

**Q1.** Sodium carbonate reacts with acids.

(i) Complete the word equation.

sodium carbonate + hydrochloric acid → sodium chloride + ..... + water

(1)

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

.....

(1)

(Total 2 marks)

**Q2.** 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.

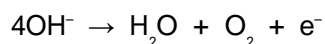
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(2)

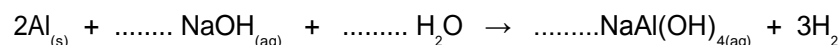
- (iii) Balance the equation for the reaction of hydroxide ions at the anode.



(1)  
(Total 4 marks)

**Q3.** 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.

.....

(1)  
(Total 6 marks)

##

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,  $\text{CO}_3^{2-}$ . 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.

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.....

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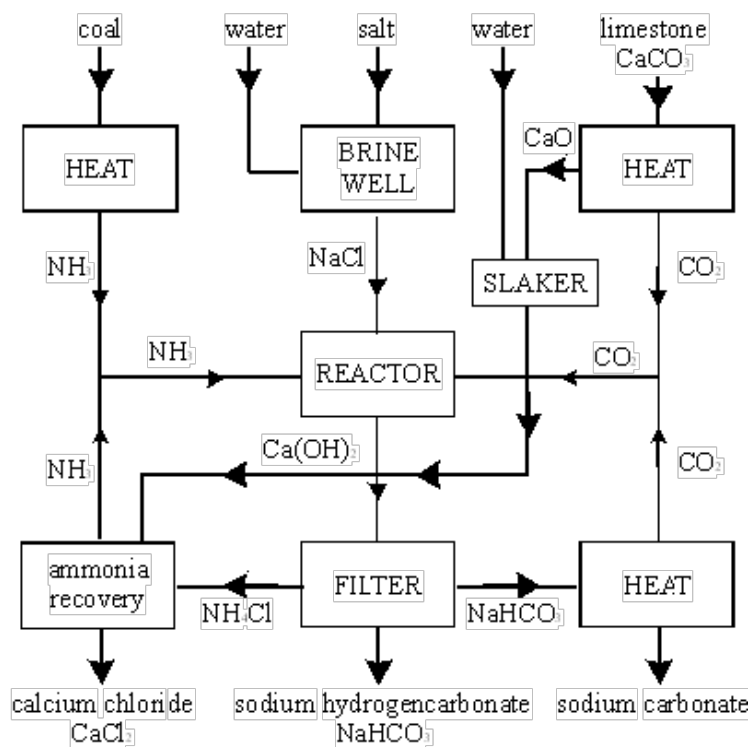
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(3)

(Total 13 marks)

**Q5.** Sodium carbonate is a useful chemical that can be made from sodium chloride.

(a) 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) 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)

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

.....

(1)

- (b) 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.

.....

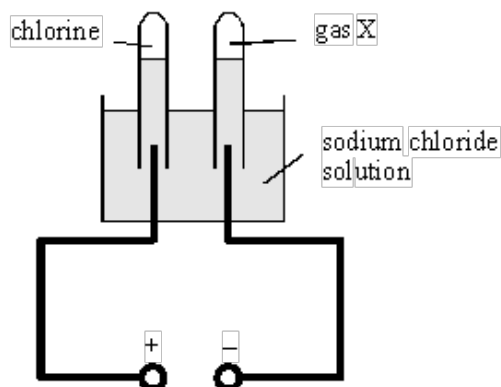
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(1)

(Total 7 marks)

- Q6.** (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.

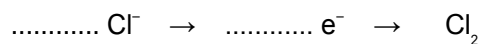


- (i) Name gas X.

.....

(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?

