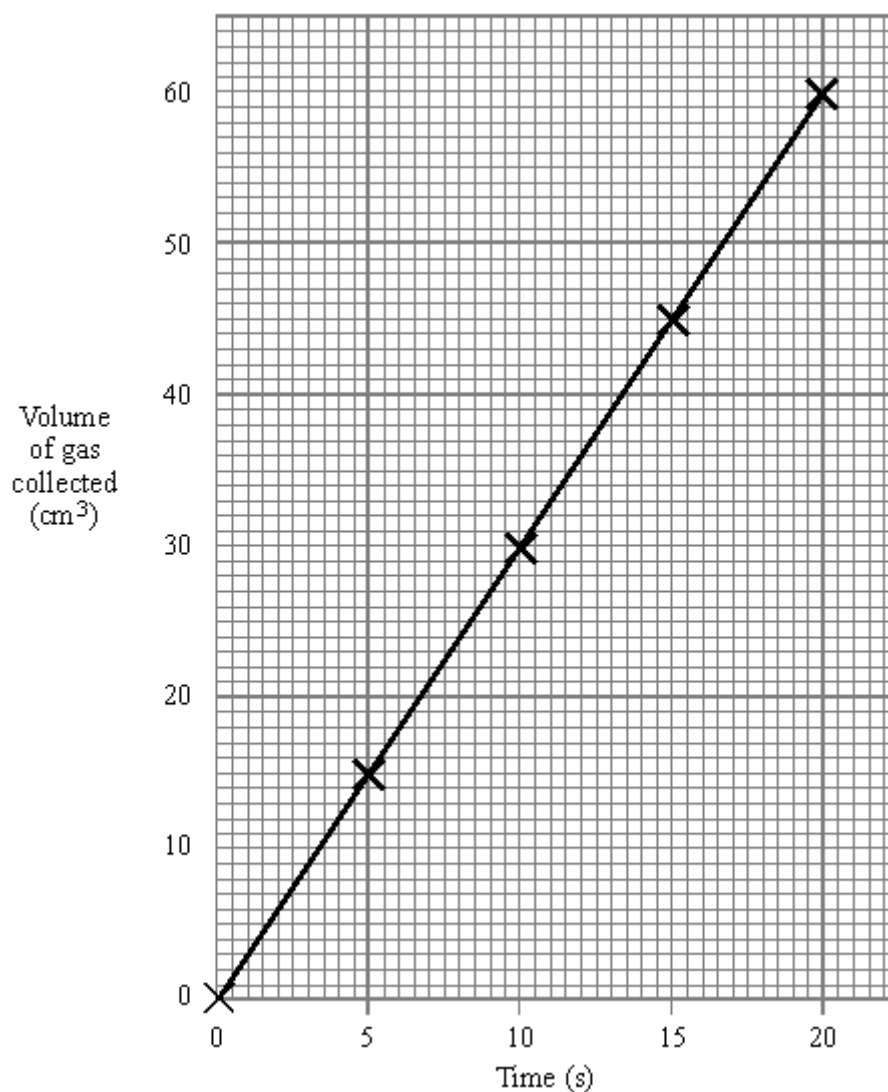
(ii) Both students X and Y used the same

- volume of acid
- concentration of acid
- temperature
- mass of sodium carbonate

Use information from the diagrams to explain why the reaction that student Y carried out was faster.

(2)

(c) The results obtained by student Y were plotted as shown below.



- (i) Student Y repeated the experiment exactly as before but used warmer acid. This made the reaction faster. On the graph draw a line for this faster reaction.

(2)

- (ii) Explain, in terms of particles, why the rate of the reaction is faster when warmer acid is used.

(3)

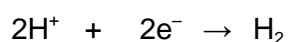
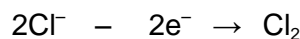
(Total 12 marks)

Q19.

The electrolysis of sodium chloride solution is an important industrial process. Three useful substances are produced:

- chlorine gas is formed at the positive electrode;
- hydrogen gas is formed at the negative electrode;
- an alkali is left in the solution.

The reactions which take place at the electrodes are represented by the equations shown below:



- (a) Name the important alkali which is left in the solution.

(1)

- (b) State why chloride ions move towards the positive electrode.

(1)

- (c) Why is the formation of chlorine at this electrode said to be an oxidation reaction?

(1)

(Total 3 marks)

Q20.

- (i) Which acid from the list should the student add to sodium hydroxide solution to make sodium sulphate?

ethanoic acid
acid

hydrochloric acid

nitric acid

sulphuric

(1)

- (ii) When the acid was added to the alkali the beaker became warm.
Name the type of reaction that releases heat.

(1)

- (iii) Use the Data Sheet to help you to write the formula of sodium sulphate.

Formula: _____

(1)

(Total 3 marks)

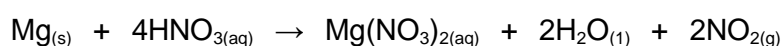
Q21.

This item appeared in the *Wolverhampton Express and Star* on October 31st, 1997.
Read the passage and answer the questions that follow.

**Fumes scare at
factory**

Workers were forced to flee a factory after a chemical alert. The building was evacuated when a toxic gas filled the factory.
It happened when nitric acid spilled on to the floor and mixed with magnesium metal powder.

- (a) The equation which represents the reaction between magnesium and nitric acid is:



Give the formula of the toxic gas that was produced.

(1)

- (b) Explain, in terms of particles, how the toxic gas was able to fill the factory quickly.

(2)

- (c) The reaction of nitric acid with magnesium metal powder is more dangerous than if the acid had fallen on to the same mass of magnesium bars. Explain why.

(1)

- (d) (i) Water was sprayed on to the magnesium and nitric acid to slow down the reaction.
Explain, in terms of particles, why the reaction would slow down.

(2)

- (ii) Explain why it is better to add alkali, rather than just add water to the spillage.

(1)

(Total 7 marks)

Q22.

- (a) (i) Which acid should the student add to sodium hydroxide solution to make sodium sulphate?