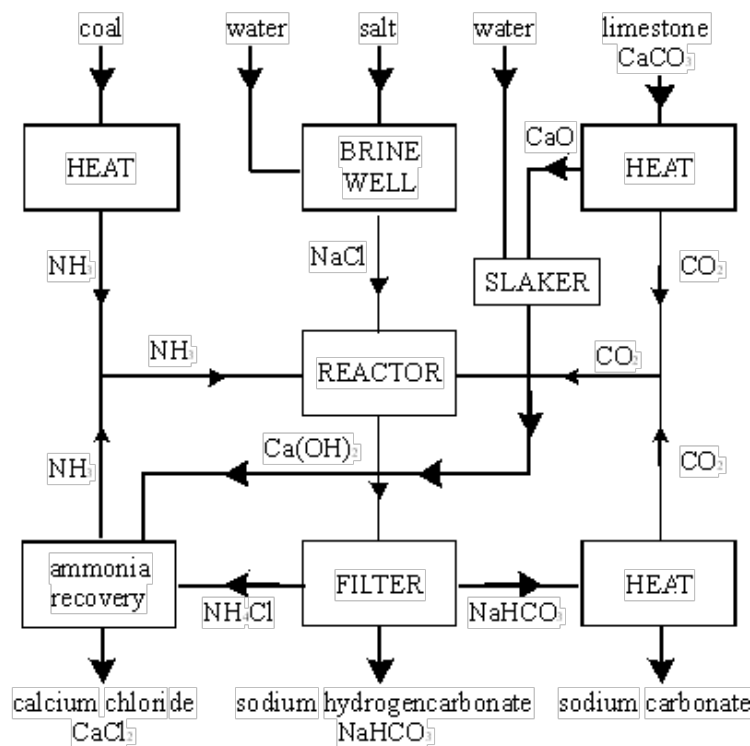
.....

(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)

- Q7. (a) This label has been taken from a packet of *Andrews Antacid*.

# Andrews<sup>®</sup> 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.  
*DO SAGE: 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)
- (iii) Write the formula of the magnesium compound present in *Andrews Antacid*. You may find the Data Sheet helpful.
- .....
- (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 cm<sup>3</sup> 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.

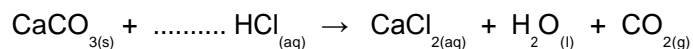
The results are shown in the table below.

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)”.

.....

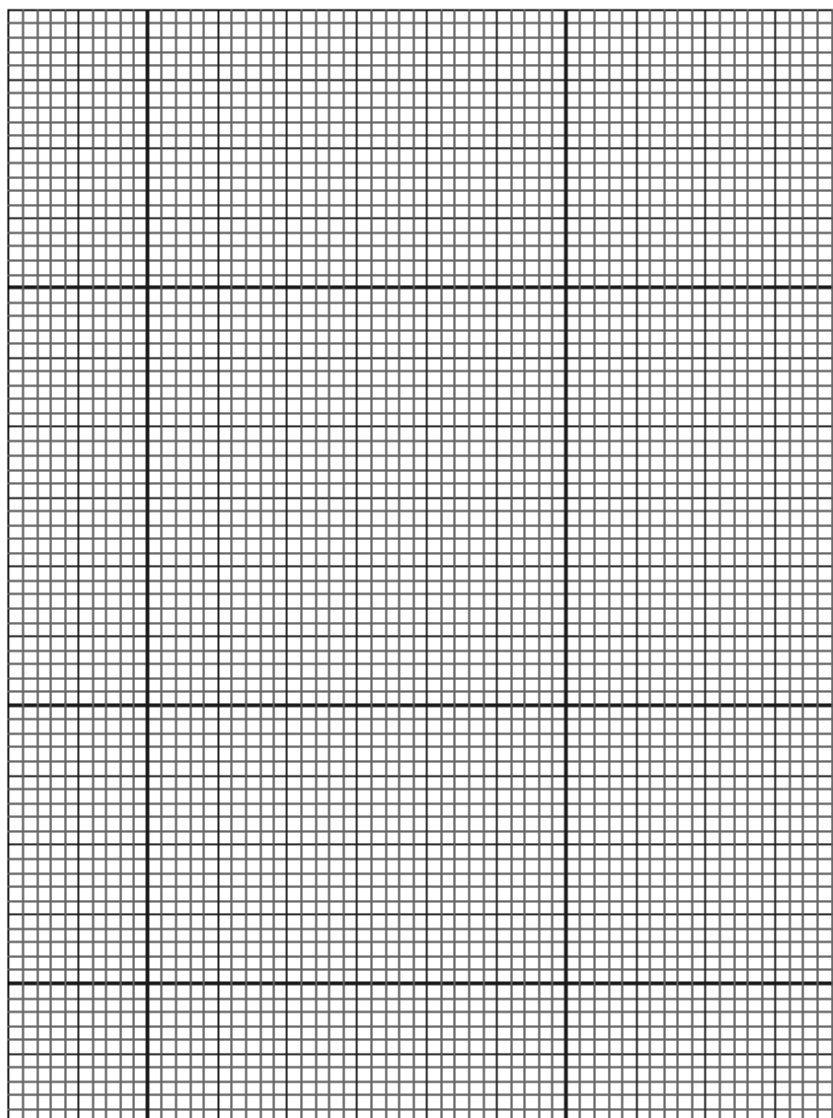
(1)

- (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.

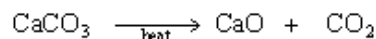
(1)

- (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)

- Q8.** Limestone ( $\text{CaCO}_3$ ) is a raw material. On strong heating it is converted to calcium oxide which is a very useful substance.



- (a) Calculate the formula mass ( $M_r$ ) of calcium carbonate.

.....

$M_r$  of calcium carbonate = .....

(2)

- (b) About 60 million tonnes of calcium oxide is made in Britain each year. Calculate the mass of calcium carbonate needed to make this amount of calcium oxide.

.....

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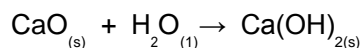
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Mass of calcium carbonate needed = ..... million tonnes

(4)

- (c) Water is added to some of the calcium oxide produced in a process known as 'slaking'. The product of this reaction is used to make plaster.



- (i) Give the chemical name of  $\text{Ca(OH)}_2$ .

.....

(1)

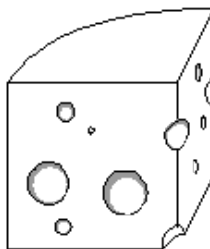
(ii) What is the physical state of the  $\text{Ca}(\text{OH})_2$  formed in the reaction?

.....

(1)

(Total 8 marks)

**Q9.** The salt sodium hydrogen phosphate ( $\text{Na}_2\text{HPO}_4$ ) is used as a softening agent in processed cheese.



It can be made by reacting phosphoric acid ( $\text{H}_3\text{PO}_4$ ) 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?

.....

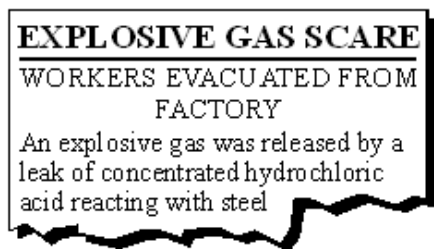
(1)

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

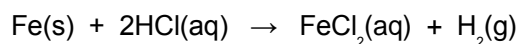
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(1)  
(Total 6 marks)

**Q10.** This article appeared in a newspaper.



- (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.

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(3)

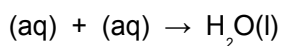
- (b) In the factory hydrogen chloride is manufactured by reacting hydrogen with chlorine. Hydrochloric acid is formed when hydrogen chloride forms a solution in water.

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

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

(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,  $\text{Ca}(\text{OH})_2$ , and not sodium hydroxide,  $\text{NaOH}$ . Suggest why.

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

(2)

(Total 10 marks)

**Q11.** Acids and bases are commonly found around the home.

- (a) Baking powder contains sodium hydrogencarbonate mixed with an acid.