_____ acid

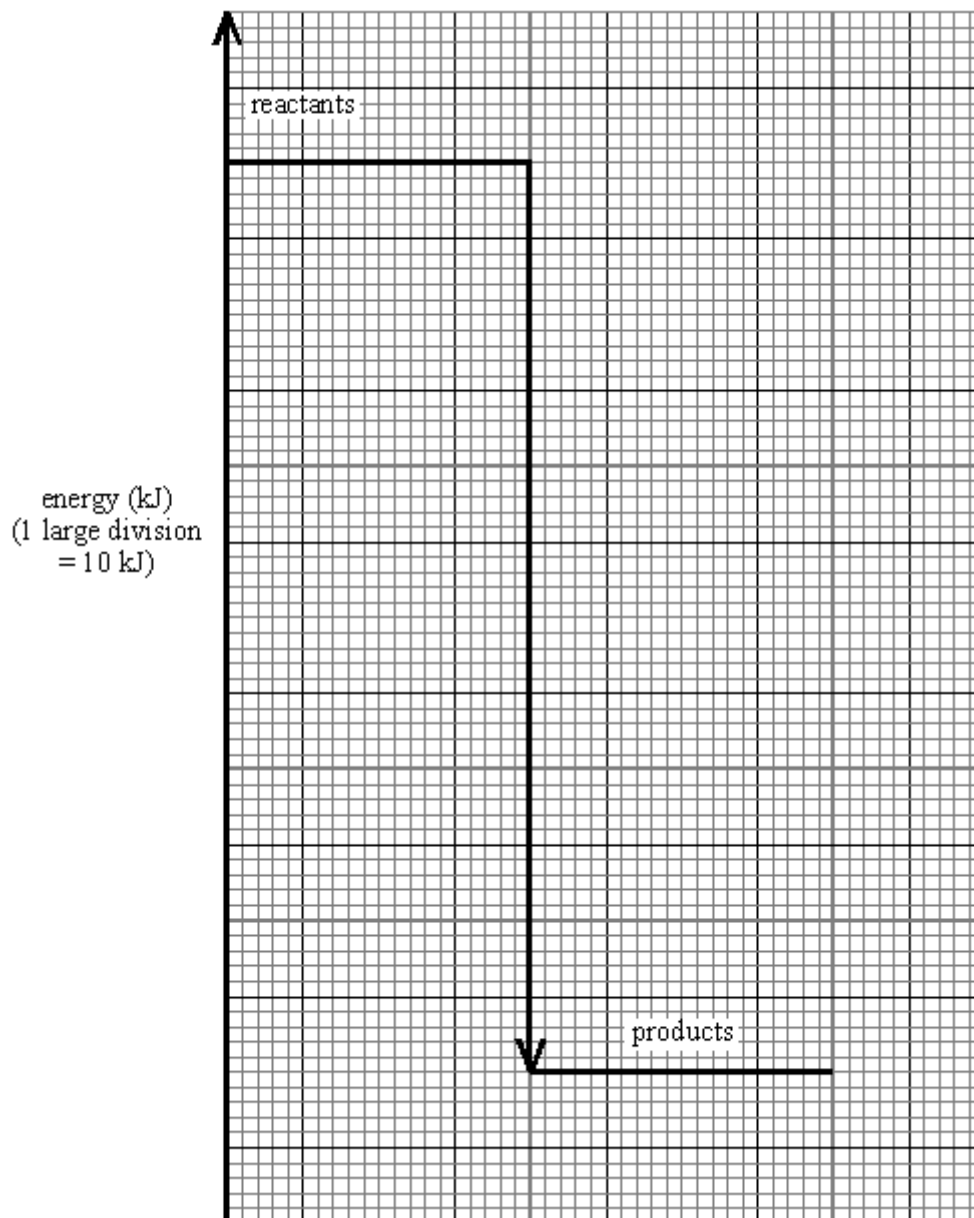
(1)

- (ii) Use the table on the Data Sheet to help you to write the formula of sodium sulphate.

Formula: _____

(1)

- (b) The student noticed that the solution in the beaker got warm when the acid reacted with the alkali.
The energy diagram below represents this reaction.



- (i) In terms of **energy**, what type of reaction is this?

(1)

- (ii) Use the energy diagram to calculate a value for the amount of energy released during this reaction.

Energy released _____ kJ

(1)

- (iii) Explain, in terms of bond breaking and bond forming, why energy is released during this reaction.

(3)

- (iv) The reaction takes place very quickly, without the help of a catalyst. What does this suggest about the activation energy for this reaction?

(1)

(Total 8 marks)

Q23.

Use the Formulae of Some Common Ions table on the Data Sheet to help you to answer this question.

Acids react with alkalis to form salts and water.

Complete the table below by writing in the name and formula of the salt formed in each reaction.

The first one has been done for you.

Acid	Alkali	Salt	Formula of salt
Hydrochloric acid	Sodium hydroxide	Sodium chloride	NaCl
Nitric acid	Sodium hydroxide		
Sulphuric acid	Potassium hydroxide		

(Total 4 marks)

Q24.

Use the Reactivity Series of Metals on the Data Sheet to help you to answer this question.

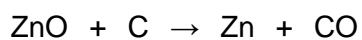
The table gives information about the extraction of some metals.

Metal	Date of discovery	Main source	Main extraction method
Gold	Known to ancient civilisations	In the Earth as the metal itself	Physically separating it from the rocks it is mixed with
Zinc	1500	Zinc carbonate	Reduction by carbon
Sodium	1807	Sodium chloride	Electrolysis

- (a) Explain why gold is found mainly as the metal itself in the Earth.

(1)

(b) One of the reactions involved in producing zinc is represented by this equation.



Explain why carbon can be used to extract zinc.

(1)

(c) Sodium is one of the most abundant metals on Earth.

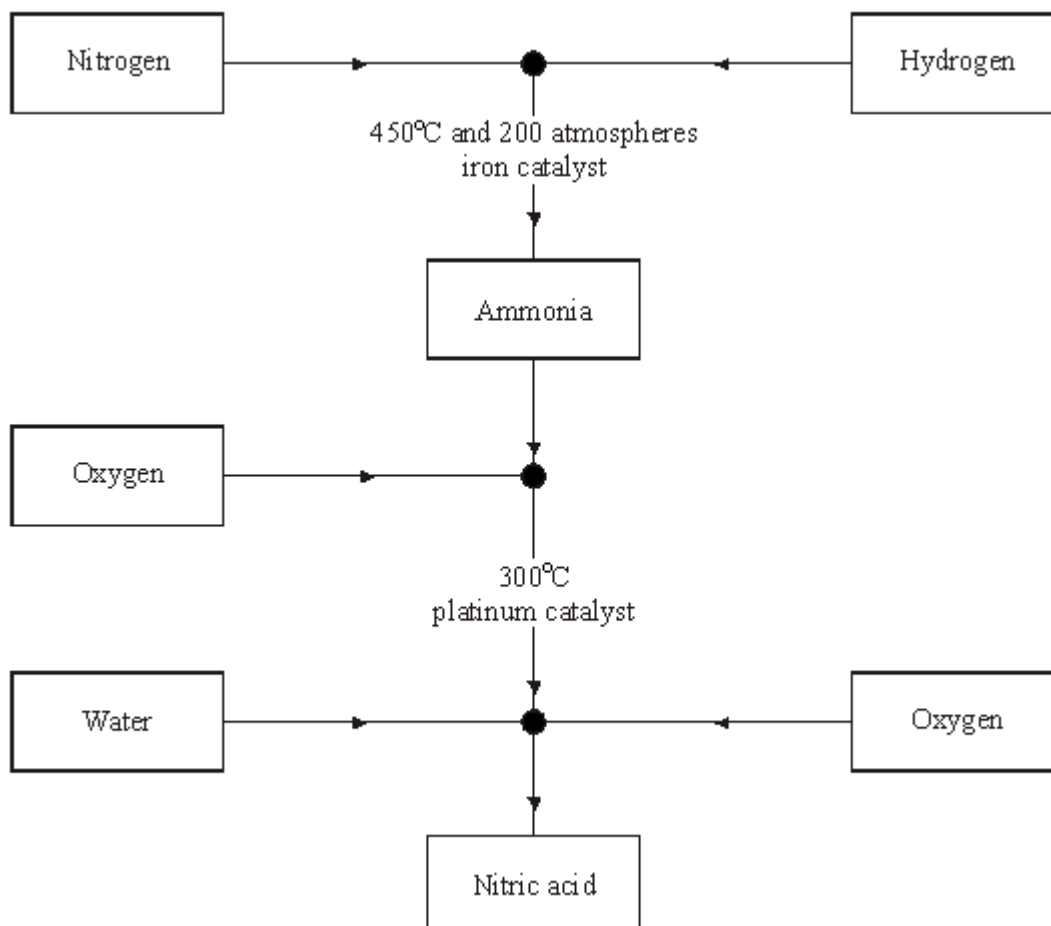
Explain, as fully as you can, why sodium was not extracted until 1807.

(2)

(Total 4 marks)

Q25.

The flow diagram shows how to make ammonia and nitric acid from the nitrogen in the air.



- (a) A fertiliser is made by neutralising ammonia with nitric acid. What is the name of this fertiliser?

_____ (1)

- (b) In the flow diagram, why are two different catalysts used?

_____ (1)

- (c) What happens to catalysts at the end of a reaction?

_____ (1)

- (d) Explain why catalysts are used in many industrial chemical reactions.

_____ (2)

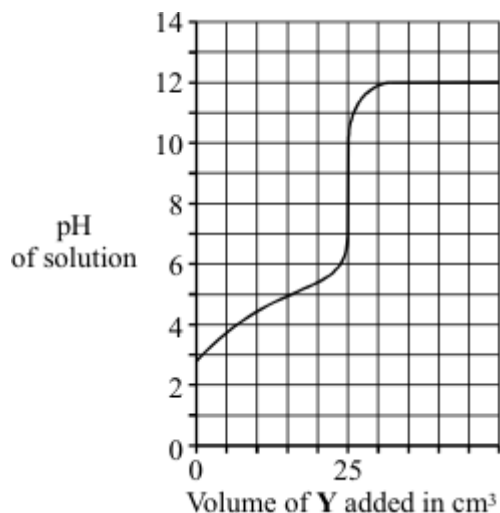
- (e) Explain, in terms of collisions between molecules, why a high pressure is used in the reaction between nitrogen and hydrogen.

_____ (2)

(Total 7 marks)

Q26.

A solution of **Y** was slowly added to a solution of **X**. The graph shows how the pH of the resulting solution changed.



- (a) (i) What was the pH of solution X before any of solution Y was added?

(1)

- (ii) State whether solution Y was acidic, alkaline or neutral.

(1)

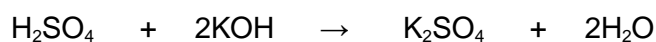
- (iii) What volume of solution Y was needed to react with all of the substance in solution X?

_____ cm³

(1)

- (b) The chemical equation shows the reaction between an acid and an alkali to form a salt and water.

- (i) Draw a circle round the formula of the alkali.



(1)

- (ii) What is the formula of the salt?

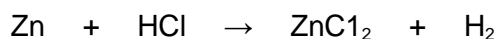
(1)

(Total 5 marks)

Q27.

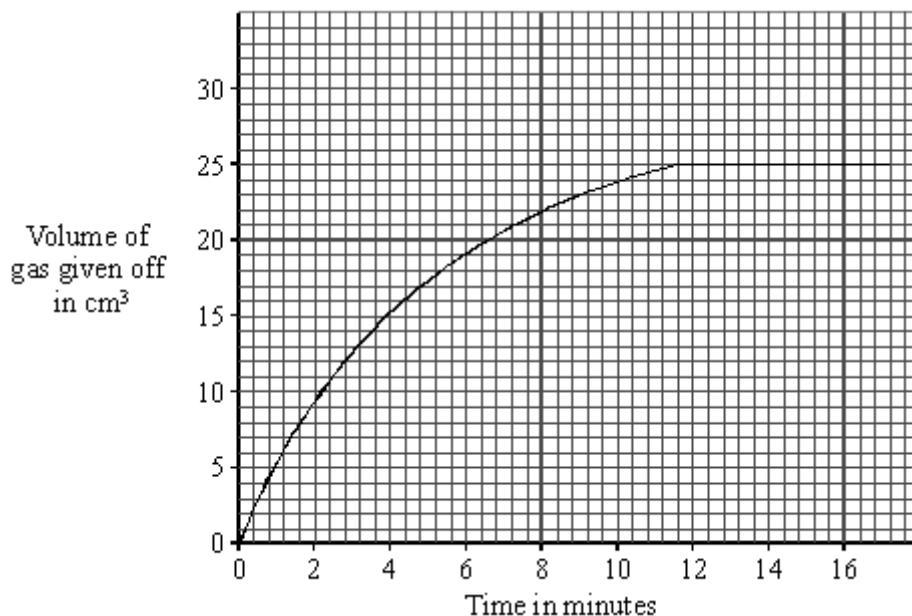
Zinc powder normally reacts slowly with hydrochloric acid.