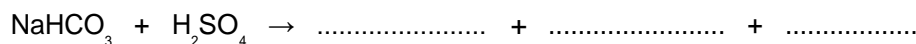
- (i) When water is added, the baking powder releases carbon dioxide. How could you test the gas to show that it is carbon dioxide?

Test .....

Result of test .....

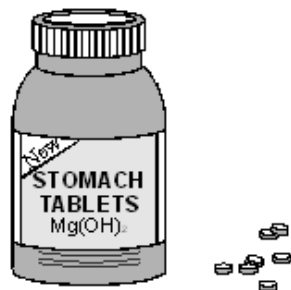
(2)

- (ii) Complete and balance the chemical equation for the reaction of sodium hydrogencarbonate with sulphuric acid.

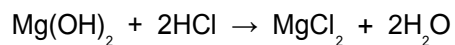


(2)

- (b) Indigestion tablets contain bases which cure indigestion by neutralising excess stomach acid.



- (i) One type of indigestion tablet contains magnesium hydroxide. This base neutralises stomach acid as shown by the balanced chemical equation.



Write a balanced **ionic** equation for the neutralisation reaction.

.....

(2)

- (ii) How does the pH in the stomach change after taking the tablets?

.....

(1)

- (c) Ammonium sulphate is used as a lawn fertiliser.



Using ammonia solution, describe how you would make the fertiliser ammonium sulphate.

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

(3)

(Total 10 marks)

**Q12.** Explain, in terms of ions and molecules, what happens when any acid reacts with any alkali.

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.....

(Total 3 marks)

**Q13.** Neutralisation reactions can be used to make salts.

(a) Write an ionic equation for a neutralisation reaction, including state symbols.

.....

(2)

(b) Ammonium nitrate is a salt used as a fertiliser.



(i) Ammonium nitrate is made by mixing two solutions. Name these solutions.

..... and .....

(1)

(ii) Hazard information about ammonium nitrate states:

- it is not itself a fire hazard (does not burn);
- it must not be allowed to come into contact with combustible materials such as fuels because it can cause these to catch fire.

Suggest why ammonium nitrate helps other substances to burn.

.....  
.....

(1)  
(Total 4 marks)

**Q14.** Photographic film often contains silver bromide. Silver bromide is changed by light to form silver which appears as a black solid. This darkens the photographic film.

A photographic film can be made by coating thin transparent plastic with a gel containing silver bromide.

The main steps in making this photographic film are as follows:

- Step 1** Gelatine is dissolved in warm water to make a solution.
- Step 2** Compound **A**, a soluble compound which contains bromide ions, is dissolved into this solution.
- Step 3** The lights are turned out in the darkroom.
- Step 4** Compound **B**, a soluble compound which contains silver ions, is dissolved in water.
- Step 5** The solution of compound **B** is added to the solution containing compound **A** and gelatine. Solid silver bromide is formed.
- Step 6** The warm mixture is poured onto thin, transparent plastic film.
- Step 7** The mixture sets to form a gel containing solid silver bromide.



- (a) The table below gives information about the solubility of some compounds.

SOLUBLE	INSOLUBLE
All sodium and potassium salts	
All nitrates	
Most chlorides, bromides and iodides	Silver and lead chlorides, bromides and iodides
Most sulfates	Lead sulfate and barium sulfate
Sodium, potassium and ammonium carbonates	Most other carbonates

Use the table to help you to name suitable compounds for **A** and **B**.

Compound **A** .....

Compound **B** .....

(2)

- (b) Suggest why the lights are turned out at **step 3** in this method of making a photographic film.

.....  
 .....

(1)

- (c) What type of chemical reaction takes place when the compounds are mixed in **step 5**?

.....

(1)

- (d) The photographic film is placed in a camera and a picture is taken. Where light hits the photographic film the silver ions ( $\text{Ag}^+$ ) are changed into silver metal ( $\text{Ag}$ ).

Explain why this reaction is a reduction.