- (a) Balance the symbol equation for the reaction.



(1)

The graph shows the results from a reaction of 1.0 g of zinc powder with 20 cm³ of dilute hydrochloric acid. It gives off a gas and forms zinc chloride, ZnCl₂. Some unreacted zinc is left at the end.



(b) Copper powder is a good catalyst for the reaction of zinc with hydrochloric acid.

- (i) A mixture of 10 cm³ of the same dilute hydrochloric acid and 1.0 g of copper powder was added to 1.0 g of zinc powder. What is the maximum volume of gas which could be given off?

_____ cm³

(1)

- (ii) Draw a graph, on the axes above, for an experiment where 20 cm³ of the same dilute hydrochloric acid was added to 1.0 g of copper powder mixed with 1.0 g of zinc powder.

(2)

- (iii) Give **two** other ways the reaction described in part (i) could be made to go faster.

1. _____

2. _____

(2)

(c) Copper powder can be formed by adding copper sulphate solution to the mixture of zinc powder and acid.

- (i) Why does zinc react with copper sulphate solution to produce copper?

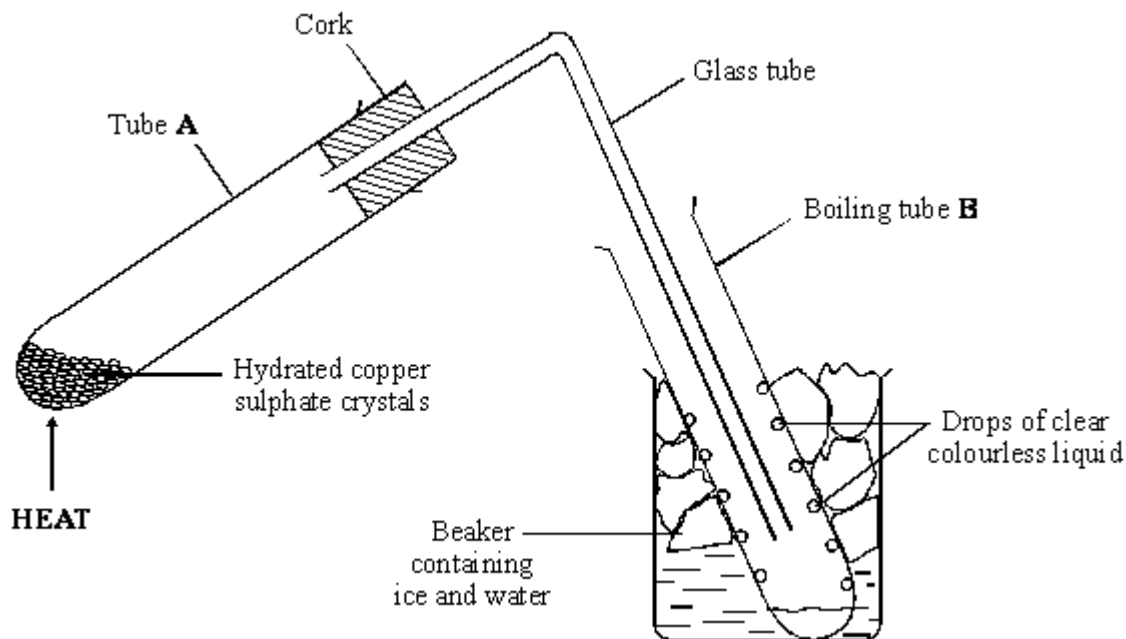
(1)

- (ii) Write the word equation for the reaction.

(1)

(Total 8 marks)

The diagram shows the apparatus for an experiment. Hydrated copper sulphate crystals were heated. They became anhydrous copper sulphate.



(a) Name a suitable piece of equipment to heat tube **A**.

(1)

(b) Use words from the box to complete the **two** spaces in the table. You may use each word once or not at all.

black	blue	orange	red	purple	white
-------	------	--------	-----	--------	-------

Name	Colour
Hydrated copper sulphate crystals	_____
Anhydrous copper sulphate	_____

(2)

(c) What is the purpose of the ice and water in the beaker?

(1)

(d) Drops of a clear, colourless liquid formed on the inside of tube **B**.

(i) Name the liquid.

(1)

(ii) Explain how the liquid came to be inside tube **B**.

(2)

(e) Anhydrous copper sulphate can be turned into hydrated copper sulphate. What would you need to add? Apart from the change in colour, what could you observe?

(2)

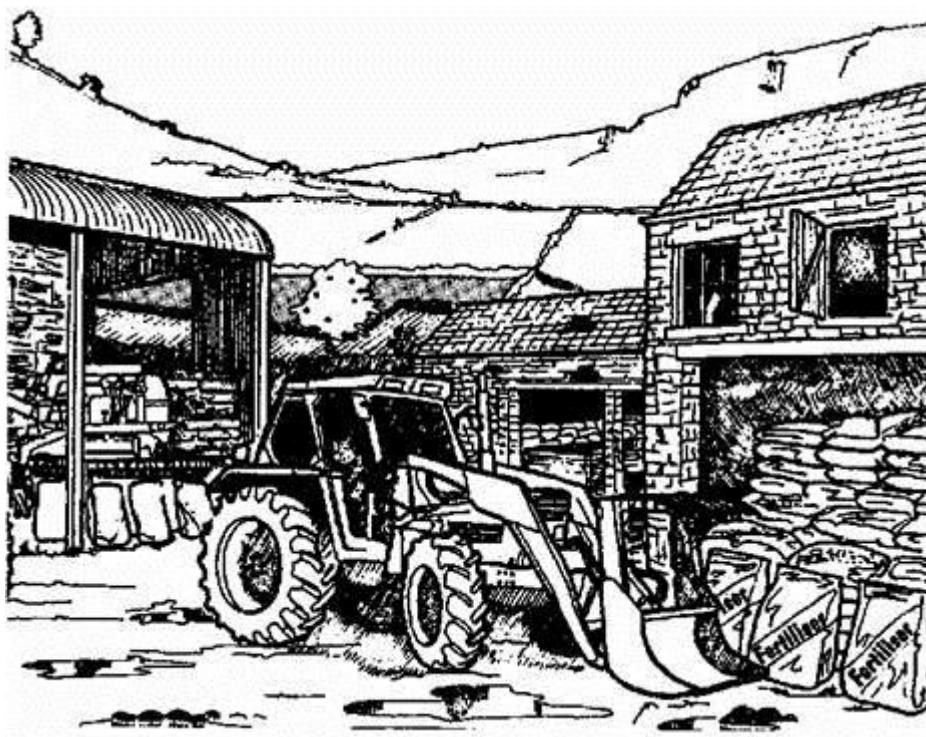
(f) Copper sulphate can be made from black copper oxide by reacting it with an acid. Name the acid.

(1)

(Total 10 marks)

Q29.

Ammonium nitrate and ammonium sulphate are used as fertilisers.



(i) Which acid reacts with ammonia to form ammonium nitrate?

(1)

(ii) Which acid reacts with ammonia to form ammonium sulphate?

(1)

- (iii) The reactions in (i) and (ii) are both exothermic. How can you tell that a reaction is exothermic?

(1)

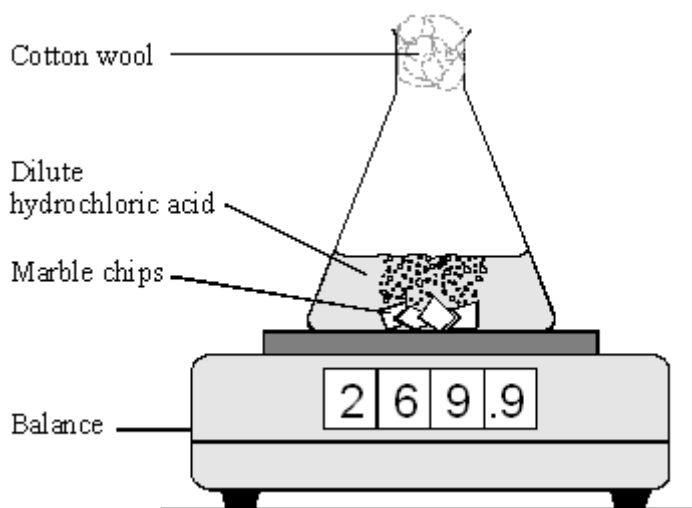
- (iv) The reactions in (i) and (ii) are both examples of acid + base reactions. What is the name of the chemical change which takes place in every acid + base reaction?

(1)

(Total 4 marks)

Q30.

The apparatus shown in the diagram was used to investigate the rate of reaction of excess marble chips with dilute hydrochloric acid, HCl. Marble is calcium carbonate, formula CaCO_3 . The salt formed is calcium chloride, CaCl_2 .



- (a) Write a balanced equation for the reaction.

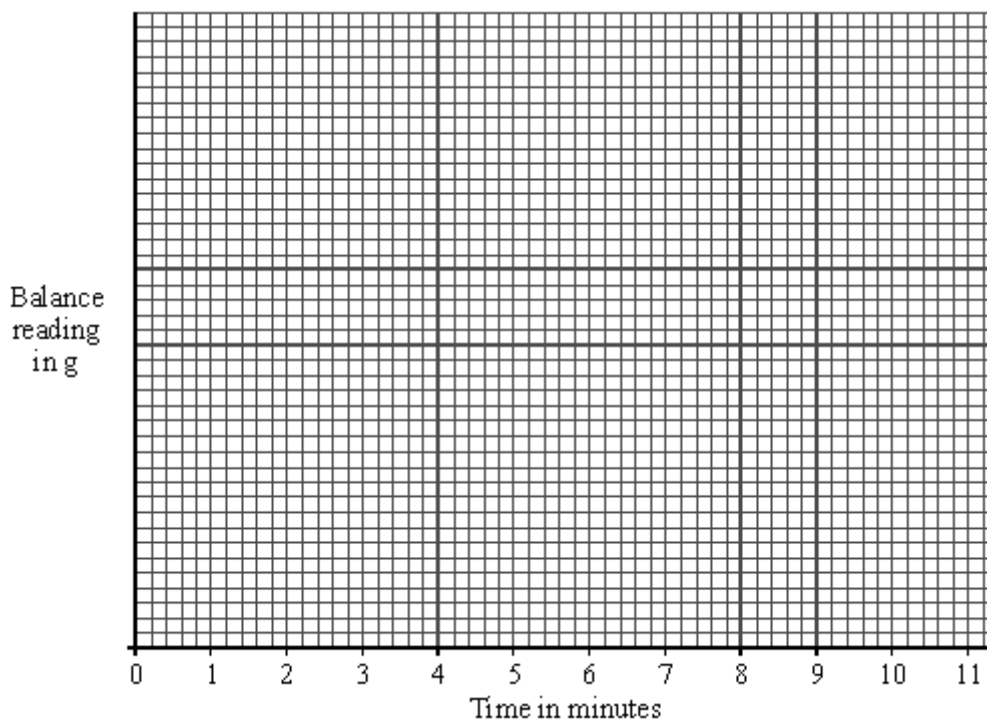
(2)

The following results were obtained from the experiment.

Time in minutes	Reading on balance in g
0.5	269.6
1.0	269.3

2.0	269.0
3.0	268.8
5.0	268.7
9.0	268.6

- (b) (i) Plot the results and draw a graph on the axes below.



- (3)
- (ii) Continue the graph you have drawn to show the expected reading after 11 minutes. (1)
- (iii) On the axes above, sketch a graph of the result which would be obtained if in a similar experiment the same mass of powdered marble was used instead of marble chips. (2)

(Total 8 marks)

Q31.

Potassium reacts violently with cold water.

It forms an alkaline solution of potassium hydroxide and hydrogen.



- (a) In what physical state is hydrogen given off?