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

(2)

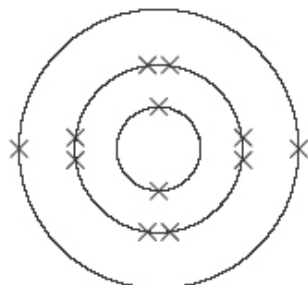
(Total 6 marks)

- Q15.** (a) Write a balanced symbol equation for the reaction between magnesium (Mg) and oxygen ( $O_2$ ) to form magnesium oxide (MgO).

.....

(1)

- (b) The diagram shows the electronic structure of a magnesium atom.  
The atomic (proton) number of magnesium is 12.



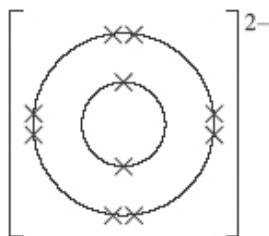
**Magnesium atom**

Draw a similar diagram to show the electronic structure of an oxygen atom.  
The atomic (proton) number of oxygen is 8.

(1)

- (c) Magnesium ions and oxide ions are formed when magnesium reacts with oxygen.

The diagram shows the electronic structure of an oxide ion.



**Oxide ion**

Draw a similar diagram to show the electronic structure of a magnesium ion.

(1)

- (d) Magnesium oxide is a white solid with a high melting point.

Explain how the ions are held together in solid magnesium oxide.

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(2)

- (e) Indigestion tablets can be made from magnesium oxide. The magnesium oxide neutralises some of the hydrochloric acid in the stomach.

Complete the word equation for the reaction between magnesium oxide and hydrochloric acid.

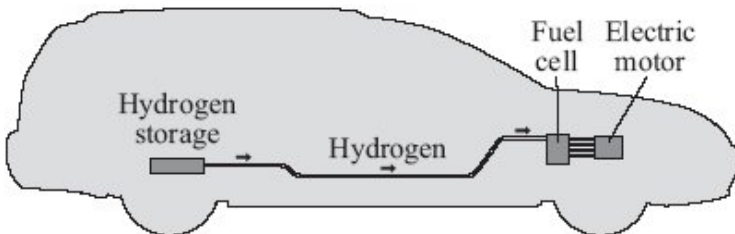
hydrochloric acid + magnesium oxide → ..... + water.

(1)

(Total 6 marks)

**Q16.** Read the article and then answer the questions that follow.

**Hydrogen fuel for cars?**



The diagram shows a side profile of a car. Inside the car, there is a box labeled 'Hydrogen storage' at the rear. An arrow points from this box to a box labeled 'Hydrogen' in the middle of the car. Another arrow points from the 'Hydrogen' box to a box labeled 'Fuel cell' at the front. A final arrow points from the 'Fuel cell' box to a box labeled 'Electric motor' at the very front of the car.

Hydrogen is an excellent fuel. It can be made by the electrolysis of potassium hydroxide solution.

Hydrogen gas can be stored under pressure in a cylinder but a leak of the gas could cause an explosion.

It has been found that lithium nitride can absorb and then release large volumes of hydrogen. A chemical reaction takes place between the hydrogen and the lithium nitride. The hydrogen is held in the resulting compounds by chemical bonds.

The problem is that the rate at which hydrogen is absorbed and then released from normal sized particles of lithium nitride is slow.

Recently scientists have made 'nanosized' particles of lithium nitride. These particles absorb hydrogen in the same way as normal sized lithium nitride particles. The 'nanosized' particles have the advantage that they absorb and release the hydrogen much faster when needed in the fuel cell.

It is hoped that 'nanosized' particles of lithium nitride may provide a safe method of storing hydrogen in the future.

- (a) Hydrogen is produced at the negative electrode during the electrolysis of potassium hydroxide solution.

- (i) Why are hydrogen ions attracted to the negative electrode?

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

(1)

- (ii) Potassium ions are also attracted to the negative electrode.

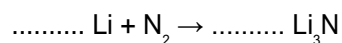
Explain why hydrogen gas is formed but not potassium.