Choose your answer from the words in the box.

gas liquid solid solution

_____ (1)

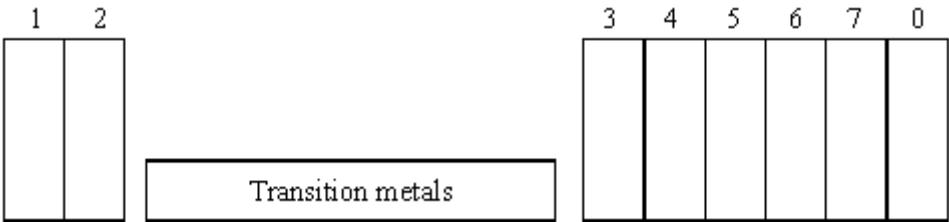
(b) (i) What type of substance will neutralise potassium hydroxide solution?

_____ (1)

(ii) What is the pH of the neutral solution?

_____ (1)

(c) In the Periodic Table there are eight main groups.



What is the number of the group that has potassium in it?

_____ (1)

(d) Sodium is in the same group as potassium.

(i) How does sodium react with cold water and what is formed?

_____ (2)

(ii) How can you prove that an alkaline solution is formed when sodium reacts with water?

_____ (2)

(e) Lithium reacts more slowly with cold water than sodium.

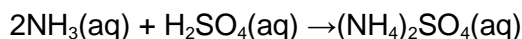
State **two** ways the reaction can be made to go faster.

_____ (2)

(Total 10 marks)

Q32.

- (a) Ammonium sulphate is made by the reaction:



- (i) Complete the **three** answers in the table.

Question	Answer
How many hydrogens are there in the formula of ammonium sulphate?	_____
What is the name of the substance with the formula NH_3 ?	_____
What is the name of the substance with the formula H_2SO_4 ?	_____

(3)

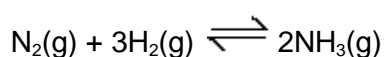
- (ii) What is the main use for ammonium sulphate?

(1)

- (iii) A similar reaction is used to make ammonium nitrate. What is the name of the acid which must be used?

(1)

- (b) NH_3 is made by the reversible reaction:



- (i) Explain what the term *reversible reaction* means.

(2)

- (ii) What is the name of the raw material which is the source of nitrogen (N_2)?

(1)

- (iii) Nitrogen is an element. Explain what the term *element* means.

(2)
(Total 10 marks)

Q33.

Part of the Periodic Table showing the symbols for the first twenty elements is given below.

			H						He	
Li	Be				B	C	N	O	F	Ne
Na	Mg				Al	Si	P	S	Cl	Ar
K	Ca	Transition metals								

(a) Draw diagrams showing the arrangement of electrons (electronic structures) in:

(i) an aluminium atom;

(ii) a chlorine atom.

(2)

(b) (i) Use electronic structures to help you show why the formula of sodium oxide is Na_2O .

(3)

(ii) State why the formation of sodium ions is classified as an oxidation.

(1)

(Total 6 marks)

Q34.

Read the passage carefully and then answer the questions.

The electrolysis of acidified water

After a few drops of dilute sulphuric acid have been added to some distilled water, there will be three types of ion in solution:

from the water, $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}^+(\text{aq}) + \text{OH}^-(\text{aq})$

from the acid, $\text{H}_2\text{SO}_4(\text{aq}) \rightarrow 2\text{H}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq})$

When the electrodes (anode and cathode) in a circuit are put into the acidified water, the hydroxide ions and the sulphate ions are both attracted to the electrode called the anode. However, it is harder for the sulphate ions to give up their electrons than for the hydroxide ions to do this. So the hydroxide ions are the ones which react and bubbles of oxygen are formed at the anode.

There are only hydrogen ions to be attracted towards the cathode and, when they get there, they take up electrons to form hydrogen molecules.

From Chemistry Matters by Richard Hart, reproduced by permission of Oxford University Press

Even in a small volume of water acidified with dilute sulphuric acid there will be billions of ions. Some will be anions and some will be cations.

- (i) Name the ions in water acidified with dilute sulphuric acid.

_____ (1)

- (ii) Explain why only some of the ions are attracted to the anode.

_____ (2)

- (iii) Balance the equation for the reaction of hydroxide ions at the anode.

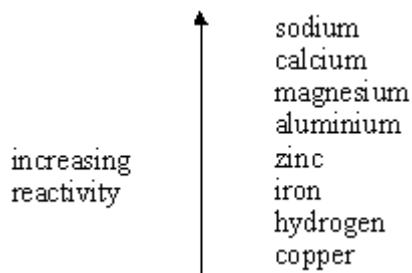


(1)

(Total 4 marks)

Q35.

Part of a reactivity series is:



- (a) Carbon is used in blast furnaces to obtain iron and zinc from their oxides, but electrolysis has to be used to obtain aluminium from its oxide.

Draw an arrow on the reactivity series above to show where carbon fits into the series.

(1)

- (b) Predict the method of extraction used to obtain calcium from its ore and explain your answer.

(2)

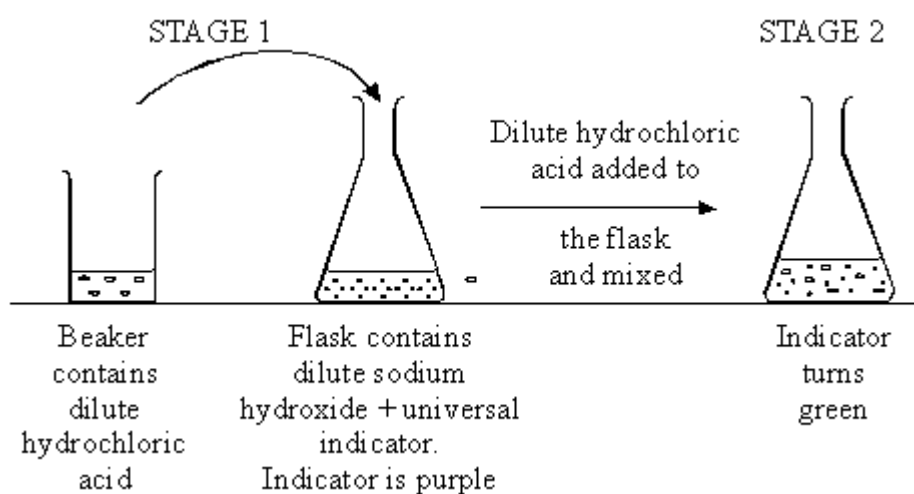
- (c) The formula for zinc oxide is ZnO. Write a balanced equation for the extraction of zinc in the blast furnace.