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

(1)

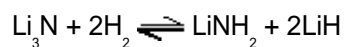
- (b) Lithium nitride is made by reacting lithium with nitrogen.

Balance the equation for this reaction.



(1)

- (c) (i) The equation for the reaction of lithium nitride with hydrogen is:



What feature of this reaction allows the hydrogen to be released?

.....  
.....

(1)

- (ii) Hydrogen stored in a fuel tank filled with lithium nitride would be safer in an accident than a cylinder full of hydrogen.

Suggest and explain why.

.....

.....

.....

.....

.....

(2)

- (d) Lithium nitride is an ionic compound which contains lithium ions ( $\text{Li}^+$ ) and nitride ions ( $\text{N}^{3-}$ ).

- (i) The formation of a lithium ion from a lithium atom is an oxidation reaction.

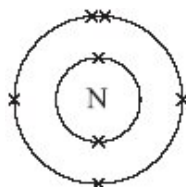
Explain why.

.....

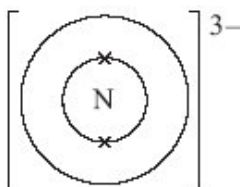
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(1)

- (ii) The diagram shows the electronic structure of a nitrogen atom.



Complete the diagram below to show the electronic structure of a nitride ion ( $\text{N}^{3-}$ ).

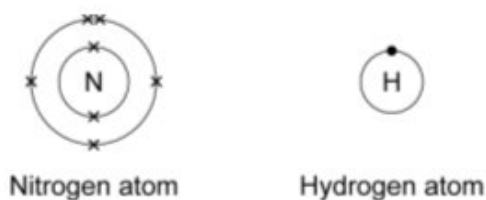


(1)

(Total 8 marks)

**Q17.** Ammonia has the formula  $\text{NH}_3$

The diagrams show how electrons are arranged in nitrogen and hydrogen atoms.



- (a) Draw a diagram to show how the electrons are arranged in an ammonia molecule.

You need only show the electrons in the highest energy level.

(2)

- (b) Ammonia is a gas at room temperature.

Explain why ammonia has a low boiling point.

.....

.....

.....

.....

(2)

- (c) Ammonia dissolves in water to form a solution with a pH of about 10.

- (i) Name the ion in the ammonia solution that causes the pH of 10.

..... ion

(1)

- (ii) Ammonium nitrate is made by reacting ammonia with an acid.

Name the acid.

..... acid

(1)

- (d) Instant cold packs are used to treat sports injuries.



One type of cold pack has a plastic bag with water inside. Inside the bag is a smaller bag containing solid ammonium nitrate.

The outer bag is squeezed so that the inner bag bursts. The pack is shaken and quickly gets cold as the ammonium nitrate dissolves in the water.

Explain why the bag gets cold.

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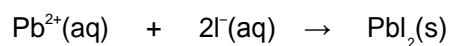
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(2)  
(Total 8 marks)

**Q18.** This question is about some compounds of iodine.

- (a) Lead iodide can be made by mixing a solution containing lead ions with a solution containing iodide ions.

Lead iodide is formed as a precipitate.



- (i) The table below gives information about the solubility of some compounds.

Soluble compounds	Insoluble compounds
all sodium and potassium salts	
all nitrates	
most chlorides, bromides and iodides	silver and lead chlorides, bromides and iodides

Use the table to help you name:

a soluble compound which contains lead ions .....

a soluble compound which contains iodide ions .....

(2)

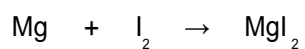
- (ii) Suggest a method of separating the lead iodide from the solution.

.....

(1)



- (b) Magnesium iodide can be made by reacting magnesium with iodine.



Magnesium iodide is an ionic compound. It contains magnesium ions ( $\text{Mg}^{2+}$ ) and iodide ions ( $\text{I}^-$ ).

Describe, in terms of electrons, what happens when magnesium reacts with iodine.

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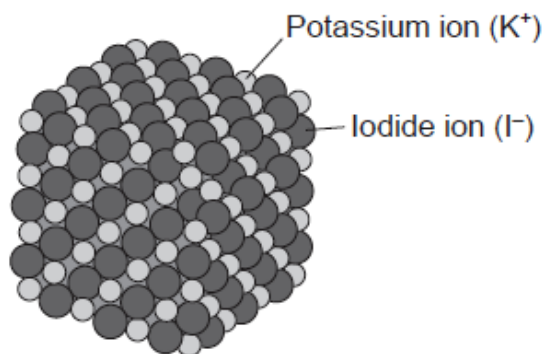
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(4)

(c) The diagram shows the structure of potassium iodide.



Explain why a high temperature is needed to melt potassium iodide.

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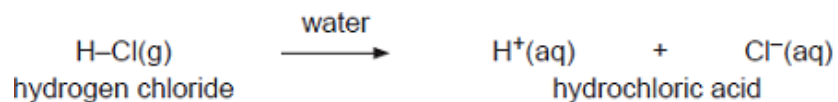
(2)  
(Total 9 marks)

**Q19.** In 1884 Arrhenius put forward ideas to explain acid-base behaviour. It was many years before his ideas were accepted.

Use the ideas of Arrhenius to answer parts (a) and (b).

(a) Hydrochloric acid is made by dissolving hydrogen chloride gas in water.

An equation which represents this reaction is:



Explain why

- a solution of hydrogen chloride in water is acidic
- dry hydrogen chloride gas is **not** acidic.

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(2)

- (b) The equation below represents the reaction between potassium hydroxide solution and dilute hydrochloric acid.



- (i) Explain why potassium hydroxide solution, KOH(aq), is a strong alkali.

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(2)

- (ii) Why is potassium chloride solution, KCl(aq), neutral?

.....

.....

(1)

- (c) In 1923, Brønsted and Lowry extended Arrhenius' ideas on acids and bases. Their ideas were quickly accepted.

- (i) What is Brønsted and Lowry's definition of a base?

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(1)

- (ii) Suggest why the ideas of Brønsted and Lowry were accepted more quickly than those of Arrhenius.

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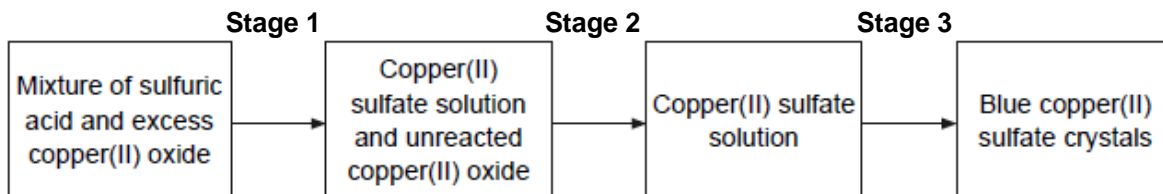
(1)

(Total 7 marks)

**Q20.** This question is about compounds of copper.

- (a) A student made some copper(II) sulfate crystals.

The flow diagram shows the stages of the preparation of copper(II) sulfate crystals.



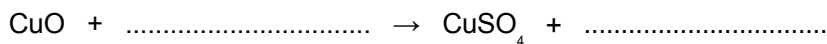
- (i) The reaction mixture is heated in **Stage 1**.

Suggest why.

.....  
.....

(1)

- (ii) Complete the equation for this reaction.



(2)

- (iii) How would the student remove the unreacted copper(II) oxide in **Stage 2**?

.....  
.....

(1)

- (iv) How would the student obtain copper(II) sulfate crystals from the copper(II) sulfate solution in **Stage 3**?

.....

(1)

- (v) The mass of crystals obtained was less than the student had calculated.

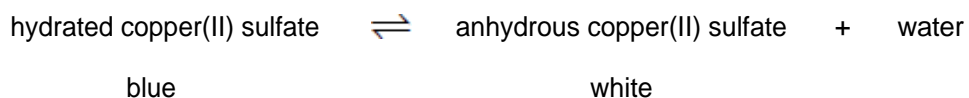
Suggest **one** reason why.