(2)

(Total 5 marks)

Q36.

The diagrams show what happens when an acid is added to an alkali.



- (a) What is present in the flask at stage 2, besides universal indicator and water?

(1)

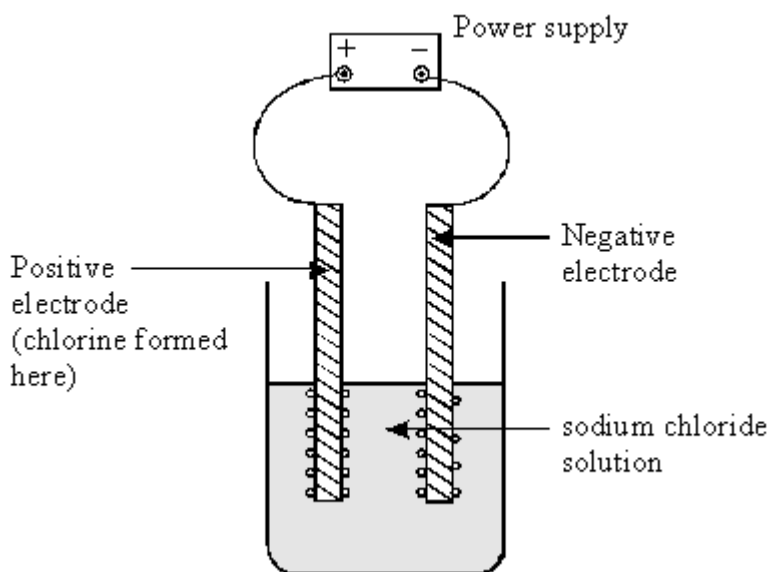
- (b) Write an ionic equation to show how water is formed in this reaction and state the

sources of the ions.

(3)
(Total 4 marks)

Q37.

The diagram below shows the electrolysis of sodium chloride solution, in the laboratory.



(a) Which gas forms at the negative electrode? _____

(1)

(b) Explain why chlorine gas forms at the positive electrode.

(2)

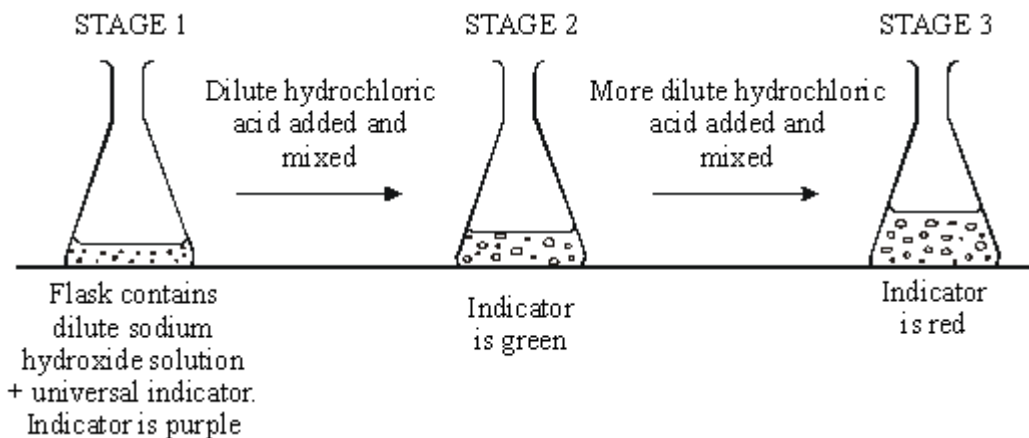
(c) State **one** use of chlorine gas.

(1)

(Total 4 marks)

Q38.

The diagrams show what happens when an acid is added to an alkali.



(a) What is present in the solution at stages 2 and 3 apart from universal indicator and water?

(i) At stage 2 _____

(ii) At stage 3 _____

(3)

(b) Write an ionic equation to show how water is formed in this reaction and state the sources of the ions.

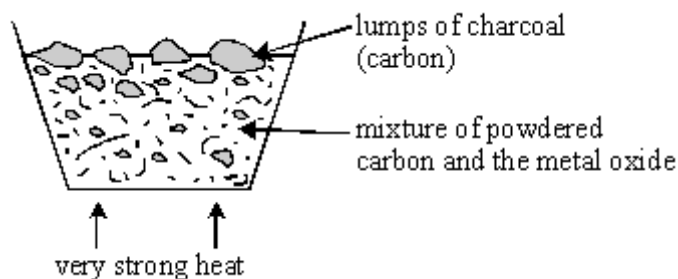
(3)

(Total 6 marks)

Q39.

A student was trying to extract the metals from lead oxide and aluminium oxide.

She heated each oxide with carbon in a fume cupboard as shown below.



She was able to extract lead from lead oxide but not aluminium from aluminium oxide.

(i) Explain the results of these experiments.

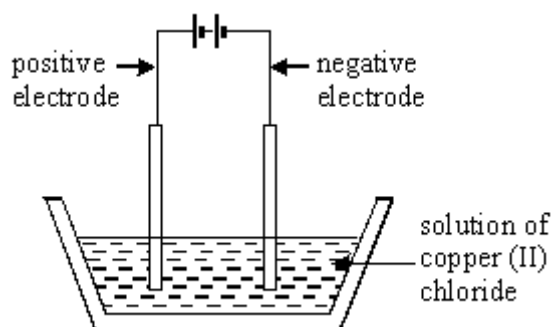
(ii) Complete this word equation for the reaction between lead oxide and carbon.



(Total 5 marks)

Q40.

Copper metal can be extracted from a solution of copper(II) chloride.



Copper chloride is an ionic compound.

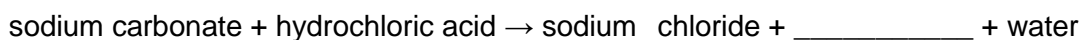
State where the copper would collect and explain your answer fully.

(Total 2 marks)

Q41.

Sodium carbonate reacts with acids.

(i) Complete the word equation.