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.....

(1)

- (b) The student heated the blue copper(II) sulfate crystals.

The word equation for the reaction is shown below.



- (i) What does the symbol  $\rightleftharpoons$  mean ?

.....

(1)

- (ii) 300 J of energy are taken in when some blue copper(II) sulfate crystals are heated.

What is the energy change when an excess of water is added to the anhydrous copper(II) sulfate produced?

.....

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(2)

- (c) A sample of copper nitride contains 3.81 g of copper and 0.28 g of nitrogen.

Calculate the empirical formula.

You **must** show all your working to get full marks.

Relative atomic masses ( $A_r$ ): N = 14; Cu = 63.5.

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Empirical formula = .....

(4)

(Total 13 marks)

- Q21.**      Spacecraft have been to the planets Venus and Mars. The spacecraft have sent back information about the atmosphere of each planet.



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- (a)    The main gas in the atmosphere of Mars is carbon dioxide.

Explain why, in terms of structure, carbon dioxide is a gas, even at low temperatures.

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(3)

- (b)    Gas chromatography linked to a mass spectrometer (GC-MS) is used to identify substances found on Mars.

- (i)    What is the purpose of gas chromatography?

.....

.....

(1)

- (ii)   What information do the molecular ion peaks from the mass spectrometer give about the substances?

.....

(1)

(c) The atmosphere on Venus contains droplets of sulfuric acid solution.

(i) Suggest a pH value for sulfuric acid solution.

pH = .....

(1)

(ii) Name the ion which makes sulfuric acid solution acidic.

.....

(1)

(d) The atmosphere of Venus contains the isotopes  ${}^2_1\text{H}$  and  ${}^1_1\text{H}$

Describe the similarities and the differences in the isotopes  ${}^2_1\text{H}$  and  ${}^1_1\text{H}$

You should refer to the sub-atomic particles in each isotope.

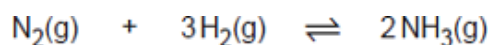
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(3)

(Total 10 marks)

**Q22.** Ammonia is produced from nitrogen and hydrogen.

The equation for this reaction is:



- (a) (i) A company wants to make 6.8 tonnes of ammonia.

Calculate the mass of nitrogen needed.

Relative atomic masses ( $A_r$ ): H = 1; N = 14

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Mass of nitrogen = ..... tonnes

(3)

- (ii) The company expected to make 6.8 tonnes of ammonia.

The yield of ammonia was only 4.2 tonnes.

Calculate the percentage yield of ammonia.

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.....

Percentage yield of ammonia = ..... %

(2)

- (iii) Use the equation above to explain why the percentage yield of ammonia was less than expected.

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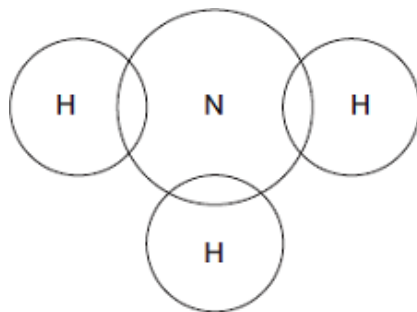
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(1)



- (b) Complete the diagram to show the arrangement of the outer shell electrons of the nitrogen and hydrogen atoms in ammonia.

Use dots (•) and crosses (x) to represent the electrons.



(2)

- (c) Ammonia dissolves in water to produce an alkaline solution.

- (i) Which ion makes ammonia solution alkaline?

.....

(1)

- (ii) Name the type of reaction between aqueous ammonia solution and an acid.

.....

(1)

- (iii) Name the acid needed to produce ammonium nitrate.

.....

(1)

- (iv) The reaction of ammonia with sulfuric acid produces ammonium sulfate.

Use the formulae of the ions on the Chemistry Data Sheet.

Write the formula of ammonium sulfate.

.....

(1)

**(Total 12 marks)**