(1)

(ii) Name the salt produced if sodium carbonate reacts with dilute nitric acid.

(1)

(Total 2 marks)

Q42.

Choose gases from this list to complete the word equations below.

carbon dioxide

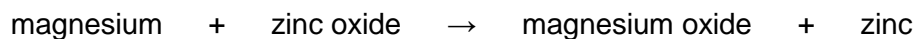
hydrogen

nitrogen

- oxygen sulphur dioxide
- (a) sodium + water → sodium hydroxide + _____ . (1)
- (b) magnesium + _____ → magnesium oxide. (1)
- (Total 2 marks)

Q43.

Here is the word equation for a chemical reaction.

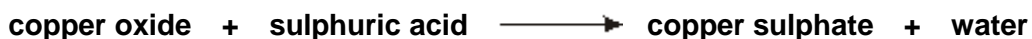


Write down everything that the word equation tells you about the reaction.

(Total 4 marks)

Q44.

Here is a word equation for a chemical reaction.



Write down everything that the word equation tells you about the reaction.

(Total 4 marks)

Q45.

Cassiterite is an ore of the metal tin.

- (a) What is an ore?

(2)

- (b) Some metals are obtained by removing oxygen from the metal oxide.

What name do we give to this chemical reaction?

(1)

- (c) Name **one** metal which must be extracted from its melted ore by electrolysis rather than by using carbon.

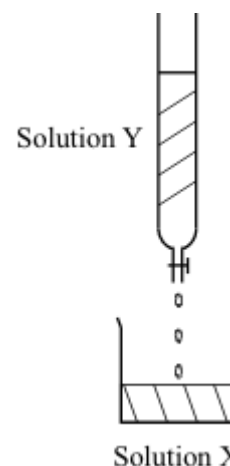
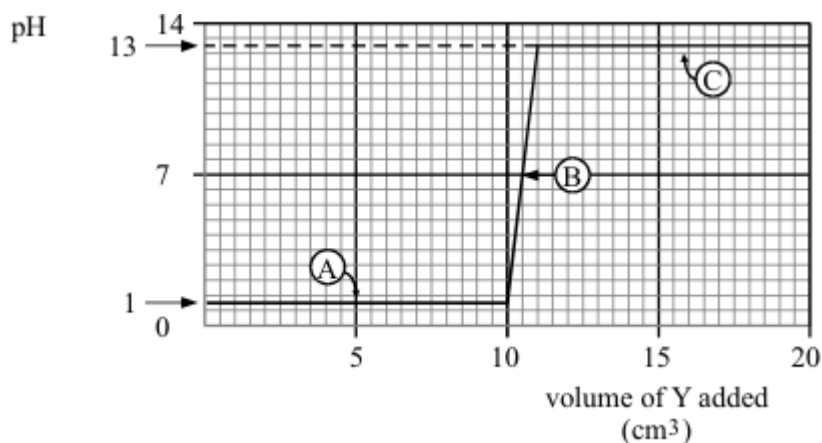
(1)

(Total 4 marks)

Q46.

Some students slowly add solution Y to solution X.

The graph shows what happens to the pH of the solution in the beaker as they do this.



- (a) Choose words from this list to complete the sentences below.

acidic alkaline neutral

At point A on the graph the solution in the beaker is _____

At point B on the graph the solution in the beaker is _____

At point C on the graph the solution in the beaker is _____

(2)

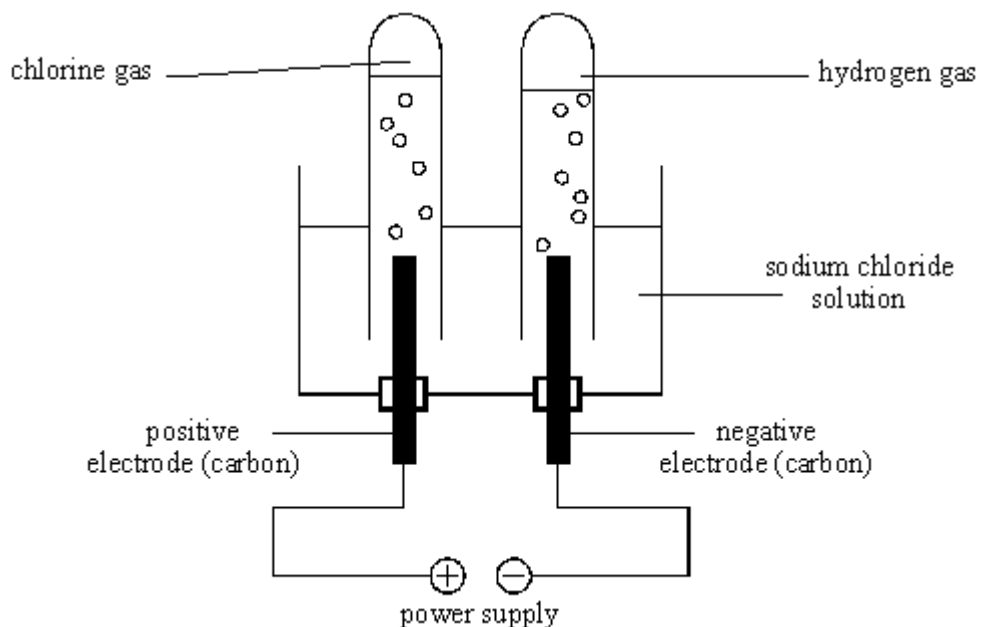
- (b) Describe, as fully as you can, what happens to the pH of the mixture as solution Y is slowly added.

(5)

(Total 7 marks)

Q47.

The diagram shows electrolysis of sodium chloride solution.



- (a) Complete and balance these equations to show the reactions during electrolysis.

At the positive electrode

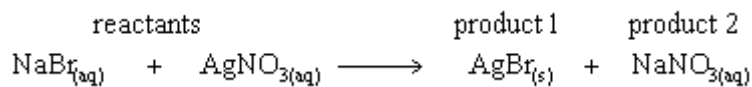


At the negative electrode



(2)

- (b) Silver halides such as silver chloride and silver bromide are used in photography. The equation shows a reaction to prepare a silver halide.



Name and describe the products of this reaction, in words, as fully as you can.

product 1

product 2

(4)

(Total 6 marks)

